

DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

**Sustaining Data Quality-
Lessons from the Field**

**Creating and Sustaining Data Quality within diverse
Enterprise Resource Planning and Information Systems**

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Submitted in fulfilment of the requirement of Nottingham Trent
University for the degree of Doctor of Business Administration

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ABSTRACT

This research has identified a gap in the literature surrounding the process of improving and sustaining the quality of data within enterprise resource planning and information (ERP) systems. The study not only established firmly that quality data is an absolute necessity for all organisations, none more so than those operating ERP systems, but identified that for any improvement process to be worthwhile it must gain some degree of sustainability. For this reason this study has attempted to discover the means by which the quality of data can be improved but more fundamentally become embedded within an organisation. A detailed review of the literature was undertaken which unearthed rich material in particular around the concept of data quality and its application within business systems, from which a correlation was established between the concepts of a planning and information system and that of a product manufacturing system. A conceptual framework was then developed based upon three conceptual elements seen to be key to any data quality programme namely: *people, processes and data*.

A qualitative study was undertaken within the researcher's own organisation Remploy, employing an action research/focus group approach aligned to a data quality improvement initiative that was already in place within the organisation. A series of site meetings and conference calls took place embracing forty eight of the fifty four factories together with seven business groups. A quantitative survey was then undertaken using a web-based self-administered questionnaire distributed to a number of the researcher's colleagues within Remploy. The findings from both the qualitative study and the quantitative survey provided unique material in terms of key findings and themes. A number of principle findings then emerged relating to: the significance of the role of a 'champion' at various levels within a project; the importance of measurement, reporting and feedback relating to any improvement process; the necessity for systems and the people that use them to be allowed to mature; and the manner in which peoples' perceptions and attitudes toward data and data quality can have considerable degrees of inconsistency.

In conclusion it is felt that the outcomes of this study have the potential to both improve and sustain quality data within enterprise systems when applied to practical business and professional settings, whilst also providing the academic community with the promise of a contribution to the body of knowledge.

Document 1

Project Identification, Research Proposal and Planning

DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

Data Quality

A fundamental element in Creating a World Class Enterprise Resource
Planning and Information System within a Multi-site Disabled Employment
Organisation

Document One

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1. Objectives and Purpose of the Project

Objective

This Project attempts to analyse, review and identify the processes that need to be in place to ensure the on-going sustainability of accurate data as part of the process of creating a World Class Enterprise Resource Planning and Information System within a Multi-site Disabled Employment Organisation.

Whilst the study relates to a Remploy-type environment it is acknowledged that the project is not intended purely for the benefit of Remploy but is essentially a lesson and blueprint for management practice. In this capacity it may be used as a tool in any situation where data is seen as being a critical resource or asset.

Research Questions

Following an initial review of the literature, an examination of the author's experiences and observations, together with discussions with colleagues and associates, the following research questions have emerged:

1. What are the attributes of data quality with particular reference to ERP?
 - What is data quality?
 - How does it impact upon enterprise resource planning?

2. What is the range of factors that impinge on data quality?
 - What are the elements that effect data quality
 - How can data quality be measured?
 - What levels of data quality are necessary?
 - What do organisations need to do to improve and sustain data quality?

3. Are there specific factors that apply to these in the context of Remploy?
 - How can the study be best related to Remploy?
 - Does Remploy's position make it unique or can common practices be applied with or without modifications?

Deciding upon the topic

The process of deciding upon the actual topic has been a 'winnowing' and 'channelling' process aimed at achieving the right focus. The initial holistic concept of 'Creating a World Class Enterprise Resource Planning and Information System within a Multi-site Disabled Employment Organisation' is an excellent ideal in itself but requires a considerable number of processes to take place in unison to make it happen, each of which can give birth to numerous research topics in itself. The process of elimination to select the topic may be seen

diagrammatically in Appendix 1 following the 'red line' which acts as a route map. Beginning with the initial concept of ERP leading then to Optimisation which in itself may be seen as a three-stage process. The first stage, one of stabilisation, comprises a number of elements and sub-elements involving users, software, processes and data. The initial thought process relating to the topic selection are identified within Appendix 2a-2c.

The topic of Data Quality encompasses all the elements above working together. Data, particularly master data, can be cleansed but will become 'dirty' again tomorrow if the other components of the chain are not in place and working. Operational and transactional data must also be correct but may not be so if there are issues with master data or if adequate housekeeping is not undertaken. All of the above is also dependent upon the right business processes being in place. Lastly systems require human interface. Users comprise all persons interfacing with the system whether they provide raw data, process data or are a recipient of data. They need to be developed, educated and trained not just in a purely focused micro way 'on their job', but also in a macro sense in order that they can understand more fully where they sit within the ERP environment and how this in turn fits within an organisation's overall strategy. In addition within a Remploy environment the concept of 'Accessibility' is introduced referring to the provision of hardware and software that assists visually, mentally or physically impaired people to gain access to IT.

Improving and maintaining Data Quality is seen as the single most important element in achieving the aim of creating World Class ERP and will have the greatest single impact for good. Stage 2 (Continuous improvement) and stage 3 (Evolution and transformation) of the optimisation process as identified in Appendix 1 are both dependent upon establishing and sustaining high levels of quality data.

Figure 1. Elements comprising the Data Quality Project

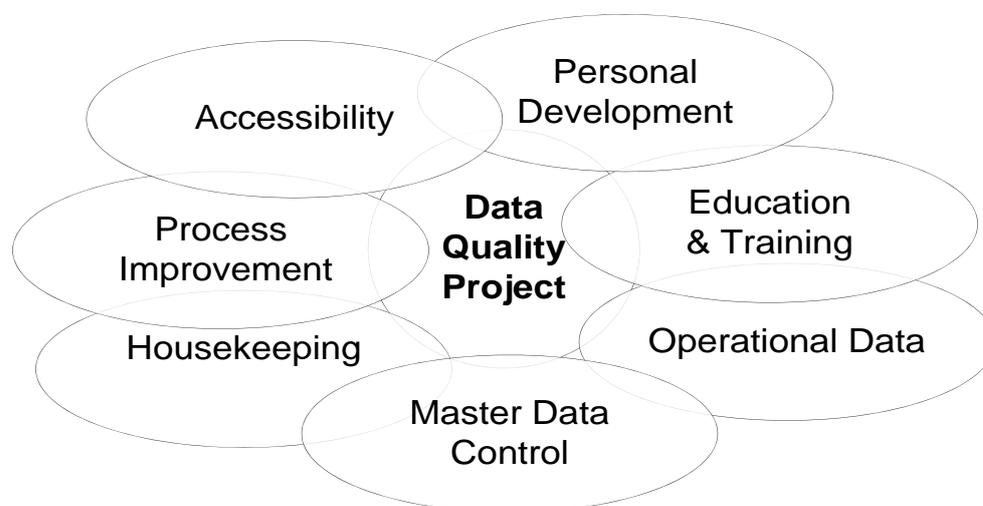


Figure 1 highlights how the elements of data, process improvement and user development described above are inter-linked.

The concept of two distinct phases of ERP was identified initially in a study carried out by Deloitte in 1999 and later extended by Willis & Willis-Brown, (2002: 35) and Botta-Genoulaz & Millet, (2005: 574). Phase one or 'first wave' relates to the pre-implementation and implementation stages, also known as 'going live'. The second phase or 'second wave' termed optimisation commences after implementation during which the organisation attempts to (or should attempt to) achieve the full benefits of ERP. This process, one of continual improvement, is not a one-off but an on-going progression.

Poor data quality can result in negative consequences for the operational, tactical and strategic organisational levels. Hassan, (2003: 121) cites Redman, (1998) in suggesting that inaccurate data can affect an organisation at an operational level leading to customer dissatisfaction, high costs of error correction and reduced employee morale; at a tactical level resulting in less effective decision making, problems with implementing data warehouses and general mistrust of all information and finally at the strategic level, diverting management's attention from its main function, and make it more difficult to devise and implement strategic plans. Wang & Strong, (1996: 5) also declare that poor data quality can have a severe impact on an organisation's future. Data accuracy is also vital to the effectiveness of business operations, decision-making activities and the success of organisational computing systems. Hassan, (2003: 124). 'Dirty data' is a term used by Vosberg & Kumar, (2001: 22) to describe inaccuracies or inconsistencies within a collection of data or when data extraction is inconsistent with intent and that the term GIGO (garbage in, garbage theory) very much applies to dirty data. Redman, (2004: 4) attempts to analyse the cost of poor data quality (COPDQ). Whilst stating that such analyses are difficult to measure, he estimates that COPDQ costs an average company a minimum of 10% of its revenue.

The importance of quality data pertains to all organisations and the applicability to disabled employers has already been identified. The following section places Remploy within the context of the project.

2. Remploy

The fundamental aim of any DBA project is to add to the pool of knowledge within management practice and this project is no exception. There is also the subordinate aim of applying the principles and practises learned and developed to practical use not only within Remploy but also within other disabled employment organisations across the World. This section provides background information and indicates how the Company is positioned within the scope of the overall project and its connections with similar enterprises.

Remploy's Mission

To expand the employment opportunities for disabled people in sustainable employment within Remploy and the communities it serves.

Remploy's Principles

The company's objective is to provide equal opportunity and to promote the independence of disabled people by creating the widest possible spectrum of employment opportunities accompanied by appropriate training and development.

Remploy is the largest employer of disabled people in the UK, employing 5,700 disabled people in 83 factories and its managed services division. Increasingly, it is focusing on finding disabled people jobs with other employers. Last year it helped 3,500 into jobs with outside employers such as BT, Asda and Christian Salvesen and supported a further 2,800 in work.

The Company implemented the Baan ERP system across the entire organisation between 1997 and 1999. Whilst considerable success has been achieved, there is certainly opportunity for further development to optimise and enhance the system, as it is recognised that approximately 40% of the full potential benefits have yet to materialise. It is intended that this study will be part of a comprehensive optimisation programme, covering all aspects of a full post-implementation 'second wave' initiative, to attain of the aim of creating a World Class Enterprise Resource Planning and Information System within a Multi-site Disabled Employment Organization.

In order to place Remploy within the context of the research project, there are certain initiatives specific to the Company's overall mission and its current data accuracy strategy, which necessitate identification. These are detailed below.

Workability

Remploy is an influential member of 'Workability International' the world's largest body representing providers of work and employment services to people with a disability. More than two million people with disabilities are engaged in work programmes delivered by the 66 Workability member organisations in some 27 different countries. The organisation is

registered in the UK. Its Secretary General, based in France, is a former employee of Remploy and access to information from within the organisation to assist this research project has been agreed. It is intended that the benefits emanating from this project will be transferable to other members of Workability International where applicable.

Accessibility

'Accessibility' refers to the hardware and software technologies that have been developed in order to assist visually or physically disabled persons gain access to information technology either for personal use or within a work environment. Fundamental to this has been the development of the concept of 'assistive technology'. Within an IT sense this refers to specialised keyboards and mouse devices, voice recognition, screen magnifiers and Braille printouts etc. In a non-IT environment the term can encompass any aid to promote greater independence for disabled persons. The Company employs an IT specialist whose responsibility is to develop assistive technology where appropriate. A part of the project will be to investigate whether further developments within this area will assist in improving data quality.

Remploy Data Accuracy Project

Remploy has initiated recently a data accuracy project aimed at improving the quality of the data with the Baan system. Data accuracy is seen as a major contributory factor to improve the Company's overall performance and as a consequence this project has the full support of the Board. A copy of the project outline is contained in Appendix 3a-3b. This initiative will support the overall aims of the research project.

3. Preliminary Literature Review

A preliminary scan of the literature reveals that in recent years a considerable amount of academic research has been carried out relating to ERP and whilst the majority of the research appears to focus on to the pre-implementation and implementation stage, there is still a considerable amount of literature relating to the 'second phase' process that of optimisation and in particular data quality upon which one can base the aims of this study. Prior to focussing on data quality it will be beneficial to place the elements of ERP in perspective.

Enterprise Resource Planning

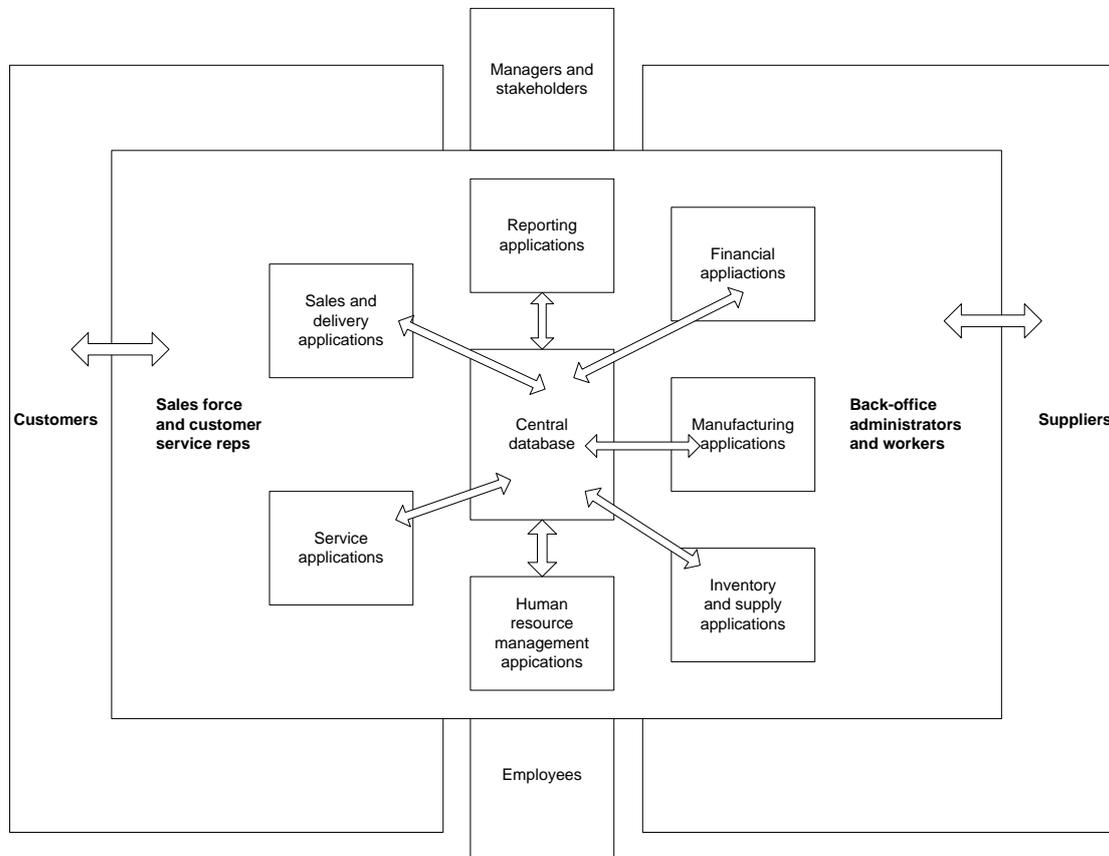
The principle aim of ERP is to support the overall business strategy. The implementation and subsequent optimisation phases must be flexible enough to ensure an organisational fit, as opposed to the business having to be 'shoe horned' to meet the requirements of a system. Wallace & Kremzar, (2001: 20), observed that 'ERP is all about processes, procedures and people, above all the latter'. Appendix 4 summaries the ERP evolutionary path from Material Requirements Planning (MRP), through Closed Loop MRP, to Manufacturing Resource Planning (MRPII) and then onto Full ERP Wallace et al., (2001: 6-12). Davenport, (1998: 125-129) identifies ERP as 'a way of doing things', rather than a series of software packages, providing a generic solution and that those businesses that stress the importance of the enterprise, rather the system, will gain the greatest benefits.

ERP emerged towards the end of the 90s as a complete business software system that allows an organisation to share common data and activities throughout, enabling the critical parts of the business processes to be automated and integrated in order to generate and access information within a real-time environment. Willis et al., (2002: 35). The concept of an all-embracing system is further advanced by Calisir & Calisir, (2004: 505-506) identifying ERP as a complete business solution comprising comprehensive software packages that seek to integrate the complete range of business processes and functions in order to present an overall view of the business from a single information point built on one database, one application and a standard interface across the entire enterprise.

Figure 2. The Anatomy of an Enterprise System

ANATOMY OF AN ENTERPRISE SYSTEM

At the heart of an enterprise system is a central database that draws data from and feeds data into a series of applications supporting diverse company functions. Using a single database dramatically streamlines the flow of information throughout a business



The above diagram taken from Davenport, (1998: 124) highlights the integrated nature of an ERP structure or an Enterprise System as referred to by Davenport. He claims that a good ES is a technological tour de force with a single database at its core coordinating and supporting virtually all of a company's business activities and warns that if a company's systems are fragmented, its business is fragmented also.

Organisations have adopted ERP for a number of reasons. In the latter 90's it was the potential problems of Y2k, whilst latterly motives have included the simplification and standardisation of systems and the ability to provide access to more accurate information to enhance communications with both internal and external stakeholders. ERP has also been implemented as a means to improve business processes, obtain greater strategic advantage resulting from the enhanced quality and availability of data and to enhance top-down decision making from senior-level management Mabert, Soni, & Venkataramanan, (2001: 3-4).

Optimisation

Optimisation, or ensuring more effective use of an ERP system, is seen as being a major factor in attaining any organisation's ambitions to maximise performance. It is essential that optimisation programs should take place as a matter of course, as a 'second wave' process as identified above, in order to make more efficient use of the available technical, human and organisational resources mobilised around the integrated information system. Botta-Genoulaz et al., (2005: 574). In addition the process will enhance the efficiency and effectiveness of ERP systems and their business processes to maximise value to the business. Outten, (2005: 24). In other cases optimisation may be employed to make better use and exploit the potential of ERP, where expected results have not been achieved or where there is insufficient knowledge of the system as it has been installed. Botta-Genoulaz et al., (2005: 580). Given the importance of the process it has to be appreciated that optimising the adoption of an ERP system by its users is a difficult challenge, requiring clear definition between roles, processes, procedures, systems and people. Worley, Chatha, Weston, Aguirre, & Grabot, (2005: 635). Within the context of optimisation, Nicolaou, (2004: 44-46), argues that a distinct relationship exists between the quality of the post-implementation review (PIL) carried out by an organisation and the extent to which it attains the desirable outcomes from the system.

ERP a Success?

How successful have ERP implementations been? Researchers have defined implementation success quite differently. A clear-cut and valid metric for measuring the effectiveness of the post-implementation ERP systems remains elusive. Yu, (2005: 129). Markus, Axline, Petrie, & Tanis, (2000: 245) also concluded that measurements of success have not been easy to define.

According to a study carried out by the Gartner organisation, only 50% of companies get it right first time Outten, (2005: 24). In another study the results indicated- 34% were very satisfied; 58% were only somewhat satisfied; 7% somewhat unsatisfied and 1% unsatisfied. McNurlin, (2001: 13). On a more positive note Mabert et al., (2001: 6) observed that 'with apologies to Mark Twain, it seems that the reports of the demise of ERP is greatly exaggerated. Companies operating ERP systems for a number of years are beginning to see some of the efficiencies and returns on investment'. In addition ERP was appearing to building consensus among cross-functional management teams. Trunick, (1999: 25)

The existent or non-existence of a number of important elements have been put forward as contributing factors in the success or otherwise of ERP systems. User satisfaction is regarded as one key factor leading to success. Calisir et al., (2004: 506). Other implementations attributed success to: adequate user training, change management and continued executive commitment. McNurlin, (2001: 13). From a different perspective Nicolaou, (2004: 44) observed that the main reasons for problematical ERP implementations are a lack of user training and a failure to understand completely how enterprise applications change business

processes. A major reason for ERP under-performance is Data Quality (although poor quality data may also be the by-product of the inefficiencies identified above) the subject is studied in greater detail below.

Data Quality

Data within a database supports a myriad of uses from master data and transactional data in applications, to management reporting and strategic information. In all cases to be effective it must be of the right quality and be both accurate and be fit for the purpose. Data quality is defined as data that is fit for use by data consumers. Wang et al., (1996: 6) their studies identified a number of data quality dimensions among them, accuracy, timeliness, completeness and consistency. Xu, Nord, Brown, & Nord, (2002: 47-46) supported these findings and within the same study identified a number of factors that influence data quality namely, training, top management support, communications, change management, employee relations and data quality controls. Xu et al., (2002: 48-56). In defining data quality Redman, (2001) draws upon the work of the quality guru J M Juran as detailed in figure 3 below.

Figure 3

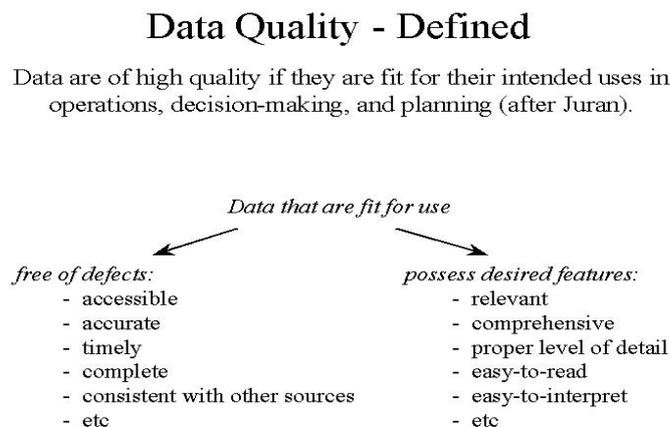


Figure 14.2

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In an earlier study Redman, (1995: 99) identified that many managers were unaware of the quality of the data they used assuming was it was perfect. He further emphasised the point that poor quality data particularly within financial and other management systems could cause immediate economic harm and seriously impede the effective implement of strategies, advocating that the right data needs to be in the right place at the right time and that only senior management can truly address data quality issues by recognising that data is an asset and being in a position to ensure that strategies are in place to improve them.

Data has to be accurate and of sufficient quality to meeting the individual requirements of an organisation's specific situation. Doubts on information validity will generate mistrust and questioning amongst all information users. It is essential for all within an organisation to be aware of potential data problems, its effects and the necessity to improve the levels necessary to provide the information to drive the organisation forward. Redman, (1995: 106) sets the concept of data quality within a geographical environment, likening a database to a lake, in that to prevent a lake from becoming polluted one must treat its feeder streams as assets. Similarly users of data should treat data processes also as assets and apply quality programmes accordingly.

It has to be recognised that each recipient of data is a customer whether they be individuals or processes and as such the accepted concepts of customer satisfaction or even 'delight', apply to data in the same manner as to the commercial transactions of buying and selling physical goods. This concept of an 'internal customer' may be applied to data whereby the output from one process provides the 'seed corn' for a further process, in the same fashion as a manufactured component or assembly forms part of a final finished product with a factory. Data is not merely an end in itself but is a fundamental building block to support the entire organisation. It is also an on-going process not a one-off 'clean up', requiring a continual process to review, revise and re-implement to maintain the levels of quality required. This point is supported by Ballou, Madnick, & Wang, (2004: 1) emphasising that high-quality information needs to be a high priority otherwise the consequences may be devastating, even threatening an organisation's very existence. Somewhat disturbingly they also add that achieving high quality data is not just difficult, but may never be achieved fully as different parties have differing views as to what really constitutes a success.

Redman, (1995: 100) proposes three strategies for improving data quality. Identify the problem, treat data and the processes around it as an asset and finally implement quality systems aimed at creating and keeping customers. Hostetter, (2004: 60) suggests implementing six practices of discipline to maintain and control data integrity. This is a concept that may be relevant particularly within a multiple business unit environment such as Remploy's. Petrick, (2004: 54) identifies five areas of potential data mistakes, emphasising the concept of a non-static moving target and suggesting that all the technological wizardry will be meaningless if the data is not up to par. Vandersluis, (2005: 13) highlights the current on-going need for 'human filtering' within systems to overcome the problems of data of questionable quality and emphasises that this must be eliminated before new generation information systems such as Microsoft's new 'Business Scorecard Manager' can possibly be implemented.

The concept of data quality management is exemplified further by Helfert & von Maur, (2001: 5) identifying the importance of quality planning and control as the key factors of data quality management and the necessity to plan, define and assess quality goals and measure quality levels as a precursor to analysing and improving data quality. This discussion leads one to consider the theories and recommendations of the great quality gurus among them W.E. Deeming, P.B. Crosby, A.V. Feigenbaum, J.M. Juran etc, as potential providers of support to resolve the accuracy issues and enhance the overall quality of data. Indeed Juran's definition of quality of information in Figure 3 above has taken the TQM concepts into the area of data management and is also identified as a important source by Landor, (2002: part 3), The writings of the academic TQM authors adds credibility and academic enrichment to the on-going business process.

EPR requires large amounts of data to operate, therefore it is important to prioritise any data quality management initiative to ensure the critical areas are recognised.

What levels of data accuracy are necessary?

Two different studies have identified the levels of data accuracy and integrity required to achieve success.

Figure 4.

Goodfellow, (1994: 18) examines how varying of levels of accuracy amongst the components of a basic planning system can affect the overall outcome.

<u>Demand data</u>	60%	100%	100%	100%
Fixed data	30%	90%	95%	97%
BOMS & Routes	90%	95%	99%	99%
Stock accuracy	50%	90%	95%	98%
Order accuracy	50%	90%	95%	97%
Overall accuracy	4%	68%	84%	91%
Error rate	24 in 25	1 in 3	3 in 20	1 in 12

The analysis can be frightening at first viewing. It is extremely difficult to achieve the latter two accuracy levels but it is essential if ERP is to be a success. ERP has to be built on solid foundations of very accurate data. Column 1 indicates a 96%- error rate, column 2- 33%, column 3- 15% and column 4- 8%. Taking the latter as an example even allowing for accuracy rates of between 97%-100% every twelfth planning message will be erroneous.

Figure 5.

Wallace et al., (2001: 195-217) distinguish between various general categories of data, forgiving and unforgiving and identify certain minimum accuracy targets

1. Unforgiving data

- a. Inventory balances- 95% accurate
- b. Production and Purchase Orders (housekeeping requirement)- 98% accurate
- c. Allocations (of stock/components)- 97% accurate
- d. Bills of Material- 98% accurate
- e. Routings- 98% accurate
- f. Customer orders- 98% accurate

2. Forgiving data- Item data- lead times, order quantities, safety stocks, plus other areas such as Work Centre Data and Forecasts- Overall accuracy needs to be less precise.

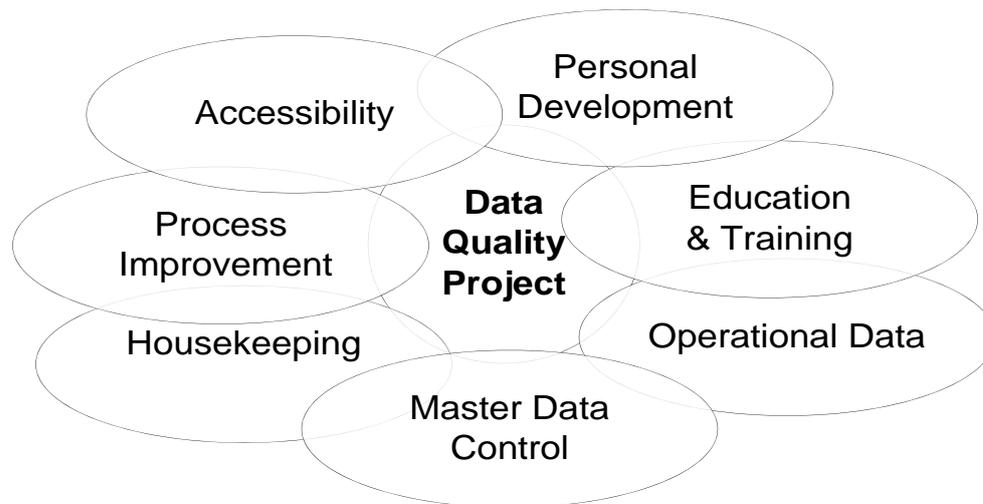
Figures 4 and 5 provide a potential indication as to the size of the project and the consequent task in hand to achieve the objectives, when one realises that these target levels not only have to be attained, but, more importantly, sustained. Numerous attempts have been made to achieve this end without a high level of success. It is perceived that the twinning of the practical application with the academic research study will enable the goal of sustainability to be attained. The concepts of academic research are dealt with in the next section.

4. Research Plan and Methods

Conceptual Framework

A conceptual framework will enable the main variables, components, themes and issues in the research project to be identified together with the ways in which they are inter-related. The aim is to provide the researcher with a clear concise structure on which to base the research. The process may take place at the commencement of the study (structured approach) or emerge during or after the data capture and analysis phase (grounded approach). (Saunders, Lewis, & Thornhill, (2000: 391); Fisher, (2004: 98-103))

The author has an initial preference for the structured approach. Within the framework it is possible to develop a mixture of both theory and one's own expectations. Saunders et al., (2000: 392). An preliminary review of the relevant literature Botta-Genoulaz et al., (2005: 584) and Willis et al., (2002: 37) together with the author's own experiences and observations over a number of years, indicate that there are potential cause-and-effect relationships which impact on the quality of data in systems. These elements were identified previously in Figure 1 above.



The author however does not wish to pre-judge the outcome of the full literature review at this early stage. It is appreciate fully that research is a very fluid process subject to constant review, refinement and revision. As Watson, (1994: 80) observed 'I do not believe that one can complete a research design at the beginning of the project and fully stick with it'.

Methodology

The decision as to which research approach to adopt will depend upon the inclinations of the researcher and the nature of the topic being researched. The decision will range between the deductive approach whereby theory guides the research process and the inductive where theory emerges from the research process. The philosophy of the natural scientist compared with that of the social scientist Bryman & Bell, (2003). Saunders et al., (2000: 91) identifies the major differences between the two. The deductive approach, one of testing theory using a highly structured format based on scientific principles, moving from theory to data, encompassing the necessary controls to ensure the validity of the data, with the need to explain causal relationships between each variable. This contrasts with the inductive approach, that of building theory providing a more flexible structure to permit changes of research emphasis as the research progresses, with a realisation that the researcher is part of the research process and therefore less concerned with the need to generalise. Gill & Johnson, (2002: 44) also use the terms Nomothetic (deduction) and Ideographic (induction).

The author has a preference towards the deductive approach with particular emphasis towards Realist research. There is a considerable amount of rich literature on the topic of data quality, which together personal experiences and observations can form a base from which hypotheses can be deduced. The potential relevance of this approach to the project may be seen in Figure 1 (repeated within the conceptual Framework section above), which highlights potential key concepts, or variables that can be tested to ascertain if they hold true. The deductive approach offers a lower-risk strategy and appeals to the author both from the perspective of a financial background and a personal bias towards a 'risk-averse' view on life. Within the deductive arena, a realist or 'hypothetico-deductive' approach is chosen rather than a positivist, on the basis that the former will bring a greater degree of objectivity to the research process. The declaration of a particular stance does not preclude more than one approach. Gill et al., (2002: 168-173), later supported by Fisher, (2004: 49-50), identifies this combination as 'methodological pluralism' recognising that an interpretivist approach can be called upon to assist realist research. Bryman et al., (2003: 493) uses the term 'multi-strategy' whilst advising that not all writers support its use.

The quality and credibility of the research findings are paramount and the major criteria for evaluating management and business research are:

- Reliability/Replication- whether the results of a study are repeatable on different occasions and/or by different researchers
- Validity- the integrity of the conclusions

Saunders et al., (2000: 100-101) Bryman et al., (2003: 33)

Research Design

Bryman et al., (2003: 39-62) identifies research design as the framework for the collection and analysis of data comprising five different types:

- Experimental design- a hypothesis that is tested between two or more variables where an experimental group is exposed to 'treatment' and compared against a control group, which does not receive the treatment. The variables are measured and analysed both before and after the experimental process to ascertain any differentiation. Experimentation is considered rare in business and management research.
- Cross-sectional design- involves the collection of data covering a number of variables at a single point in time to ascertain relationships. Also known as survey research, data is collected predominately by questionnaire or structured interview. It can be utilised within both quantitative and qualitative research strategies.
- Longitudinal design- a process where data is collected on a sample at two or more points in time in order to identify and map the changes and developments that have taken place between the various data collection dates.
- Case study design- entails the detailed and intensive analysis of one or a small number of cases to provide deep and intensive understanding within a focussed environment. Whilst particular circumstances in one particular case may not be fully representational, generalisations may be made. Fisher, (2004: 52). A large amount of the literature surrounding enterprise resource planning is based partially on case studies.
- Comparative design- entails the comparison of two or more contrasting cases using identical methods. Examples of this design exist in cross-cultural or cross-national research and also in the form of multiple-case studies.

Action Research

Action research, as the title implies, focuses on action and promoting and managing change within an organisation, akin to a process of trial and error, within a controlled environment. Fisher, (2004: 45-46) emphasises the aspects of learning from experiences by taking action and monitoring the consequences to then developing and promoting improvements within an organisation. Fisher, (2004: 46) also warns against using action research within large-scale change projects arguing that the approach is better suited to smaller-scale issues.

Research Methods

Research methods are the techniques used to collect data for research and comprise interviews, questionnaires, panels, observations, and documents including electronic databases. Each method may be used in both quantitative and qualitative research in that any of the research methods may be used in any research approach. Different methods can be

used for different purposes in a study, ensuring that the important issues are addressed whilst acting as a control mechanism for data validation. Saunders et al., (2000: 98-99) recognises this a 'multi-method' or 'triangulation' approach that often may prove to be beneficial. Bryman et al., (2003: 291) identifies the use as a process of crosschecking findings derived from both quantitative and qualitative research.

Proposed approach towards the Study

A multi-method approach involving triangulation is envisaged. Saunders et al., (2000: 98) supports this view although one is aware that one must safeguard against the risks outlined by both Fisher, (2004: 49) and Bryman et al., (2003: 493)

5. Overview of Documents 3, 4, 5 and 6

This project proposal has been essential in designing and constructing a route map for the entire project journey as outlined in Section 1. The initial attempt to identify a topic produced a far too high-level concept that was not sustainable.

Document 2- Critical Literature Review and Conceptual framework

A critical literature review is essential to form the foundation on which the research project will be based, whilst developing an insight into previous research and trends that have emerged Saunders et al., (2000: 44). The process will necessitate taking a critical stance involving a familiarisation with what has been said by the relevant authors and the extent to which this makes sense. Jankowicz, (2005: 183-184), this will assist in identifying any weaknesses and limitations in writers' theories and arguments. Fisher, (2004: 63)

The process will be focussed on the literature and the extent to which it assists in answering the research questions and achieving the project objectives. As the work progresses there may be a requirement to review, refine or revise the research questions as well as widening the scope of the literature itself.

A number of documents have been consulted and identified as potential material for Document 2 but have not been used as source material within this document- these are listed in Appendix 5. A further tranche of documents have been printed and whilst an initial part-review did not identify any real relevance with the research questions they may still contain some potential material and will be reviewed again accordingly. A list by author, title and broad subject area is contained in Appendix 6. At the moment this is merely a list and therefore not referenced fully. In addition to the above the recent discovery of new databases and sources of information as detailed within the section on Resources will undoubtedly provide further potential rich material.

A conceptual framework will be defined and constructed as described above.

Document 3- Research Methodology & Non-Survey Based Research

The research will be focussed upon answering the specific research questions and developing ideas for further research.

It is intended to carry out a series of in-depth interviews during the course of the study. These will be conducted with:

- Remploy colleagues in various departments and functions:
 - IS Department- technical and operational
 - Users at factories and business offices

- Central and Head Office users
- Managers and senior recipients of information
- SSA- the world-wide Baan software supplier
- SSA/Baan User Group
- The General Secretary (a former employee of Remploy) and fellow member organisations of Workability International. Full access and cooperation has been promised.

It is also intended to undertake an micro-ethnographic study Bryman et al., (2003: 317) (also known as an auto-ethnographic study) in the form of a short-term participant observation programme. This may be focussed purely within Remploy, but does exclude the possibility of involving other Baan users if access can be obtained.

Access is also being sought currently to hold interviews with:

- Other individual Baan user companies
- Other major ERP software providers
- Large organisations- suppliers/customers of Remploy

If direct access the above cannot be gained efforts will be made to obtain information via a non-structured or structured questionnaire (see Document 4 below)

There is also potential access to providers of Accessibility hardware and software. Abilitynet, Remploy's main provider, is the largest supplier in the UK. In addition the author has access to senior members of the IBM Worldwide Accessibility Centre in the US. IBM is the industry leader in this arena and its commitment to people with disabilities pre-dates the First World War.

Other potential sources for face-to-face discussion will be IT conferences and shows in addition to specific data quality meetings, conferences and events.

It is envisaged that during the research process possible answers and solutions to the research questions may be generated. This may take the form of small incremental improvements capable of being implemented on an on-going basis. This may provide an opportunity to apply an Action Research approach to test any theories either within a 'test' environment or within a 'live' situation. There may also be an opportunity to write-up the results in the form of small case studies especially if experiments are carried out within individual Remploy sites.

Consideration is will be given to using some form of computer-assisted qualitative data analysis software (CAQDAS) to assist in data analysis. Possible sources are NVivo or NUD*IST.

Document 4- Survey Based & Statistical Research

The research will be focussed upon answering the specific research questions and developing ideas for further research.

A series of structured questionnaires will be developed and administered to:

- A selection of the corporate membership of Workability within various parts of the World, with a view to ascertaining how each have treated data quality with particular reference to their disabled employee base.
- A sample of ERP users to ascertain their approaches to data quality.
- Other individual Baan user companies, other major ERP software providers and large organisations- suppliers/customs of Remploy- if access cannot be gained to carry out face-to-face interviews (see Document 3 above).

The exact format for the surveys will be developed in depth over the next six months.

Databases and other sources of statistical information will be interrogated to support the quantitative research process.

Consideration is will be given to using some form of software to assist in analysing the quantitative data. It may be possible to use Microsoft Excel and Access, but SPSS software is also being considered.

Documents 5 and 6- The Thesis and Critical Reflection

The different research approaches carried out in documents two, three and four will be consolidated to ensure a triangulation approach.

The literary review will be updated and revised. There will also be opportunity to identify any new additional literature and electronic material. The qualitative research will be re-examined and additional interviews carried out in order to test the validity of the earlier findings. This principle will also be applied to all quantitative research.

It is appreciated that there will be a substantial learning process carried out during years one and two that will necessitate reconsideration of the all the research outcomes within year three as Document 5 is progressed.

A research diary is being maintained to provide the basis of a on-going reflective review to be contained within each of the five Documents (See Section 8 below). These will be reviewed and consolidated to form Document 6.

6. Research Resources

Action Learning Sets

The Action Learning Set M1 inaugurated at the September Workshop has been of immense value. The eight members have worked very closely together. The group has held one full meeting at NTU plus a number of conference calls. In addition there has been considerable email activity offering support, advice and information. It is envisaged that the group will remain together for the duration of the DBA and continue to provide support and assistance to all members. There is also considerable inter-action with DBA colleagues from the other learning sets sharing information, support and ideas. This should augur well for the future.

EndNote

The acquisition of the EndNote software package has been extremely beneficial in marshalling information and maintaining a controlled bibliography. The more elegant and advanced features will be utilised for future documents.

Supervisors

There will be continual communication with the course supervisors. The author views the student/supervisor relationship as being the single most important resource.

Further NTU Support

Several NTU workshops have been identified within the Programme of Supportive Studies, which will assist in improving research skills. An application has been made to join several workshops scheduled for the spring of 2006. These include the areas of- database management software; use of spreadsheets in research projects, using SPSS parts 1 & 2 and writing for academic purposes.

Colleagues

There will be a continual dialogue with colleagues within Remploy in what is perceived as three-form process; as providers of information, advice and support (suppliers): as recipients of information, proposals, solutions (customers) and as potential beneficiaries of improvements.

Access to Other Organisations

Access to world class organisations is being sought to research their data quality programs, policies, procedure and processes.

Academic Support

The Massachusetts Institute of Technology (MIT) Data Quality Management Program has been identified as a major academic source of research on the subject of data quality and will be used extensively within the project. The MIT Total Data Quality Management (TDQM) website provides contact information and a number of the members of the team have been contacted directly and have provided support:

Richard Y Wang- Co-Director of the TDQM Program at MIT and a pioneer and internationally known leader in the field of data quality, provided a link to the International Conference on Information Quality website together with related links: www.iqconference.org

Stuart E Madnick- John Norris Maguire Professor of Information Technology at MIT Sloan School of Management, provided a link to the Social Science Research Network website <http://hq.ssrn.com> containing links both to his own papers and others relating to data quality.

Harry Zhu- Research Scientist at MIT TDQM Program. Harry has offered to help with any specific questions that the author may have on the subject.

Other Sources

Other sources have been identified as rich source of literature:

Infoshare Limited- A UK data quality software and services company set up to address data quality issues in Local and Government organisations www.infoshare-is.com Adrian McKeon the MD has been very helpful.

Information Impact International Inc- A US based organisation specialising in consultancy and education in Information Management and Information Quality. www.infoimpact.com

7. Issues and Outcomes

Research Ethical and Organisational political Issues

The author has executive approval from Remploy to undertake this project and this should assist in obtaining access to both information and persons. The author has also been a member of the organisation for twelve years within both the Financial and IS areas. It is appreciated that 'internal politics' and elements of subjectivity of various types can impinge on any type of work especially involving research. Every effort will be made to maintain objectivity at all times

All participants in any interview will be informed at the beginning and consent will be obtained prior to commencement

Remploy has devised five values- namely Professionalism, Passion, Respect, Openness, and Keeping Promises. These values will be at the forefront of this project at all times.

Outcomes

Personal

The author will derive considerable benefits and satisfaction:

- Gaining considerable experience and knowledge of a subject that is of interest from both an academic and practical workplace perspective
- Personal satisfaction from achieving a long-held goal
- Assisting in the advancement of knowledge
- Gaining and practicing advanced research skills
- Obtaining a very worthwhile qualification
- Widening one's personal boundaries and horizons
- Improving academic and intellectual skills
- Gaining knowledge in new areas
- Working closely together with other members of the M1 Learning Set to engender team working, comradeship and hopefully long term friendships

Organisational and Managerial

Remploy will benefit by:

- Gaining a wider understanding and knowledge of the subject and its implications on the organisation
- Obtaining short, medium and long term tangible benefits both operationally and financially
- Combining both academic and management principles to resolve a practical business problem

It is also intended to make such benefits available to other members of Workability International where applicable.

Management and Management Practice will also benefit by virtue of:

- A considerable piece of research on a topic of general interest focussed partly within a unique organisation
- Contribution to the overall knowledge-base of the subject
- Adding to the overall pool of knowledge within Management Practise
- Providing a firm base for further research within the subject area

It is hoped also that part of the project will provide material for publication within an academic journal or provide the basis of a conference presentation paper.

8. Reflective Review- Document One

Reflections on the process of doing research and the DBA

This reflective review is a personal appraisal of the past five months and therefore adopts a first-person approach. It has been arguably the most dynamic period of academic learning in my entire life and one has to admit, equally as enjoyable. The learning curve has been rather steep given that the last period of real academic study, leading to an MBA, took place over thirteen years ago. The MBA programme was by essence a very practical one leading to the final dissertation (one of 20000 words) dealing with specific & practical business issues without the requirement for a considerable amount of detailed academic research. The considerable step change from a Masters qualification to a DBA together with this over-long period necessitated a speedy catch-up.

Changes in one's values and understanding relating to research and the process of learning

The DBA is part of an on-going personal development programme and whilst these notes and jottings form part of the Document 1 Reflective Review they also represent current fixed points against which I can measure progress over the next three years of the DBA AND future learning and development during the post-DBA years. As a prelude to commencing work fully on Document 1, I undertook a process of 'academic rehabilitation' and relearning, reading books and documents relating to both doctoral works in general and business research in particular.

Fisher, (2004)- the first publication studied and it provided a solid background with substance and structure to my thought processes, together with an excellent framework for the work of Document 1 (plus future documents). It has been used continually. Phillips & Pugh, (2005)- provided a perspective on the wider process of studying for a doctorate. Contains an interesting chapter covering 'How not to get a PhD'. Will be referred to continually as a general support guide. Bryman et al., (2003)- parts 1 and 4 which provided a good understanding of the concepts of business research without at this stage delving into the absolute detail of Parts 2 and 3 which deal with quantitative and qualitative research respectively. The book provided substance and definitions and assisted greatly in understanding a partially new vocabulary. Will be invaluable in particular for Documents 3 and 4. Bell, (2005)- provided a very good basic background to the process of carrying out a research project with recommendations for future reading. This book complements Fisher, (2004). DBA Cohort 7 Handbook- the handbook has also assisted in the learning process and at the same time became more coherent as the concepts of research and the DBA were being assimilated. Resources- those elements of learning necessary to make best use of the

resources available and to generate new resources have been dealt with in detail earlier in this document.

Reflective learning and analysis

The development of the processes of reflective learning, double loop learning, critical scrutiny and reflective analysis are seen as being vital to all progress throughout the programme. It is now being recognised that reflection is a part of learning, not just accepting knowledge passively, but to make a critical assessment, to analyse it, to break it up into its constituent parts and to take ownership of knowledge. Analysis involves reflection and the ability to question both previous and current understandings. That one's knowledge may be transitory or provisional subject to the continuing cycle of questioning, reviewing, revising then questioning again.... Phillips et al., (2005: 38) makes the point that 'research means finding good questions as well as good answers'. The challenging of pre-conceived ideas or the open-mindedness to be prepared to 'unlearn' and 're-think' concepts, these processes are seen as assisting in both intellectual and professional development, as well as day-to-day living.

Academic writing

Within one's own experience a great deal of the reporting within a business environment, has required short punchy documents comprising, on numerous occasions, a single A4 sheet incorporating numbers, facts, figures, built-pointed or notated, delivering information in a speedy, efficient and focussed method. The move from a concise précis-type, singular approach to an academic dialogue approach has required almost a re-learning of academic essay writing. An analysis of one's communication patterns over the last six months reveals the quantum leap necessary. 90% of communications have been via email, spreadsheets, financial reports, or power point displays. Only 10% has been via 'Word' generated documents and these have been relatively 'Spartan' by comparison to that required of a DBA document. Coming to terms with a new vocabulary and approach to writing has been a challenge albeit an enjoyable one.

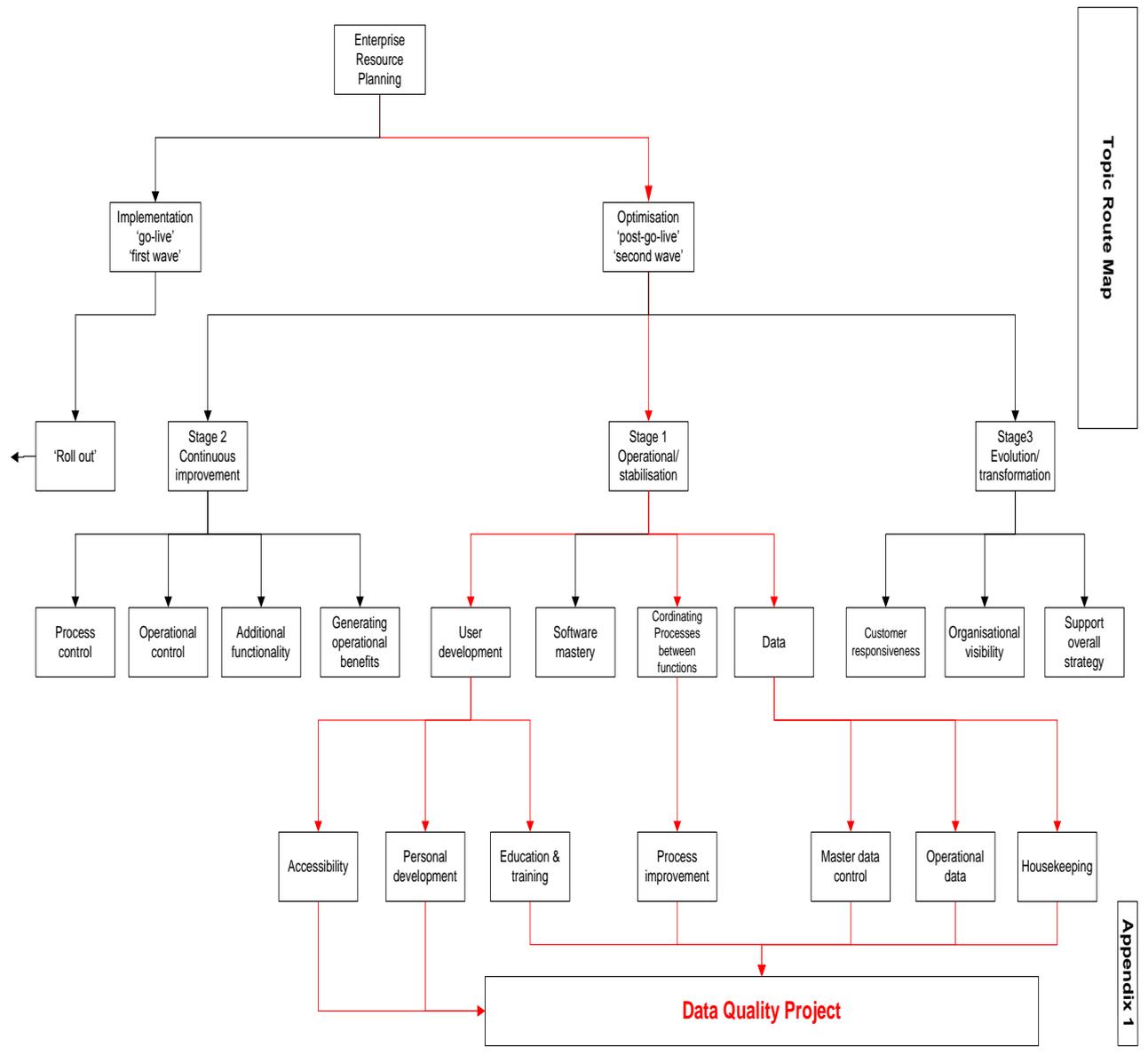
Reflections

It is anticipated that, each document will present new challenges but also bring with it rewards. The learning curve will continue to be steep, but the progress one feels one has made during this initial period utilising the resources available and the opportunities to learn and develop, promise well for the future.

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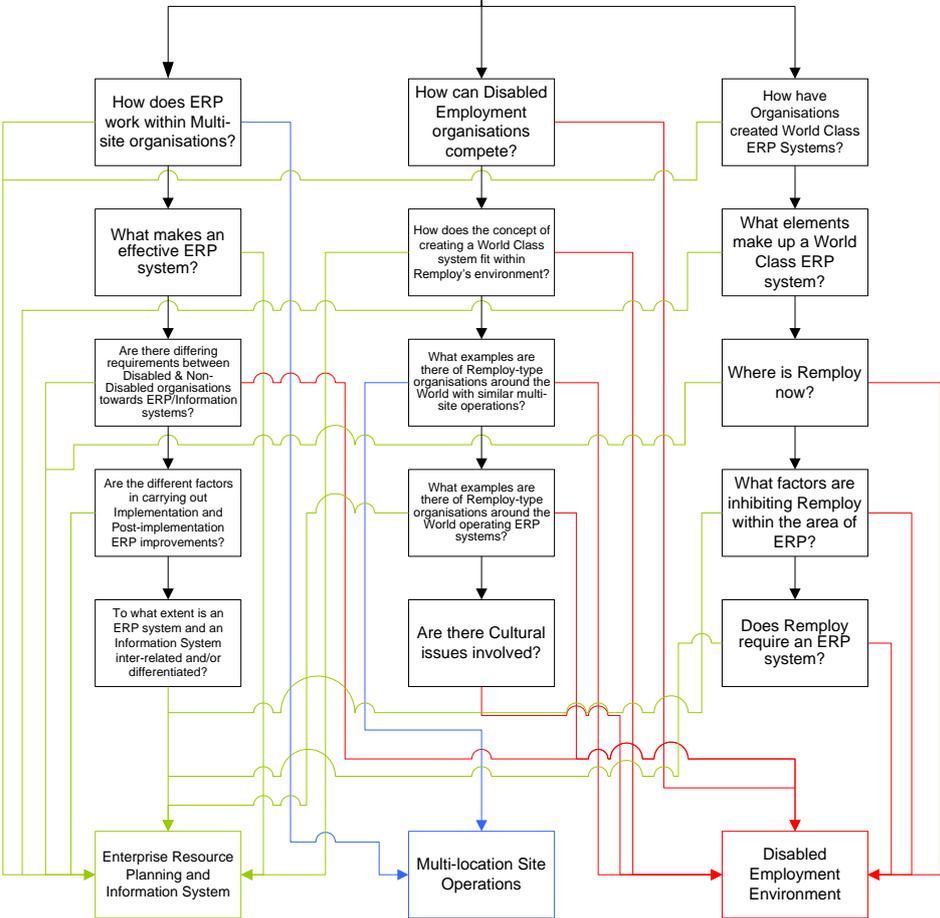


Strategic Question

Creating a World Class Enterprise Resource Planning and Information System within a Multi-location Disabled Employment Environment

Research Questions

Topic Element



Creating a World Class Enterprise Resource Planning and Information System within a Multi-location Disabled Employment Environment

Remploy	Information	Data Accuracy	Enterprise Resource Planning	Learning/ Training/ Education
<p>Remploy Values Keeping Promises Respect Openness Passion Professionalism</p>	<p>Types of Information Personal HR Operational Strategic</p>	<p>How accurate does it have to be?: Robin Goodfellow</p>	<p>Does Remploy require an ERP system?</p>	<p>Learning for the disabled- who are the experts?</p>
<p>Mission Statement 'To expand the opportunities for disabled people in sustainable employment within Remploy and in the communities it serves'</p>	<p>To what extent is Information & Data different and/or interchangeable?</p>	<p>Data Housekeeping Procedures</p>	<p>One main theme from which all other elements are connected without being the central core focus: ERP: Information: Data/Information; Learning: Communication</p>	<p>To what extent is Learning, Training & Education interchangeable and/or interchangeable?</p>
<p>International & World experience of disabled organisations</p>	<p>What type for whom?</p>	<p>Data for the Disabled</p>	<p>What makes an effective ERP system?</p>	<p>General learning</p>
<p>Are there any incidences of Remploy type organisations around the World with similar multi-site operations?</p>	<p>When is it relevant & time-important?</p>		<p>How can you create world class ERP?</p>	<p>Carole Tansley's leaning experiences</p>
<p>Is Remploy unique- 83 sites, a supported workforce with Interwork & other operations</p>	<p>Internal Information</p>		<p>Are there differing requirements between Disabled & Non-Disabled organisations towards Information/ERP systems?</p>	<p>Types of Learning</p>
<p>How can we co-ordinate all disparate Businesses/Sites & function to a common controlled purpose?</p>	<p>External Information</p>		<p>ERP providers: SSA et al</p>	<p>Learning: Communication/ Data/ Information</p>
<p>Disability Community- Its constituency</p>	<p>What is an Information System</p>			<p>Learning & Development- Internal</p>
<p>Co-ordinating the disparate units with each doing its own thing</p>	<p>How specific?</p>			<p>Learning & Development- External</p>
<p>Problem- Remploy has 83 sites plus other operations- no common overall policy to co-ordinate data & common actions- each business on its own?</p>	<p>Information/ Data: Learning/ Communication</p>			<p>Personal Development Plans</p>
<p>Stakeholders: users/suppliers/customers/beneficiaries/employees/DWP</p>	<p>What is needed?</p>			<p>Job Training</p>
<p>How do we support all elements of the Company?</p>	<p>Who are the recipients?</p>			<p>Life Training</p>
<p>How can we best improve the flow?</p>	<p>What format required?</p>			<p>Disability Training</p>

Communication	World Class/Best Practice	Culture	Researching	Others
Communication Theory: Disabled Non-Disabled. Any differences in the message?	What is World Class?	How can we develop the right Culture to achieve Remploy's objectives?	What problems does Remploy have in the field I am researching?	Workability
How best to Communicate?: 1) Information- what Information? 2) Training/Education to produce Information	How can we become World Class?	Culture of Openness: Climate to be able to admit failure & let people know, not hiding it or blaming others	Are there better ways of doing things- challenge old assumptions- find new alternatives or validate old existing ones- Be Critical	1) Communication is the vehicle to pass data up & down the organisation 2) Learning/Education/training to enable things to happen 3) Data has to be accurate
Types of Communication	Where are we now?	A 'Can do' Culture	What research has been carried out on this topic?	Accessibility & Assistive technology
Communication: Learning/Information/ Data	Who is World Class?	Is Culture an issue, if so how can we change it- IIE?	Why do I want to carry out this research project?	The right Information reaching the right people at the right time in the right format. Result- 'Good to Great'
Information Exchange	Any difference in the concept of a World Class system between a predominant disabled employee base organisation and not?			Definitions: 1) Learning 2) Training 3) Education 4) Data 5) Information 6) Communication 7) Disability 8) World Class 9) Best Practise
	What is Best Practise?			How can Data, Learning, Education, Learning all be rolled together & Communicated to achieve the project objective?
	What do the Best do?			Relating elements: 1) Direct links 2) Other related links
	Best Practise- co-ordination, accuracy data, visibility- inhibiting factors?			
	Who are the Best?			

Creating a World Class Enterprise Resource Planning and Information System within a Multi-location Disabled Employment Environment

What?	Why?
I want to understand why are we only utilising only 50%-60% of the potential of the existing Baan system- half of the 'iceberg' is still under the water?	It will be of interest because it may help organisations to optimise their performances regardless of whether they are employers of disabled persons or not
What can we do to make things better?	As a guide it may assist users/potential users/software & hardware suppliers to understand better the requirements of a disables user community
What does it take to achieve a far better performance from the software, processes, procedures & people and therby improve the Business?	A highly effective & efficient ERP and information system has the potential to enhance dramatically the performance of the Company- particularly in areas of Planning, Logistics, Finance, Management Information as well as overall Corporate performance
Key research questions- see Relevance Tree	As a contribution to knowledge it may provide a comparative analysis of areas not researched previously in any considerable degree
How- conceptually?	How- practically?
<p>Models/concepts/theories</p> <p>a. Structured approach- preliminary theories, concepts and hypotheses that guide research and data collection</p> <p>b. Grounded approach- the project may require pure material & data collection without any relation to pre-concepts</p>	<p>Research methods</p> <p>a. Quantitative: KPIs- Internal- in use currently within remploy plus those to be developed as part of the optimisation programme.</p> <p>b. Quantitative: KPIs- External- to measure progress towards achieving comparative status with best of class & world class in ERP users & disabled employers</p> <p>c. Use of analysis techniques identified in academic journals on the subject</p> <p>d. Qualitative: Interviews, questionaires to various sources of information such as: Workability; ERP providers Baan, SAP, J D Edwards; Best of class organisations; plus colleagues and associates</p> <p>e. Potential use of Balanced Scorecard framework for assessing & comparing effectiveness</p> <p>f. Possible use of Action Research techniques using 'test company' facility within Baan to simulate/test theories, new processes & procedures prior to corporate 'roll-out' across the full system</p> <p>g. Review existing major case studies in the topic area, as well as the possibility of designing specific case studies around the Remploy model</p>
Key research questions- see Relevance Tree	

Data Accuracy Project

The objective of the Business Optimisation Project, sponsored by the Finance Director, is to move our existing Baan systems from a support and control tool into one that can be used for the positive advantage of the businesses in providing accurate, timely and easily accessible data that will allow us to better manage our businesses, products and cash.

As with all databased, integrated systems, one of the fundamental requirements is for a high degree of data accuracy: errors made early in a process can be compounded by further inaccuracies as the data moves through the systems. The output from any system where this takes place is therefore inaccurate! The effect on the recipient of the data or information is to have little or no confidence in the data they receive, leading to the use of “off-line” check systems (eg spreadsheets) that are often costly, not “real time” and are themselves prone to data input and calculation errors. Even with a “hit rate” of between 90-95% accuracy of data, by the time this compounds through just four integrated processes for example the accuracy of output may have sunk to less than 70%

So, no matter how much we improve our processes, technical knowledge and understanding, if the data is not accurate then optimisation will not be of benefit to anyone – we can improve processes, but without accurate, quality data to work with, the output will continue to create unnecessary cost and lost opportunity.

The Finance Managers have agreed to act as the conduit to drive forward the concept of data accuracy improvement in each area of their responsibility. To assist in this process a small project team has been assembled to initiate the improvement programme as part of the overall Business Optimisation Project.

In order to measure data accuracy and subsequent improvements, we must define some key performance indicators against which we can measure progress. Following discussions a series of KPI's have been proposed to measure data accuracy improvement.

- 1. % Variance: Standard GM v Actual GM.** Compares the level of actual GM against the standard GM (Actual sales less standard cost of sales). Can be affected by inaccuracies in: material standards, purchase order prices, BOM's, stock accuracy, internal trading etc.
- 2. Aged Receipts not Invoiced- RNIs value & number.** Shows the level of receipts that have been booked into either stock or cost s that have not yet had an invoice matched against it. Can be affected by inaccuracies in: booking in quantities, purchase order prices.

3. **Purchase Invoices Under Query - value & number.** Identifies those invoices that cannot be matched & approved against a receipt. Can be affected by inaccuracies in: booking in quantities, purchase order prices.
4. **Outstanding Orders: Production/Purchase/Sales.** Identifies orders that are still outstanding requiring further transactions to be completed. Can be affected by inaccuracies in: quantities booked, poor housekeeping (failure to complete/close)
5. **Sales- DNYI & Invoices at 'Reserved' status.** Shows where we have despatched goods, but have not yet invoiced the customer or where the invoicing process is incomplete.
6. **Stock Takes (Accuracy) Number and value of Stock takes, Number and Value of adjustments.** Can be affected by inaccuracies in: stock booking, stock issuing, BOM's (backflushing/issuing), despatching, shrinkage etc
7. **Credit Notes- Value & Reason Codes.** Shows the amount and value of credit notes issued and the reasons for the issue. Can be affected by inaccuracies in: quantity invoiced, price charged, invoice/delivery address VAT etc
8. **Analysis of GL Journals.** Shows the value of manual adjustments being made in order to correct data inaccuracies. Can be affected by- almost anything!

If we are serious in addressing this issue, then we will need the commitment of the Business and Support Teams (including Corporate & Interwork) in recording and acting upon this data. To ensure that this takes place, there should be an upward reporting process that makes the businesses and support functions accountable for the accuracy of the reporting and the actions being taken to improve the KPI's, possibly through red-book reporting or as part of the QBR's.

As stated previously, unless we get our data accurate (probably up to 99% accuracy within processes), we will never be in a position to optimise our investment in our Business Systems. We will continue to operate expensive off-line systems. Our ability to manage our cash will be constrained and our credibility with both our internal and external customers/suppliers will continue to suffer.

We seek the support of the executive in promoting the above KPI's within the businesses and support functions and monitoring the performance of these KPI's.

DATA ACCURACY ISSUES- SUMMARY

Items

BOMs

Integration

Production Orders

Purchase Orders

RNIs

Accounts Payable

Inventory

Sales Orders

Accounts Receivable

MRP/SIC/MPS/Manual etc

Sales/Purchase Pricing

Costing

Customer/Suppliers Master data

PLUS PROCEDURES, PROCESSES & PEOPLE

Extract from

Wallace, T. F. & Kremzar, H. H. (2001) ERP: Making It Happen: The Implementers' Guide to Success with Enterprise Resource Planning. New York: John Wiley & Sons.

The Evolution of ERP- from MRP to ERP

1. Material Requirements Planning- MRP

A better way to order manufacturing materials

- a. What are we going to make?
- b. What does it take to make it?
- c. What do we have?
- d. What do we have to get?

2. Closed Loop MRP

Priority planning v Capacity

3. Manufacturing Resource Planning MRPII

Grown from 1 & 2 with additional elements

- a. Sales & Operations Planning to balance demand and supply and provide better control
- b. Financial interface to quantify transactions in financial terms
- c. C. Simulation- provide 'what-if' scenarios

4. Enterprise Resource Planning ERP

Grown from 1, 2 & 3 with an organisation-wide set of forecasting, planning and scheduling tools to enable a business to:

- a. Predict and balance supply and demand
- b. Link customers and suppliers into a complete supply chain
- c. Employ proven processes for decision-making
- d. Coordinate sales marketing, operations, logistics, purchasing, finance, product development, and human resources

(Wallace & Kremzar, 2001: 6-12)

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ANALYSIS OF JOURNAL ARTICLES PRINTED BUT NOT CONSULTED

Appendix 6

Author	Title
Abbott	Data data everywhere- & not a byte of use
Akoumianakis	Propagating experience-base accesibility guidelines to user interface development
Al-Mashari	ERP systems: a research agenda
Alshawi	Integrating diverse ERP systems: a case study
Amoak-Gyampah	ERP implementation factors- A comparison of managerial & end-user perspectives
Bendoly	ERP system & implementation benefits
Bhatt	Business process improvement through EDI systems: an empirical study
Bititci	The interplay between performance management, organisational culture & management styles
Bradford	Does you ERP system measure up?
Burn	Managing knowledge in an ERP virtual organisation
Chand	A balanced scorecard based framework for assessing the strategic impacts of ERP systems
Davenport	Competing on analytics
Davenport	Managing information about processes
Davenport	The coming commoditization of processes
David	Drowning in data
Ettlie	Strategic predictors of successful enterprise system deployment
Fahy	Why best-of-breed ERP systems add up for finance what CFOs really want
Gal	The reward effect: a case study of failing to manage knowledge
Gattiker	What happens after ERP implementation: understanding the impact of inter-dependence & differentiation on plant-level outcomes
Gordon	Making knowledge management work
Griggs	Corporatisation of the Not-For-Profit Sector: strategic planning & organisational performance in disability-based organisations
Gumbley	Knowledge management
Hedman	Narratives in ERP systems evaluation
Helo	Logistic information systems- An analysis of software solutions for supply chain co-ordinations
Holbrook	Adding value with analytics
Huang	Transplanting the best practice for implementation of an ERP system: A structured inductive study of an international company
Hurley	Facilitating corporate knowledge: building the data
Ingemansson	Reducing bottle-necks in a manufacturing system with automatic data collection & discrete-event simulation
Ioannou	Theory of constraints-based methodology for effective ERP implementations
Johnson	An evaluation of accessibility in online learning management systems
Johnson	Strategies for Data Warehousing
Karabas	Developing strategic information systems
King	Ensuring ERP implementation success
Lado	Expert systems, knowledge development & utilisation & sustained competitive advantage: a resource-based model
Lee	Developing the information systems architecture for world-class organisations
Lengnick-Hall	The role of social & intellectual capital in achieving competitive through ERP systems
Lidvall	Software systems support for knowledge management
Liebman	ERP's housekeeping headaches
Luscome	Customer-focused MRPII
Mark	Global trade management after Sarbanes-Oxley
Matolcsy	Economic benefits of ERP systems: some empirical evidence
McAdam	ERP & organisational innovation- management perspective
Moad	Juggling act: Baan struggling to win new accounts in ERP
Mouritsen	Developing & managing knowledge through intellectual capital statements
Murby	System dynamics: taking the scorecard further
Muscattello	The potential use of knowledge management for training
Newell	Implementing ERP & knowledge management systems in tandem: fostering efficiency & innovation complementary
Newell	Social capital & knowledge integration in an ERP project team: the importance of bridging & bonding
O'Kane	Simulation as an enabler for organisational excellence
Petroni	Critical factors of MRP implementation in small & medium-sized forms
Salaheldin	A study on MRP practices Egyptian manufacturing companies
Salisbury	Putting theory into practice to build knowledge management systems
Scott	Post-implementation usability of ERP training manuals- user perspective
Songy	IT system gives managers standardised view of costs at multi-site companies
Spring	Knowledge management in extended operation networks
Swan	Knowledge management & innovation; networks & networking
Tchkogoe	Key lessons from the implementation of an Erp at Pratt & Whitney Canada
Verville	So you're thinking of buying an ERP? Ten critical factors for successful acquisitions
Yen	Aligning ERP implementation with competitive priorities of manufacturing forms
Zuckerman	Pushing ERP integration into the Supply Chain

Document 2

Critical Literature Review and Conceptual Framework

DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

Data Quality

A fundamental element in Creating a World Class Enterprise Resource
Planning and Information System within a Multi-site Disabled Employment
Organisation

Document Two

Tony O'Brien

Document Two is submitted in part fulfilment of the requirement of Nottingham Trent
University for the degree of Doctor of Business Administration

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Abstract

Document 1 of this project identified that quality data was an important factor in creating a world class enterprise resource planning and information system and this document re-affirms that stance. Poor data quality can have a considerable negative impact on corporate performance, but the concept of data quality appears to have largely been ignored by most organisations. This document in the form of a critical literature review undertakes a critical account of the literature relevant to data quality defines working definitions for the key concepts and constructs a strong robust conceptual framework intended to support the project throughout the remaining time of the DBA. The most important elements of the literature relevant to the substance of the project are identified, described and evaluated. Certain key themes emerge in particular those relating to people, processes and data itself, together with data dimensions. The relationship between the concept of a product manufacturing system and that of an information manufacturing system is identified in terms of raw data as an input, an information system as a process and an information product as an output and the concepts of total quality management (TQM) are seen as being relevant to improving data quality. The initial research questions are re-assessed and extended following the review of the literature and a plan for undertaking Documents 3, 4 and 5 is established. The implications with regards to Remploy and other disabled employment organisations are also discussed.

1. Introduction and Objectives

Introduction

This literature review is presented in the context of a broader concern, outlined in Document 1 (O'Brien 2006), that of creating a world class enterprise resource planning and information system. The initial literature search carried out for that document indicated that data quality might be a fruitful area for investigation and consequently this document focuses on that area. The document will re-affirm the importance of data quality and the impact it has within the context of an ERP and information system, thereby justifying further research within this area. A brief description of the literature and management issues relating to data quality will follow, before carrying out a review of the objectives and research questions generated from Document 1. The key concepts will then be defined and working definitions developed within a strong robust conceptual framework designed to support the project throughout Documents 3, 4 and 5, followed by a detailed critical review of the main literature relating to data quality. The other elements identified in Document 1 as being key to the project, namely master data management and organisational and human resource issues, will be discussed, in addition to aspects of strategy and control embracing the governance, auditing, monitoring and measurement of data and information. Reference will also be made to the resources available to support the author during the whole of the DBA. A concluding section will summarise the main working definitions, and emerging themes, re-visit the research questions and present an overview of Documents 3, 4, 5 and 6. Finally a reflective review is included which will identify the author's learning and development experiences and personal feelings as they have emerged during the process of working through Document 2.

Data quality is one of the most important issues facing any organisation, but paradoxically it is also one of the most neglected. Organisations have three fundamental resources at their disposal namely: Capital, People and Data. Considerable effort and expense is expended attempting to monitor and control capital assets of both a physical and financial nature, whether they be buildings, plant, machinery, equipment, inventory, cash or other financial instruments. Risk Management is also a thriving profession, which itself has generated a growing research village. The explosion in Human Resource management operations has followed the acceptance that 'people' are an organisation-leading source of added value and successful organisations have focussed and expanded within this area. Data as a business resource has been neglected significantly by comparison. In a similar vein organisations go to considerable lengths to improve product and service quality, expending enormous resources in the areas of total quality management, continuous improvement, Kiazen, inbuilt quality initiatives etc, without any real corresponding initiatives within the field of quality data management. Document 1 (O'Brien 2006: 13) identified a potential link between the concepts of product or service quality as personified by the works of the leading

authorities within the area of total quality management and that of data quality, but this relationship has yet to be recognised by many organisations.

The Impact of Poor Quality Data

Extensive literature has been unearthed on the subject of data quality, but apathy continues to exist within the unenlightened user community. Is this the result of a 'myopic' attitude on behalf of the potential beneficiaries or to a lack of penetration by the providers of this 'enlightenment'? Numerous studies have identified individual horror stories emanating from data quality imperfections, some of which estimate losses exceeding the GDP of some developing countries. A report from The Data Warehouse Institute estimated that data quality problems costs US business \$600 billion a year in postage, printing and staff overhead costs alone, whilst the majority of the senior managers in those companies affected remained unaware (Eckerson 2002: 3). Findings from the PricewaterhouseCoopers Global Management Survey, published at the end of 2004, identified that 75% of those surveyed reported major problems resulting from faulty data, half reported incurring additional costs resulting from the need to carry out extra internal control work, whilst a third had been forced to delay new system implementations (Informatica. 2005: 2). There were also predictions that during 2006/2007 more than half data warehouse projects would have only limited success at best (Informatica 2005). The fact that data quality is not perceived as a high priority maybe attributable to sheer complacency or total ignorance, which only becomes apparent when a crisis occurs necessitating instant remedial action. Poor quality data can have both obvious and hidden implications. The former may take the form of late delivery of orders, over stocking, missing inventories etc (Redman 2004). Even more insidious is the hidden effects, including reduced employee morale, organisational mistrust, loss of sales, missed opportunities, and followed by the steady erosion of credibility within corporate stakeholders leading to the eventual loss of customers and subsequent revenues (Redman 1998: 79). Whilst Redman believes that the overall costs of poor data quality (COPDQ) are difficult to analyse, he suggests that the figure is in excess of 10% of organisation revenues, maybe upwards of 20% especially when one factors in hidden costs (Redman 2002: 2, 2004: 4). Redman develops the concept of 'The Rule of Ten' whereby if it costs £1 to complete a simple transaction or operation when the data is complete and perfect, then it costs £10 when it is not (ie inaccurate, late, incomplete etc) (Redman 2004: 3). Redman further identified the impacts of data quality problems within Table 1 (Redman 2001: Table 8.1).

On Operations	
On Customer Satisfaction	Lessened. Customers are often unforgiving of simple data errors
On Cost	Increased. Upwards of 10% of revenue For service organizations, up to 50% of expense is due to poor data
On Employee Morale	Lowered. Dealing with errors is hard, unfulfilling work
On Decision-Making/Tactics	
Decision Making Capability	Reduced. Poorer, less confident decisions that take longer to make
Data Warehouses	Delayed implementation
Re-engineering	Poor quality is a major impediment
Trust between organizations	Dramatically lowered
On Labor Pool	Skilled employees required for non-value-added work*
On Strategy	
Setting Strategy	Take longer and is more difficult
Execution	More difficult, due to impact on operations and tactics
Ability to derive value from data	Contributing factor to reduce ability. Exacerbates issues of data ownership
Ability to align the organization	Compromised. Data don't align, so departments can't talk to one another
Management Attention	Diverted from other issues

Table 1. The impacts (often hidden) of poor-quality data on the organization

Data Quality Within the Literature

The vast majority of the literature covering data quality emanates from the 'general' academic, consultancy and software-provider sectors. There appears to be a general lack of interest or enthusiasm amongst the more 'serious' academic journals to publish research within this area and the author has carried out a small amount of research, which confirms this 'phenomenon'. The research was undertaken by analysing the 'Classification of Academic Journals in the Field of Business and Management Studies' published by (Bristol Business School 2005). The study identified 1162 academic journals listed under various subject headings and ranked using certain classifications based upon peer assessment, one of which is 'World Elite Academic Journal' which "signifies by common consent that the journal is regarded as of the very highest quality and that publication in the journal is a signifier of the very highest quality research" (Bristol Business School 2005). 39 journals (3%) were awarded this status of which 21 (2%) were listed within subject areas considered to be potentially applicable to this project. Each of the 21 journals was reviewed using the NTU 'eSearch' search engine, looking for occurrences of the words 'data quality' or 'information quality'. From this analysis, 28 articles were found, with varying degrees of relevance to the project, as detailed below in Table 2.

Subject Area	No. Journals	Applicable	No. Articles	No. Relevant
Accounting & Finance	5	Yes	7	
Economics	11	No		
General Management	4	Yes	2	1
HRM	1	No		
International Business	1	Yes	0	
Information Systems	2	Yes	12	
Marketing	4	Yes	7	
Operations & Technology	1	Yes	1	1
Operations Research	1	Yes	6	1
Organisation Studies	2	Yes	0	
Psychology	4	No		
Social Studies	2	No		
Business Strategy	1	Yes	0	
Total	39	21	35	3

Table 2. Analysis of ‘Serious’ Journals research into Data Quality

There are of course degrees of subjectivity regarding any study, but even allowing for this the overall results remain conclusive that the ‘serious’ academic literature, within the criteria specified, has bypassed data quality for whatever reason. It is not within the scope of this project to speculate why ‘serious academia’ considers data quality to be ‘insignificant’ but it is important to highlight what appears to be a serious omission. It may be to approach those journals listed under the subject headings of General Management, Information Systems, Operations & Technology and Operations Research in an attempt to ascertain their priorities with regards to data quality. However its significance within both the business and research communities must not be ignored.

Managing Data Quality Issues

There is no quick fix to achieving quality data. Tackling data quality requires a structured approach towards all the elements that encompass the complete time frame of short, medium and long-term approaches. From simple data housekeeping exercises, in maintaining, cleaning and closing completed or redundant customer/supplier orders etc, to implementing a full corporate data quality strategy and policy. All have their place in this ongoing continual process. A data quality strategy requires a total understanding and appreciation of what is required. A sound fundamental understanding of the whole process is essential, otherwise any programme or initiative to improve data quality will be hit or miss at best, or at worst be counter productive, worsening a company’s position. As with any improvement cycle, one must first understand the processes, where everything fits and the terminology involved. Many data improvement initiatives do not succeed as a result of a failure to appreciate these complex and multi-stage processes, which involve the themes of data and information. Tackling only the components in isolation will not succeed on a long-term basis. The

individual elements each have their own inter-dependences, which by nature requires a harmonious approach. All these stages demand a complete understanding and appreciation of their implications and the related processes need to be managed actively to avoid poor results. Data quality is not just about IT, it is not just about business users or business processes. It comprises all of these, plus above all people.

Personal email correspondence with certain established data quality writers supports the necessity for a comprehensive and balanced approach, to resolving data quality problems.

In a personal email to the author: Ralph Kimball advises that... "In my opinion data quality is merely diagnosed and described in an information system. Once the bad data is captured at its origin, there is relatively little the information system can do to make the bad data better. This is a critical misunderstanding that executives have about IT and especially the data warehouse's responsibility for bad data. The long-term solution to bad data relies on business process re-engineering (using Michael Hammer's original definition) where the entire organization mobilizes to create higher quality data. This means better business rules, better data entry screens, and better recognition for data entry personnel. This means executive involvement and executive investment (dollars) in these factors. I have written quite a bit about data quality, especially in my ETL Toolkit book, but it mostly boils down to diagnosing and describing data quality issues after the data is collected. Maybe it's an artificial boundary but I believe the data warehouse is mainly the canary in the mine, not the creators of transaction capture systems. Sorry for the mixed metaphor..." (Kimball 2006)

In a further personal email to the author: Larry English responded by emphasising... "Thank you for your email and your interest in Information Quality Management. If an organization wishes to be world class, it needs to focus not just on data quality but on information quality management that includes addressing quality of the defined meaning of data and its business rules and valid values that make up the "information product specifications." A world class approach to IQ focuses on the presentation of information to knowledge workers eliminating bias and presenting information concisely and effectively so that knowledge workers take the right action or make the right decision". (English 2006).

A Review of the Project Objective and the Research Questions from Document 1

Within Document 1 of this project (O'Brien 2006: 4) identified data quality as the single most important element in building a World Class Planning and Information System. This focus has not changed. Indeed the importance of quality data has been even more emphasised in the intervening period of research. The initial document identified a number of significant points, which emerged to form the basis of the project research questions. These were seen at the time, as the essential issues, which needed to be investigated to provide the rich research material essential to attaining the overall project objective. An important aspect of Document 2 is to challenge these initial assumptions. In the light of further research these questions

have remained essentially robust overall, but will require additional elaboration and expansion as further questions and issues have arisen. It will be beneficial to identify and review the initial research questions and then expand upon these, as they have developed in line with one's thinking during the literature review.

Research questions from Document 1 (O'Brien 2006: 3)

2. What are the attributes of data quality with particular reference to ERP?
 - What is data quality?
 - How does it impact upon enterprise resource planning?

2. What is the range of factors that impinge on data quality?
 - What are the elements that effect data quality?
 - How can data quality be measured?
 - What levels of data quality are necessary?
 - What do organisations need to do to improve and sustain data quality?

3. Are there specific factors that apply to these in the context of Remploy and related organisations?
 - How can the study be best related to Remploy?
 - Does Remploy's position make it unique or can common practices be applied with or without modifications?

The above research questions require further elaboration and extension. There is a requirement to cover additional extensive definitions especially relating to information, learning, and knowledge; to explain in detail the interaction between data, an enterprise resource planning system and information; the requirement to ascertain the cost and impact of poor data quality together with the benefits of such improvements. In addition the title encompasses the words 'World Class'. This may have a number of connotations and questions. How does one know when one achieves world-class performance? What is world class anyway? How can it be achieved? In reality does an organisation need to achieve world-class performance? Is achieving world-class status cost effective? Is one over-complicating the issues and 'over-egging the pudding' in aiming to be world class when something less may be sufficient? All these questions are very relevant. Is the most appropriate goal, that of aligning quality data to produce real quality information within an effective enterprise resource planning environment in order to assist the organisation to achieve its strategic objective? Are we looking for world shattering change or progressive amelioration and aggregated improvements?

This project will continue to focus on the quality of data and information as they related to the operations within an enterprise resource planning system. A considerable amount of valuable literature covers data and information per se, without direct reference to the operations of an ERP system. This wealth of supportive evidence will not of course be neglected, but will be viewed and filtered by reference to its applicability to the true focus of the project and the established research questions. Other systems external to an ERP system such as customer relationship management (CRM), supply chain management (SCM), fixed asset management packages etc, do not form part of the scope of this project, except is so far as they have a direct interface and provide direct input data into it. The principles of data quality that apply to normal input data will apply in a similar way to these extraneous systems.

The continuing motivation for undertaking the DBA programme remains the achievement of a major academic goal, but equally important is the goal of providing input into the field of management practice, covering a neglected area that is relevant to all types of organisations. The author has a real interest in the subject and an emotional feeling that real incremental progress can be made by any organisation in the area of data quality. It requires motivation and the right climate. These themes will be developed further within this document.

Implications for Remploy

As emphasised in Document 1, the fundamental aim of any DBA project is to add to the pool of knowledge within management practice and this project is no exception. There is also the subordinate aim of applying the principles and practises learned and developed to practical use not only within Remploy, but also within other disabled employment organisations across the World. This subordinate aim has not changed, indeed its importance, within Remploy specifically, has increased considerably within the last six months. The Company is carrying out a fundamental strategic review of its entire operations, in collaboration with its single shareholder, the Department of Work and Pensions and other stakeholders including employees and unions. At this moment the final outcome is not known, but it is likely that there may be considerable structural and strategic change within the Company during the next two years, with the possibility of withdrawal from unsustainable operations, producing a new working model for those remaining businesses, whilst growing the 'Interwork' operation, its disabled person recruitment, rehabilitation, learning and external placement business, by a factor of four. These overall changes will place considerable strain on all areas of the Company and require considerable change-management resources, skills and support. The implications for quality systems, quality data and quality information are enormous. It is intended that this project will assist the Company during this period of fundamental change. Indeed some short-term initiatives have already been implemented during the last six months and appear to be generating improvements.

The objectives of this critical literature review is to enable the author to explore, assimilate and articulate the wealth of knowledge appertaining to the project, whilst evaluating and

critiquing the relevance of the material to the overall project's objectives. Within this process a conceptual framework will be developed, as a route map, to guide the research through the rest of the literature review and provide a solid foundation for the on-going stages of the research project within the DBA documents 3, 4 and 5.

2. Conceptual Framework

The development of the conceptual framework has 'emerged' out of the literature and the author's own experiences gained over a number of years, as something that 'appeals' and appears to 'fit' within the overall scope of the project. The conceptual framework will identify the key concepts and assist in establishing key formal working definitions on which to 'hang' the developing research by simplifying reality to make it easier to discuss, analyse and carryout research (Fisher 2004: 102). This will inevitably lead to a wide-ranging debate which will raise areas, sub-topics and subjects that are outside the real boundaries of the project, by being marginal, peripheral, secondary or irrelevant and will be 'bracketed out' of the real project focus, thereby retaining what is real and key, holding a position 'x' and focussing on this position (Fisher 2004)

A strong dual inter-linked conceptual framework has been developed from an intensive review of the literature. The first stage is based upon the principles of the **Data Quality Project** as defined in Document 1 (O'Brien 2006: page 4 & Appendix 1), comprising the data elements of master data management, operational & transactional data, the necessary housekeeping processes plus systems and process improvements, together with the human elements of education and training, personal development, coupled with accessibility, the provision of hardware and software support designed to assist disabled persons to maximise their ability to interface with IT. The framework is displayed graphically in Appendix 1a. To support this, the original process by which the project developed within Document 1 is reproduced in Appendix 1b (O'Brien 2006: Appendix 1), commencing with the initial concept of ERP, leading to the optimisation 'second wave', then onto the initial stage of stabilisation, comprising the identified elements and sub-elements involving users, software, processes and data. These components were linked together in Document 1 as Figure 1 (O'Brien 2006: 4) and are reproduced again as Appendix 1c, to emphasis the inter-relationships and the way in which they have been developed and linked further as dependencies and inter-dependencies .

This initial framework is intended to provide the necessary fundamental source(s) of quality data, as raw material input into the operations of an ERP system, to generate improved quality information and decision making to form the initial stages of the **The Data Value Creation Chain**. The Data Value Creation Chain is designed to assist in knowledge creation and enable the organisation to take the necessary actions to create **real value** from **quality data** and assist in providing support to achieve it's strategic objectives. This is shown diagrammatically in Appendix 2a. It has been adapted by the author from Redman's linear 'Generic Information Chain' (Redman 2001: Figure 15.12) reproduced as Appendix 2b and Brackett's pyramidal Business Intelligence Value Chain (Brackett 1999: 2) shown in Appendix 2c, and expanded further by Palmer (Palmer 2006). This dual framework is seen as a clear and concise representation of the key elements surrounding the subject. (English 1999: 160-162) has devised a similar termed model the 'Information Value and Cost Chain'.

Its objective is to identify and plot all the points at which data accuracy can impact on an organisation's processes and applications. It is a complex model and whilst it is an important tool, which may be used within an information quality assessment process, it is not seen as being appropriate for use as a conceptual framework within this environment.

The Data Quality Project framework is intended at this stage to encapsulate the full spirit and overall objective of this DBA project and will therefore comprise the basis for documents 3, 4 and 5. The inter-linked Data Value Creation Chain is of considerable benefit as it provides a vision of how the project sits within the overall organisational data, information, knowledge and value stream and to emphasis how critical this is to overall organisational success. Appendix 2a also identifies how the process of producing quality information, knowledge and value derived from quality raw data maybe seen as akin to a product manufacturing process. This very useful analogy between a product manufacturing process and an information manufacturing process has its roots in the literature (Wang 1998: 59) and this will be emphasised together with the parallels between the quality management principles. The relationship in the step-by-step linked components of the data to value column is compared with the production process steps within a generic manufacturing system, leading eventually to the product sale and income generation. Just as the quality of a product depends upon the process by which it is designed and produced, the quality of data depends upon the on the design and production processes involved in generating the data (Wand and Wang 1996: 89). The components will be dealt with in greater detail.

3. Defining the Concepts and Developing Working Definitions

Introduction

One of the first major decisions to be made when commencing a research process is to decide at which stage one should commence to define those essential concepts which will provide the foundations of the research programme and then to draft a conceptual framework which will act as a route map through the on-going research mine field. There are two options available, either to carry out the process during the initial stages (known as a structured approach) or to leave it towards the end (a grounded approach) (Fisher 2004: 99). The modular nature of the DBA dictates that this process should commence early in the programme. This timing also suits the inclination and working style of the author in that the structured approach will provide a more controlled environment within which to work, utilising this format to assist in the development of the initial concepts and theories, the on-going gathering of research material, as well as providing greater precision within pre-determined timescales, milestones and completion dates.

Concepts are seen as the foundation on which the project's research will be based comprising the building blocks of models and theories (Fisher 2004: 101). It is essential therefore that appropriate working definitions be agreed for all the key terms based largely upon the material gathered from the literary review. It is intended that the process of definition will focus on the concepts identified within the conceptual frameworks of the Data Quality Project and the Data Value Creation Chain. It is recognised that there may be conflict, between the various definitions, which could lead to ambiguity and confusion unless: working definitions that match the context of the project are chosen which reflect practice and reality. If there is disagreement concerning definitions within the data quality academic fraternity, then similar if not greater divergence or misunderstandings are bound to exist within those organisations that have practical experience of using data and information.

Data Quality

For the purposes of the project the expression Data Quality will apply generically to encompass both the quality of the data and the quality of the information within an enterprise resource planning and information system. The definitions of both data and information, together with other key concepts, will be detailed further within this document. Data quality appears in the literature as early as 1962 within a book titled 'Data Quality Control- The New Research Technique' by Raoul Naroll, reviewed by (White 1963: 667). The book begins by claiming that "This monograph offers a new method- Data Quality control...offers a way to control the effects upon correlations not only of bias in data reports but also of random error there". This reference is not intended to imply that Narol invented the term; indeed data quality pre-dates him by some time, but to highlight the fact that the subject has been under scrutiny for over forty years and one is tempted to ask "what progress has been made, during the intervening four decades, to improve the issue?"

Data or information quality has been defined variously as “data that are fit for use by data consumers” (Wang and Strong 1996: 6) , “data are of high value if they are fit for their intended uses in operations, decision-making and planning” (Redman 2001: Figure 14.12). “Data quality means having the right and correct data in the right format, in the right place at the right time to complete an operation, satisfy a client, conduct an analysis, or make and execute a plan”(Redman 2004: 2, 2005b: 1). “Data quality is the measure of the agreement between data views presented by an information system and that same data in the real-world” (Orr 1998: 67). “Data quality is the process which focuses on the control and reduction of error while data is moving through an information system” (Griffin 2005c: 2). “One single version of the truth across the enterprise” (Deloitte Consulting LLP and Hyperion Solutions Corporation 2006: 1; Griffin 2005b: 2; Williams and Beyer 2006: 2) Quality may be measured by: “how well the demand for business information is met” (Brackett 1999: 1), “the degree to which information consistently meets the requirements and expectations of the knowledge workers in performing their jobs” (English 1999: 478) and quality means: “consistently meeting knowledge worker and end-customer expectations” (English 1999: 24). Defining precise terms is not an easy task, in fact the MIT Total Data Quality Management research programme states that “data quality is not well defined in practice” (TDQM 2006).

Data

A considerable number of the leading articles fail to provide detailed definitions of either data quality or ‘data’ itself. Indeed a number (Strong, Lee and Wang 1997: 103; Wang 1998: 59; Wang, Allen, Harris and Madnick 2002: 1) state specifically that the terms data and information may be used interchangeably. The situation appears to be complicated even further concerning discussions around the topic of ‘dimensions’. A number of articles use the term ‘data dimensions’ (Strong et al. 1997: ; Wand et al. 1996: ; Wang et al. 1996) whilst others on the same subject, originating from the same source, use the term ‘information dimensions’ (Lee, Strong, Kahn and Wang 2002: ; Wang 1998). In attempt to clarify this uncertainty the author contacted one of the co-writers Diane Strong, a prominent writer on the subject of data and information quality, who had provided assistance earlier in the project.

The author’s question is replicated below:

“I am making great headway with my literature review within which I am attempting to determine strong working definitions for the main concepts. Two of these happen to be ‘Data’ and ‘Information’. I notice that a number of the TDQM articles state that the two terms are interchangeable- ie the ‘Data Quality in Context’ article you quoted earlier. In addition the ‘DQ Category and DQ Dimensions’ quoted in this 1997 article, are termed ‘IQ Category’ in the 2002 article ‘AIMQ: a method for information quality assessment’. Are precise definitions advisable in attempting to differentiate between the two?”

Diane Strong replied stating:

"We switched from using the term 'data' to using the term 'information' for practical reasons -- computer scientists generally objected to having subjective dimensions beyond accuracy labelled as data quality. Yes, you can find definitions in various intro IS textbooks, and other places. We found from experience that trying to stick to formal definitions does not work."

(Strong 2006).

One had begun to appreciate, during the literature review, that a number of the dimensions relate more to 'information' than to 'data', given the more precise definition(s) of the two terms as detailed below. The reply is however very interesting particularly with the comment relating to the lack of formal definitions. It has to be stated that other established writers on the subject have failed to distinguish fully between the two and it is hoped that there will be further opportunities to request additional clarification as to why such writers (one must assume that the opinion is shared within the MIT TDQM team) are of the opinion that 'formal definitions do not work'. These comments however will not deter the author from establishing his own working definitions that fit within the overall project. Further detailed discussion of the subject of dimensions appears later in this document. It should be noted also that the term data is really the plural of 'datum' however the former will be used in all instances.

(Fox, Levitin and Redman 1994: 11-12) provides a short chronological potted-history of the notion of data, citing a number of definitions prior to stating their own viewpoint. (Blumenthal 1969: Fry and Sibley 1976) both define data as a 'set of facts', (Davis and Rush 1979: Yovits 1981) refer to the way it can be obtained, as the results of measurement and observation. (Dorn 1981) definition, 'the raw material from which information is developed' has a distinct ring of truth, which will be examined later. (Langefors and Samuelson 1976: Burch 1983) refer to data as 'symbols' highlighting the sound of a train whistle as an example. Although one could debate whether a train whistle is data or information its relevance to this project appears to be somewhat tenuous. The article then focuses on the approach developed by the database research community citing the works of (Mealey 1967: Kent 1978: Tsichritzis and Lochovsky 1982: Loeb1 1990) from which a framework of 'data items' are devised, comprising entities, attributes and values (e, a, v) termed a 'triple'. The example specified relates to employee records:

Entity Class:	Employee record table		
Entity:	Individual employee record-		
Attribute:	Name:	Employee No:	Date of Birth:
Value:	Tony O'Brien	123456	25/01/1947

The concept was developed further within the article by defining a set of rules for the recording and representation of the said data items (Fox et al. 1994: 13). An example of this may be the building-in of validation checks, ie name must be text only; employee number must be numeric; date of birth must be dd/mm/yyyy (or mm/dd/yyyy in the US) etc. This

concept is interesting particularly with regard to master data management. However it has to be appreciated that this relates only to part of the debate, the record may be valid, but will not be accurate if the wrong text/numbers/dates are inserted. This article is useful in that it also highlights the high degree of subjectivity involved in attempting to come to any form of consensus regarding definitions. The article also discusses data dimensions, which as already stated will be covered in further detail. A number of these definitions are relevant but depend upon the way in which the author decides how the concept(s) of data will be used, as raw material input and as data within a database etc.

In deciding upon working definitions it important to ensure that the agreed terms for both data and information are individually 'ring-fenced' to avoid any confusion. There are also a number of basic definitions available for data from both established writers and from informational databases, these are replicated here. "Simple observations of the world, easily structured, captured, transferred and quantified" (Davenport and Prusak 1997: 9). "Data may be viewed as individual raw facts out of context, with no meaning, involving numbers, characters, text, and images in fact any form in which a fact may be presented" (Brackett 1999). "The representation of facts, the raw material from which information is produced when it is put in a context that gives it meaning" (English 1999: 468). "A single item of data has often been seen as having negligible value in itself that can cause quality problems as the majority of data capture takes place at this lower level" (Information Alchemy 2006: 1). "Signals about human events and activities" (Davenport and Marchand 2000: 165). "Part definition of raw data is numbers, characters, images or other outputs from devices to convert physical quantities into symbols, in a very broad sense. Such data are typically further processed by a human or input into a computer, stored and processed there, or transmitted (output) to another human or computer" Answers.com. "Data can encompass any form of fact whether on paper or in electronic form. It may refer to any electronic file in whatever format. Everything made ready by a computer can be considered data except for the programming instructions- i.e. software" Answers.com. "Data consists of a series of facts or statements that may have been collected, stored, processed and/or manipulated but have not been organised or placed into context. When data is organised, it becomes information. Information can be processed and used to draw generalised conclusions or knowledge" About.com

At this stage the author views data as raw data yet to be processed, akin to product raw materials. It may comprise transactional data in the form of an order from a customer either verbal or in writing, or master data containing details relating to a new customer or product prior to entry into the customer or item data master file. A possible grey area that requires resolution relates to raw data received from an IT or system generated source. This may take many forms including an electronic data interchange (EDI) message, a Customer Relationship Management (CRM) communication or even a direct posting from a networked fixed asset package. As stated previously such sources are outside the scope of ERP and

this project and are therefore of an external nature and should be subjected to the same treatment as the manual customer order. Exceptions to this are system generated messages from within the ERP system such as suggestions to purchase or manufacture products, emanating from MRP or MPS processes, reacting to certain system parameters. This dialogue takes place within the ERP database and is therefore seen as 'data in context' rather than raw data.

By making this distinction one is able to overcome partially the criticism by (Fox et al. 1994: 11) of the (Dorn 1981) definition of data as "raw material from which information is developed", highlighted above, in that one is establishing a real demarcation between data and information or indeed raw data and data within a database. Raw data without an end product is of no single use to any potential user.

Data in Context (Data in an ERP Database)

Data within an ERP database is by nature at least one step removed from the basic material comprising the initial input. It is data within the system and depending upon the control mechanisms existing within the operating system, will have been subjected to various processes. Bracket (Brackett 1999: 2) described data in context as facts comprising raw data that can readily be understood, BUT unlike information has no relevance or time frame. It is data that is arranged and labelled.

An example of the transition from raw data to data in context may be seen using the example below relating to a customer order:

Raw data:

Sales order from: Bradford Royal Infirmary, for: 150 Class A 16" X 16" Wheelchairs in Ninian material @ basic NHS price for delivery 50 units on 1st September, October, November.

Data in Context:

Customer number:	<u>241300</u>
Customer name:	Bradford Royal Infirmary NHS Trust
Customer Address:	Duckworth Lane Bradford West Yorkshire BD9 7DR
Delivery address:	If different
Item Code:	<u>MA1235633</u>
Item description:	Class A Wheelchair size 16" X 16", Colour Ninian
Price:	£155.50 per chair
Deliver date/Quantity:	<u>01/09/06</u> <u>50</u> <u>01/10/06</u> <u>50</u>

	<u>01/11/06</u>	<u>50</u>
Total order value goods:	£23325.00	
VAT:	£4081.88	
Total order value:	£27406.88	

The conversion from raw data to data in context takes place by the inputting of a number of variables (those underlined), which in turn interact with the relevant master data relating to the customer, item, sales price to complete the order:

Customer number:	to generate customer name, address and vat liability
Item code:	to generate item description
Customer/item: (From above)	to generate selling price from pricing tables (unless entered manually) and to calculate the VAT amount if applicable
Delivery date:)	To identify when the customer requires the goods to be delivered
Quality:)	

The data within the database may contain not only the base master data relating to the sales order, but also the various planning elements and parameters of the ERP system in order to make various recommendation with regard to the manufacture and/or purchasing of the relevant material(s) to ensure the customer receives the goods within the timeframe they are required. The raw data is now within the context of the system and is arranged and labelled with certain elements of meaning, but at this stage has no real value. It is no longer a pure input, but still remains a systems process. At this stage the data, having been extracted, may be stored, recorded, aggregated, stored again and manipulated, waiting to be extracted finally as information. The quality of the resource data determines the real foundation of the information, knowledge and value generation process. It can enhance or worsen the whole of the value chain initiative that comprises the foundation for business intelligence. (Brackett 1999: 1)

Information

As stated previously the intention is to differentiate information from 'facts' and from 'data' albeit the three are used interchangeable by numerous leading academics in the data quality field.

Prior to highlighting the various definitions of information as proposed by current day writers, it will be beneficial to look back to the burgeoning days of the then new concept of 'information theory' which had its base as a discipline of applied mathematics involving concepts of communication. A couple of groundbreaking papers were published just after the Second World War. 'A Mathematical Theory of Communication' was published in 1948 by Claude Shannon which helped establish the discipline of information theory, centring on the engineering problems of transmitting information over a noisy communication channel or

telephone line (Sveiby 1998: 2). Shannon viewed information as merely the quantitative measure of communicative exchanges, concentrating solely on the transmission of messages within a telecommunication system environment, attempting to ensure that the message received by the recipient was exactly or as close as possible to that transmitted by the sender from the source. (Losee 1998: 274). One concludes that the focus of this study was centred upon the accuracy of the transmission and reception rather than the accuracy of any perceived meaning intended to be transmitted. This point was highlighted within a subsequent article by Shannon and Weaver published in 1949 (Checkland and Holwell 1997: 93). Shannon is also credited with defining information as “that which reduces uncertainty” (Emery 2006). Tom Redman also echoed this view during the one-to-one conference call with the author (Redman 2006).

The article by (Losee 1998) quoted above, contains a number of definitions relating to ‘information’, emanating from the worlds of electronics and mathematics, as well as those of information science and the social sciences. Information is seen as relating to meaning, the transmission of knowledge or a reaction which occurs in the mind of a recipient of a message (Losee 1998: 258). An interesting definition suggests that information is produced by processes and is represented by the sum of the values of the characteristics of these processes’ output. (Losee 1998: 259). The ‘process’ theme is elaborated within figure 1 whereby the value of the output of a process, is informative about the process and its input (Losee 1998: 265)

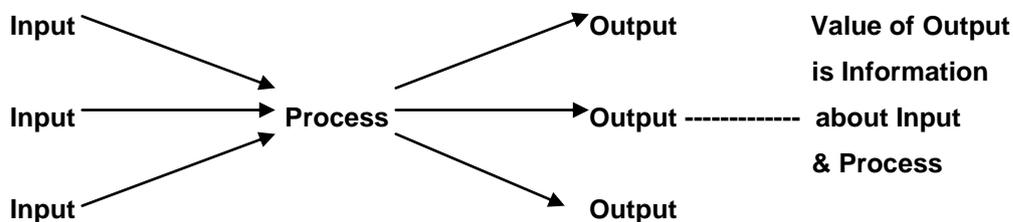


Figure 1. Information as an output of a process

This model mirrors the early stages of the Data Value Creation Chain: (data; to data in a database; to information) but concentrates on emphasising the ‘process’ without any real discussion concerning the quality of input or of the information output. The Losee article, whilst identifying certain relevant points appears to meander around the information discussions. The salient points tend to be lost in the detail and loose emphasis as a consequence.

Peter Drucker has been credited with defining information as data endowed with relevance and purpose (Davenport et al. 1997: 9). In a later article (Drucker 1998) highlights the fact that we are currently within the fourth information revolution. The first being the actual invention of

writing some 5000 to 6000 years ago, the second, around 3000 years ago, resulted in the development of the written book, whilst the third was heralded by the invention of the printing press some 500 years ago. The fourth, within which we now live, centres on the 'meaning' and 'purpose' of information, an area which he claims has been largely neglected by the IT community in its dash for enhanced technology, machinery, techniques, software and speed, focussing on the 'T' of IT. He argues that in the future the crusade will be taken up by top management demanding that information be made available to support the 'business enterprise' in achieving its aims of value and wealth creation. The impact of the huge technological advances have so far been seen in a more 'operational' context in running processes within organisations, rather than the actual delivery of improved decision making information. Drucker's thoughts have interesting connotations; if the fourth information revolution is that of the generation of new concepts and the search for the meaning and purpose within information; then the current IT driven technological movement must still be part of the 'third' revolution, if so, is the current IS or IT industry merely a modern day extension of the Gutenberg or Caxton printing press?!!!!!!

From personal experience the author has been involved within the area of computers, systems, IT, IS etc (what ever name is in vogue) for in excess of forty years experiencing the advances from machines using valves, transistors, punched cards and tape etc within enclosed rooms approximating an operating theatre with the emphasis on mainly customer invoicing and credit control, inventory management and payroll; through the introduction of the first PCs in the early 80s; to today's flexible and highly transferable technology of 'IT on the go'. Throughout the four decades the author believes the emphasis has remained focussed more upon processes and systems rather than information generation, as witnessed with the rise of the new enterprise resource planning, customer relations management and supply chain management systems etc. Criticism cannot be levelled purely at IT's door, the management of corporations have authorised countless IT capital investment plans without necessarily factoring in improved management information systems, or even more importantly carrying out subsequent appraisals to ascertain whether such projects have achieved the agreed targets. The drive for improved quality information, the drive for improved quality data, will only materialise fully, if it has the sponsorship of executive and top management. The question is, do many have the intension or inclination, or more importantly, the awareness?

The reference made above to information being the 'reduction of uncertainty' (Emery 2006: ; Redman 2006) appears to be a rather narrow definition with somewhat negative or reactionary connotations. A number of related definitions promote a wider perspective. (Marchand 2000: 4) describes information as the way people in business express, represent, communicate and share their knowledge with others to accomplish their activities and objectives. (Davenport et al. 2000: 165) suggest that information is what data becomes as humans interpret and contextualise it. (Brackett 1999: 2) views information as a set of data in

context, that is relevant to one or more people at a point in time or for a period of time. Emphasising that information is data that is imbued with meaning, relevance and purpose, without which it remains merely raw facts- 'data noise'. It only becomes information when its recipients accept the facts as relevant to their needs. Within the context of a formula, he equates information to: *raw data + in context with reasoning + relevance & purpose*. In a similar vein Larry English sees information as "Data in context, the meaning given to data or the interpretation of data based on its context" (English 1999: 476). He associates data with raw materials and information with finished goods resulting from the interpretation of data, emphasising that information is the meaning of data whereby facts become understandable. Similar to Bracket he formularises his interpretation in the form of: *Information = data + definition + presentation* (English 1999: 19). Richard Boland identified the correlation between information and meaning as ".....the task of information systems is to support human inquiry as a process of subjective, interpretive, meaning making". (Boland, Tenkasi and Te'eni 1994: 459) and goes onto extend this further by stating that "Inquiry is the act of producing knowledge" (Boland et al. 1994: 462). (Mutch 1996: 58, 1997: 381) identifies earlier definitions from Boland published in 1987 that information "is not a resource to be stockpiled as one more factor of production. It is meaning, and can only be achieved through dialogue in a human community. Information is not a commodity. It is a skilled human accomplishment" and "information is a thing to be searched for, stored and identified" (Mutch 1999: 327). Bracket, English and Redman remain among the most established figures in the realm of data and information quality, whilst Boland's reputation within the disciplines of accountancy and information systems supplemented by Marchand, is considerable, therefore their contribution within the literature review is extremely valuable. (Marchand 2000: 25-27) identifies four ways that companies can use information to create value for business by; minimising risks particularly in the in the areas of marketing, finance, operational and legal; reducing costs by improving processes and transactions; adding value to customers and markets and finally creating new realities by way of innovation and R&D.

Data can be stored in a system database but information cannot. Information in the form of a report becomes information when it reaches the public domain, that is, in the possession of the recipient from which he or she will derive relevance, meaning and purpose. The report remains data in context (data within a database) whilst it is stored and only becomes information when it is retrieved and distributed. The attempts for clarity, if not precision, in defining terms are important, in particular the differentiation between data and information and this activity has been supported by the veracity of the literature. Whilst it is accepted that information can also be the raw data for the next job or task, as highlighted by the loop within the Data Value Creation Chain, it is not reasonable to accept that the two are therefore solely interchangeable sharing a common meaning.

Part of the process of this document has been to challenge the assumptions contained in Document 1 with regard to both the scope of the project and to the research questions. The scope has remained robust following the review of the literature and continues to be contained within the boundaries as defined by the Data Quality Project conceptual framework in Appendix 1. There are certain other important concepts which form part of the Data Value Creation Chain in Appendix 2, but are not considered to be 'key' concepts in so far as they are outside the scope of an enterprise resource planning and information system, but do require some form of definition both for completeness and to justify their continuing omission.

Other Relevant Definitions

Learning

It may be said that learning is the commencement of the internalisation of the information received, by the recipient. It is the process whereby skills and knowledge are acquired.

Knowledge

The World's economies are fuelled by knowledge (Wenger 2002). Knowledge is information of which someone or something is aware and may be gained by the processes of learning, experience, and deduction, reflecting an understanding of the essentials of a subject to enable the recipients to use the information for a purpose. It reflects the outcome of the connectivity between a person's experiences and skills with the incoming information message. Knowledge is internal within a person and only people can understand, only people can be aware- knowledge exists only in people's heads. "Knowledge is information combined with experience, context, interpretation and reflection. It is a high-value form of information that is ready to apply to decisions and actions". (Davenport, De Long and Beers 1998: 43). Knowledge is information in peoples' minds (Davenport et al. 2000: 165) or as "valuable information from the human mind, including reflection, synthesis and context" (Davenport et al. 1997: 9). English defines knowledge as information within a context, leading to an understanding of the significance of the information supplied (English 1999: 481) and further as a formula $Knowledge = People + information + Significance$. (English 1999: 20). (Marchand 2000: 3) defines knowledge as "our experiences, skills, expertise, judgement and emotions"

Knowledge can be 'tacit' reflecting the knowledge within an individual or a collective such as an organisation and is often contained within the subconscious. It cannot easily be shared but has been found to be a strong foundation within the process of creativity and innovation. Explicit knowledge on the other hand is knowledge that can be articulated and shared. It is also claimed that explicit knowledge can be codified and stored. This presents a point that could generate an interesting discussion. If knowledge is stored does it still retain its label of knowledge or does it become data in context under the agreed definition above? One may be

tempted to say “Discuss”, but as knowledge is seen to be peripheral to the main thrust of the project, this temptation can be easily resisted.

Within the overall concept of knowledge there has developed sub concepts of ‘The Knowledge Worker’ and ‘Knowledge Management’. Simplistically, the knowledge worker, using the term coined by Peter Drucker in 1959, is deemed to be someone who interacts and works with knowledge within his or her working environment. Or as Individuals who, in the course of carrying out a task or process, use information in any form (English 1999: 481). Thomas Davenport (Davenport 2004: 17) suggests that they are workers who are tasked principally with the creation, distribution or application of knowledge. Michael Hammer selects a more specific definition as devised by Peter Drucker, which defines a knowledge worker as “someone who knows more about his or her job than anyone else in the organisation” (Hammer 2004: 14). A knowledge worker is a recipient of information and therefore may also be viewed as an information customer or consumer. In the information or knowledge age, knowledge workers are now estimated to outnumber all other workers in North America by at least a four to one majority

Knowledge management refers to the systems or environment within which organisations acquire, accumulate, organise and manage information and knowledge. It can be an environment, either physical or metaphorical, where the knowledge workers reside, enabling tacit knowledge to be converted into explicit knowledge, for onward distribution within the organisation in order to add value. (Wenger 1997) uses the term ‘Communities of Practice’ to refer to people working and learning together towards a shared goal and this is developed further, (Wenger 2004) within a knowledge management environment, to apply to groups who share a common passion about a subject of which they have knowledge, interacting regularly in order to learn and improve.

Whilst knowledge is considered to be ‘internal’ within the individual, the terms ‘knowledge worker’ and ‘knowledge management’ appear to imply some form of ‘external’ manifestation of knowledge. This raises a number of potential questions. Are knowledge workers really data workers or information workers? Are they in fact ‘movers’ of data rather than knowledge, working with external data rather than internal knowledge? The discussion again returns to the matter of establishing working definitions and interpretations. Where there is no common accepted terminology we find ourselves within a potential tautological minefield. (Mutch 1996: 58-59) raises the demarcation issues between data, information and knowledge. The question arises is this the result of an accidental blurring of the boundaries, or are there elements of intellectual snobbery involved regarding information and knowledge versus what is perceived as ‘mere’ data? The wide-ranging definitions applied to the term ‘knowledge worker’ detailed above highlights the issue. Maybe one should attempt to be more specific and apply the terms ‘data worker’ to those who provide and process the data, ‘information worker’ to those

who are the actual data consumers as defined below and 'knowledge worker' to persons who are tasked with the distribution and application of knowledge. These issues also apply to 'knowledge management' or should it be 'data management' or 'information management'?

The entire process of turning data into knowledge is encapsulated in a single model proposed by (Checkland et al. 1997: 86-92) in Figure 2.

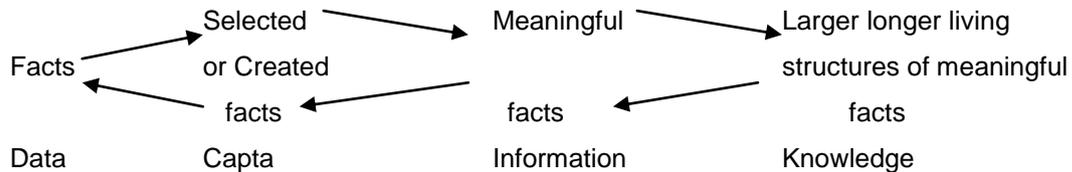


Figure 2. Data, Capta, Information and Knowledge- Three Step Process

The three step process commences with *data*, comprising a mass of raw facts, from which part of the data is selected for attention as being useful and relevant and thereupon becomes known as '*capta*' (meaning 'to take'); this is then converted into *information* by having some form of meaning in context attributed to it albeit of a short term nature; the process is completed when information gains a degree of longevity within the mind of the recipient in the form of *knowledge*. The example can be used to model any data-to-knowledge environment. The act of creating information and knowledge is seen as a human act, outside the scope of any machine. When applied to the context of an enterprise resource planning, or any other database system, it is only the processed *capta* (selected data) or (data in context as described above) that resides within the database. The model is useful in that the 'capita' stage provides a clear division between raw data and information particularly within a non-database environment where the distinction may otherwise become blurred.

Action and Value

Informed knowledge enables people and organisations to take action and thereby create value. Armed with knowledge people can take action, make decisions, develop strategies and eventually add real value. The internal knowledge, resident within people or organisations, can be transferred in the real world environment in the form of actions, which can be strategic, tactical or operational, with the objective of creating value for the individual, organisation or community. The Data Value Creation Chain envisages a closed loop whereby the end product of these actions also creates raw data, which feeds back into the overall model.

The scope of the project as stated previously, is focussed on quality data, quality data in context and quality information as already specified. The author feels that the project can make a contribution within these areas. Learning and knowledge have been excluded as these relate to internal issues within individuals and improving the quality of the data and information would make major improvements within the area of knowledge.

Redman suggests a somewhat interesting, if flippant, range of definitions within a narrative article:

Question: "What the heck are 'data' and information' anyway?"

Answer: "Do we really know? There are a lot of opinions and it gets worse if we throw in 'knowledge' and 'wisdom'." For now: Data can be structured to fit a database, information is what you didn't know before, knowledge can get you out of trouble and wisdom can help you avoid trouble in the first place" (Redman 2005a: 22)

4. Data Quality

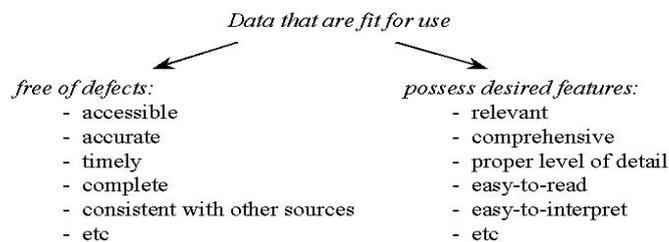
Introduction

For the purposes of the project the expression Data Quality will apply generically to encompass quality raw data, quality data in context within the ERP database and quality information. This is not intended as a volte-face on the stated intention of using appropriate working definitions, but merely to use an umbrella term to encompass the three elements, which are all inextricable, inter-linked.

In order to address data quality issues, it is paramount that quality, within this context, is defined correctly. The end product of any data quality initiative, must be to improve information available to the end user, the customer or consumer, therefore it is useful to define the term from a customer perspective that of “data that are fit for use by data consumers”. (Wang et al. 1996: 6) supported by (Xu, Nord, Brown and Nord 2002: 47). (Redman 2001: Figure 14.12) draws upon the field of manufacturing quality and the work of J M Juran as detailed in figure 1 below.

Data Quality - Defined

Data are of high quality if they are fit for their intended uses in operations, decision-making, and planning (after Juran).



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Figure 14.2

Figure 3. Data Quality defined

Quality definitions relating to ‘fit for use or fit for the purpose’ recognise the established management maxim that an organisation’s overall goal should be to delight its customers. This represents an admirable objective or better still corporate value, but is not specific enough on which to base an entire data quality programme. Indeed achieving high quality data is an on-going battle, which can never be truly won, as there is no real end to the process as the various interests or parties often have varying priorities. There cannot be a ‘one size fits all’ solution. In order to research and improve data quality, it is essential that it be not only defined (if this is indeed achievable fully) but also measured and analysed in order to be able to identify and implement improvement programmes.

A considerable amount of research has taken place on or around categories of data known as dimensions which attempt to describe various characteristics and features of data. There is a tendency to focus attention solely on accuracy and whilst accuracy is important it is only one of a number of data dimensions. (Wang et al. 1996: 6) define these dimensions as “a set of data quality attributes that represent a single aspect of data quality”. Prominent dimensions identified in studies include accuracy, timeliness, completeness and consistency. This list is by no means exhaustive, in fact a considerable number of such terms have been identified and whilst it cannot be said that there is total common agreement in respect of either their number or individual definition, they still represent a very important field to investigate and may prove to be akin to DNA as the genetic material comprising data quality.

Research into Data Quality

There has been active research into data dimensions from the end of the 1970s, prominent amongst the researchers has been Donald Ballou who in particular with Henry Pazer published a number of embryonic works during 1980s (Wang et al. 1996: 23; Xu et al. 2002: 57), also prominent is Thomas Redman (Fox et al. 1994: 13; Redman 1992). The research carried out by (Wang et al. 1996) has proved to be of interest within which they examined data quality through the concept of data dimensions with particular regards to the requirements of data and information users, customers and consumers. Previous approaches had tended to be focussed on an intuitive approach, selecting those attributes, which related to the particular topic or goal of the study, or a more theoretical approach, which attempted to identify all the potential areas of data deficiency within the production, or processing of the data. It is claimed that both these approaches paid attention to the development rather than the use of data. Wang and Strong attempted to redress this by carrying out an empirical study to identify the feelings and opinions of the end user customers with regard to their opinions as to the fundamentals requirements of quality data. (Wang et al. 1996: 7). Deming also accepted the case that quality cannot be addressed without involving the customer (Deming 1986).

It will be beneficial to follow the research approach, method and process, as the published article has been used in numerous subsequent research studies and may proved to be useful within the context of this project. An implicit assumption was made at the commencement of the research, that data could be treated as a product and an information system viewed as a data manufacturing process with raw data as an input and then processed to provide output data and data products. An illustration of this may be seen in Appendix 2. The research method comprised a framework consisting of a two-stage study followed by a two-phased sorting process. The first survey was aimed at producing a list of potential data quality attributes or characteristics collected from a sample of 25 data consumers working in industry and 112 MBA students who had data consumer experience. The results yielded 118 attribute items, which were then subjected to the second survey, of 1500 randomly selected subjects,

who were asked to rate each attribute in importance. This generated 355 viable responses, the results reflecting the overall responders' ratings of these attributes. The importance ratings were then subjected to factor analysis and consolidated into an intermediary set of twenty data quality dimensions, which were subsequently reduced to fifteen. The two-phase study then placed the fifteen dimensions into four categories based on the varying characteristics and recognised patterns of data quality problems. The result was a hierarchical framework of data quality as depicted below. The results are based upon a sizable sample of actual data users from varying backgrounds and experiences, all having encountered data problems, which added credibility to the outcomes. The combination of two surveys, one of a qualitative and the other of a quantitative nature also provides balance. It is also important that users' opinions and experiences are taken into consideration, not only within data quality research but also within the actual information systems design process (Boland 1978).

A detailed appreciation of the concepts surrounding data dimensions can provide significant assistance in improving data quality. (Tayi and Ballou 1998: 56) support this point by emphasising that data quality problems cannot be resolved without a thorough understanding of data quality dimensions. The framework enables the three elements to be put into perspective. Data attributes or characteristics are the most numerous and represent the lowest level at which data problems may be encountered but because of their multiplicity are difficult to analyse. When aggregated up into dimensions the identification and analysis process becomes easier and the data problems can be assessed, root causes identified and improvements applied. There is considerable evidence to believe that the concept of data dimensions will provide rich input into this project and therefore it is planned that it will be revisited within documents 3, 4 and 5. In support of this, the (Wang et al. 1996) model also provided the basis for a study of data quality in the healthcare industry (Gendron and D'Onofrio 2001). The research covered all the elements of a complex organisational structure covering the for-profit, mixed and non-profit sectors, mirroring the diverse structures relating to Remploy and other disabled employment organisations.

A diagram of the hierarchical relationships between the categories, dimensions and the attributes is shown below in figure 3 (Abate and Diegert 1998: 5), together with detailed definitions of the individual categories and dimensions. Further research has been carried out into data dimension used within the fields of national and international statistics to identify definitions used by Eurostat (European Statistical System- ESS) (OECD 2005), International Monetary Fund (IMF) (OECD 2005), Organisation for Economic Co-operation and Development (OECD) (OECD 2005), UK Office of National Statistics (National Statistics Methodology Advisory Committee 2003), United Nations- ECLAC (United Nations Economic Commission for Latin America and the Caribbean- ECLAC 2003) and the United Nations Statistical Commission (Laliberte, Grunewald and Probst 2004) and described in Appendix 3

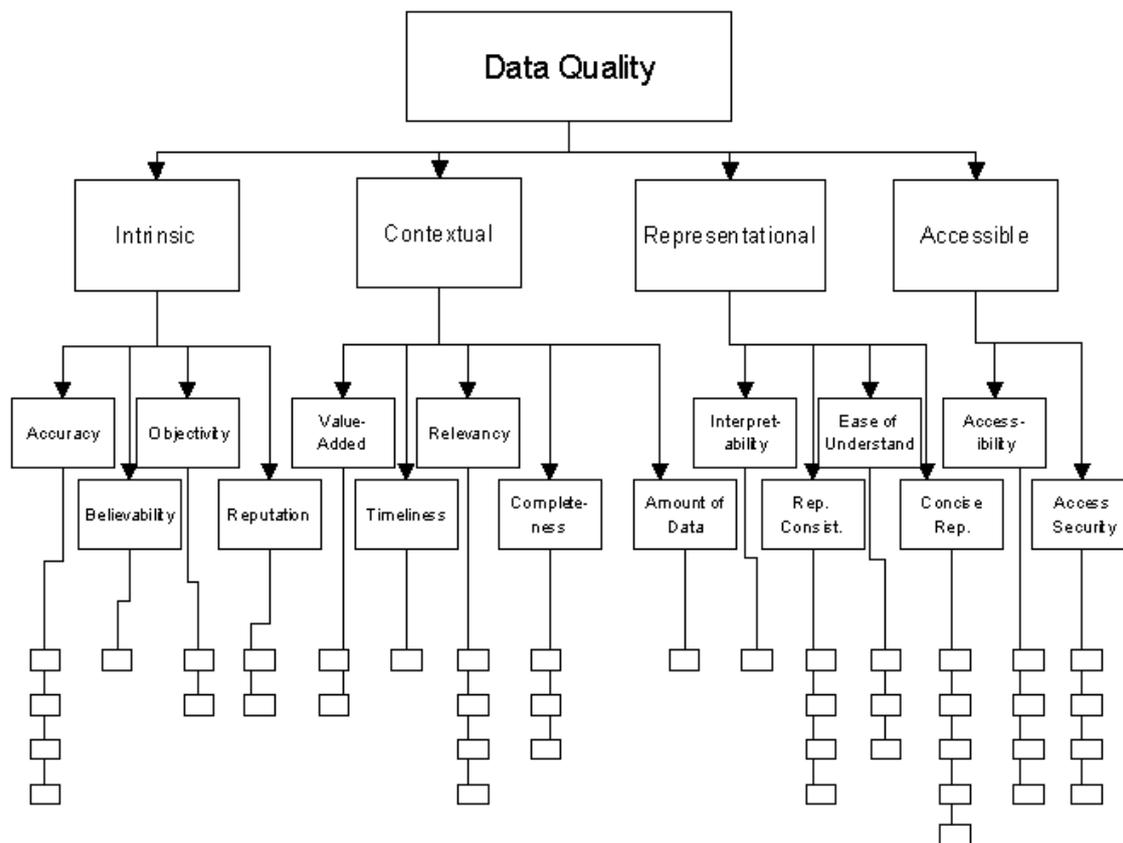


Figure 3. Data Quality Improvement Hierarchy

Data Quality Categories, Dimensions and Attributes

Category: Intrinsic

Data must conform or correspond to the actual or true values. Maybe seen as being similar to actual product quality

Dimensions:

Accuracy: data must be correct, reliable and free of error.

Believability: data must be accepted or regarded as true, real and credible.

Objectivity: data must be unbiased, unprejudiced and impartial

Reputation: data must be trusted or highly regarded in terms of source and content

Category: Contextual

Data that is applicable or pertinent to the task of the data user

Dimensions:

Amount of data: the quantity or volume of data must be appropriate

Completeness: data must be of sufficient breadth, depth and scope for the task in hand

Relevancy: data must be applicable and helpful for the task in hand

Timeliness: the age of the data must be appropriate for the task in hand
Value-added: data must be beneficial and provide advantages from their use

Category: Representational

Data that is represented in an intelligible and clear manner

Dimensions:

Concise: data must be brief in presentation, yet complete and to the point

Consistency: data must always be in the same format and compatible with previous data

Interpretability: data must be in an appropriate language and units with clear data definitions

Understanding: data must be clear, without ambiguity and easily comprehended

Category: Accessible

Data that is readily available or obtainable

Dimensions:

Accessibility: data must be available or easily retrievable

Access security: data must be restricted where appropriate and hence kept secure

A far more theoretical approach to the discussions on data dimensions is exemplified in (Wand et al. 1996) which takes a more intrinsic stance and analyses the ontological nature of information systems and data quality, re-iterating the lack of consensus in defining dimensions. It analyses data quality in terms of measuring deficiencies between two views of what is seen as the real world, comprising a user's view of the world as seen through a direct observation of events and a view inferred from the information system. The measurement of quality (or lack of quality) being based upon the degree of divergence between what a user perceives to be the truth and what the information systems is telling him/her. The information system comprises two transformations: a representational transformation that of creating a representation of the real world within the information system by designing, creating and populating the system with data and a interpretation representation which refers to the way in which the system infers and presents an actual view of the world (Wand et al. 1996: 88). The article is informative and thought provoking in recognising areas of potential divergence with the resultant data quality problems. If an information system is to truly reflect the real world and thereby reality, its operations has to replicate reality, its source data must mirror reality (representation transformation) and the output must be produced in a format which reflects reality, enabling the uses to view the information in the same light as they would the real world (interpretation transformation). The analysis generated four generic dimensions identifying whether data is complete, unambiguous, meaningful and correct. It concluded by recommending that a rigorously defined set of data quality dimensions be developed to provide a common set of terms.

The differing intrinsic and empirical approaches of to the study of data quality dimensions used by (Wand et al. 1996; Wang et al. 1996) are brought together by (Strong et al. 1997).

The study adopts a data consumer perspective using a qualitative method to analyse data quality projects within three leading-edge organisations. It uses the term 'data manufacturing system' highlighting the concept of a data production process transforming data into information for use by data consumers. (Strong et al. 1997: 104) Three leading roles are identified within the data manufacturing system:

Data Producers:	Generate data
Data Custodians:	Manage, store and process data
Data consumers:	Use data

With the proviso that the output supplied to the consumer may then be aggregated and integrated back into the system creating a closed loop as identified in Appendix 2a. The data quality categories and dimensions outlined above in (Wang et al. 1996) were used within the study together with a three-step data problem solving process, namely: problem finding (how the problem was identified), problem analysis (determining the cause) and problem resolution (changing the processes). This process is akin to the total quality management 'plan, do, check, act cycle' (Deming 1986).

The data manufacturing concept is also used as the basis of (Wang 1998) highlighting the relationship between quality issues in product manufacturing and those in 'information' manufacturing (data and information used interchangeable again).

Manufacturing Process	Product	Information
Input	Raw materials	Raw data
Process	Assembly line	Information system
Output	Physical products	Information products

The output of the information manufacturing process is seen as an information product to be distributed to a consumer. The study identifies four roles within the information process: information suppliers who create or collect the source data; information manufacturers who design, develop, and maintain the manufacturing environment; information consumers who receive and use the products and finally information managers responsible for managing the entire process. Deming's 'plan, do, check, act' cycle (Deming 1986) is then used as the basis for developing Total Data Quality Management data quality cycle 'define, measure, analyse improve'.

Define:	Data quality dimensions and requirements
Measure:	Data quality metrics- where are we now?
Analyse:	Identification of root causes and impact of poor quality
Improve:	Improvement initiatives

The TDQM cycle has been adopted subsequently by the US Department of Defence (DoD) as the four faces in a continuous life cycle (Lee et al. 2002: 136). The overall approach is once again based upon a data consumer perspective returning to the data quality dimensions developed within (Wang et al. 1996). It has to be remembered that the importance of each

dimension is dependant upon the individual requirements of each consumer. (Wang et al. 1996) concentrates mainly on the definition process with far less emphasis on the measure, analyse and improvement steps, but does offer guidelines which may provide the basis for application within the boundaries of this project.

The above observation concerning the lack of emphasis on the latter three element of the TDQM cycle is echoed in (Lee et al. 2002: 133). The article proposes a methodology called AIM quality (AIMQ). It uses a 2x2 framework model developed to identify what quality means to information consumers and managers based upon work by (Kahn, Strong and Wang 2002: 188) as the 'product and service performance model for information quality' (PSP/IQ) and seeks to integrate the product perspective, of conformance to specifications, with the service perspective, of meeting consumers' expectations. The data quality dimensions developed within (Wang et al. 1996) are again used within both of these studies. The PSP/IQ model feeds into a two-step process, which first collects and measures the data quality deficiencies and then analyses the gaps to determine the appropriate areas within which to focus improvement efforts. The same quality improvement maxim, mantra continues to apply – assess, analyse, improve; find, analyse, resolve; identify the problem, identify the cause, action the change.

It is necessary to understand what data quality means and the work carried out on definitions supports this, but it is equally important to understand how it is measured. Measurement and analysis are essential to improving data quality. Data quality is a multi-dimensional concept and requires a quality assessment process, which reflects such diversity using appropriate metrics (Pipino, Lee and Wang 2002). Assessing an organisation's data quality requires both a subjective and objective assessment. The subjective measures reflect the personal needs, requirements and experiences of those who interact with the data, being the suppliers, manufacturers, consumers and managers referred to above (Wang 1998: 60). The objective assessments focus on the actual data, using task-independent metrics that take a generic view of the data without particular regard for any specific application and task-dependent metrics that look at the data from the organisation's view relating to individual operation and applications. (Pipino et al. 2002) propose a format of three types of metrics to cover the subjective and objective assessments using a simple ratio, min or max and weighted average. This model was developed further by (Cappiello, Francalanci and Pernici 2004) although they focussed purely on the user perspective. It is important to appreciate that when using any form of measurement one must, confirm the scales and the results (what result is good, what result is bad) and to measure continually. The author's own data quality key performance indicators (see Appendix 4a) are updated each night and are continually available.

The TDQM cycle was extended by (Redman 2005a: 14) adding a further element, that of 'control' relating the adapted model to the quality concept of Six Sigma. This aspect of control

was also emphasized in an earlier article (Kaplan, Krishnan, Padman and Peter 1998: 74) and is also reflected within a number of the data quality dimensions identified above. Inherent within the TDQM cycle, is the importance of effective feedback. Ken Orr devised his concept of 'user-based' data quality arguing that the one certain way to improve the quality of data was to increase the use of that data (Orr 1998: 71). He argues that the use of a feedback control system (FCS) is a key control element in any system, which interacts with the real world to ensure that any changes in the real world are then fed back into the system and the relevant elements updated accordingly (Martin 2005). Orr's model comprises an input: process: output model, with a feedback loop to provide new input, not unlike the closed loop 'data value creation chain' in Appendix 2. It is possible that some of the data problems identified by Orr particularly around legacy systems, out-of-sync data and multiple re-entry of data may be overcome by the integrated nature of an enterprise resource planning system. Notwithstanding this Orr presents some useful ideas in a straightforward and coherent manner.

A considerable amount of the literature on data quality has focussed upon the consumer with attempts to identify and measure user satisfaction. A limited study was carried out, during the 6th International Conference on Information Quality held at MIT in November 2001 and published in (Chung, Fisher and Wang 2002), with the aim of gaining an understanding of how data quality research and skills complement each other and to determine which areas of the subject should receive attention. Whilst the preliminary findings suggested that 'adaptive capabilities', those relating to user satisfaction, were perceived as the most important, in fact 'interpretive capabilities' relating to the identifying and articulating the implications of data quality within organisations, were seen as the most significant by corporate executives, project managers and academics. The findings, although based on a limited sample, do suggest that a more balanced approach between internal and external viewpoints from an organisation perspective may be beneficial.

Data is capable of crossing departmental boundaries, inter-company boundaries and even trans-national boundaries whether via manually or automated processes; originating orders, creating transactions and generating postings (Redman 2005a: 21). Most of this data travels horizontally across structures, but most organisations are managed vertically. It is important therefore, that organisations create management and control structures that are aligned to these data flows or chains. In order for any organisation to be able to manage correctly, there has to be ownership, responsibility and accountability and data is no exception. Redman also contends that for data to be good, those who create it must be accountable, they have to know they are accountable and they have to have the tools they need to make the data good (Redman 2005a: 17). This appears to be true only partially, the ownership, responsibility and accountability extends not only to data creators and producers, but also to data custodians and ultimate consumers. The success is in identifying where the responsibility lies within the

overall data flow or chain and in aligning this responsibility to the relevant parties as data moves along the chain from the initial raw data to the final information generation.

Wang's description of the final output of a data manufacturing system as an 'information product' (Wang 1998: 59) was preceded by (Orna 1996). Here information products are seen as the visible vehicle by which information is presented for use either on paper, in electronic form or in any other media, the 'telling' end of the scale (Orna 2001: 302). The basis of the process involves 'information presentation', the process whereby knowledge is transformed into information. This appears to recognise the previously identified concept that knowledge is the internalisation of information and can only be transferred by the external process of information transfer. The Orna definition assumes the transference of knowledge from one to another via the vehicle of an information product, the process by which knowledge is turned into information, distributed via an information product and used by the recipient to convert that information into knowledge (Orna 2001: 313). The concept does not assume the presence of an ERP system within the operation, but does not preclude it. An ERP system may well be the fulcrum within the information presentation process itself, with the knowledge that is to be transferred into information, being the initial raw data input. Within both articles (Orna 1996, 2001) attempts to ascertain how organisations manage the production and distribution of information and how this effects the organisations' ability to achieve their strategic objectives (Orna 1996: 342).

A considerable portion of the debate surrounding data quality has been focussed on information flows either within information manufacturing systems, or across organisations. For these flows to be effective a system's master data has to be of a high quality.

5. Master Data and Master Data Management

Master data is the base corporate data, which comprises the nucleus of any enterprise resource planning system. It is also referred to as reference data as opposed to transactional or operational data. Master data management focuses on the development of a central repository of core reference data covering materials, products, suppliers, customers, employees and assets (Williams et al. 2006: 4), whilst also ensuring that processes and components are in place to guarantee that these key business objects are accurate and consistent when used both inside and outside the organisation (Williams et al. 2006: 2). Within an enterprise resource planning environment, master data spans all an organisation's business functions, comprising data that is necessary to create and maintain an enterprise-wide record system for those core business entities, to facilitate business transactions and maintain results (Griffin 2005b: 1). A view of the conceptual framework Data Quality Project in Appendix 1a identifies master data management as one of the fundamental elements in achieving quality data. Master data management (MDM) can assist in streamlining the enterprise by creating master data uniformity, based on a common process with a common language, to establish data synchronisation via a controlled environment (Williams et al. 2006: 5). This controlled environment has to be established as that essential part of an organisation's data strategy relating to data governance. There has to be a common policy to establish common processes and procedures to ensure that the entire enterprise follows a common approach to the creation of master data, requiring disciplines to avoid creating erroneous and duplicated data. Conceptually, a master data management policy is designed to provide that "single version of the truth" identified above as being a definitive element of quality data.

The concept of a common approach to master data management is emphasised by (Madnick, Wang, Dravis and Chen 2001b: ; Madnick, Wang and Zhang 2002: ; Madnick 2003) all of which highlight examples of problems in attempting to extract information from master data elements. A specific example within these collective studies is identified when one attempts to ascertain: "how much did MIT buy from and sell to IBM last year?" The example is complicated, as in many organisations, by the existence of a number of different incidences of 'IBM' appearing in MIT's supplier data file, together with the existence of numerous 'IBMs' appearing in the customer data file, either with differing titles or locations (whether error induced or not), or various subsidiaries, which do not even have 'IBM' in the title or cannot be identified as such. This example is supported by (Redman 2005a: 14) and by the author in numerous personal incidences. This problem, categorised under the concept of a 'Corporate Household' (Madnick and Wang 2001a: ; Madnick et al. 2001b: ; Madnick et al. 2002: ; Madnick 2003: ; Madnick and Wang 2003: ; Madnick et al. 2004a: ; Madnick, Wang and Xian 2004b: ; Madnick and Zhu 2005), does not relate solely to customers and suppliers, but to other complicated relationships within an organisation's master data base. The corporate household concept relates to, business units within an organisation such as suppliers,

customers, materials, products etc whose relationships within the organisation must be captured, managed and applied within an overall context (Madnick et al. 2002: 40). The concept of corporate householding is also associated with data quality and problems relating to 'data misinterpretation' known as 'data semantics' (Madnick 2003: ; Madnick et al. 2005). The seemingly disparate elements within master data are seen to create inter-relationships within a corporate household, when they are categorised within a family type 'context' of grandparent, parent, aunts/uncles, children, cousins etc. The requirement is to establish the context that joins them together- the family tree.

Organisations require a clear definition and vision of their master data. It has been stated previously that master data comprises the core data of the organisation, embracing materials, products, suppliers, customers, employees and assets. However within each of these elements there exists a myriad of inter-related data fields. Within Remploy's Baan ERP system, item master data has 85 different data fields ranging from item code and description, units of measure, planning and reorder points to sales and production data and to add further complexity, this number excludes the data held in any related bills of material and production routings. In a similar vein customer master data has 62 separate fields and supplier data 66. When one factors in the fact that there are thousands of customers, hundreds of suppliers and literally tens of thousands of individual items, the opportunity for data errors to occur are very high. As in all other areas of data quality, improvements in business processes hold the key to realising value from any MDM initiative (Deloitte Consulting LLP et al. 2006: 4). Griffin highlights four processes essential to a high quality master data management strategy (Griffin 2005c: 1); commencing with data migration and integration where data from external systems are aggregated and cleansed prior to being loaded and integrated into the 'host' system ensuring that duplicate and obsolete records are excluded; to data maintenance which ensures that master data is synchronised and co-ordinated with business processes whenever there are changes to the latter; to data quality assurance being the requirement to have controls systems in place to ensure that new master data, together with updates to existing data, fits the right criteria and finally data archiving to ensure that data is available to satisfy commercial, operational, audit and legal requirements. Errors in the creation of transactional data will certainly effect those particular related transactions, plus potentially other peripheral operations, but should be basically of a short-term nature, unless they relate to inherent process problems, whereas master data errors are permanent and will effect all transactions interfacing with the relevant data fields, until corrected. The interaction between master and transactional data is illustrated above on pages 19-20 within the example of data in context within an ERP system.

Master data is regarded by some as the most valuable non-monetary asset an organisation owns (Griffin 2005b: 1) and treating data as an asset whether it be reference or transactional data automatically raises its profile within an organisation (Redman 1995: 102), providing support and credibility to those pursuing data quality initiatives thereby creating greater

awareness among those who interact with data and information. Cleaning master data should be a one-off process not an on-going operation. Rather than continually correcting defective records, the goal must be to identify and eliminate the root causes of the defects (Redman 1995: 103). (Redman 1995: 106) also sets the concept of data quality within a geographical context, likening a database to a lake, in that, to prevent a lake from becoming continually polluted, one must treat the streams that feed it as assets and eliminate all sources of pollution from them. This fact is supported by the email from Ralph Kimball quoted earlier in the document on page 9 and by (Russem 2006: 8) who advocates fixing at source, by moving data quality best practices 'upstream', ideally prior to the data entering the system- "an ounce of prevention being better than a pound of cure". The concept is also illustrated within the Data Quality Project conceptual framework Appendix 1, with the overall 'Improvement Process'; targeting the process improvement/re-engineering (defective prevention) initiatives at the commencement of the data cycle and a one-off data inspection, correction and cleaning process, focussed on the data in context residing within the ERP database, further down the cycle. The key to establishing effective master data management practices requires high-level support ideally emanating from the organisation's data governance policy

6. Data Governance and Data Strategy

A view of the conceptual framework Data Quality Project in Appendix 1a identifies data governance as the theoretical sponsor of the entire data quality project as part of an overall enterprise-wide data strategy. Data was held traditionally within self-contained silos, to an extent 'ring fenced', within departments, functions or single databases, which encouraged sub-optimal practices with data held solely by individuals (whether persons or collectives) as a source of power and influence. The development of more expansive systems with the advent of MRP, MRPII and latterly ERP has encouraged organisations to take a wider perspective with regard to IS strategy and to develop enterprise-wide data policies such as enterprise data management (EDM) (Griffin 2005a: 3) or more specific to this project, enterprise data quality (EDQ) (Russem 2006: 15) The effect of the latter is that it not only breaks down barriers, but makes data quality an enterprise wide initiative.

The policy of treating data as an enterprise-wide asset assists in establishing a data governance strategy. The concept behind adopting a data governance approach is to enable an organisation to create an environment within which data is controlled and co-ordinated. As with most successful enterprise-wide initiatives, data governance requires a mandate, ideally in the form of sponsorship from a leading executive (Russem 2006: 19). Without intending to imply flippancy, the old adage and one of which the author has personal experience, "what gets measured gets done", may be extended to "what gets measured by the executive, gets done quicker". Without a strong mandate for change, a data governance policy and indeed a data quality initiative, cannot hope to be successful. Data governance refers to the overall management of the data within an organisation involving, not only the security of the data, but also determining who are the true owners and custodians of the enterprise's data assets procedures and processes, establishing the approach towards data quality and instilling a culture of data stewardship and quality through out. The author sees data stewardship as the process of taking the data governance policies and initiatives and implementing them within the organisation at a task and operational level. This is not just a data cleaning exercise but a culture change, the policies and initiatives need to be institutionalised so that they become part of the organisational fabric. However with this come the dangers of 'corporate politics' and inherent resistance to change, which can de-rail the process if the mandate for change is not strong. Data governance can take the shape of a formal hierarchical structure with a governance committee at the apex with one or more subsidiary layers beneath; alternatively a less formal approach may be taken. Some form of data governance is imperative as it provides data quality and other data management practices with consistency, efficiency and a mandate within the enterprise (Russem 2006: 22). Once a data governance policy has been implemented the data control elements of auditing, profiling, measuring and monitoring become easier to apply.

7. Data Auditing, Data Profiling and Information Auditing

An organisation needs to undertake a thorough assessment of data quality in all its key subject areas. This process is known as data auditing, data profiling or data discovery and aims to identify common data defects, create metrics and measures to detect defects as they arise, and create rules and actions for fixing and resolving errors and problems (Eckerson 2002: 19). The assessment process should entail a review of all data elements, identifying problems relating to missing data, incorrect values, duplicate records and violations of business data rules. Audit techniques assist in diagnosing issues relating to; data structure, whether the data matches the corresponding metadata (data about data); Data content, the extent to which it is complete, accurate etc; and data relationships within data columns, tables and databases (DataFlux 2005: 2). Although it is appreciated that this latter source is from a commercial organisation providing solutions for business data problems, it serves to illustrate the methods, services, resources that are available. The process essentially audits data files and may be undertaken in house via manual interrogation processes or the use of commercial profiling tools or alternatively the services of an external bureau may be used.

It is interesting to compare the more focussed, detailed and specific methods used within the data audit domain as described in the examples above, with the less precise approach to the concept of information audits employed within the literature relating to the field. Both (Orna 1999: 69, 2004: 46) and (Jones and Burwell 2004: 50) employ the Association of Information Management's definition of an information audit as: "A systematic examination of information use, resources and flows, with a verification by reference to both people and existing documents, in order to establish the extent to which they are contributing to an organisation's objectives". This lack of precision is understandable when one considers that a data audit, given the above definition, focuses on specific numbers, text or symbols (or the lack of them) within the database in rows, columns, fields and the extent to which they conform to certain rules and requirements. To use the Data Value Chain as an example in Appendix 2a, the real area of interest for the data audit is 'data in context', an enclosed semi-tangible and objective environment. An information audit by comparison employs a much wider perspective involving more imprecise and subjective themes including people, politics and culture. Information audits look at information services, systems and products and how these assist organisation in achieving their objectives by supplying effective information (Orna 2004: 48). Information may be viewed as soft and intangible (Jones et al. 2004: 50) and an information audit may appear to be far less intimidating and important and than a financial audit. This cannot be further from the truth. A financial audit deals essentially with history (apart from any business control issues) whereas an information audit deals with the present and the future with the consequential implications. Orna recognises that there is no standard for carrying out information audits (Orna 2004: 47). In addition semantics can get in the way of a true definition, with other terms such as 'needs assessments' and 'surveys' being used interchangeable along side information audit (DiMattia and Blumenstein 2000: 48), whilst

(Jones et al. 2004: 51) suggest that there is no universal accepted definition and that determining what is, and what is not, an information audit is challenging for many. (Swash 1997: 314) is rather more positive, claiming that an audit can play an important role as a basic management tool and that its purpose is to identify what information exists and where, who uses it, what it costs and what benefits can be derived. A certain amount of the literature has focussed on information audits with a library environment (DiMattia et al. 2000: ; Jones et al. 2004) and to a certain extent (Orna 1999, 2004) or not-for-profit organisations (Swash 1997), but this does not preclude its application within a wider aspect. Both information audits and data audits should be used in tandem, the latter to focus on the data within the database and the former to manage the overall process including the people and political issues. Without wishing to become too prescriptive and anxious about specific definitions, a more effective and elegant description maybe a 'data and information assessment'.

8. Data Quality Measurements and Monitoring

In order to maintain any element of control over data quality, to ensure that organisations do not lose the benefits of any data/information assessment and improvement programme and to ascertain whether any progress is being made, data quality has to be measured and monitored. (Redman 2003: 1) echoes the much repeated management mantra “you can’t manage what you don’t measure”. The practice of monitoring and measuring augments the data and information audits processes, it does not replace them. There are a number of methods of measuring data quality, some of which have already been identified. (Redman 2003: 9-14) suggests that there is no best approach for all situations and that various types of measurement systems may each be applicable in relevant circumstances, the secret being to apply the correct approach in the right situations, whilst being aware of potential difficulties and consequences.

The author has personal experience of developing data quality measuring and monitoring systems particularly within Remploy:

Data Accuracy Key Performance Indicators

A set of 8 Key Performance Indicators has been developed within Remploy comprising graphical and numeric data that will enable both individual businesses and factories to monitor and highlight issues relating to both data and accuracy system housekeeping within its operations. The data accuracy reporting system, which has executive support, is currently in the process of being rolled out across the entire company and details are contained in Appendix 4a. In addition an Index based upon the concept of the Balanced Scorecard (Kaplan and Norton 1992) has been developed to monitor and summarise results from the number of disparate measures within the KPIs and an illustration is contained in Appendix 4b. Initial feedback has been very positive and it is intended that the index will form part of each business’s reporting process and will be monitored by the company executive at each during each of its quarterly business reviews.

Remploy Year 2000 Compliance Project

From more of an audit perspective the author was responsible for testing Remploy’s Baan system for Year 2000 compliance. The project took place between January and March 1999 and a copy of the draft report is contained in Appendix 5.

9. Organisational issues

The approach towards data and information may appear somewhat mechanistic especially when one looks at the automated and integrated processes operating within an ERP system. However all planning and information systems by necessity have to engage with that most unpredictable variable, 'People', either as individuals or collectively within organisations.

Information Politics and Culture

(Davenport, Eccles and Prusak 1992: 64) recognized that managing the politics of information is difficult, complex and time consuming, requiring detailed management attention together with changes in organisational culture. Five models of information politics were identified as being representative of the practices employed within information environments and are detailed below in order of increasing effectiveness (Davenport et al. 1992: 56; Davenport et al. 1997: 69):

Technocratic Utopianism: A heavily technical approach to information management stressing categorisation and modelling of an organisation's full information assets, with heavy reliance on emerging technologies.

Anarchy: The absence of any overall information management policy, leaving individuals to obtain and manage their own information.

Feudalism: The management of information by individual business units or functions, which define their own information needs and report, only limited information to the overall corporation.

Monarchy: The definition of information categories and reporting structures by the firm's leaders, who may or may not share the information willingly after collecting it.

Federalism: An approach to information management based on consensus and negotiation on the organisation's key information elements and reporting structures.

The key is to match the organisation to the political structure that provides the best fit (Davenport et al. 1997: 68), by ascertaining which model is currently in ascendancy within the organisation and to which model the organisation should be moving (Davenport et al. 1992: 62). Whilst one's initial thought is that Remploy is hovering currently around the monarchy model with elements attempting to veer towards feudalism, a more detailed assessment within Document 3 will prove beneficial.

(Davenport et al. 1997: 84) defines information culture in terms of the attitudes and patterns of behaviour that identifies an organisation's approach towards information. Culture has an important influence on how an organisation views and uses information (Orna 2004: 36). The author has always viewed culture as 'the way we do things around here' involving beliefs and values. Corporate values themselves play an integral part in the development of an information culture. Remploy's 'five values'- keeping promises, respect, openness,

professionalism and passion, by their very nature should support any change management initiatives directed towards data and information improvements.

Implementing Improvements and the Management of Change

Considerable discussion has taken place within this document relating to, the problems emanating from the lack of quality data, possible causes and potential remedies. The discussion is supported by extensive literature, amongst which are a number of very practical guides aimed specifically at improving data and information quality, in particular (English 1999: ; Orna 1999, 2004: ; Redman 2001). They present an almost step-by-step approach taking the reader through an extremely detailed diagnostic process reminiscent of the very practical car servicing and repairing guides. The one area that appears to be neglected is the actual implementation of the change programme. References are made to gaining executive sponsorship to facilitate the change, but practical advice on actually making the change happen at an acceptable pace, appears to be ignored. (Orna 1999: 177, 2004: 110) comments, “it is not reasonable to expect immediate and full understanding at the top level” and “Experience shows that a long time is needed for such ideas to take root in the thinking of senior managers, but it is time well spent”. Organisations operating with poor data and information do not normally have a ‘long time’ to implement improvements.

Data and information are very emotive subjects even within a static environment, but when one adds an element of change the climate becomes even more volatile. The finest data improvement initiative will flounder unless the process is managed correctly. Human and organisational factors are commonly identified as causes and contributors to failures and difficulties in implementing planned change. A study carried out by (Lewis 2000: 151) identified that communication or the lack of it, played a fundamental part in the success or failure of programmes of change and that around this central core of communication, four key themes emerged relating to; creating and communicating a vision to highlight the purpose and intent of the change and to promote a shared understanding amongst those effected; sense making around the mission and the provision of adequate feedback facilities; establishing legitimacy for the change programme to important stakeholders; and communicating goal achievements, both as a means of publicising successes, and providing evidence of continued progress towards targets and milestones. How do others implement change? A more detailed assessment of the aspects of organisational culture, politics and change management within Document 3 will prove beneficial.

10. People Issues

A view of the conceptual framework Data Quality Project in Appendix 1 identifies the 'People' related elements of Education and Training, Personal Development and Accessibility as fundamental to the success of the project. An ERP implementation or optimisation is at its core a people project and the biggest challenge before and after implementation is not related to technology but to the people issues (Deloitte Consulting LLP 1999: 10). The (Deloitte Consulting LLP 1999: 17) survey conducted amongst 99 large corporations, 90% of which had annual revenues exceeding US\$1 billion, found that 57% of the issues and obstacles were people related, most noticeably change management, staff adequacy and training. The necessity for effective change management has already been made but success in this area is also dependant upon adequate education and training. Training covers the basic skills that are necessary to use the system correctly, but education progresses further by identifying to the users how the system will help the organisation (and thereby themselves) become more effective. It assists user buy-in by enabling all individuals to see where they fit within the entire context of the system and how they each can contribute to the overall success. If people understand their roles they are more likely to embrace rather than resist change. (Goodfellow 1994: 46) identifies user education as the single most essential factor in determining successful or unsuccessful projects. (Wallace and Kremzar 2001: 16) identify 'people' as the key, the most important element within an ERP system and that it is the people, who are trained to use the right tools and to work together as a team, that will make it happen (Wallace et al. 2001: 142)

Remploy has a proven track record within learning, education and training and each year all employees undergo a personal appraisal and development review, an essential part of which comprises a detailed learning and development plan, which is reviewed throughout the year. One area that is not covered comprehensively, relates to the subject matter of this project. The necessity for a Baan related education and training review has been identified. Such a programme was carried out within the implementation phase during the latter 1990s but has not been followed up fully. Key personnel have left and new users have been 'trained' by other users passing on bad habits and faulty work practices in some cases. A user skills audit followed by an education, training and development plan should form part of any data quality initiative and a more detailed assessment within Document 3 will prove beneficial.

'Accessibility' refers to the hardware and software technologies that have been developed in order to assist visually or physically disabled persons gain access to information technology either for personal use or within a work environment. Fundamental to this has been the development of the concept of 'assistive technology'. Within an IT sense this refers to specialised keyboards and mouse devices, voice recognition, screen magnifiers and Braille printouts etc. In a non-IT environment the term can encompass any aid to promote greater

independence for disabled persons. The Company employs an IT specialist whose responsibility is to develop assistive technology where appropriate. A part of the project will be to investigate whether further developments within this area will assist in improving data quality.

11. Research Resources

Action Learning Sets

The Action Learning Set M1 inaugurated during the initial September Workshop has been of immense value. The eight members have worked very closely together. The group has held meetings at NTU plus a number of conference calls. In addition there has been considerable email activity offering support, advice and information. It is envisaged that the group will remain together for the duration of the DBA and continue to provide support and assistance to all members. There is also considerable inter-action with DBA colleagues from the other learning sets sharing information, support and ideas. This should augur well for the future. The group has continued to communicate on during Document 2 providing considerable support to one another. A meeting was also arranged with Jim Stewart in March to discuss the requirements of Document 2.

EndNote

The acquisition of the EndNote software package has been extremely beneficial in marshalling information and maintaining a controlled bibliography. The more elegant and advanced features will be utilised for future documents.

Supervisors

There will be continual communication with the course supervisors. The author views the student/supervisor relationship as being the single most important resource.

Colleagues

There will be a continual dialogue with colleagues within Remploy in what is perceived as three-form process; as providers of information, advice and support (suppliers): as recipients of information, proposals, solutions (customers) and as potential beneficiaries of improvements.

Access to Other Organisations

Access to world class organisations is being sought to research their data quality programs, policies, procedure and processes.

Initial Academic Support

The Massachusetts Institute of Technology (MIT) Data Quality Management Program has been identified as a major academic source of research on the subject of data quality and will be used extensively within the project. The MIT Total Data Quality Management (TDQM) website provides contact information and a number of the members of the team have been contacted directly and have provided support:

Richard Y Wang- Co-Director of the TDQM Program at MIT and a pioneer and internationally known leader in the field of data quality, provided a link to the International Conference on Information Quality website together with related links: www.iqconference.org

Stuart E Madnick- John Norris Maguire Professor of Information Technology at MIT Sloan School of Management, provided a link to the Social Science Research Network website <http://hq.ssrn.com> containing links both to his own papers and others relating to data quality.

Harry Zhu- Research Scientist at MIT TDQM Program. Harry has offered to help with any specific questions that the author may have on the subject.

Additional Academic Support

Direct contacts have been established with a number of the other world's leading academics and writers in the field of data and information quality.

Tom Redman- Participated in an hour-long one-to-one international conference call, which provided valuable information. He suggested that we should continue to communicate.

Michael Bracket- Suggested certain websites and books and offered assistance with any resultant questions

Larry English- Supplied advice and offered assistance with any questions

Diane Strong- Has supplied advice and has offered to be of assistance in the future

David Loshin- has promised to supply a copy of an article soon to be published on the subject of building a business case for a data quality policy

Other Sources

Other sources have been identified as rich source of literature:

Infoshare Limited- A UK data quality software and services company set up to address data quality issues in Local and Government organisations www.infoshare-is.com Adrian McKeon the MD has been very helpful.

Information Impact International Inc- A US based organisation specialising in consultancy and education in Information Management and Information Quality. www.infoimpact.com

The Data Warehouse Institute (TDWI)- A leading research and education in the fields of business intelligence and data warehousing. The TDWI is a considerable source of reports and white papers. Joined as a student member

The European Foundation for Quality Management (EFQM)- supplied with a free copy of the EFQM Excellence Model for used solely within this project

12. Conclusion

Working Definitions

One is attempting to formulate working definitions for the key concepts that fit within the overall context of the project. One has begun to appreciate that it is impractical to attempt to determine true and precise definitions because of the complexity of the subject, coupled with the fact that there appears to be a lack of overall consensus within the literature with regard to any single key element. This ambiguity within the literature with regard to meaning, underlines the subjectivity surrounding data quality, which may in turn lead to confusion and uncertainty within organisations and be responsible in part for their apparent lack of enthusiasm with regards to the employment of data improvement initiatives. Appropriate working definitions will be identified and will then be tested within Document 3.

Data Quality

For the purposes of the project the expression Data Quality will apply generically to encompass both the quality of the data and the quality of the information within an enterprise resource planning and information system. An all-embracing definition would be one that encompasses all the data definitions but this would be far too complex, therefore a simpler definition that appears to fit the project is:

“Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise”

Being an amalgam of (Redman 2004: 2, 2005b: 1) and (Deloitte Consulting LLP et al. 2006: 1; Griffin 2005b: 2; Williams et al. 2006: 2)

Data

The concept of data as raw material for an information manufacturing system fits the project and is best represented by the (English 1999: 468) definition:

“The representation of facts, the raw material from which information is produced when it is put in a context that gives it meaning”

Data in an ERP Database- Data in Context

Data in context is data within the database and is no longer raw data, but it is not yet information. By residing within an ERP system it is easily identified as such whether it is master or transactional data.

Information

To paraphrase the work of a number of the leading authorities, an adequate definition of information is considered to be:

“Data that is presented in an external form which has meaning, relevance and purpose”

Knowledge

As stated previously knowledge is not considered to be a 'key' concept in so far as it resides outside the scope of an enterprise resource planning and information system, but is included within this section for balance and completeness. The (Davenport et al. 2000: 165) definition: "Knowledge is information in peoples' minds" encapsulates succinctly the spirit of knowledge within a few words.

Emerging Key Themes

During the literary review certain key themes have emerged that are perceived to have the capacity to impact heavily upon the project. Foremost amongst these are the three elements of 'People', education and training, personal development and accessibility; 'Processes', housekeeping and process improvement and 'Data' both master and transactional. Their importance was identified initially during the production of Document 1 and is now highlighted further by their presence within the main conceptual framework. Another important key theme is seen to be the data dimensions identified earlier. Further research will be carried out within future documents to identify those dimensions most appropriate to the project, establish relevant working definitions and determine their relationship to each of the main concepts of data, data within a database and information. These latter three concepts have themselves emerged from that aspect of the literature which links data management and quality to product and service quality by developing the concept of an information manufacturing system based upon a real life product manufacturing process with its own inputs, processes and outputs. This latter analogy in turn identifies the fact that the project not only has a strong academic base but has major practical implications which lead to a further key theme, that of aligning the theoretical and academic theories, with the operating environment of a real life organisation, in order to implement a successful data quality improvement initiative. Whilst this project has at its heart the development of management practice, both theoretical and practical, within the area of data quality, in relation to planning and information systems, it cannot be denied that a further theme is the applicability of the project to a Remploy type environment and this will also be developed further within each of the forthcoming documents. Further key themes and ideas have emerged and these will be expanded and developed as part of the review of the Research Questions which follows.

Review and Development of the Research Questions

The original research questions from Document 1 and Section 1 above are reproduced again:

1. What are the attributes of data quality with particular reference to ERP?
 - a. What is data quality?
 - b. How does it impact upon enterprise resource planning?

2. What is the range of factors that impinge on data quality?
 - a. What are the elements that effect data quality?
 - b. How can data quality be measured?
 - c. What levels of data quality are necessary?
 - d. What do organisations need to do to improve and sustain data quality?

3. Are there specific factors that apply to these in the context of Remploy and related organisations?
 - a. How can the study be best related to Remploy?
 - b. Does Remploy's position make it unique or can common practices be applied with or without modifications?

Following an evaluation of the original research questions, a further examination of the author's own experiences and observations, together with an appraisal of the issues emanating from the literature review, additional research questions have emerged:

4. What is the impact of poor quality data?
 - a. What is the true cost?
 - b. What are the benefits of improved data quality?

5. How can the concept of 'World Class' be related to ERP and Information?
 - a. What is world class and how can it be achieved?
 - b. Is world class feasible or cost-effective?

6. How can a data quality improvement programme best be implemented with regard to?
 - a. The management of organisational change
 - b. The management of organisational politics and culture
 - c. The education, training and development of people
 - d. Remploy-specific issues (tie in with 3 above)

Overview of Documents 3, 4, 5 and 6

Document 2 established a strong robust conceptual framework, which will support the project throughout Documents 3, 4 and 5.

Document 3- Research Methodology & Non-Survey Based Research

The research will be focussed upon answering the specific research questions and developing ideas for further research.

It is intended to carry out a series of in-depth interviews during the course of the study. These will be conducted with:

- Remploi colleagues in various departments and functions:
 - IS Department- technical and operational
 - Users at factories and business offices
 - Central and Head Office users
 - Managers and senior recipients of information
- SSA- the world-wide Baan software supplier
- SSA/Baan User Group
- The General Secretary (a former employee of Remploi) and fellow member organisations of Workability International. Full access and cooperation has been promised.

It is also intended to undertake a micro-ethnographic study Bryman et al., (2003: 317) (also known as an auto-ethnographic study) in the form of a short-term participant observation programme. This may be focussed purely within Remploi, but does exclude the possibility of involving other Baan users if access can be obtained.

Access will also be sought currently to hold interviews with:

- Other individual Baan user companies
- Other major ERP software providers
- Large organisations- suppliers/customers of Remploi

If direct access to the above cannot be gained efforts will be made to obtain information via a non-structured or structured questionnaire (see Document 4 below)

A number of the leading authorities within the field of data quality including Tom Redman, Michael Bracket, Larry English and Diane Strong, have offered assistance in answering any questions. It is intended to follow up these offers in the form of a structured questionnaire and in the case of Tom Redman a further one-to-one conference call if this is possible.

There is also potential access to providers of Accessibility hardware and software. Abilitynet, Remploi's main provider, is the largest supplier in the UK. In addition the author has access to senior members of the IBM Worldwide Accessibility Centre in the US. IBM is the industry leader in this arena and its commitment to people with disabilities pre-dates the First World War.

Other potential sources for face-to-face discussion will be IT conferences and shows in addition to specific data quality meetings, conferences and events.

It is envisaged that during the research process possible answers and solutions to the research questions may be generated. This may take the form of small incremental improvements capable of being implemented on an on-going basis. This may provide an opportunity to apply an Action Research approach to test any theories either within a 'test' environment or within a 'live' situation. There may also be an opportunity to write-up the results in the form of small case studies especially if experiments are carried out within individual Remploy sites.

Consideration is will be given to using some form of computer-assisted qualitative data analysis software (CAQDAS) to assist in data analysis. Possible sources are NVivo or NUD*IST.

Document 4- Survey Based & Statistical Research

The research will be focussed upon answering the specific research questions and developing ideas for further research.

A series of structured questionnaires will be developed and administered to:

- A selection of the corporate membership of Workability within various parts of the World, with a view to ascertaining how each have treated data quality with particular reference to their disabled employee base.
- A sample of ERP users to ascertain their approaches to data quality.
- Other individual Baan user companies, other major ERP software providers and large organisations- suppliers/customs of Remploy- if access cannot be gained to carry out face-to-face interviews (see Document 3 above).

The exact format for the surveys will be developed in depth over the next six months.

Databases and other sources of statistical information will be interrogated to support the quantitative research process.

Consideration is will be given to using some form of software to assist in analysing the quantitative data. It may be possible to use Microsoft Excel and Access, but SPSS software is also being considered.

Documents 5 and 6- The Thesis and Critical Reflection

The different research approaches carried out in documents two, three and four will be consolidated to ensure a triangulation approach.

The document will be build upon the work undertaken within each of the preceding four documents. In addition further primary research will be carried out on the issues and themes

that have emerged from Documents 3 and 4. The conceptual framework will be reviewed in the light of any new material and a further critical literary review will be carried out to identify any further additional relevant literature or electronic sources where they relate to new material or to new themes that have emerged from earlier documents..

It is appreciated that there will be a substantial learning process carried out during years one and two that will necessitate reconsideration of the all the research outcomes within year three as Document 5 is progressed.

A reflective review will be produced for Documents 1 to 5, which will identify the author's learning and development experiences and personal feelings as they have emerged during the process of working through each document. These will then be consolidated together with an overall personal appraisal of the way the whole DBA experience has effected the author.

13. Reflective Review

The Process of Learning and Development

I have attempted to stand back and look at the literature and determine what it says and examine the various debates and arguments emanating from this. Certain topics and writers in particular have emerged, some of whom are among the world's leading practitioners in their related fields, and a number of these have been engaged in one-to-one communication, either verbally or electronically, providing a unique perspective on the subject. It is envisaged that access to some or all of these contacts will continue during the duration of the project. This has led me to the aim of firming up my position to determine exactly what I am attempting to achieve and the 'stories' or evidence, which fit the scenarios. I am looking to obtain a feeling of what is right, what speaks for me and what I can believe in, to provide, what may be called an 'epiphany' moment, to use an emotive expression, ie something that really hits me between the eyes. Themes and people have emerged and continue to do so. Out of this process a conceptual framework or 'concept map', as described by (Fisher 2004: 102), has emerged and has been developed within Appendix 1 and 2. An attempt has been made to view the subject through different views as outlined in both the January and April workshops although this is proving difficult. I understand that it is necessary to; partially suspend one's own feelings, assumptions, judgements, prejudices and even knowledge to look at the topic as a puzzle to be solved; but this is not proving an easy exercise. Years of experience and professional training tend to focus one in specific areas. However many of the definitions, concepts and arguments stand out because are appealing, logical, reconcile with one's experiences, and originate from creditable sources for which one has considerable respect.

An example 'my epiphany' arose after reading a chapter covering data integrity in (Wallace et al. 2001: 202) an good book covering ERP implementations, which turned around my thought processes. In the section relating to inventory cycle counting it states that the justification for inventory counting is to identify inventory errors and then take action to eliminate them, the actual correction of records being far less importance. The priority being to discover and eliminate the problem NOT just 'correct the error to get the books right', prevent the symptoms rather than just cure them. This was also echoed subsequently by other literature reviewed later in the review (Kimball 2006: ; Redman 1995: 106).

Document 2 the Process

1.I have continually searched for new literature even though I know I should have been writing- its infectious!!!. Even so I appear to be returning to the main sources, whether they relate to:

- a. General academic journals- Boland, Wenger, MIT TDQM team,

- b. Established academic/consultants- English, Redman, Bracket, Kimball, Dravis, Hammer, Davenport etc
- c. Commercial software vendors- white papers
- d. Professional/ consultant organisations- Deloitte etc reports
- e. Research bodies- TDQM, TDWI & IAIDQ, and EFQM

The literature has taken the form of recognised books; academic journals, periodicals -DM Review/Harvard Business Review etc; white papers; reports etc. I believe the subject is both an academic and a practical business problem and has been enriched by the academic literature, balanced by professional reports and established periodicals. The problem or frustration is that almost two hundred plus documents, articles, books web sources etc have been reviewed in one form or another and most will not even reach Document 2 but have enriched the project nevertheless by virtue of having been read. A list is contained within Appendix 7.

2. I feel that the overall conceptual framework particularly within Appendix 1 identifies the way to go and will remain robust for the duration of the project. An initial conceptual framework identify relevant areas to study and review is contained in Appendix 6.

3. There are gaps to research and investigate. For example: matching the concepts and theories relating to conceptual framework with the practical elements of the project; relating what I have discovered, to the 'business problem' identified within the project, relating the concepts of data dimensions to Remploi or any organisation both in application and definition.

4. Detailed research was also carried out with regard to the way a critical literature review should be undertaken. The core course textbooks (Bryman and Bell 2003: ; Fisher 2004: ; Hart 2005) together with (Jankowicz 2005) provided rich material to assist in completing this document. In addition a number of university articles and web sites were also investigated (Obenzinger 2005: ; Trochin 1989: ; University of Melbourne 2004: ; University of South Australia 2005).

5. A form of literature review involving the concepts of a 'systematic review', developed originally by Archie Cochrane to support scientific research into evidence-based research among the UK medical profession (Orna 1999: 282) was identified as being of potential interest. The process utilises explicit methods to perform a thorough literature search and critical appraisal. A systematic review comprehensively locates, evaluates and synthesises all the available literature using a specific scientific design- Systematic reviews generally focus on reports from randomised control trials (RCTs) (Student's Scientific Research Centre 2005) and appear superseding narrative reviews within medical research (Davies and Crombie 2001). A number of papers and articles were reviewed principally with a medical bias (Davies

et al. 2001: ; Joanna Briggs Institute 2001: ; Lloyd Jones 2004: ; Student's Scientific Research Centre 2005). A number of articles were identified that extended the concept of a system review within the area of management studies as an alternative to the traditional 'narrative' style reviews. In particular (Thorpe, Holt, Macpherson and Pittaway 2005: ; Tranfield, Denyer and Smart 2003) provided general background support reading with regard to both identifying the relevant material and taking an overall approach to reading and reviewing the literature. An over view of the concept of a systematic review proved useful as an alternative method of approaching the literature, but appeared to be too scientific and clinical. One feels more comfortable with the narrative approach taken.

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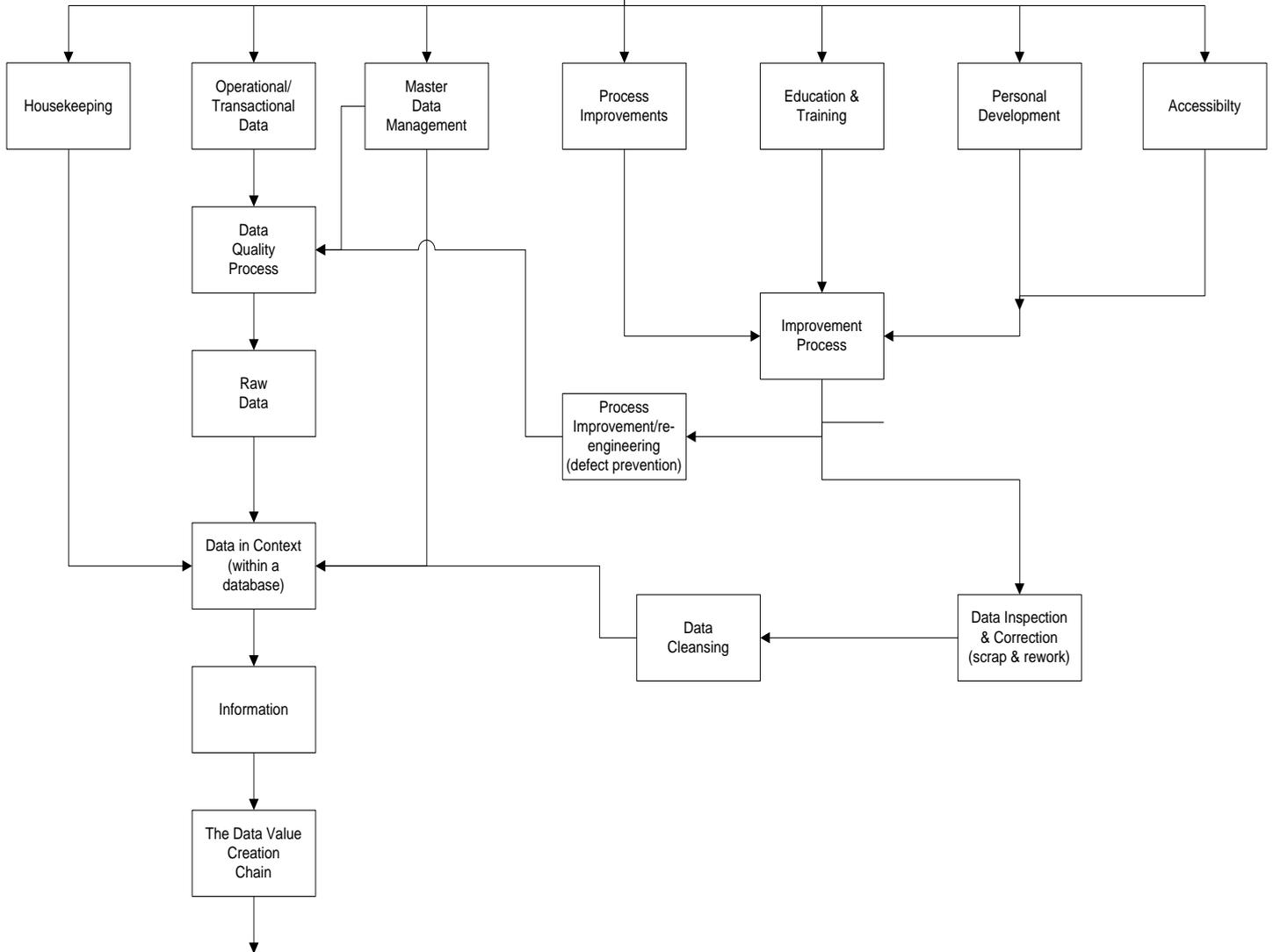
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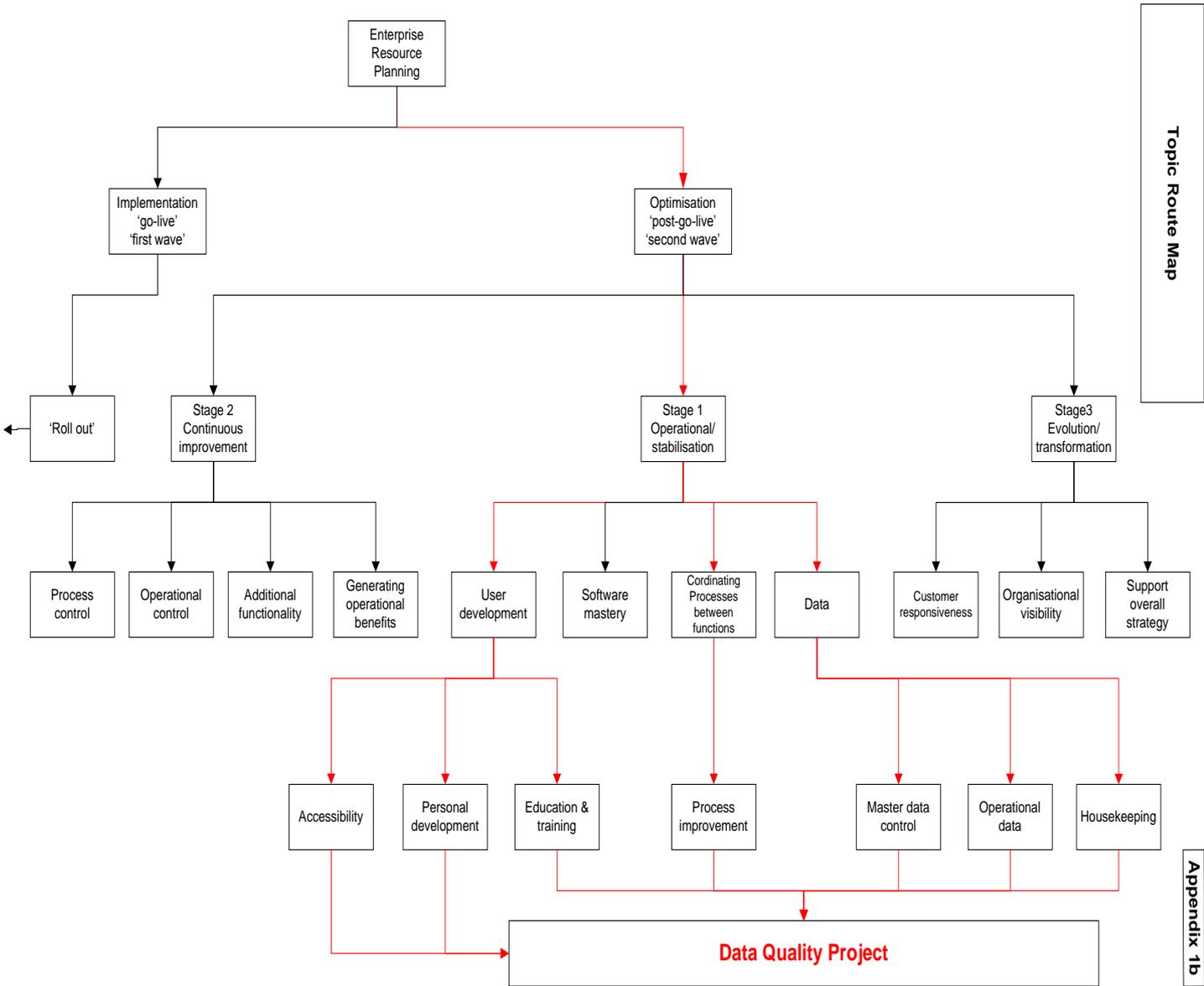
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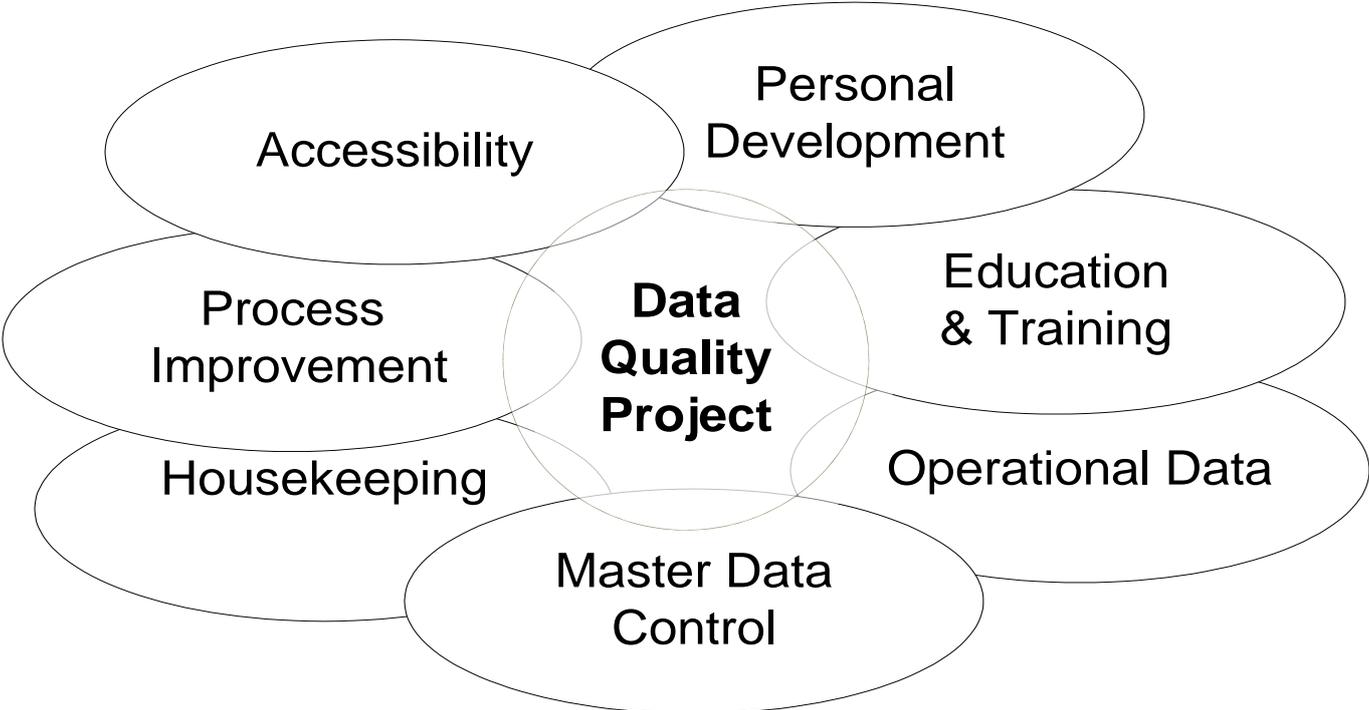
Data Governance/Data Strategy

Appendix 1a

Data Quality Project

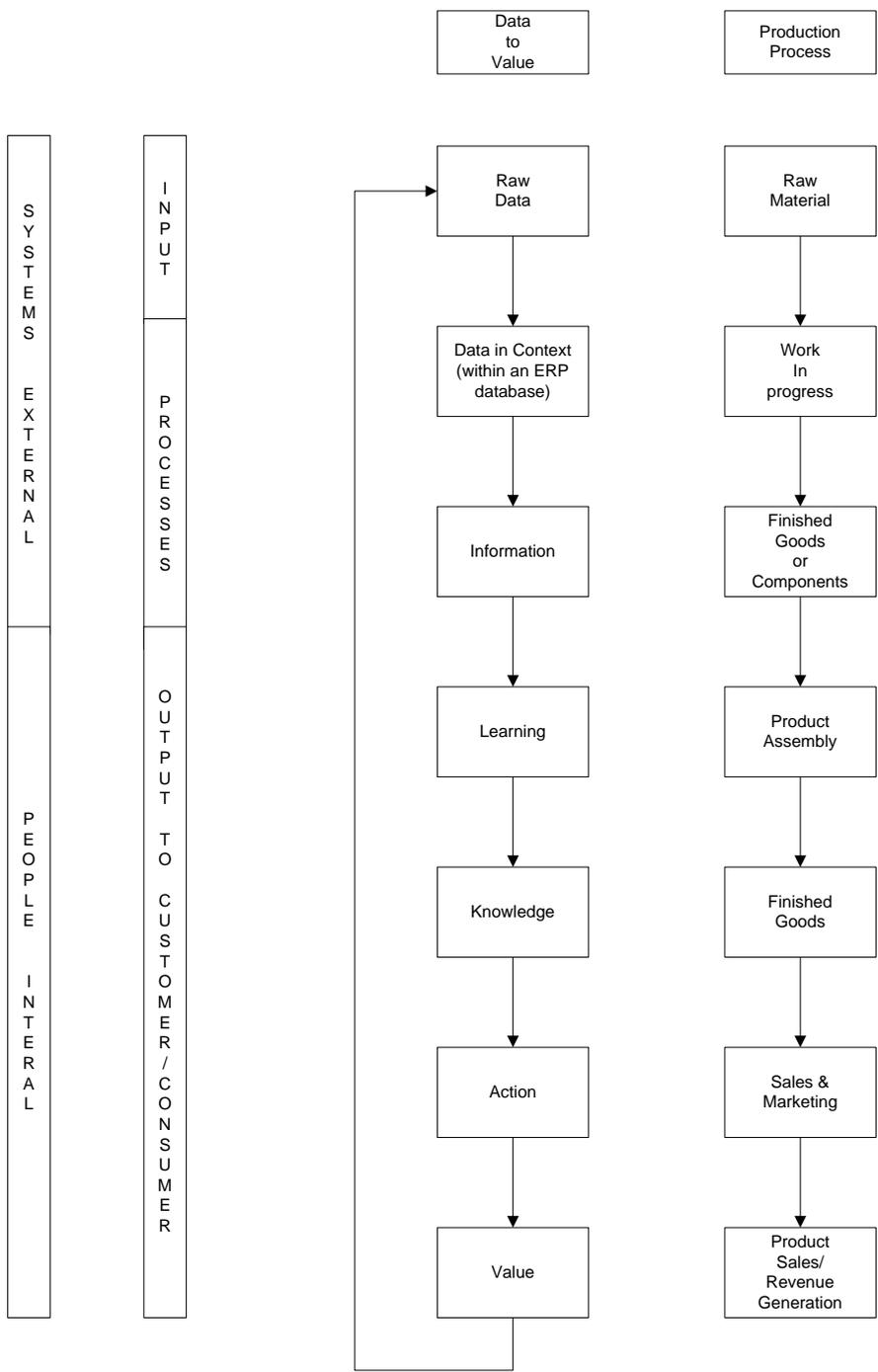






THE DATA VALUE CREATION CHAIN

Appendix 2a

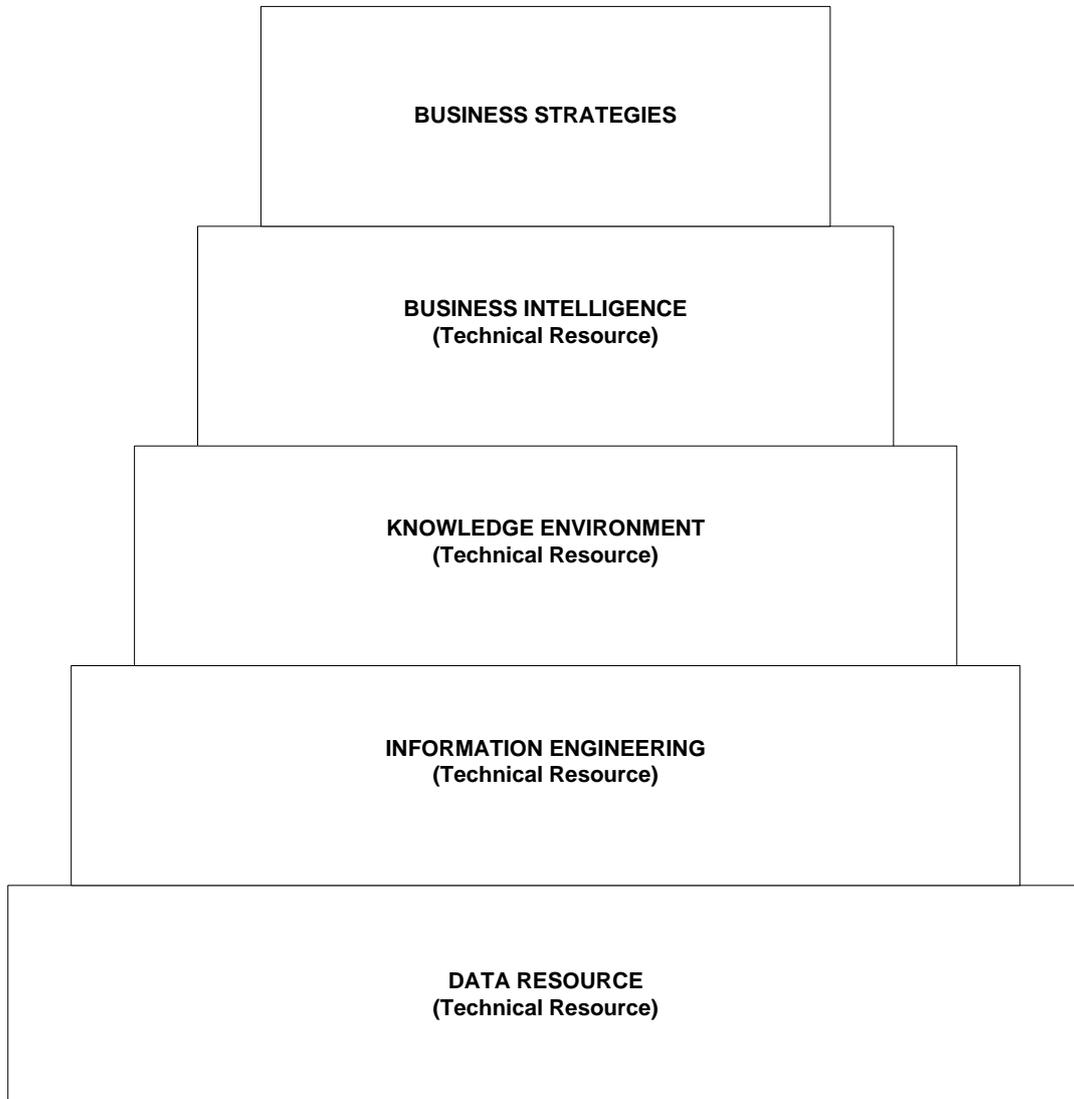


**THE GENERIC INFORMATION CHAIN
(Tom Redman)**



**THE BUSINESS INTELLIGENCE VALUE CHAIN
(Michael Bracket)**

Appendix 2c



Appendix 3

DATA QUALITY DIMENSIONS DEFINITIONS USED IN NATIONAL AND INTERNATIONAL STATISTICS

A. Eurostat

The statistical Office of the European Commission- Eurostat under the auspices of the European Statistical System (ESS) defines the quality of statistics with reference to six criteria as published under “Assessment of quality in Statistics- Definition of Quality in Statistics”, Working Group, Luxembourg, October 2003 (OECD 2005)

1. Relevance- An inquiry is relevant if it meets user’s needs. The identification of users and their expectations is therefore necessary. In the European context, domains for which statistics are available should reflect the needs and priorities expressed by the users of the European Statistical System. (Completeness- No 7 in certain examples).
2. Accuracy- Accuracy is defined as the closeness between the established value and the (unknown) true value.
3. Timeliness and punctuality in disseminating results- Most users want up-to-date figures, which are published frequently and on time at pre-established dates.
4. Accessibility and clarity of the information- Statistical data have most value when they are easily accessible by users, are available in the form users desire and are adequately documented.
5. Comparability- Statistics for a given characteristic have the greatest usefulness when they enable reliable comparisons of values taken by the characteristic across time and space. The comparability component stresses the comparison of the same statistics between countries in order to evaluate the meaning of aggregated statistics at the European level.
6. Coherence- When data originates from a single source, statistics are coherent in that elementary concepts can be combined reliably in more complex ways. When originating from different sources, and in particular from statistical surveys of different frequencies, statistics are coherent in so far as they are based on common definitions, classifications and methodological standards.

B. International Monetary Fund- (IMF)

The IMF data quality dimensions published under the “Data Quality Assessment Framework (DQAF) Glossary” are: (OECD 2005)

1. Integrity
2. Methodological soundness
3. Accuracy and reliability
4. Serviceability
5. Accessibility
6. Prerequisites of quality

C. Organisation for Economic Co-operation and Development- (OECD)

Quality is viewed as a multi-faceted concept. The quality characteristics of most importance depend on user perspectives, needs and priorities, which vary across groups of users. Given the work already done in the area of quality by several organisations, notably, Eurostat, IMF and Statistics Canada, the OECD was able to draw on their work and adapt it to the OECD.

The conclusions were published under the Organisation for Economic Co-operation and Development (OECD), "Quality Framework for OECD Statistics", Paris, June 2002.

Quality is viewed in terms of seven dimensions, namely: (OECD 2005)

1. Relevance
2. Accuracy
3. Credibility
4. Timeliness
5. Accessibility
6. Interpretability
7. Coherence

D. National Statistics Methodological Advisory Committee

Published under the auspices of the UK Office of National Statistics and based on the ESS Eurostat agreed data quality *attributes* (dimensions). (National Statistics Methodology Advisory Committee 2003)

1. Relevance- Concepts, measurements and products reflecting user needs.
2. Accuracy- Usually measured as the average distance between the estimated and the true (unknown) parameter value
3. Timeliness and punctuality in disseminating results- Responsiveness to user needs
4. Accessibility and clarity of results accessible in a user-friendly manner

Users provided with information about quality of the statistics and about methods used to derive figures

5. Comparability- Allowing comparisons over time, geographies and between sub-populations
6. Coherence- Consistent standards
7. Completeness- Coverage reflecting user needs (now merged with relevance)

E. United Nations- Economic Commission for Latin America and the Caribbean- ECLAC

Report on Data Quality in National Statistics Institutes based partly on the Eurostat studies identify proposed standard quality indicators focussing on the dimensions and sub-dimensions of data quality. (United Nations Economic Commission for Latin America and the Caribbean- ECLAC 2003)

Contains detailed useful requirements and quality indicators and further detail.

1. Relevance- Statistics are relevant when they meet user needs.
2. Accuracy- The closeness between the estimated value and the unknown true value of the population. *Accuracy has also been defined as the reverse of total error, including bias and*

variance. Is this correct does it imply an error free environment? Minor inaccuracies maybe acceptable when further improvements are not necessarily cost-effective.

3. Timeliness and punctuality- Refers to the time elapsed between delivery of the results and the reference period. Punctuality has to do with the difference between the date on which results actually become available and the date on which they should have been available, according to a pre-established timetable.

4. Accessibility and clarity- Refers to the physical conditions in which users have access to data; where and how data may be requested; time it takes for delivery; clear pricing policy, forms used, others. Clarity refers to supplementary information provided with the data: explanatory texts, documentation, graphs, maps, others.

5. Comparability- Has to do with measuring the impact of differences in the application of concepts and definitions when the data are compared across geographical regions, domains or reference periods.

6. Coherence- Statistical data are coherent when they become reliable in different ways and for different purposes, regardless of whether they originate from a single source or from different types of statistical research studies. *Does this mean consistency?*

7. Completeness- In the ESS, completeness refers to the difference between statistics that are available and those that should be available in order to meet the requirements of the Community legislation or other agreements. *Related to Relevance?*

F. UN Statistical Commission comparison between IMF and Eurostat Data Quality Assessment and Definitions

Review carried out to minimise the differences between the two approaches and identify opportunities for harmonisation, integration and rationalisation of any differences. The main findings concluded that IMF and Eurostat quality approaches are complementary. (Laliberte, Grunewald and Probst 2004)

Eurostat further summary:

1. Relevance- Are the data what the user expects?
2. Accuracy- Are the figures reliable?
3. Timeliness and punctuality- Does the user get the information in time and according to pre-established dates?
4. Accessibility and clarity- Are the figures easily accessible and understandable?
5. Comparability- Are the data in all necessary respects comparable across countries?
6. Coherence- Are the data coherent with other data?

IMF Framework:

1. Integrity- Adherence to objectivity in the collection, compilation and dissemination of statistics so as to maintain users' confidence. Professionalism, transparency and ethical standards.
2. Methodological soundness- Refers to the application of international standards, guidelines and agreed practises to produce statistical outputs. Fosters international comparability.

Concepts and definitions, scope, classification and basis for recoding *Can relate equally to business organisations*

3. Accuracy and reliability- The emphasis is on the quality of the data sources, including information on sampling and non-sampling errors in data sources. Source data, assessment of source data, statistical techniques, assessment and validation of immediate data and statistical outputs and revision studies.

4. Serviceability-

Periodicity- Refers to the frequency of dissemination of the data.

Timeliness- Refers to the amount of time between the reference period and the dissemination date.

Consistency

5. Accessibility- Refers to revisions following a regular and publicised pattern, with preliminary data clearly identified and revision studies made public. Availability of information to users.

Data accessibility, metadata accessibility and assistance to users.

6. Prerequisites of quality- Refers to the institutionalisation and organisational conditions that have an impact on data quality. Legal and institutional environment, resources, relevance and other quality management.

Comparison analysis of IMF DQAF and Eurostat Quality Definitions

IMF		Eurostat
Prerequisites of quality) Integrity)	Institutional and organisational arrangements	(Relevance
Methodological soundness) Accuracy and reliability)	Core statistical processes	(Comparability (Accuracy
Serviceability)	Statistical products	(Coherence (Timeliness
Accessibility)		(Accessibility & clarity

Laliberte, L., Grunewald, W. and Probst, L. (2004) Data Quality: A Comparison of IMF's Quality Assessment Framework (DQAF) and Eurostat's Quality Definition: 18: United Nations Statistical Commission.

National Statistics Methodology Advisory Committee; Quality Measurement and Reporting; http://www.statistics.gov.uk/methods_quality/downloads/NSMAC; 5/07/06.

OECD; Glossary of Statistical Terms- Quality <http://stats.oecd.org/glossary/details.asp>; 5/07/06.

United Nations Economic Commission for Latin America and the Caribbean- ECLAC. (2003) Data Quality in National Statistical Institutes: 14. Santiago, Chile: United Nations.

Data Accuracy Key Performance Indicators

What are they?

A set of reports that give 8 Key Performance Indicators. The reports give graphical and numeric data that will enable you to monitor your site, and highlight any issues regarding system maintenance.

The reports follow a rolling 12 month period.

How to find them

Login to Cyberquery then follow the relevant path;

For Charts,

Corporate > Finance > National Businesses > Data Accuracy > Charts > Workscope

You will then be able to click on the KPI and site of interest.

The screenshot shows a web browser window titled "Workscope - Cyberquery Launchpad - Microsoft Internet Explorer". The address bar shows the URL: http://cyberquery:614/remploy_rs/launchpad/Corporate/Finance/National_Businesses/Data_Accuracy/Charts/Workscope/. The page features the Remploy logo and navigation links for "Home" and "Subscriptions".

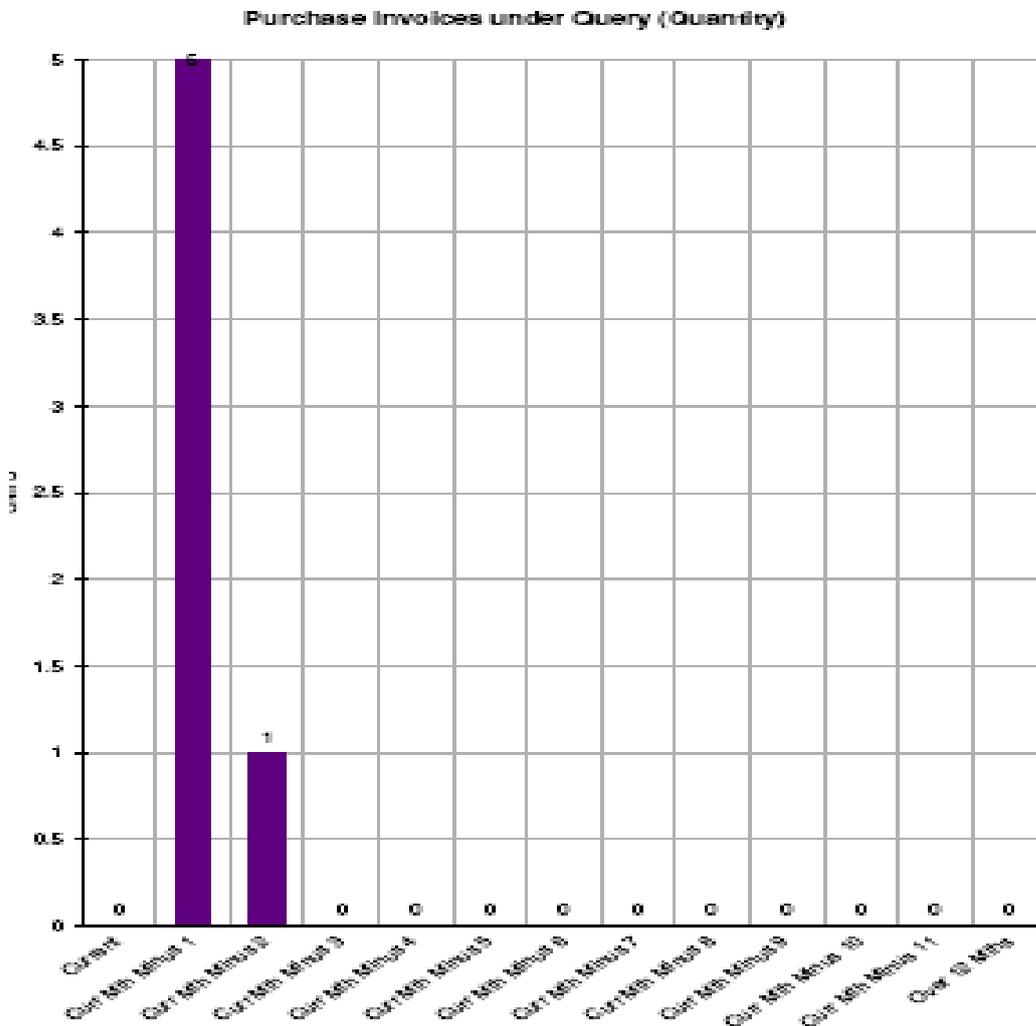
The breadcrumb trail reads: **You are here:** Home > Corporate > Finance > National Businesses > Data Accuracy > Charts > Workscope. A "Show more detail" link is visible next to the breadcrumb.

The main content area displays a table titled "All documents in Workscope". The table has four columns: "Commands", "Last updated", and "Area of interest". The "Commands" column lists various KPI identifiers, each with a small icon and a link. The "Last updated" column shows dates and times. The "Area of interest" column consistently lists "Workscope".

Commands	Last updated	Area of interest
kpi 1 all	07/06/06 05:14	Workscope
kpi 2 811	07/06/06 05:14	Workscope
kpi 2 813	07/06/06 05:14	Workscope
kpi 2 817	07/06/06 05:14	Workscope
kpi 2 821	07/06/06 05:14	Workscope
kpi 2 829	07/06/06 05:14	Workscope
kpi 2 832	07/06/06 05:15	Workscope
kpi 2 835	07/06/06 05:15	Workscope
kpi 2 836	07/06/06 05:15	Workscope
kpi 2 839	05/06/06 05:19	Workscope
kpi 2 846	07/06/06 05:15	Workscope
kpi 2 848	07/06/06 05:15	Workscope
kpi 2 849	07/06/06 05:15	Workscope
kpi 2 851	07/06/06 05:15	Workscope
kpi 2 856	07/06/06 05:15	Workscope

On the left side, there is a "Browse" menu with a tree view of categories including Charts, Building Products, Central Costs, Community Enterprises, ECycle, Electronics, Furniture, Healthcare, Household and Toiletries, Interwork, Learning, Managed Services, Manufacturing, Offscope, Packaging and Print, Public Sector, Textiles, and Workscope. Below the menu is a "Report Viewer" section with a link to download the report viewer.

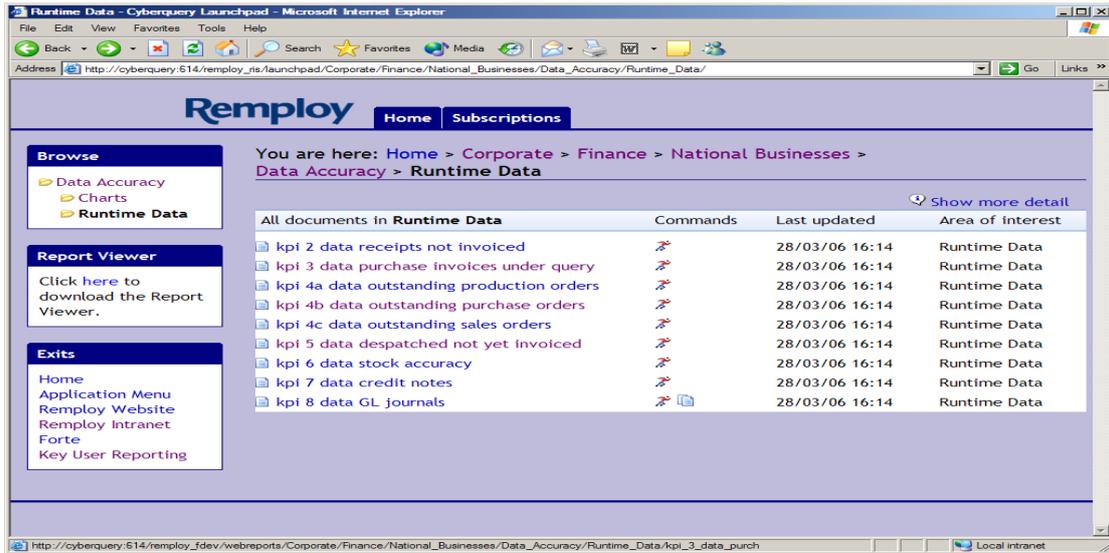
You will be presented with a chart detailing the KPI information for the previous 12 months.



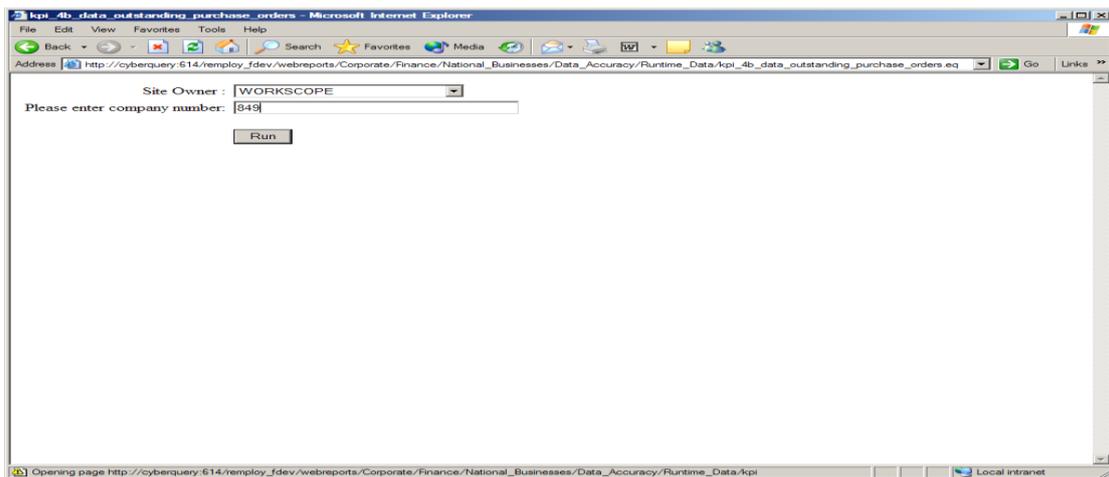
The above shows the amount of purchase invoices under query (KPI3), In this instance there are 5 in the last month and 1 from 2 months ago. For further detailed information go to the Runtime Data.

For specific numerical information,

Corporate > Finance > National Businesses > Data Accuracy > Runtime Data



Click on the KPI required then you will be asked to enter the site owner (Workscope) and the company (Baan) number.



Once entered click on Run to generate the information.

				Purchase Invoices under Query (Quantity)							
<i>Log Co</i>	<i>Trans Type</i>	<i>Doc No</i>	<i>Doc Date</i>	<i>Curr Mth</i>	<i>> 1 mth</i>	<i>> 2 mths</i>	<i>> 3 mths</i>	<i>> 4 mths</i>	<i>> 5 mths</i>	<i>> 6 mths</i>	<i>> 7 mths</i>
832	PUR	10651220	27-Apr-06			1					
832	PUR	10662443	18-May-06		1						
832	PUR	10665168	01-Jun-06		1						
832	PUR	10665194	31-May-06		1						
832	PUR	10665280	30-May-06		1						
832	PUR	10665908	31-May-06		1						
REPORT TOTAL				0	5	1	0	0	0	0	0

The sheet above gives the information as summarised in the previous chart, however you can now see the relevant dates and invoice number

The Data Accuracy KPIs

A. Product Business

1. % Variance: Standard GM v Actual GM.

Compares the level of actual GM against the standard GM (Actual sales less standard cost of sales). Can be affected by inaccuracies in: material standards, purchase order prices, BOM's, stock accuracy, internal trading etc.

Identify the individual variances by reference to Trial Balance GM report

B. Site Owner/Site

2. Aged Receipts not Invoiced- RNIs value & number.

Shows the level of receipts that have been booked into either stock or cost s that have not yet had an invoice matched against it. Can be affected by inaccuracies in: booking in quantities, purchase order prices.

3. Purchase Invoices Under Query - value & number.

Identifies those invoices that cannot be matched & approved against a receipt. Can be affected by inaccuracies in: booking in quantities, purchase order prices.

4. Outstanding Orders:

- a. Production
- b. Purchase
- c. Sales.

Identifies orders that are still outstanding requiring further transactions to be completed. Can be affected by inaccuracies in: quantities booked, poor housekeeping (failure to complete/close)

5. Sales- DNYI

Shows where we have despatched goods, but have not yet invoiced the customer or where the invoicing process is incomplete.

6. Stock Takes (Accuracy) Number of Stock adjustments.

Can be affected by inaccuracies in: stock booking, stock issuing, BOM's (backflushing/issuing), despatching, shrinkage etc.

Note each positive or negative adjustment count as one.

7. Credit Notes- Number & Reason Codes.

Shows the number of credit notes. Can be affected by inaccuracies in: quantity invoiced, price charged, invoice/delivery address VAT etc

C. Site Owner/Product Business

8. Analysis of GL Journals.

Shows the number of manual journal adjustments being made in order to correct data inaccuracies plus. Can be affected by- almost anything!

DATA ACCURACY KPI BALANCED SCORECARD

AS @ 30/08/06

Appendix 4b

Description	Month												Total	Index
	0	1	2	3	4	5	6	7	8	9	10	11		
WORKSCOPE COMPANY :ALL														
KPI2	709	366	273	171	224	243	181	133	63	14	11	8	50	2446
% of total	0.29	0.15	0.11	0.07	0.09	0.10	0.07	0.05	0.03	0.01	0.00	0.00	0.02	
Weighted total	0.29	0.30	0.33	0.28	0.46	0.60	0.52	0.43	0.23	0.06	0.05	0.04	0.27	3.85
KPI3	79	32	10	1	3	6	1	1	0	0	0	0	3	136
% of total	0.58	0.24	0.07	0.01	0.02	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.02	
Weighted total	0.58	0.47	0.22	0.03	0.11	0.26	0.05	0.06	0.00	0.00	0.00	0.00	0.29	2.07
KPI4A	316	146	26	10	10	3	1	0	0	0	0	0	6	518
% of total	0.61	0.28	0.05	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
Weighted total	0.61	0.56	0.15	0.08	0.10	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.15	1.70
KPI4B	428	229	66	49	57	42	114	114	29	55	60	38	444	1725
% of total	0.25	0.13	0.04	0.03	0.03	0.02	0.07	0.07	0.02	0.03	0.03	0.02	0.26	
Weighted total	0.25	0.27	0.11	0.11	0.17	0.15	0.46	0.53	0.15	0.32	0.38	0.26	3.35	6.51
KPI4C	387	27	17	10	9	12	3	3	1	9	2	2	20	502
% of total	0.77	0.05	0.03	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.00	0.00	0.04	
Weighted total	0.77	0.11	0.10	0.08	0.09	0.14	0.04	0.05	0.02	0.18	0.04	0.05	0.52	2.19
KPI5	68	3	28	0	0	2	0	0	0	0	0	0	14	115
% of total	0.59	0.03	0.24	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.12	
Weighted total	0.59	0.05	0.73	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	1.58	3.06
KPI7	25	24	23	30	25	40	61	74	9	14	21	13	26	385
% of total	0.06	0.06	0.06	0.08	0.06	0.10	0.16	0.19	0.02	0.04	0.05	0.03	0.07	
Rev. weighted total	0.84	0.75	0.66	0.78	0.58	0.83	1.11	1.15	0.12	0.15	0.16	0.07	0.07	7.27
Index for Company ALL														26.65

***REMPLOY
LIMITED***

YEAR 2000

COMPLIANCE

PROJECT

A O'BRIEN- MARCH 1999

YEAR 2000 COMPLIANCE PROJECT

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YEAR 2000 COMPLIANCE PROJECT

SUMMARY REPORT

I. PROJECT OBJECTIVE

To determine whether the Company's Baan, Informix and Unix software will operate to the specified standards defined for Year 2000 conformity

II. KEY FINDINGS

A. The processes appear to operate satisfactorily within each test period- with the exception of the EDI module. The current version is NOT YEAR 2000 COMPLIANT. There are versions available which are compliant, these are being investigated.

B. Printed output and on-screen enquiries show the correct data

III. CONCLUSIONS

A. The results of the testing indicate that the software, as detailed in Section I. A. of the main report, appears to operate to the specified standards defined for Year 2000 conformity- WITH THE EXCEPTION OF THE CURRENT EDI MODULE.

B. The hardware specified in Section I. B. of the main report operates satisfactorily.

A O'BRIEN- MARCH 1999

The testing process has been carried out in collaboration with:
Carol Brown, Howard Chambers, John Davies, Richard Ormerod, Phil Sephton, Paul Smith and Colin Spoor

YEAR 2000 COMPLIANCE PROJECT

MAIN REPORT

I. General

A. Introduction

The purpose of the project is to determine whether the Company's software will operate to the specified standards defined for Year 2000 conformity. The software is defined as:

Unix HPUX11.xx operating system
Informix 7.xx database management system
Baan 4.c3 applications
Other specific software run in collaboration with the above

In addition certain other 'potentially problematical' dates (9th & 19th September 1999) were also tested

The project is intended to be a brief and concise appraisal. Its scope is restricted to that specified in the initial project plan as detailed in Schedule II

B. Process

The test procedure comprises the processing of a series of Baan sessions containing transactions, processes, documentation, enquiries and reports designed to test the systems' operations during certain specific time frames and to validate the resultant data.

The dates chosen represent the critical time periods during the Year 2000 cut-over namely:

1. 9th & 19th September 1999- Potential sensitive dates
2. 25th-30th December 1999- To input transactions to be completed in the next year and generate reports
3. 31st December 1999- 23.50hrs- To print reports and allow clock to move into new year
4. 1st January 2000- To review previous 1999 test data
5. 28th February 2000- 23.50- To allow clock to move to Leap Year date
6. 29th February 2000- Test transactions & processing on Leap Year day
7. 1st March 2000 onwards- Continued testing in Year 2000

A document detailing the processes tested during each time period is contained in Schedule I. Copies of all sessions, transactions, processes, documentation, enquiries and reports are contained in separate files.

C. Hardware

1. The procedure was carried out on machine 'Galaxy', using initially Textiles- Company 610 for testing all transactions and processes except EDI, JIT and Self Billing. These latter modules were then tested on Manufacturing Services- Company 310.

2. Data was inputted via a mixture of PCs and dumb terminals
3. Desk jet and MT151 printers were used as 'slaves'. Initial attempts to use line printing facilities on Galaxy proved difficult.

II. Process Testing and Results

This section details the testing which was carried out during each of the periods. The results being successful unless stated:

A. 9th September 1999

1. Generate Planned (MPS)/MRP Orders

Following orders generated:

- a. Purchased item- YW016222- planned orders 1000-4
- b. Production item- 3MO081321QD00/40- planned orders 1000-5

2. Planned MRP Production Order/Actual Production Order

Planned order 1005- confirmed/transferred. Production order 190001 completed and closed

3. Planned MRP Purchase Order

Planned order 1004- confirmed/transferred

4. Sales Order

Order 990010 entered and completed

5. SIC- Generate Planned INV. Orders

Purchase item- CW010430155- planned order 1

6. Planned INV. Purchase Order/Actual Purchase Order

Planned order 1- confirmed/transferred. Purchase order 160281 completed

B. 19th September 1999

1. Sales Order

Projected order 990011 entered and completed

2. SIC- Generate Planned INV. Orders

Purchase item- CW010430155- planned order 1

3. Purchase Order

Manual order 990006 entered and completed

4. Production Order

Manual order 100310 entered completed and closed

5. Generate Planned (MPS)/MRP Orders

No orders generated- see notes. Session run successfully following date (25th December 1999)

C. 25-27th December 1999

1. Generate Planned (MPS)/MRP Orders

Planned orders 870-877 generated

2. Sales Orders

Orders 990012-15/17 entered and acknowledgment printed. One order with foreign currency

3. Purchase Orders

Manual orders 990007-9/12 entered and printed. One order with foreign currency

4. MPS

Input of demand. Generate MPS. Print output

5. Generate Planned (MPS)/MRP Orders

Planned production and purchase orders generated and printed. Some strange planned order/delivery dates

6. Sales Orders not Invoiced

Orders 990007-12 printed. Delivery dates correct. Order 990017 in French Francs. Report does not convert to GBP

7. General Enquiries

Display Sales/Purchase by Item

D. 31st December 1999

1. Print Customer Balances

Only one test invoice posted to Accounts Receivable. Second test invoice not printed or visible on customer enquiry

2. Print Supplier Balances

No test transactions posted to Accounts Payable

3. Data problems in Finance module. Post integration transaction session generating errors

E. 1st January 2000

Reprinting and reconciliation of late December output/reports:

1. MRP Orders

Re-print planned production and purchase orders

2. Purchase Orders

Re-print of orders 990007-12

3. Sales Order Acknowledgments

Re-printing of orders 990012-7

4. Sales Orders not Invoiced

Re-printing of orders 990012-7

5. General Enquiries

Display Sales/Purchase by Item

6. Customer/Supplier Balances

Continued problems with printing

F. 29th February 2000

1. MRP Purchase Orders

Confirmation/transfer of planned order 706. Completion of purchase order 280078

2. MPS Production Orders
Confirmation/transfer of planned order 92. Completion of production order 260969

3. Sales Order
Completion of order 990012

4. Purchase Order
a. Completion of order 990007 with quantity rejected on approval
b. Completion of order 990008 with shortage

5. Sales Order
Completion of part of order 990014 with back order

6. Sales Orders not Invoiced
Print of orders 990013-7 after processing 990012/4

7. General Enquiries
Display Sales/Purchase by Item

8. Customer/Supplier Balances
Continued problems with printing

G. 1-31st March 2000

In order to resolve the data problems within the initial copy of company 610, a further copy of 610 was made from Titan. All previous test data was over-written

1. Sales Pricing
Pricing order using existing pricing table data. Setting new price with effective date in 2000.
Sales order entered new price generated

2. Inventory Transactions
Completion of inventory adjustment and stock transfer transactions

3. Sales Statistics
Printing of a sales statistics report for Year 2000/Period 12- (March 2000)

4. PRP
Entry of Projectised sales order 710003- PRP 'Yes'. Planned PRP purchase order 1 generated

5. DRP
Set up bill of distribution; enter sales order; generate planned DRP orders 1; confirm/transfer planned DRP orders; complete RPL order 260086

6. Sales Orders not Despatched- (Textiles)
Print of orders 710001-4

7. Sales Delivery Report
Print of orders 710001-2

8. Despatches not Invoiced
Print of Warehouse 407

9. Sales Orders not Invoiced
Print of orders 710001-4. Exclude order discount

10. Customer Balances

Invoice and complete orders 710001-2. Print/display customer invoices- detail and total include new invoices. Errors detailed above resolved

11. Sales Statistics

Printing of a sales statistics report for Year 2000/Period 12- (March 2000). Includes all orders entered/invoiced

12. Inventory Valuation

Print of Warehouse 267

13. Receipts not Invoiced

Summary report

14. Specific Routing Report- (Textiles)

Print of specific item. Reconciliation with routing data

15. WIP- Summary

Print of production order 710001

16. Print/Display Inventory Transactions

To confirm that Year 2000 transactions are placed in correct chronological order

H. LAPR

1. LAPR Employee Data

Set up and print employee master data

2. Payroll

Process and print payslips

3. Batch Ticket Labels

Enter work data and print labels

4. Production Order batches

Maintain and generate batches. Process production order template

5. Production Orders

Maintain and display orders

I. JIT- (Man. Services)

1. Sales schedule

Enter a supply chain sales schedule. Display data

2. MPS

Generate master production schedule

3. MRP

Generate planned MRP orders.

4. Display Inventory Movements

Display planned movements- shows Year 2000 orders following 1999

K. Finance/Archiving

1. Journals and accruals

2. Post integration transactions to General Ledger
3. Batch finalisation
4. Period close- All modules
5. Autobalancing
6. Year end close
7. Archiving

No test documentation is available but it is understood that the test results were satisfactory

L. EDI- (Man. Services)

Initial investigations reveal that the current version of the EDI software V1.61 is NOT Year 2000 compliant. There will be a requirement to upgrade to V1.62.01/02 or V2.2. Enquiries are underway to obtain upgraded software. A version of EDI is used currently by Packaging Group. This has not been tested

M. Self Billing

The Self Billing element of the Supply Chain module is not being used currently . It is not known whether it will be implemented in the future

It is understood that a manual version of the self billing process is used in Furniture. It appears to be a manual process within the Accounts Receivable module

N. Year Break Point

Baan allows the entry of a two-digit year date and will interpret this as either a 1900 or a 2000 year date- ie. 99 = 1999; 02 = 2002. The current cut-off or 'break point' is 50. 49 will produce 2049, whilst 50 will produce 1950.

Within Informix this is known as the 'DBCENTURY feature'. See Informix Year 2000 Readiness Disclosure- Appendix A

III. Third Party Disclosures

The test data has been supplemented by Year 2000 Readiness Disclosure documentation supplied by Baan and Informix, summarised in Schedule III and detailed in Appendices A-C. No documentation has been obtained from Unix.

IV. Key Findings

A. The processes tested appear to operate satisfactorily within each test period, however it is understood that the current version of the EDI module is NOT Year 2000 compliant.

1. Some processes generated errors, but these appear to be due to input problems or corrupt system data. In all cases testing in subsequent periods produced successful results.

2. The dates of some planned MRP transactions looked strange initially, but these appear to be the result of 'rolling' the system date forward from February 1999 to the respective test dates, thus leaving outstanding transactions as at February 1999 uncompleted. This should not occur in reality.

B. Printed output and on-screen enquiries show the correct data, although certain customised reports require small amendments (Not related to Year 2000)

C. Output is printed within the correct fields

D. Some dates printed show only a two-digit year, but the majority are four digit

E. The current 'year break point' is 50

F. New porting sets must be installed once they become available- See Schedule III. II. A. 3

V. Conclusions

BASED UPON TEST RESULTS DETAILED IN SECTION II

A. The results of the testing indicate that the software as detailed in Section I. A. appears to operate to the specified standards defined for Year 2000 conformity. WITH THE EXCEPTION OF THE CURRENT EDI MODULE.

B. The hardware specified in Section I. B. operates satisfactorily. No other hardware has been tested. It is assumed that general hardware testing will be undertaken outside this project.

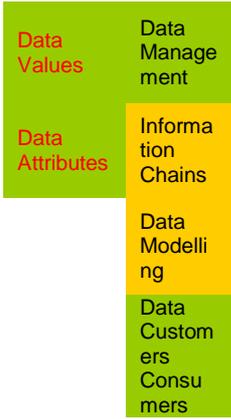
A O'BRIEN- MARCH 1999

Data Quality- Creating a World Class Enterprise Resource Planning and Information System within a Multi-site Disabled Employment Environment

Key
 Investigate
 Possibility
 Leave for now



Data	Data Warehousing	Evidence-based Policy	Data Quality & Accuracy Measurement	Systems Processes & procedures	Enterprise Resource Planning	Approach-Structured	Concepts Definitions Conceptual Framework Theories Key Factors Constructs Variables
Information	Information Products	Systematic Review	Data Integrity		Enterprise Systems	Approach-Grounded	
Knowledge	Information Policy	Activity Theory	QIS		Multi-Site ERP		
Understand	Information Design	Enterprise Information Portals	TDQM		Enterprise Performance Measurement		
Communication	Information Presentation	Economic & Social Research Society	Process Change		Integrate Optimise Informate		
Phenomenon	Information Systems	Systems Theory	Data Semantics		Critical Success Factors		
Intellectual Capital	Data Mining		Corporate Householding		Balanced Scorecard		
Organisational Knowledge	Data Relationships		Information (Quality) Life Cycle		ERP Scorecard		
Critical Business Knowledge	Data Housekeeping		Information Quality Maturity Model		Enterprise Information Management		
Data Dimensions	Information Management		Quality attributes Dimensions				
Data Entity Class	Information Factories		Data Quality Assessment				
Data Entity	Data Elements		Data Audit				



Information Quality Assessment

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Document 3

Research Methodology and Non-Survey Based Research

DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

Data Quality

A fundamental element in Creating a World Class Enterprise Resource
Planning and Information System within a Multi-site Disabled Employment
Organisation

Document Three

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Document Three is submitted in part fulfilment of the requirement of Nottingham Trent
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Abstract

Documents 1 and 2 established firmly that quality data is an absolute pre-requisite for any enterprise resource planning and information system, whilst also identifying a correlation between the concepts of a planning and information system and that of a product or service manufacturing system. Document 3 re-affirms this stance and identifies that the total quality management principle of initial error prevention, by the identification and elimination of the root causes of data defects, is a key element in achieving high quality data. Document 3 proceeds to carry out qualitative research into this principle of prevention rather than cure, within the author's own organisation Remploy, by attempting to identify, how an organisation can prevent problem data from entering its system whilst maintaining any subsequent improvements. An action research approach is taken using focus groups containing Remploy employees, with the data being collected by means of process mapping. The outcomes are presented in the form of process/data flows, related issues and opportunities, together with detailed action points. The action points are then represented within a matrix to assist in analysing and initiating on-going data improvement programmes. The research questions are re-assessed and extended and a plan for undertaking Documents 4 and 5 is established. The implications with regards to Remploy and other disabled employment organisations are also discussed.

1. Introduction and Objectives

Introduction

Document 1 identified and developed the concept of data quality per se and then proceeded to place this within the context of an enterprise resource planning and information system encompassing a multi-business/multi-site operation, employing disabled people. The initial investigation highlighted this as a fruitful area for further research, generating a number of interesting research questions. Document 2 developed this theme much further, confirming even more strongly the critical importance of the impact of data quality within the context of an ERP information system. The detailed review of the literature unearthed a considerable amount of research material and findings, which has enabled one to gain an understanding of the topic and its implications within organisations. From this, the key concepts and themes emerged, were defined and their working definitions developed within the context of the overall project. The development of a conceptual framework emerged from both the study of the literature and the author's own experiences over a number of years and is replicated again in Appendix 1. The framework encapsulates the three main elements identified early in Document 1 and extended further in Document 2; namely data, processes and people and how these may interact to stimulate an environment within which quality data becomes the norm. The framework has remained robust during Document 3. It is not envisaged, at this time, that there will be any fundamental changes to either the key concepts or the conceptual framework in forthcoming documents.

Emerging Key Concepts and Themes

During the literary review certain key concepts and themes emerged that were perceived to have the capacity to impact heavily upon the project. Foremost amongst these, are the three elements of 'People', education and training, personal development and accessibility; 'Processes', housekeeping and process improvement and 'Data' both master and transactional. Their importance was identified initially during the production of Document 1 and was highlighted further by their presence within the main conceptual framework in Document 2. These three concepts have themselves emerged from that aspect of the literature which links data management and quality to product and service quality by developing the concept of an information manufacturing system based upon a real life product manufacturing process with its own inputs, processes and outputs. This latter analogy in turn identifies the fact that the project not only has a strong academic base but has major practical implications which leads to a further key theme, that of aligning the theoretical and academic concepts, with the operating environment of a real life organisation, in order to implement a successful data quality improvement initiative. Whilst this project has at its heart the development of management practice, both theoretical and practical, within the area of data quality in relation to planning and information systems, it cannot be denied that a further theme is the applicability of the project to a Remploy type environment and this will also be developed further within each of the forthcoming documents. As further themes and ideas

emerge, they will be expanded and developed further as part of the review of the research questions, which follows.

Review and Development of the Research Questions

The original research questions from Document 1 and the additional questions from Document 2 are reproduced again, together with an indication of where and when they are to be addressed:

2. What are the attributes of data quality with particular reference to ERP?
 - c. What is data quality? (Doc2-5)
 - d. How does it impact upon enterprise resource planning? (Doc2-5)

2. What is the range of factors that impinge on data quality?
 - e. What are the elements that effect data quality? (Doc2-5)
 - f. How can data quality be measured? (Doc4/5)
 - g. What levels of data quality are necessary? (Doc4/5)
 - h. What do organisations need to do to improve and sustain data quality?
(Doc3-5)

3. Are there specific factors that apply to these in the context of Remploy and related organisations?
 - a. How can the study be best related to Remploy? (Doc3-5)
 - b. Does Remploy's position make it unique or can common practices be applied with or without modifications? (Doc3-5)

Following an evaluation of the original research questions, a further examination of the author's own experiences and observations, together with an appraisal of the issues emanating from the literature review, additional research questions emerged within Document 2:

4. What is the impact of poor quality data?
 - a. What is the true cost? (Doc 4/5)
 - c. What are the benefits of improved data quality? (Doc3-5)

5. How can the concept of 'World Class' be related to ERP and Information?
 - c. What is world class and how can it be achieved? (Doc4/5)
 - d. Is world class feasible or cost-effective? (Doc4/5)

6. How can a data quality improvement programme best be implemented with regard to?
 - e. The management of organisational change (Doc 3-5)

- f. The management of organisational politics and culture (Doc 3-5)
- g. The education, training and development of people (Doc 3-5)
- h. Remploi-specific issues (tie in with 3 above) (Doc 3-5)

Basis for Document 3

Document 2 O'Brien (2006a: 29, 33) recognized the correlation between the concepts of a planning and information system and that of a product or service manufacturing system each with identifiable inputs, processes and outputs, as developed by Wang and Strong (1996) and later by Strong, Lee and Wang (1997) and Wang (1998). In addition Deming's Total Quality Management philosophy of 'plan, do, check, act' Deming (1986) was used to develop the Total Data Quality Management principles of 'define, measure, analyse and improve', O'Brien (2006a: 33). Implicit within any TQM initiative is the importance of ensuring that the initial inputs and processes are effective thereby building in defect prevention at the front end and avoiding scrap and rework activities later. This principle of prevention rather than cure is applicable equally to data and information systems. Indeed this is explicit in the conceptual framework shown in Appendix 1, which focuses on the improvement process built into the beginning of the cycle. The identification and elimination of the root causes of data defects was emphasised further in Document 2 O'Brien (2006a: 39) citing the works of Redman (1995: 103, 106) and Russem (2006: 8) and further supported by a personal email to the author by Kimball (2006) in which he states that, "Once bad data is captured at its origin, there is very little the information system can do to make the bad data better". All sources indicate that real improvement will only be made by 'upstream solutions' to use Redman's phrase, coupled with on-going housekeeping and once-only database cleaning. This approach is also supported by a number of email discussions carried out within the International Association for Information and Data Quality (IAIDQ) Forum. A number of the resultant discussion points surrounding improving data quality have centred on the areas of data ownership and accountability, process flows, and all instances where data is created or affected in any way.

The initial layout of the Conceptual Framework has been used to identify how the overall DBA Project will fit within Documents 3, 4 and 5. This is set out in Appendix 2a in a colour-coded format to emphasise the individual focus of each of the documents and how each fits within the overall programme as it is envisaged currently. This document will focus on the front-end elements of data defect prevention and the identification and elimination of data deficiencies, targeting the process improvement/re-engineering (defective prevention) initiatives at the commencement of the data cycle- identified by the yellow boxes. This will be followed by a brief review of the one-off data inspection, correction and cleaning process, focussing on the data in context residing within the ERP environment further down the cycle. Given the working definitions contained in Document 2 O'Brien (2006a: 50), Document 3 research will concentrate mainly upon the 'Data' as it enters the ERP database (Data in Context). This

project plan is detailed further within Appendix 2b highlighting the key points identified so far, the intended focus of Document 3 and the proposed approaches to Documents 4 and 5.

Reference has already been made as to how the triple concept of 'Data', 'Processes' and 'People' emerged early in the research for Document 1 and has been reinforced at each subsequent stage, and how in Document 2 a parallel 'triple concept' developed highlighting the relationship between a data/information system and a manufacturing system. One can view both of these concepts not as individual components but as interrelated elements of the whole as highlighted below:

Generic Process	Manufacturing System	Generic Information System	ERP Environment
Input	Raw materials	Raw data	People- Processes- Data
Process/ Operations	Assembly line	Information system	ERP Database
Output	Physical products	Information products	Information-People

If the above is then superimposed upon the Conceptual Framework in particular as depicted in Appendix 2a then it becomes even more obvious that the inputs within the ERP environment impact upon the quality of every subsequent process or action and thereby emphasises the absolute necessity of 'getting it right first time'

The author uses the term 'ERP Environment' to emphasise that it relates not only to an 'internal' database encompassing the software and data contained within the hardware configuration, but also the external processes, systems and people which interact with it to make it a 'living' and integrated operation which can and should act as a catalyst for the business process as a whole. A further detailed reference to enterprise resource planning follows in a subsequent section.

Working definitions

It will also be beneficial at this time to revisit and review the working definitions agreed within Document 2 evolving from the detailed review of the literature O'Brien (2006a: 50).

The process was to formulate working definitions for the key concepts that fit within the overall context of the project. It became evident that it is impractical to attempt to determine true and precise definitions because of the complexity of the subject, coupled with the fact that there appears to be a lack of overall consensus within the literature with regard to any single key element. This ambiguity within the literature with regard to meaning, underlines the subjectivity surrounding data quality, which may in turn lead to confusion and uncertainty within organisations and be responsible in part for their apparent lack of enthusiasm with regards to the employment of data improvement initiatives. During the short intervening period between the publication of Document 2 and the writing of this current document it is evident that the definitions agreed and reproduced again below have remained robust and one cannot foresee that there will be any changes within Documents 3, 4 or 5.

Data Quality

For the purposes of the project the expression Data Quality will apply generically to encompass both the quality of the data and the quality of the information within an enterprise resource planning and information system. An all-embracing definition would be one that encompasses all the data definitions but this would be far too complex, therefore a simpler definition that appears to fit the project is:

“Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise”

Being an amalgam of Redman (2004: 2), Redman (2005a: 1), Deloitte Consulting LLP and Hyperion Solutions Corporation (2006: 1), Griffin (2005: 2) and Williams and Beyer (2006: 2)

Data

The concept of data as raw material for an information manufacturing system fits the project and is best represented by the English (1999: 468) definition:

“The representation of facts, the raw material from which information is produced when it is put in a context that gives it meaning”

Data in an ERP Database- Data in Context

Data in context is data within the database and is no longer raw data, but it is not yet information. By residing within an ERP system it is easily identified as such whether it is master or transactional data.

Information

To paraphrase the work of a number of the leading authorities, an adequate definition of information is considered to be:

“Data that is presented in an external form which has meaning, relevance and purpose”

Knowledge

Knowledge is not considered to be a ‘key’ concept in so far as it resides outside the scope of an enterprise resource planning and information system, but is included within this section for balance and completeness. The Davenport and Marchand (2000: 165) definition:

“Knowledge is information in peoples’ minds”- encapsulates succinctly the spirit of knowledge within a few words.

2. Enterprise Resource Planning

This project is looking at the elements of data quality as they interact within the dynamics of an enterprise resource planning and information system, the principle aim of which is to support the overall business strategy.

At this stage it will be useful to return to a diagram contained within Document 1 O'Brien (2006b: 9), taken from Davenport (1998: 124) which highlights the integrated nature of an ERP structure or an Enterprise System as referred to by Davenport. He claims that a good ES is a technological tour de force with a single database at its core coordinating and supporting virtually all of a company's business activities and warns that if a company's systems are fragmented, its business will be fragmented also.

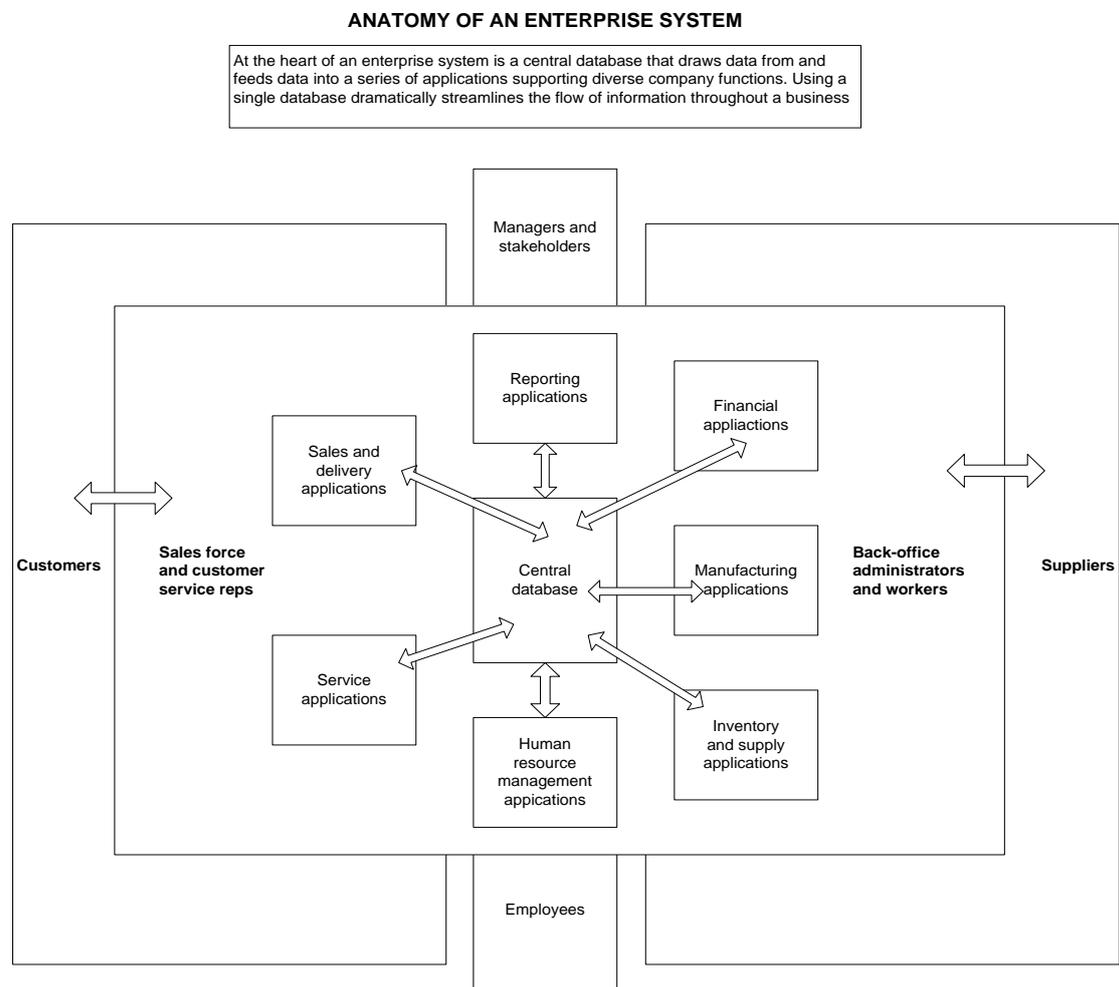


Figure 1. The Anatomy of an Enterprise System

The complex nature of the model with its integrated modular processes and activities attempts to serve all the departments within an enterprise from a single database, in order to provide a single version of the truth throughout the entire organisation by means of a unified

system. Within the context of the Conceptual Framework as depicted on both Appendix 1 and 2a the ERP database resides within 'Data in Context' being the 'Process' that converts the raw 'Data' input into one of numerous 'Information' product outputs.

The above model illustrates how the functions of the organisation are interrelated whereby the effect of a single transaction has a knock-on effect within or between departments of the enterprise. An ERP system operates horizontally across an enterprise working within and between functions, departments and businesses, whereas most organisations manage and control vertically. This potential management misalignment may cause control problems if not recognised and eliminated as tasks within a process move from one department or function to another, consequently there has to be ownership of the data or information that is passed or forwarded onwards. Organisations must recognise this potential misalignment and manage the data and information to match the required processes and flows. This should be viewed as a supplier/customer relationship with the same responsibilities towards customer relations and satisfaction as exists or should exist in external commercial relationships. The model can become even more complex where the ERP system encompasses more than one organisation across numerous countries with differing currencies and time zones. Managing data flows and processes is paramount.

At the heart of most ERP systems are commercial transactions involving the supply of goods or services, encompassing sales, purchasing, manufacturing and distribution all of which have financial implications. Appendix 3 identifies the generic process through which a customer order for a manufactured product will progress from an initial enquiry to final completion and payment and how the physical processes of order satisfaction, inter-act with the data flows and processes within the ERP environment. In many ways the 'system' drives the physical processes, indicating what, when and how, to supply, manufacture, purchase and distribute products to enable the customers' requirements to be satisfied. This generic model will be extended further within this document as part of the qualitative research process. This model can apply equally to the provision of services whether in a commercial or not-for-profit organisation.

3. Remploy

The fundamental aim of any DBA project is to add to and develop the pool of knowledge within management practice and this project is no exception. There is also the subordinate aim of applying the principles and practises learned and developed to practical use not only within Remploy but also within other disabled employment organisations across the World. This objective is relevant as the majority of the qualitative research conducted for this document will be within a Remploy environment. This section provides background information and indicates how the Company is positioned within the scope of the overall project and its connections with similar enterprises.

This subordinate aim has not changed, indeed its importance, within Remploy specifically, has increased considerably within the last twelve months. The Company is carrying out a fundamental strategic review of its entire operations, in collaboration with its single shareholder, the Department of Work and Pensions and other stakeholders including employees and unions. At this moment the final outcome is not known, but it is likely that there may be considerable structural and strategic change within the Company during the next two years, with the possibility of withdrawal from unsustainable operations, producing a new working model for those remaining businesses, whilst growing the 'Interwork' operation, its disabled person recruitment, rehabilitation, learning and external placement business, by a factor of four. These overall changes will place considerable strain on all areas of the Company and require considerable change-management resources, skills and support. The implications for quality systems, quality data and quality information are enormous. It is intended that this project will assist the Company during this period of fundamental change. Indeed some short-term initiatives have already been implemented during the last six months and appear to be generating improvements.

Remploy's Mission

To expand the employment opportunities for disabled people in sustainable employment within Remploy and the communities it serves.

Remploy's Principles

The company's objective is to provide equal opportunity and to promote the independence of disabled people by creating the widest possible spectrum of employment opportunities accompanied by appropriate training and development.

ERP History

Remploy is the largest provider of employment opportunities for disabled persons in the UK, employing almost 6000 disabled people in 85 individual factories across the entire country, whilst placing over 5000 others into open employment. The Company, which has an annual turnover of £160m, is supported by the UK Government's Department of Work and Pensions

and was founded over 60 years ago initially to provide employment for war victims. A Baan/Infor ERP system was implemented over eight years ago and whilst there have been many benefits overall, there is still considerable scope for further improvements, especially within the area of data quality. Maintaining sustainable quality data within any ERP system can be problematical at best, but when one factors in an organisation with twelve individual business streams operating within such diverse areas as automotive, electronics, packaging, PC recycling, healthcare, furniture, in addition to manufacturing protective clothing against nuclear, chemical and biological threats for the UK military and police, the overall picture can become very complex with a high potential for errors and problems. This position is complicated even further when it is then superimposed within a network of eighty plus separate sites with 1600 users many of whom are disabled in one form or another.

Remploy Data Accuracy Key Performance Indicators

A set of 8 Key Performance Indicators has been developed within Remploy comprising graphical and numeric data to enable both individual businesses and factories to monitor and highlight issues relating to both data and accuracy system housekeeping within its operations. The data accuracy reporting system, which has executive support has been rolled out across the entire company and details are contained in Appendix 4a. In addition an Index based upon the concept of the Balanced Scorecard, Kaplan and Norton (1992), has been developed to monitor and summarise results from the number of disparate measures within the KPIs and an illustration is contained in Appendix 4b. The feedback has been very positive and the index now forms part of each businesses' budgeting reporting process and will be monitored by the company executive at each of the quarterly business reviews. During the first six months of operation the overall index shows an improvement of almost 30%.

Data Improvement Initiatives

A number of data improvement initiatives are underway within Remploy designed to identify and eliminate the root causes of data problems in line with the intended focus of Document 3 as detailed above. These form part of the qualitative research for this document and will be dealt with in considerable detail in latter sections

Accessibility

'Accessibility' refers to the hardware and software technologies that have been developed in

order to assist visually or physically disabled persons gain access to information technology either for personal use or within a work environment. Fundamental to this has been the development of the concept of 'assistive technology'. Within an IT sense this refers to specialised keyboards and mouse devices, voice recognition, screen magnifiers and Braille printouts etc. In a non-IT environment the term can encompass any aid to promote greater

independence for disabled persons. The Company employs an IT specialist whose responsibility is to develop assistive technology where appropriate. A part of the project will be to investigate whether further developments within this area will assist in improving data quality.

Workability

Remploy is an influential member of 'Workability International' the world's largest body representing providers of work and employment services to people with a disability. More than two million people with disabilities are engaged in work programmes delivered by the 66 Workability member organisations in some 27 different countries. The organisation is registered in the UK. Its Secretary General, based in France, is a former employee of Remploy and access to information from within the organisation to assist this research project has been agreed. The author has also been in communication with the Secretary of the European branch and it is intended that research within this area will be carried out within documents 4 and 5. It is anticipated that the benefits emanating from this project will be transferable to other members of Workability International where applicable.

4. Research Focus for Document 3

The focus of this document's research upon up-front data error prevention and eradication has already been established earlier and graphically identified in Appendix 2a. The purpose being to prevent data errors and problems entering the data flow cycle in the same manner as food and drug regulations are in place to attempt to ensure that our food chain is kept free of harmful imperfections. Numerous articles cited both in this document and in Document 2 support this process. However two new important research questions arise immediately from this data strategy:

Firstly- "How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?"

Secondly- "How can an organisation maintain and sustain any improvement identified and implemented arising from answers to the first question?"

There appear to be a myriad books, articles, case studies, tutorials and personal experiences that provide examples of 'generic' improvement processes, but the key appears to be in applying these to specific detailed circumstances. The second question appears to be even more subjective and hazy in that one is dealing with people and is a subject that ERP vendors as well as operators and users have hitherto appeared to have largely ignored.

The author has initiated a Company-wide data improvement programme part of which will involve investigating business processes and their related data flows. The research for this study will be carried out within a number of Remploy sites, the first four cases of which will be the major source of research for this document. This will provide dual benefits for both Remploy, as its programme will contain a powerful academic under-pinning and the DBA, which will have a strong practical outcome. The overall objective from both fronts is to initiate improvements within the area of data quality and the end product of this dual process will undoubtedly produce recommendations for change. The author feels that an appropriate vehicle to promote and control the process of change through meaning, understanding and knowledge creation will be the use of a cyclical action research approach. Action research appeals because it facilitates change through a logical step-by step process of exploration, discovery and action involving like-minded motivated people.

Action Research

Action research may be described as an approach where researchers collaborate in the diagnosis of a problem in order to develop an appropriate solution based on the diagnosis Bryman and Bell (2003: 303-304). Action research, as the title implies, focuses on action and promoting and managing change within an organisation, based on the philosophy of learning by experience akin to a process of trial and error, within a controlled environment. Fisher

(2004: 45-46) emphasises the aspects of learning from experiences by taking action and monitoring the consequences and then developing and promoting improvement and change within an organisation. Bryman and Bell (2003: 304) identifies action research as a real life experimental process enabling an organisation to solve problems through a process of identification, planning, action and evaluation. This may then lead to the re-education and the changing of peoples' patterns of thinking via action through participation, contributing to both academic theory and practical action. The author feels that the latter point epitomises the entire concept of the DBA by linking both theory and practice to bring about beneficial improvements within management philosophy and real life business situations. The first conscious use of action research in name appears to be attributed to Kurt Lewin who attempted to apply social science knowledge to resolve problems within groups with particular regard to individual peoples' eating habits during the Second World War, Gill and Johnson (2002: 72)

As implied above there is also a relationship between action research and action learning whereby the motivation for improvement is inherent within everyone whether it be related to organisational processes or personal development within the cycle of reflectivity, action and review with the aim of participatory action to encourage continuous learning between members of an organisation. One may also see a direct connection with the quality management cycles of plan, do, check, act: or define, measure, analyse, improve, referred to earlier in this document. There is a considerable element of practicality as well as theory surrounding the subject. It has been stated that action research is about improving practice rather than about producing knowledge Fisher (2004: 46). One can accept the practical aspect of this statement but also argue that valuable practical improvements in any environment should also improve the overall pool of knowledge available and therefore they are not mutually exclusive.

Eden and Huxham (1996: 75) identify a theme of action research whereby the research output results from an involvement with members of an organisation over a matter, which is of genuine interest to them. They further suggest that such events may be one-off occurrences and thereby may be open to criticism for lack of repeatability and rigour, but counter this by arguing that the involvement of practitioners in issues that really matter to them provides a richness of insight, which would not be gained in other ways. Whilst the word action does not appear in this definition it is implicit, in the concept of involvement and personal motivation by the participants. Equally implicit is the way this description also has a distinct leaning towards the concept of focus groups a research method, which will be discussed later within this document. Action research is also seen as a method of developing effective professional practice focussing on the individual rather than the organisation, which assists in generating personal benefit and is therefore a form of self-development or action learning Eden and Huxham (1996: 77)

The application of both the practical and theoretical aspects of action research is a logical consequence. In addition to being relevant in every day business and personal life it embraces academic study and as a result enables researchers to generate theory from the consequential gradual incremental action steps generated by the process whilst also reminding them of the practical implications of their project. In this way action research can build bridges between business researchers and practitioners particularly within the very difficult area of change management. It may be claimed that action research is 'grounded in action' Bryman and Bell (2003: 305). Action research applied to a business or commercial environment implies involvement between members of the organisation in a topic or issue of general concern to them. The existence of 'action' implies that events will happen and that participants will be involved hopefully with an element of empowerment Bryman and Bell (2003: 304). The author has had considerable experience of 'improvement initiatives' in many areas, which have foundered because of the failure to have in place an adequate process to promote, implement and control actions and solutions. The action research approach is seen as potential means of providing this mechanism within this project.

This concept of action also appears to integrate with the philosophy of focus groups, which may be seen as the practical vehicle through which to carry out action research methods. In a similar way to focus groups action research may be criticised for lack of repeatability and theoretical rigour, however the very fact of practical interaction of theory and practice may mitigate such criticism.

Bryman and Bell (2003: 304-305) identify action research as a useful tool in researching organisational processual problems and accept that it may be valuable where research is carried out by part-time students undertaking work within their own organisations, but warns that certain issues may arise which need to be addressed by the researcher. These relate to the circumstances whereby the individual is already immersed in the organisation and therefore must guard against, their pre-understanding of the settings whereby their knowledge and experiences may close their minds; role duality which sets them apart from other organisational members and organisation politics which may occur within any structure particularly where the research challenges the status quo. Gill and Johnson (2002: 78) also warn that management students run the risk of being stereotyped as an academic even if they are working full time as a manager, which may impinge on the successful outcome of their project. The author recognises fully these issues but feels that his experiences in implementing new processes, procedures and systems, together with long established relationships with numerous colleagues will help mitigate somewhat such potential problems.

Following the December 2006 DBA workshop and in particular the tutorial introducing action research, it has become apparent that the concept lends itself readily to the data improvement initiative outlined above and to the aims and objectives comprising Document 3,

and as a result it will become the research focus for this document. The initial article supplied in conjunction with the workshop, Stewart (2006), provides a thorough academic background to the subject and highlights a number of additional articles and websites, one of which McNiff (2002) provides a very useful explanation and tutorial on action research. One of the most appealing aspects of action research is its multiple-applicability to both practical and academic perspectives (in the way that the DBA fulfils both elements), as well as providing a template for one's own personal and professional development (once again including the DBA). This is emphasised by Stewart (2006: 1) highlighting that within the context of action research the purpose of understanding is to generate improvement. It also appears to have strong connections with the management quality improvement concepts of Continuous Improvement, Kaizan and Six Sigma. Action research and action learning form the basis of the reflective review process for Documents 1 to 5 as well as Document 6

McNiff (2002: 11-12) underscores all the salient points surrounding action research discussed above and also provides a very practical action plan for applying the concepts as depicted below:

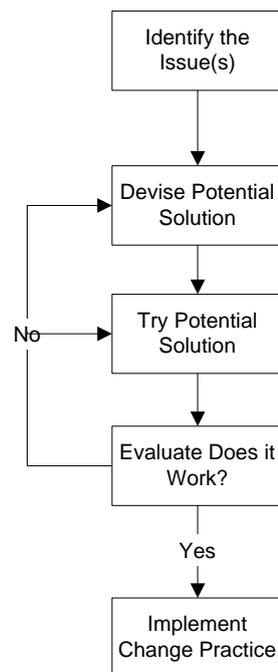


Figure 2. Action Research Action Plan

Having established that this is an appropriate approach to take, the next phase is to determine the most suitable research method(s) to employ.

5. Methodology

The first of the research questions relating to this document concerns ascertaining how data and processes interact with one another within a specific business environment with a view to enhancing the overall quality of the data. The second relates to ensuring that any new improvements that are put in place acquire a degree of permanency.

Qualitative Research

Whilst an ERP system may almost be seen as a objective ontological object, external to the people, encompassing equipment, software, processes, procedures and outputs whether in hard or soft format having almost a physical presence; its dependence upon processes, systems and data, are people-driven which necessitates a more subjective ontological approach. These same persons (actors) must own both the processes and the data, because they alone can make it work by taking ownership. In this way it can be argued than the research strategy for this document has a qualitative rather than a quantitative bias and therefore has a far greater leaning towards an interpretivist open-minded approach rather than a harder and fast natural science based positivist epistemological orientation. This is not to say that a positivist approach has no place in this project, indeed it will be very relevant within Document 4, but an interpretivist stance appears to be more relevant to this document. No amount of Central authority or persuasion can ensure any long-term sustainable improvements without individual ownership. Experience over many years and numerous implementations have identified that things will go wrong the moment the day-to-day pressure to confirm to a system or process is no longer applied and people will revert to type unless they are involved. Sustainability requires individual ownership of the process and the data.

The route to obtaining the information to answer these research questions lies with discussion and interaction between 'People' ideally working together within a team. The research team may draw its members from a number of areas and backgrounds but above all it must include those individuals who work within the target environment and are involved directly with the processes through which the data flows and can provide details and evidence of what actually occurs or perhaps more likely what they *think* occurs. Ultimately it will become a two-way process whereby the initial 'information providers' will become 'information recipients' when or if any procedural changes are implemented resulting from the initial research. There may well be others whose views, opinions, experiences and expertise are sought to aid the initial information gathering, formulate actions and assist with the implementation of any new processes.

During these initial discussions within this document, it is also becoming apparent that a further element of Document 2 may be useful, that being the Data Value Creation Chain shown originally in Appendix 2a and re-shown within this document in Appendix 6. It was stated in Document 2 O'Brien (2006a: 13) that the model contains all the elements of the conceptual framework and is then extended further by bringing in concepts of learning,

knowledge, action and value. As stated in Document 2 it is designed to assist in knowledge creation and enable an organisation to take the necessary actions to create real value from quality data. The data value creation chain encourages knowledge creation, learning, understanding and meaning to create value all of which may prove beneficial in identifying, implementing and sustaining data quality initiatives.

The core focus of the research is the gathering of material from people by communication, rather than the pure collection and analysis of raw data, with the emphasis on 'words' rather than numbers, implying an 'inductive' approach towards theory and research whereby the former is generated from the latter Bryman and Bell (2003: 280). A further emphasis towards a qualitative approach within this research is that, one is seeing life through the eyes of the people (and processes) being studied Bryman and Bell (2003: 293), in order to probe beneath the apparent surface appearances. One is attempting to *understand* the behaviours of the research participants taking a more an interpretivist stance rather than the positivist viewpoint of attempting to *explain* the behaviour. The importance of taking an open-minded approach must also be emphasised.

The nature of qualitative research enables theories or theoretical ideas to emerge out of the collection and analysis of the data, Bryman and Bell (2003: 285), and also may form the basis of the concept of theory generation known as Grounded Theory Fisher (2004: 99). This project is not looking to generate theories from a Grounded Theory perspective within a totally unstructured environment, but rather to identify or discover what actually occurs within a specific business process and system. This does not of course invalidate the use of a qualitative, interpretivist approach, as the desired end product is the outcome of the result(s) of the research. One is ostensibly starting with a 'clean sheet of paper' to identify the processes which are actually carried out within the structure of the Baan ERP environment, conforming to the overall systems and operations of the Company. The analogy of starting with a 'clean sheet of paper' is not a cliché but part of the research process which will become apparent in subsequent sections. There is certainly scope for employing a positivist approach of testing theory or evidence within the project but this will be reserved more for Documents 4 and 5. It is for above reasons it has been decided that an interpretivist qualitative methodology is best suited to answering the research questions relating to this document.

Having established qualitative research as the chosen strategy, employing an inductive role of theory with an interpretivist epistemological orientation and people driven constructionist ontological orientation one must address the other related elements within this research.

Research Design

Bryman and Bell (2003: 39-62) identifies research design as the framework for the collection and analysis of data comprising five different types:

- Experimental design- a hypothesis that is tested between two or more variables where an experimental group is exposed to 'treatment' and compared against a control group, which does not receive the treatment. The variables are measured and analysed both before and after the experimental process to ascertain any differentiation. Experimentation is considered rare in business and management research.
- Cross-sectional design- involves the collection of data covering a number of variables at a single point in time to ascertain relationships. Also known as survey research, data is collected predominately by questionnaire or structured interview. It can be utilised within both quantitative and qualitative research strategies.
- Longitudinal design- a process where data is collected on a sample at two or more points in time in order to identify and map the changes and developments that have taken place between the various data collection dates.
- Case study design- entails the detailed and intensive analysis of one or a small number of cases to provide deep and intensive understanding within a focussed environment. Whilst particular circumstances in one particular case may not be fully representational, generalisations may be made Fisher (2004: 52). A large amount of the literature surrounding enterprise resource planning is based partially on case studies.
- Comparative design- entails the comparison of two or more contrasting cases using identical methods. Examples of this design exist in cross-cultural or cross-national research and also in the form of multiple-case studies.

Research Methods

Research methods are the techniques used to collect data for research comprising interviews, questionnaires, panels, observations, and documents including electronic databases. Each method may be used in both quantitative and qualitative research in that any of the research methods may be used in any research approach. Different methods can be used for different purposes in a study, ensuring that the important issues are addressed, whilst acting as a control mechanism for data validation. Saunders, Lewis and Thornhill (2000: 98-99) recognises this a 'multi-method' or 'triangulation' approach that often may prove to be beneficial. Bryman and Bell (2003: 291) identifies the use as a process of crosschecking findings derived from both quantitative and qualitative research.

The quality and credibility of the research findings are paramount and the major criteria for evaluating management and business research are:

- Reliability/Replication- whether the results of a study are repeatable on different occasions and/or by different researchers
- Validity- the integrity of the conclusions

Saunders, Lewis et al. (2000: 100-101) Bryman and Bell (2003: 33)

At all times one must be aware of the ethical considerations relating to research, which by their nature should govern all the research activities relating to this project. This will be discussed in greater detail within Section 7.

6. Chosen Research Method

The chosen method to carry out research into the questions:

“How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?”

and

“How can an organisation maintain and sustain any improvement identified and implemented arising from answers to the first question?”

will be the use of Focus Groups in conjunction with an Action Research approach. A focus group is a form of panel interview where discussion can be free flowing in both an open or pre-coded manner on a focussed topic Fisher (2004: 133). Action Research assists in adding value and understanding to the research process by enabling the researcher to challenge and improve their understand of the subject being researched by investigation and taking action based on the results and learning from the changes and the resultant experiences. This presents an opportunity for considerable multiple benefits to occur in that knowledge of the subject or topic being researched can be increased, the actions taken can bring about improvements within the research area(s) and the researcher’s own learning can also be enhanced Fisher (2004: 45).

It has been decided to use focus groups, comprising the Company’s employees from within the individual site(s) being studied together with other colleagues from related departments, as the preferred research method, because it was felt that this medium will best generate that essential interactivity between employees; all of whom share the common interest of improving their working environment, to tease out the information required and thereby present a wider and more detailed picture of what actually occurs; than individual interviews, participant observations or questionnaires. It also provides the opportunity for all the interested parties to make a contribution together should they wish. If facilitated correctly the outcomes will be seen as the product of the team rather than a collection of individuals’ own viewpoints and thereby generate a collective ownership of the end result(s). It has to be appreciated however that whatever research strategy or method is applied the ultimate value of any research carried out is related directly to the care taken by the researcher in specifying at the outset what exactly is required from the research Pearce (1998: 72)

Focus Groups

A focus group is an amalgam of the *group interview* whereby multiple interviewees discuss a number of topics and the *focus interview*, which centres on open questioning on specific situations or events. It has also been defined as a form of group interview with discussions taking place on a fairly tightly defined topic, generating interaction between the group members, leading to the joint construction of meaning Bryman and Bell (2003: 570). The focus group approach relates to a method of interviewing that entails carrying out an interview with more than one interviewee on a specific issue or topic Bryman and Bell (2003: 368). It

can be defined further as “a group of individuals interacting together with common interests or characteristics, brought together with the assistance of a moderator to gain information about a specific or focussed issue by use of group interaction” Marczak and Sewell (2006: 1).

The focus groups approach lends itself to a qualitative research strategy as the interaction between the participants and the openness of the questioning means that information or outcomes tend to reveal themselves as discussion takes place, in many cases with surprising results. A focus group session is run under the auspices of a facilitator or moderator whose role is to guide the process without being too obtrusive. Focus groups are run for a wide variety of purposes although they are usually associated with market research and to a lesser extent to researching political opinion. Early use of focus groups were seen as means of assisting individuals to work through problems together to identify common solutions Bryman and Bell (2003: 369). This has theoretical links with action research and action learning, an area to which the document will return in forthcoming sections. Focus groups are also an ideal format for the elicitation of facts and information which, can be ‘teased’ out of the participating individuals as the group discussion reflects upon the processes that create and construct meaning in day to day life Bryman and Bell (2003: 371). Focus groups are sometimes criticised because of the unsystematic nature of the sampling process and the potential difficulties of replicability and reliability Bryman and Bell (2003: 371). However this may also be seen as a strength or advantage because the resultant unpredictability of the outcomes, particularly where strong personal interaction takes place may be appropriate to a particular topic or area being researched.

A number of generic guidelines appear in the literature. Fisher (2004: 134) recommends that the group size should ideally be between four and twelve, participants should be of around a similar status, a maximum of two hours should be allowed for any meeting, ideally the session should be run by an able facilitator and that meetings should be tape-recorded where possible. Bryman and Bell (2003: 371-379) echoes a number of these points, recommending strongly that sessions be tape-recorded, that the number of participants be between six to ten whilst allowing for potential non-attendees, and that the selection of participants raises certain issues as to whether they should be natural grouping, for example from within a department or site with the resultant hierarchical implications, or be selected randomly.

The practical involvement of the facilitator appears to be the subject of much discussion in particular the degree of latitude given to participants. It is appropriate that sessions remain unstructured and be free flowing, but if discussions continually go off at a tangent or appear to be totally irrelevant and unproductive, there may be a requirement for the facilitator to refocus the group back to the main topic area(s). There is a fine balance between intervention and non-intervention requiring a fair degree of skill from the facilitator as when to make any interjection or to guide the process through to a conclusion.

With regards to a group's size, the appropriate number will vary with regards to the topic or subject being researched and the width or range of the desired discussions. Complex or controversial topics may well necessitate a lower number of participants especially where members are likely to become emotional or discussion becomes heated albeit for the right reasons. This will apply to the context of this document's research.

A recent development in this area has been the increase in the use of virtual focus groups whereby group participants communicate via networked computers using specific software rather than a live facilitator Bryman and Bell (2003: 372). This allows for anonymity and a chance for each member to participate equally and avoid the process being dominated by a small number of participants or by one narrow focussed issue.

Bryman and Bell (2003: 380) also highlight a number of limitations associated with focus groups. Recording can be more time consuming to transcribe than normal interviews and the resultant data may be difficult to analyse. Gathering a number of participants together in one place at the same time may be more problematical to organise than individual meetings, and there is also the inherent danger of domination by one participant or a small minority, or by the continual focusing upon a single idea to the disadvantage of other members and the detriment of the overall objectives. The latter points however can be mitigated by effective facilitation. Focus groups can provide data as to how people think or feel about a subject, why they hold these opinions, whilst assisting in the planning and design of new programmes and systems by means of analysis and evaluation Marczak and Sewell (2006: 1). This may be seen as somewhat subjective however in that one is gathering personal feelings and opinions which, may be what participants, *think* happens rather than a more objective view of what *actually* occurs.

An advantage associated with the use of focus groups is that they are seen as a proactive vehicle to jointly construct meaning around a particular issue or interest, allowing participants to reveal information, which would not otherwise have been made available within a more common one-to-one interview environment. Marczak and Sewell (2006: 2-3) claim that the advantages of focus groups are that they enable people to naturally interact and be influenced by others, provide data more quickly and at a lower cost than individual interviews, be assembled at shorter notice requiring less preparation and are easier to conduct whilst being very flexible enabling the researcher to gain a deeper meaning on the focussed subject. They also see the disadvantages as providing less control both in proceedings and data received, be rather chaotic, have limited sampling capabilities, require skilled facilitation and can potentially produce skewed or biased evidence. Bryman and Bell (2003: 382-383) have produced a detailed checklist of issues to consider when undertaking research using focus groups and this is replicated in Appendix 7.

7. Ethical Aspects of Qualitative Research

Ethical issues within the area of qualitative research are often more subtle than issues in quantitative and survey based research. The greater interactivity between people and the more open and less structured approach suggests a greater risk of incurring problems with ethical issues. There are four main areas of concern involving; the protection of participants from harm, prevention of deception, protection of privacy and informed consent Bryman and Bell (2003: 535). Fisher (2004: 55-56) also identifies certain ethical dilemmas surrounding, negotiating access within organisations embracing the terms of reference; the right to privacy; access to sensitive records; and the collection of data and the reporting of findings. The main stance is focussed on the ethical concerns arising from the collection and analysis of the data and dissemination of the resultant information together with the relationship between the researcher and the research participants Bryman and Bell (2003: 548).

Gill and Johnson (2002: 93-94) refer to certain ethical issues relating to action research including the acceptability of the client/project to the researcher, the values relating to the parties and the confidentiality and the protection of respondents. They further identify that there may be circumstances where respondents wish to remain anonymous which in practice may prove very difficult, also some business may be happy to be identified whilst others do not. Similarly in the case of a student carrying out research within an organisation where the content has a marketing focus there may be difficulties arising from the publication of sensitive information, which may be of value to competitors.

Miles and Huberman (1994: 290-297) identify certain specific ethical issues surrounding qualitative research; the worthiness or value of the project, the competency and expertise of the researchers, obtaining informed consent, the benefits/costs trade-off, potential harm and risk, trust and honesty, privacy, confidentiality and anonymity, research quality and integrity, the use and miss use of the results and potential conflicts, dilemmas and trade-offs. They offer advice and guidance in addressing such issues by suggesting that researchers should be aware of their general ethical position in making choices, plan in advance and anticipate potential problems and issues and as a result attempt to obtain up-front agreements from participants. In addition they also suggest that researchers should attempt to establish regular communication between parties and identify any such issues at an early stage to ensure there is repeated feedback, with opportunities for renegotiation of terms of reference if needed.

The author has executive approval from Remploy to undertake this project and this should assist in obtaining access to both information and persons. The author has also been a member of the organisation for thirteen years within both the Financial and IS areas. It is appreciated that 'internal politics' and elements of subjectivity of various types can impinge on any type of work especially involving research but every effort will be made to maintain objectivity at all times. All participants in any interview or focus group will be informed at the

beginning and consent will be obtained prior to commencement. The author is known within the business and has worked closely with a large number of the participants for a number of years. In addition it is hoped that there will be early benefits emanating from the research, allied to its practical nature, which should assist in encouraging effective participation. Remploy has devised five values- namely Professionalism, Passion, Respect, Openness, and Keeping Promises. These values will be at the forefront of this project at all times and a more detailed explanation of these values is contained in Appendix 8.

8. Data Collection

It has been established that this research document will attempt to answer the following research questions:

“How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?”

and

“How can an organisation maintain and sustain any improvement identified and implemented arising from answers to the first question?”

by taking an action research approach allied to focus groups as the most appropriate research method. In order to achieve this, the research will focus on the business process within each of the chosen research sites and will investigate how data interacts with the processes, using process mapping to collect the information.

Process Mapping

Process mapping has been a proven method for collecting data around processes and procedures particularly within an operational and manufacturing environment for a number of years and has been a popular and successful data gathering technique within Remploy. It is felt that with this success and the familiarity gained over this time, process mapping should provide the firm base on which to carry out the research for this document.

The method will entail determining where data interacts with the business processes and will attempt to establish overall acceptance, ownership and responsibility for the data, whilst reviewing the processes themselves for efficiency and effectiveness. In order to carry out this investigation it will be necessary to map the processes within the target business/sites using ‘process mapping’ as the medium. A process may be defined as a series of step or actions carried out to achieve a given outcome. This description that may be applied to almost any form of action but for the purposes of this project, the term will apply to a business process similar to that depicted in Appendix 3 referred to earlier in this document. Process mapping refers to the graphical representation of a process from start to completion by way of a flowchart to promote greater understanding of what actual takes place in a given situation by depicting inputs, outputs and activities. It represents the initial step in process management and although it is used extensively in total quality management and six sigma circles within a manufacturing environment, it is also highly applicable to data/information/IS processes and their peripheral activities.

Process mapping has its own nomenclature together with specific symbols/shapes representing appropriate activities. The development of a process map entails progressing through certain steps, determining the boundaries as to where the process starts and finishes, listing the operations preferably using action words, sequencing these by use of post-it notes to enable one to move the tasks around as appropriate, drawing the sequence of events by

use of appropriate symbols, linking these symbols by way of arrows to depict the direction flow and finally adding feedback loops where appropriate. The process diagram can then be written in an electronic format or manually using a mapping template fpm (2006). The method itself can take the form of either a general process flow or a more detailed approach itemising every finite action and decision point. As an alternative to the format identified above, specific process mapping software exists which can replicate the manual process electronically.

Data Capture Process

It is intended that the major element of qualitative research for this document will be carried out by way of a focus group approach comprising appropriate Remploy personnel from both the chosen target site and beyond, using process mapping as the appropriate medium by which to capture the actual data, then applying action research and action learning techniques to develop, test and implement appropriate improvements. The chosen method encapsulates the three key elements emphasised at the beginning of this document relating to 'People' in the form of participants who will be identifying the 'Processes' to be mapped in an attempt to improve 'Data' quality.

An additional subordinate research opportunity emerged part way through this document. The author was invited to make a short presentation at the 4th Information Quality Forum at Dublin City University in February 2006 and chose as his topic the title 'Maintaining sustainable data quality within a diverse Enterprise Resource Planning and Information System'. A copy of the presentation notes and related slides are contained in Appendix 5a and 5b.

The focus of this research takes place within four Remploy factories and a related business office. These are the initial investigations within an ongoing data improvement programme within Remploy which may encompass all eighty-five sites and twelve business. The author, as a result of the progress made so far within the DBA, instigated this process and the research depicted here represents the first four investigations. The generic elements relating to focus groups, process mapping and action research have already been described and discussed in detail within this document, but these will now be applied specifically within the chosen Remploy environment and will be modified where appropriate to suit the particular situations, unique circumstances and idiosyncrasies existing within the Company.

The process will not conform to the suggestion that proceedings should be tape-recorded as it is felt that this would be totally inappropriate given that the tape recording of meetings has never been part of the Company's practices. In addition it is considered highly likely that it would be treated with deep suspicion by participants, inhibiting greatly the opportunity for open and frank ideas, views and discussions which are so essential for this research and might even generate a refusal to participate by some persons. In addition given the highly charged political climate within the Company resulting from the on-going strategic review highlighted earlier, the taping of meetings may have even wider implications within the

organisation. It is appreciated fully that the recording of research proceedings assists greatly in maintaining an accurate record of events, however given that the research objective is to identify data flows and processes by recording them on paper together with related issues, opportunities and consequential actions all of which will be verified later by all the participants, it is felt that the decision not to use tape recordings will not cause a problem. It is also likely that certain of the other guidelines relating to the size of the group, duration of proceedings and existence of a hierarchical structure within the participants will not be followed, but after due consideration it is felt that this will not present a risk to the quality of the research indeed there would be a greater risk in following slavishly what are basically generic procedural suggestions.

The other limitations identified, relating to the time-consuming element of recording and analysis, will not apply and the availability of participants should not present a problem providing diaries can be synchronised. Other potential problems of a procedural nature relating to domination by individuals or by a single topic or overall loss of control should be overcome by effective facilitation and also by the sequential nature of the mapping process.

Basic Research Process

This section describes the generic steps through which the research will progress. Each of the four research events will be discussed in detail with reference to this generic process highlighting any exceptions with relevant explanations. The inherent criticism regarding lack of repeatability and rigor may be overcome by integrating the findings of the four events and whilst these are seen as separate sites within potential differing issues it should be possible to overlay the actions to determine any commonality.

The team undertaking the process mapping exercise will comprise those persons who actually carry out the processes being studied within the department or site together with the relevant manager, a facilitator and certain other people from around the organisation who are able to contribute or are present merely to observe. The participants will be asked to 'talk-through' the processes and procedures as they actually occur and record the information on post-it notes, which are then inserted on a sheet of brown paper preferably attached to an adjacent wall. The actual information recorded will comprise the step-by-step events, which are required to complete the process either in summary or detailed form. Superimposed on this map will be those incidences where data intervenes either where incoming data is received, or is entered into or generated out of the ERP database, together with any problems or issues, which emanate from any of the steps and tasks. Participants are also encouraged to identify any opportunities, which may be available to improve the processes and/or address the issues. All the incidences of the process steps, data interventions, issues and problems and possible opportunities are written on different coloured post-it notes in order to differentiate them- for example process- yellow; data- blue; issues- green; opportunities- pink.

Post-it notes are used to provide flexibility so as to enable them to be moved around the map until the correct sequence of events is agreed. At this stage each post-it note can be linked to its neighbour by an arrow to highlight the direction of the flow after which they can be affixed permanently to the paper by the use of cello tape to provide a lasting record. Brown paper is used as this provides a good background and is strong and durable. This medium may appear somewhat rudimentary but is a long established and practical method having been used successfully within Remploy for a considerable period especially in carrying out continuous improvement and kaizan exercises and therefore many of the staff are familiar and comfortable using it.

The process is completed by drawing up a list of action points aimed at addressing the issues and problems and incorporating any identified opportunities. These actions should be prioritised, have the relevant persons responsible identified and individual completion dates agreed. This final initial step is vitally important. Any improvement initiative will fail to achieve its objectives if there is no effective action plan. As part of the action research process there should be follow up meetings or conference calls during which the agreed action points will be discussed, reviewed and updated with the whole process revisited again if necessary. This ongoing process, following the principles of Action Research, is vital to ensure that the momentum and robustness of the exercise is maintained. As identified earlier specific process mapping software exists which can replicate the manual process electronically but it is considered that this format would not be appropriate for use within Remploy at this moment as the manual process has total acceptance within the Company with proven success.

It is important that this exercise is carried out in its entirety and reliance is not placed on any pre-existing process map which may be available either in a procedure or quality manual as the objective is to determine what *actually* happens currently, rather than what *should* happen or *has* happened in the past.

9. An account of the individual Research Events

The initial four research events took place between 4th December 2006 and 19th February 2007 at four factories and a related business office within two of Remploy's twelve business streams. These were chosen because the management teams within the two businesses are committed to improving data quality within their relative organisations and either volunteered to participate or welcomed an approach to carry out the exercise. This is not to say that other Remploy businesses do not have a commitment to improve data quality but the two operations were involved earlier in 2006 during the implementation of the Data Accuracy Key Performance Indicator Initiative referred to in Section 3. In addition the four factories produce different products ranges, for mainly different markets, supplying different customers and encountering different issues, problems and concerns, thereby providing a rich and varied environment on which to base the research for this document and to commence the Company's wider data quality improvement initiative. The research will be focussed on the operations carried out in each of the sites, which basically encompasses the successful completion of a customer order from initial order enquiry to final despatch. The generation of the invoice and subsequent cash collection processes are carried out centrally, although each factory may be involved with any subsequent customer query. Even though both businesses are relatively diverse, they both operate a 'make to order' concept rather than a 'make for stock' in that the customer will generate the chain of events and the business will react rather than manufacture products in anticipation of a customer order. This is because of the semi-bespoke nature of the product ranges and the difficulties in anticipating and forecasting customer demand. The ability to react successfully to customer orders within very tight lead times is vitally important, placing even greater pressure on systems, procedures and processes. A decision has been made that each research event will be reported in chronological order rather by each Remploy businesses, as this best reflects the evolutionary learning aspect of the research process.

The Businesses

The two business streams involved in the research are identified below:

Workscope

A provider of business services covering the design, manufacture, distribution, supply, export, import, packing, filling and assembly services to various manufacturing industries including foodstuffs, furnishings and beds. Other business areas includes: Electronics - design, manufacture, distribution, supply, export, import, assembly and fitting of filters and electronic/electrical appliances including printed circuit boards. Building Products - Design and manufacture of UPVC windows and doors. The business comprises nineteen factories and a business office. The sites visited for this document were Newcastle, Barrow and Hartlepool. To a considerable extent each Workscope site is viewed as a separate commercial entity from order enquiry to final delivery with its own local business team and

whilst there is also interactive support from the business office and departmental support functions, the emphasis is upon individual site self sufficiency. One very encouraging outcome has been the fact that after the second event (Barrow) the Workscope business decided to take ownership of the programme within its business and initiated its own plan to complete an entire review of all its sites based upon the current process. Specific dates have been agreed for each site with an intended completion date of June 2007. This initiative has now a momentum of its own, independent of the author, although he will continue to attend future events, diary permitting.

Packaging and Print

Manufactures solid board boxes, corrugated cases, litho printed cartons, specialised packaging solutions and commercial printing. Packaging and Print is firmly established as one of the UK's leading packaging companies. The strength of the business is reflected in a £ multi-million turnover and a growing customer base including blue-chip names such as The Body Shop, Ilford, Terinex, and many more. The business comprises seven factories and a business office and differs from the Workscope business in that all of the front-end customer enquiry, sales order processing and customer service functions are concentrated at the central business office situated within the Norwich factory. The factories are mainly manufacturing and distribution units working within a centrally planned supply chain operation with a large number of the products being interchangeable between factories.

The Sites

The individual research events are described below and the comments and assumptions relate to the author's personal feelings and perceptions following each event.

Newcastle

The initial event took place at the Newcastle factory on 4th December 2006. The site employs 99 people of whom 93 are supported (disabled). The site manufactures and distributes beds and is part of the Soft Furnishings division of the Workscope business it has an annual turnover of £1.3m and has in particular one major customer who supplies beds and bedroom furniture to a number of the main budget hotel groups. The author is familiar with both the site and the personnel having been responsible for implementing the Baan ERP system into the site in March 1999.

The research group comprised all the relevant parties, with representatives from the factory in the form of the Local Remploy Manager, Production Controller and the Stores Controller; in addition the departmental Soft Furnishings manager, members of the Workscope Business Team including the Finance Manager, Business Development Manager and the Systems Project Engineer. Also in attendance was a senior member of the Corporate IS team plus the author.

The event followed basically the generic process described above. The Business Development Manager, who also had prior experience of managing the factory, facilitated the meeting. Being the first such occasion it quickly became a learning process for all. The issues, Baan interventions and opportunities were all extracted during the process outline. The individual personnel responsible for each step along the chain were given the task of describing their elements of the process. It was identified that the initial customer order generation process took place off-site within a central Soft Furnishings divisional office in Oldham and was then mapped as an external process leading into the site operation. As the process was outlined, the Baan interventions, issues and any opportunities were linked to each related process step. Upon completion the interventions, issues and opportunities were all listed on a flipchart with the relevant job roles responsible, allocated to them. Each of the points listed within the three elements was set within a 2x2 'Impact Priority Matrix' to assist in identifying those areas to investigate. Finally a list of actions was generated from the opportunities and issues. The process data flow chart; list of Baan interventions, issues and opportunities; the priority matrices and action points are contained within Appendix 12

All the hope-for outcomes were achieved via open and frank discussion and the initial reaction was that the process had gone very well and appeared to be an effective vehicle for the process. It was also felt that the open reactive discussions between the factory personnel and the business office helped to tease out issues etc that would not have been possible with one-to-one interviews or individual observation. The process took over six hours, which was felt to be far too long, putting pressure on everyone's attention spans. In addition the action points were rushed at the end and appeared to be not as focussed as they should be. It can be argued that if the mapping process and the related interventions, and issues reflect accurately the real life operations, then the actions and recommendations are the single most important outcome of the proceedings. The action points were subsequently reviewed and their focus enhanced.

The meeting appears to have been the catalyst. A number of individual visits were made subsequently to the factory to follow up on actions. A conference call was held on 6th March comprising all the parties at which all action points were reviewed and updated. A further call will take place at the end of March followed by regular meetings or calls. The proactive approach re-emphasises the point that the quality of the actions and recommendations and the subsequent follow-up(s) will determine the quality and success of any improvement programme.

Barrow

A research event was carried out at the Barrow factory on 9th January 2007. The site employs 34 personnel of whom 33 are supported and is a major designer and manufacturer of bespoke filtration systems supplying large customers around the world in numerous industries

including nuclear power. Whilst it currently has an annual turnover in excess of £500k the business is expected to expand its operation from within the Barrow site by over a third during the forthcoming three years.

The research group comprised representatives from the factory in the form of the Local Remploy Manager, Production Manager, Production Controller, Storekeeper, Factory Administrator; the Workscope Finance Manager and Systems Project Engineer; together with a senior member of the Corporate IS team, the Corporate Purchasing Manager, an Internal Auditor who acted as facilitator plus the author.

The event followed basically the generic process described above, but instead of concentrating solely upon the process and the data interactions, discussion flowed freely and the proceedings expanded to encompass elements of a business process re-engineering nature outside the immediate scope of the intended project. It was decided to let this continue as the meeting did not wish to restrict proceedings especially as the site has been somewhat neglected in terms of process improvements in recent years and the potential expansion of the business with the inherent additional pressure that this would bring. In a similar way to Newcastle, the ERP interventions, issues and opportunities were identified and written up during the process outline. The entire proceedings again lasted in excess six hours and the pressure on time necessitated cutting short the impact priority matrix analysis to concentrate on completing detailed action points in order to learn from the Newcastle experience. Detailed and focussed action points were drawn up to ensure that each issue and opportunity was addressed in full with detailed responsibilities allocated with a number given a high priority rating. The actions were also divided between those relating directly to the data quality project and the others, which were seen to be more of a general business nature.

The general consensus was that the event had achieved its immediate objectives in spite of being over-long and missing a number of intended steps. In line with Newcastle, there have been a number of subsequent visits and a follow-up conference call took place on 26th February 2007 during which it was agreed that real progress was being made at an acceptable pace. A further meeting at the site has been arranged for 21st March. A copy of the process data flow chart, the list of Baan Interventions, issues and opportunities, together with the detailed action points are contained with Appendix 13

Following on from this second data workshop a document was produced which attempts to bring together the learning outcomes and identify further guidelines for future meetings. This is reproduced with Appendix 9.

Norwich

The research event covering the Packaging and Print Business Office and the Norwich factory took place over 6th and 7th February 2007. As already stated the Sales Order and

Customer Service department is a separate central business-wide function servicing all seven factories and therefore it was decided to split the process mapping into two parts, office and factory, It was also decided to identify specifically all the data interactions, highlight them on the flow chart in red and detail them separately on a data risk identification matrix as an alternative approach to identifying the risk, responsibility and ownership of the data. The Packaging and Print Business employs 1047 people of whom 975 are supported and has an annual turnover of £25m. The corresponding figures for the Norwich factory are 72, 46 and £4m respectively.

The research group comprised representatives from the business in the form of the Customer Service Manager, a Sales Order Processing Supervisor, the Norwich factory Local Remploy Manager, and the Production Manager; together with three senior member of the Corporate IS team, two of which had direct experience of the business, an Internal auditor who acted as facilitator plus the author.

The business is currently implementing a new external estimating/quotation system from an organisation called CDM to deal with customer enquiries, quotations and sales orders. The Customer Services Manager outlined the front-end ordering process highlighting the methods by which the new system integrates with the Baan ERP system. The CDM package was only partially implemented at the time of the visit therefore both the old and new processes were mapped for completeness. The data interactions were highlighted on the process map as numbered red circles and a list produced on a flip chart in respect of each related task, identifying the source of the data, processes involved, plus any related issue or opportunity. The output of the sales order processing operation places a demand upon a factory to supply goods to a customer and this was duly represented by means of a link from the Business Office process map to the Norwich factory document.

As stated previously the vast majority of items within the main Corrugated product range are interchangeable between factories, but Norwich is unique in that it alone also manufactures the Litho products range which follows a slightly different manufacturing pattern. The Local Remploy Manager and the Production Manager then worked through the factory processes detailing carefully the process variances. Whilst the resultant map appears somewhat convoluted it was validated as faithfully representing a complex production process. The issues and opportunities identified during the process were listed on a flipchart from which a detailed action list was created with relevant responsibilities. To this was added other related concerns and problems, which impinge upon the data but do form part of the process mapped. As a result the process became more embracing and comprehensive. The process flow charts, list of issues and opportunities, the data risk identification matrix and the Action list are contained within Appendix 14. The whole process was spread over a day and a half and has broken down into segments with intervals in between. It was felt that this

improved greatly the flow of discussion with less pressure on attention span. All parties felt that real progress had been made.

A follow up meeting will be held in Norwich on 14th March 2007 with the business management team to review process and plan the roll out across the remaining six sites.

As has been stated the front-end order enquiry and sales order processing operation is applicable to all sites and the Norwich factory process covering the Corrugated product range is fairly generic therefore it is possible that the processes mapped at Norwich will be fairly representative of the Packaging and Print organisation.

Hartlepool

A research event was carried out at the Hartlepool factory on 19th February 2007. The site which employs 79 personnel of whom 76 are supported, operates in a number of markets including the manufacture of beds and soft furnishings and the packaging of electrical components, automotive parts and food containers, the latter carried out under strict hygiene conditions. The site has an annual turnover of £500k.

The research group comprised representatives from the factory in the form of the Local Remploy Manager, Production Controller, Storekeeper, the Workscope Systems Project Engineer who acted as facilitator plus the author.

The event followed basically the generic process described above concentrating on the data process flows. The site is well managed at all levels with knowledgeable people in key positions and as a result the mapping process flowed smoothly. The Baan interventions, issues and opportunities were easily identified and the opportunities were then superimposed on an impact priority matrix. Finally detailed action plans were drawn up with responsibilities identified and completion dates allocated. The format was changed in that instead of attempting to identify the entire element in one pass, the processes, Baan interventions, issues and opportunities were each identified separately. The mapping process took three hours to complete and a further hour to finalise the documentation and circulate the results. A copy of the process data flowchart, Baan interventions, issues and opportunities, priority matrix and detailed action point are contained in Appendix 15.

The improved efficiency of the event may be the cumulative result of Hartlepool being a well run site with few problems, one main key operator outlining the process (his colleague was away that day) together with an overall improvement in the mapping process gained from the learning experiences of the previous events.

It is planned to hold a conference call during week commencing 12th March at which all action points will be discussed.

All of Workscope's documentation is being maintained within a specific directory on the Company network accessible to all parties in order that the action plans can be reviewed and updated on an on-going basis.

10. Summary- Analysis and Findings

The quality of the research analysis, the resultant findings and the overall success of the research project are dependant in part upon a number of factors embracing, the openness of the participants; the expertise of the facilitator; the accuracy of the data capture to generate the process/data flows, interventions, issues and opportunities; the soundness and focus of the resultant actions and robustness of the review procedures. This should ensure that the actions are followed-up and acted upon to enable the initiative to develop an on-going existence independent of the actual research project. The programme then takes upon a life of its own bringing a degree of sustainability to the improvement initiative. Each of the four events was perceived by the participants to have been successful in generating detailed research findings and outputs in the form of the process/data flows, Baan interventions, issues, opportunities priority matrices and actions described above, all vitally important to that individual site. The action points represent the initial outcome of each event and are to an extent the external manifestation of the internal research process in that the actions represent the perceived occurrences that need to happen to achieve the research objective(s). The four events generated seventy nine actions and therefore it is important to obtain an overall consolidated picture from this research, not only from the limited research carried for this document but also for the wider corporate perspective as the Remploy project encompasses more and more sites.

Analysis

It has been decided to represent the main outcomes of the research in the form of an interpretive grid matrix analysing the detailed actions by site across a range of generic processes to identify functional clusters and determine whether there is any commonality and trends etc between them. Miles and Huberman (1994: 127-128) support this approach in the form of a conceptually clustered matrix, which has rows and columns organised to consolidate items that 'belong together'. A detailed matrix itemising each individual action by function and site is contained within Appendix 10 and an extended analytical summary is featured in Figure 3 below.

DATA QUALITY WORKSHOP ACTION MATRIX

Action Categories	Sites & Dates of Workshops				Total	%
	Newcastle	Barrow	Norwich	Hartlepool		
	4-Dec-06	9-Jan-07	6-Feb-07	19-Feb-07		
A. Order Enquiry/Quotation	1	2	2	1	6	8%
B. Sales Order	1	4	4		9	11%
C. Production	2	2	5		9	11%
D. Purchasing	5	5	7		17	22%
E. Distribution		1	1	1	3	4%
F. Shared Service Centre		2			2	3%
G. Training	1	1	2	4	8	10%
H. Master Data- Items/BOMs/Routes		6	1	1	8	10%
I. Customer/Supplier	2	1	1	1	5	6%
J. Management/Personnel	2	3	2	1	8	10%
K. Systems		2	2		4	5%
Total	14	29	27	9	79	100%
<u>Status as @ Last Review</u>						
Complete	9	11	4	8	32	41%
Ongoing	5	10	16	1	32	41%
Not Yet Started		8	7		15	19%
Total	14	29	27	9	79	100%
<u>KPI Index</u>						
Prior to Workshop	18.6	16.6	30.6	13.6	19.9	
As @ 15/05/07	14.6	17.7	27.1	14.8	18.6	
Variance %	21.5%	-6.6%	11.4%	-8.8%	6.5%	

Figure 3. Conceptual Clustered Matrix

The basic action summary has been supplemented with further analysis to focus upon both the major functional areas and also identify any developments that have taken place between the actual workshop events and the submission of this document (May 2007). This takes the form of three elements, a summary of the actions by each generic function by site together with an total %; an appraisal of the overall progress made by each site as at their last review meeting or conference call; and a comparison of the movement of the Site Data Accuracy Index- taken immediately before the workshop and again prior to the completion of this document. In order to develop some form of rationale from the above base data it will be beneficial to examine the overall consolidated picture and then consider elements of the individual sites. The outcome of this analysis may go some way to addressing the major questions and stimulate further discussion and research.

Findings and Discussion

In total, order processing- sales, production and purchasing, comprise over half the incidences (52%) with purchasing slightly greater than sales/order enquiry. From one's knowledge and experience this is not a total surprise and it is interesting to see that there is

also a reasonable distribution across other process and system areas. Over 80% of the actions were complete or in progress at their last review and a detailed appraisal appears to indicate that the remainder are either of a long term nature or relate more to general business/site development matters than specific data quality issues. There is no evidence to suggest that actions are being ignored, which in itself supports the concept that regular thorough reviews assist in maintaining momentum. When one then attempts to superimpose the Data Accuracy KPI Index for each site upon the matrix in an attempt to produce a 'before and after' appraisal, an interesting picture develops in that whilst there appears to be an aggregated average improvement of 6.5% there are wildly varying results across the four sites.

Analysing the data by individual location stimulates further considerable discussion and debate even allowing for such a small sample. The number and distribution of the actions across the generic functions may mirror somewhat the perceptions gained from each event. Newcastle was focussed mainly on data accuracy with the majority of actions order based and whilst conceding that the action generation was undoubtedly rushed, the last review indicated that all major issues at the site had been resolved. Both Barrow and Norwich show a significant number of actions distributed across the functions with some yet still to commence for the reasons described above. As already discussed, both events encompassed general business issues as well as data accuracy matters and these have each been identified and 'ring fenced'. Hartlepool, considered a good site in terms of systems and personnel, was very focussed on data accuracy and generated only one order processing issue. One has to ask however whether this is a true reflection in that it was based around the one major user and took only a third of the time of the other three. Was it too rushed and did it only reflect a single person's viewpoint?

The Data Accuracy KPI Index analysis is very intriguing and may well support a major hypothesis. There is potential evidence to attempt to explain the improvements in both Newcastle and Norwich. In Newcastle the site manager was involved early in the implementation of the KPIs some three months prior to the workshop and has continued to encourage his team to monitor these on a regular basis, which may also explain the early resolution of all the issues at this site. Does this represent the commencement of a real data accuracy culture within the site? Norwich also identifies an improvement but it is perceived that much of this is the result of assistance to 'clean up' old orders and there is yet still no on-going stimulus although there is recognition within the Business that data accuracy is important. Barrow and Hartlepool have each worsened albeit each from a low index base. It has been established that Barrow and its Filter business had been somewhat neglected in terms of both strategic and operational assistance and the workshop may be seen as 'making up for lost time' as evidenced by the large number of actions for such a small site. The necessity to focus on these may be seen to have a greater priority than the general system

housekeeping processes covered by the KPIs. Whilst Hartlepool shows a slippage but still remains within the top 25% of the Company, one question may be asked as to whether this slightly disappointing result can be allied is to the fact that the workshop process was relatively short with far fewer actions than the other sites and as a consequence generated less internal focus.

It has to be appreciated that this research represents only a small portion of the overall Company (5%) and may well change as other businesses and sites are covered, but not withstanding this it still provides a useful format to stimulate discussion on the elements effecting data quality per se. A meeting is to be held in June between the main parties involved in the four workshops to discuss the evidence of the matrix together with all the elements of the above discussion.

The analysis, findings and results fulfil two purposes, initially they identify the steps that are required to be made to bring about improvements at each specific site, but further by identifying possible explanations, trends and solutions, which may be applicable to a wider audience not only within other Remploy sites but externally. This wider applicability may become more of a reality as the Company's data quality review programme is extended across additional sites and businesses and more data is accumulated. This potential benefit arising from the finding's output is the possibility that a generic process/data flow may emerge consolidating best practice from a wide variety of sites and lead to the creation of generic standard operating procedures which can be adapted where appropriate to fit specific local and business operating conditions.

Research Questions

Whilst it has already been acknowledged that the research sample is somewhat limited, it will be beneficial to relate the analysis and findings discussed above within the context of the two research questions:

“How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?”

and

“How can an organisation maintain and sustain any improvement identified and implemented arising from answers to the first question?”

Each event has to a greater or lesser extent exposed both the site and related business personnel to the concepts and principles of data quality and has asked them to review their basic ways of working within this context. The first question has both business/site specific and generic implications that cannot all be addressed or answered wholly in such a short time, but the general premise that 'prevention is preferable to cure' still rings true.

As to the second question of sustainability, the experiences of the Newcastle site, where the on-going improvement appears to be coming from within as much as from external pressure, hints that 'winning the hearts and minds' to inculcate the concepts within a site culture is a possibility. The next question may be 'for how long?', especially when the focus is no longer there and or personnel change.

11. Conclusion

The research for this document has re-affirmed the concepts identified in Documents 1 and 2 that any attempt to improve the quality of data within any organisation must be centred on *people* whether data creators, users or information recipients; the *processes* that receive, handle, action and pass on data and information; as well as the *data* itself where ever it sits within the data cycle of input, process and output. Data quality improvement is not just about fixing data or improving quality within a single business application or process but by a forward looking enterprise wide approach addressing cultural issues, winning *peoples'* heart and minds at all levels, initiating long term *process* and procedural improvements by a step-by-step incremental approach, whilst ensuring that the *data* conforms to appropriate specifications. It is also appropriate that one should return to the author's definition that quality data is all about "having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise".

Review and Development of Research Questions

The research questions from Document 2 and Section 1 above are reproduced again, together with an indication of where and when they are to be addressed:

1. What are the attributes of data quality with particular reference to ERP?
 - a. What is data quality? (Doc2-5)
 - b. How does it impact upon enterprise resource planning? (Doc2-5)

2. What is the range of factors that impinge on data quality?
 - a. What are the elements that effect data quality? (Doc2-5)
 - b. How can data quality be measured? (Doc4/5)
 - c. What levels of data quality are necessary? (Doc4/5)
 - d. What do organisations need to do to improve and sustain data quality?
(Doc3-5)

3. Are there specific factors that apply to these in the context of Remploy and related organisations?
 - a. How can the study be best related to Remploy? (Doc3-5)
 - b. Does Remploy's position make it unique or can common practices be applied with or without modifications? (Doc3-5)

4. What is the impact of poor quality data?
 - a. What is the true cost? (Doc 4/5)
 - c. What are the benefits of improved data quality? (Doc3-5)

5. How can the concept of 'World Class' be related to ERP and Information?

- a. What is world class and how can it be achieved? (Doc4/5)
 - b. Is world class feasible or cost-effective? (Doc4/5)
6. How can a data quality improvement programme best be implemented with regard to?
- a. The management of organisational change (Doc 3-5)
 - b. The management of organisational politics and culture (Doc 3-5)
 - c. The education, training and development of people (Doc 3-5)
 - d. Remploy-specific issues (tie in with 3 above) (Doc 3-5)

The total quality management philosophy of getting it right first time is a guiding principle that has influenced the author's approach to this subject and is the foundation upon which the research for this documents is based, namely that data should be of the requisite quality at the time of input into the system as raw data. From this principle two further detailed research questions emerged:

- 7. How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?
- 8. How can an organisation maintain and sustain any improvement identified and implemented from the answers to the above question?

Research Process

The research undertaken for this document has attempted to address these two latter questions using the author's own organisation, Remploy, as the basis for the investigation, employing a qualitative research strategy. It was decided that studying the Company's business processes within a number of its sites, to determine how data interacted with these processes, would provide rich information to assist in detecting data and process problems and also identifying ownership and responsibility for the data. An action research approach was chosen because the project is attempting to bring about change and improvement within real life organisations via incremental enhancements. Action research, with its accent on the continual cycle of critical reflection, action, review, and further reflection etc, was deemed to be the most appropriate research approach to promote change through understanding. It was also decided to use focus groups, comprising the Company's employees from within the sites being studied and externally as the research method. This method was chosen because it was felt that the interactivity between employees, all of whom share the common interest of improving their working environment, would be more suited, to tease out all the information and thereby present a fuller picture of that actually occurs, than individual interviews or questionnaires.

The research was carried out at four factories and one business office as part of a wider Company initiative. Process mapping was used to collect the data and the findings were

written up in the form of process/data flow diagrams, lists of related data interventions, issues and opportunities, together with detailed action plans. The action plans are seen as the catalyst to promote change and improvement, providing that they truly reflect reality and are focussed and acted upon to make them an on-going working document. For this reason it was decided to present the results in the form of the detailed action points analysed within a conceptually clustered matrix in both detailed and summary form.

The findings, analysis and results fulfil two purposes, initially they identify the steps that are required to be made to bring about improvements at each specific site, but further by identifying generic solutions and trends, which may be applicable to a wider audience not only within other Remploy sites but externally. This wider applicability will become more of a reality as the Company's data quality review programme is extended across additional sites and businesses and more data is accumulated.

Data Quality within Remploy

There appears to be a real sea change within Remploy with regards to data accuracy and data quality. The overall initiative appears to be gaining a momentum with wider executive support and a real appreciation that data quality is important. The Data Accuracy KPI graphs and index, referred to above have gained in prominence with the indices being reported by site and business every two weeks, including one in the form of a league table- See Appendix 11. Whilst it is appreciated that an index is a measure of relative change and is not necessarily a score, analysing the on-going results in a table appears to be focusing peoples' minds to the fact that "what gets measured gets done.....but what gets measured by the Exec gets done quicker". Winning hearts and minds is an ideal means of sustaining long-term improvements, but in the shorter term the concept of the 'stick' rather than the 'carrot' is just as applicable. As one seasoned Remploy manager confided to the author "my index is now below 17, isn't it is surprising what a telling-off can do".

Overview of Documents 4, 5 and 6

Document 3 commenced the process of establishing the means by which data quality improvements can be maintained and sustained by recognising that the two research questions are key to long-term quality data. The questions have not yet been answered fully nor was it envisaged that they would be, by the submission of Document 3. They are part of a longer research programme and it is envisaged that Documents 4 and 5 will return to this subject. The research questions have been re-emphasised earlier in this section with an indication as to where they will be addressed.

Document 4- Survey Based and Statistical Research

It has already been identified and highlighted in Appendix 2a and 2b that Document 4 will focus on establishing the methods by which the quality of data can be measured, the costs of poor data quality ascertained, the benefits of making improvements evaluated, as well as

determining the levels of quality necessary to be maintained in each area. In addition it is intended to examine the subject of data and information profiling and auditing both in general terms and in relation to Remploy's ERP environment. There is also an intention to focus upon those aspects of data inspection, correction and cleansing in relation to the Baan database (Data in Context) as highlighted by blue boxes within Appendix 2a. This will be carried out via a quantitative research strategy employing in part a hypothetical-deductive approach to the research.

In addition a series of structured questionnaires will be developed and administered to:

- A selection of the corporate membership of Workability in various parts of the World, with a view to ascertaining how each have treated data quality with particular reference to their disabled employee base. Discussions have already taken place with the Secretary General of the European Federation who has promised to provide contact details of members throughout the World.
- A sample of ERP users to ascertain their approaches to data quality.
- Other individual Baan user companies, other major ERP software providers and large organisations- suppliers/customers of Remploy

The author is also a student member of the International Association for Information and Data Quality (IAIDQ), which operates an electronic forum for members to raise issues, share ideas, concepts and general information. A number of PhD students have already used this medium as a vehicle for undertaking research. The author will consider seriously utilising this service and has had offers of assistance from members of the UK and Eire branches.

The author has contacts within Dublin City University following his recent presentation at an Information Forum. The senior lecturer Mark Helfert is also researching methods of measuring data quality and arrangements have been made for the author to visit Dublin during the spring 2007. DCU also has connections with the Massachusetts Institute of Technology.

Databases and other sources of statistical information will be interrogated to support the quantitative research process. Consideration will be given to using some form of software to assist in analysing the quantitative data. It may be possible to use Microsoft Excel and Access, but SPSS software is also being considered.

In addition the data quality improvement initiative taking place currently within Remploy will be reviewed with particular regard to the way in which this project has contributed to and received inputs from it.

Documents 5 and 6- The Thesis and Critical Reflection

It has already been identified and established in Appendix 2a and 2b that Document 5 will focus on the process outputs in the form of information products with particular reference to the requirements of all of the information customers as highlighted by orange box within Appendix 2a. In addition the author will attempt to place the entire project within a company-wide data strategy with particular reference to the establishment of a data governance policy. This will be aimed at managing the Company's data across all of the businesses together with the establishment of data stewards whose task will be to take the data governance policies and initiatives and implement them within the organisation at task and operational levels. This is not just a data housekeeping and cleansing exercise but a culture change, the policies and initiatives will need to be institutionalised so that they become part of the organisational fabric.

The document will also build upon the work undertaken within each of the preceding four documents including the two research questions emerging from Document 3. In addition further primary research will be carried out on the issues and themes that have emerged from Documents 2, 3 and 4. The conceptual framework will be reviewed in the light of any new material and a further critical literary review will be carried out to identify any further additional relevant literature or electronic sources where they relate to new material or to new themes that have emerged from earlier documents. The different research approaches carried out in documents two, three and four will be consolidated to ensure a triangulation approach. In addition the data quality improvement initiative taking place currently within Remploy will be reviewed with particular regard to the way in which this project has contributed to and received inputs from it.

It is appreciated that there will be a substantial learning process carried out during years one and two that will necessitate reconsideration of all the research outcomes within year three as Document 5 is progressed. A reflective review has already been produced for Documents 1 to 3 and this will be continued within Documents 4 and 5, which will identify the author's learning and development experiences and personal feelings as they have emerged during the process of working through each document. These will then be consolidated together with an overall personal appraisal of the way the whole DBA experience has affected the author within Document 6.

12. Reflective Review

Document 3 the Process

The research process of employing focus groups using process mapping to collect the data whilst applying an action research approach evolved during the first part of this document. The planned approach towards Document 3 as stated in Document 2 O'Brien (2006a: 53) made no mention of this. The focus was on mainly in-depth interviews with a range of Remploy employees, ERP vendors and other Baan users. The change of focus emanated from the realisation that up-front error prevention was key and therefore essential to achieving quality data. Whilst this was identified within Document 2 its wider impact began to be appreciated as one attempted to apply the concepts and ideas stemming from the DBA to an actual real life organisation. The structure of Remploy with individual sites each with its own individual set of processes lends itself to a modular form of incremental improvement. The end result appears to be an approach, which fulfils the requirements of both an academic study and a business review.

The author has been aware of the concepts of action learning prior to it being introduced during the initial DBA workshop in September 2005 with the setting up of the learning sets. A similar format was used during the author's MBA programme at Leeds Metropolitan University in the early 90s. However this document has really emphasised the point that learning is a cyclical and incremental event or experience. One thought has occurred that action learning is basically putting into practice one's positive experiences whilst being aware of one's own and others' mistakes and eliminating or disregarding unsuccessful occurrences. To emphasise the application of this process, it is worth re-iterating part of quote from Document 2 O'Brien (2006a: 27) "knowledge can get you out of trouble but wisdom can help you avoid trouble in the first place" Redman (2005b: 22).

There is also a distinction or lack of distinction between action research and action learning and even experimental learning. Where does one start and the other ends? Each appears to use the same continual cycle of critical reflection, action, review, and further reflection etc, compare and contrast? Possibly the real distinction is that when the process is applied externally to say an organisation's processes it is termed action research and when applied to an individual's personal development, then the term action learning is used.

The author contacted Jean McNiff, an influential writer and lecturer on action research with regard to its application within the scope the project. Within an email reply she stated: "As we know, there are many different perceptions of action research and how it can be done. My way is to focus on the individual who asks, 'How do I improve what I am doing?' I don't know if you wish to take an 'I' perspective in your research, or adopt a more traditional interpretive view. If you did want to take an 'I' perspective, then I'd be asking questions of the kind, 'what do you want to investigate? What do you want to find out? How will you show the

evolving situation as you take action to improve things? How are you going to generate evidence to show that your own learning and actions are having some influence in your own and other people's learning? How do you judge the quality of what you do?" McNiff (2007). The author intends to develop the points raised in Documents 4 and 5.

The author feels fortunate in the manner in which the DBA programme has assisted both in personal development and career development. The DBA and the working environment have both benefited immensely from this interactivity bringing both an academic and a practical perspective to a business problem in the true spirit of the BDA concept.

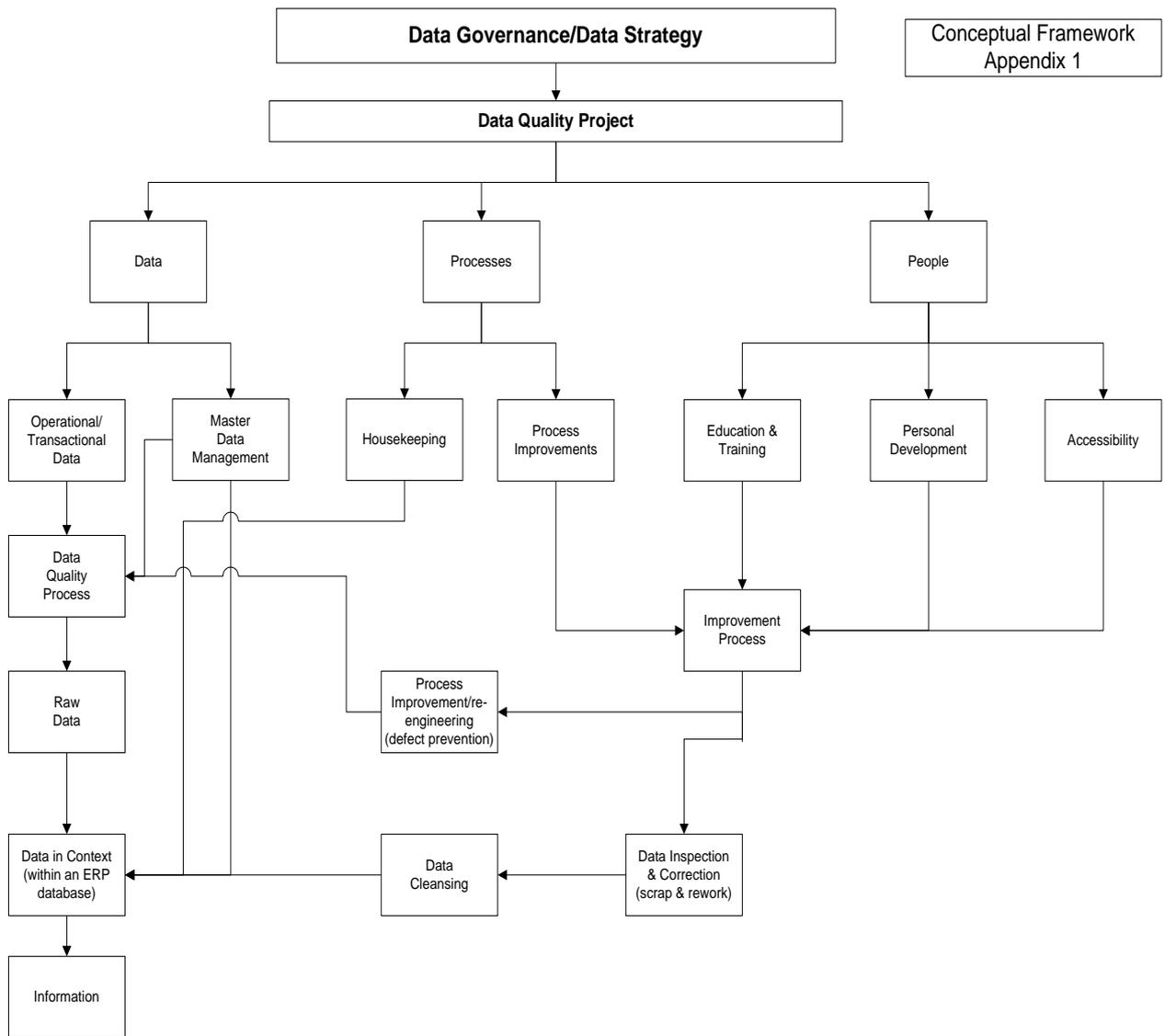
The presentation at the Information Forum at Dublin City University in February 2006 proved very beneficial. The experience of presenting a short paper to an audience of 50 plus interested persons was a valuable learning experience. The background preparation and thought processes also contributed to this document. Following on from this event the organiser has extended an invitation to re-visit DCU to make a presentation to MSc students.

As this project continues to evolve, a further question has arisen in relation to the overall project title and the concept of 'World Class' as referred to in the research questions 5 a-b above, in that the term appears to be somewhat of an indeterminable nature. What is world class anyway and how does one know when it is achieved if at all? The title of the author's presentation in Dublin 'Maintaining sustainable data quality in a diverse Enterprise Resource Planning and Information System' may be more precise and applicable. By the time of completion of Document 4 the title may have changed not because of any alteration in focus, emphasis or direction but more for clarity of purpose and to remove any potential vagueness as to the overall project's objective.

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PROJECT PLAN AS AT DOCUMENT 3

Topic: Data Quality

'A fundamental element in creating a World Class Enterprise Resource Planning and Information System within a Multi-site Disabled Employment Organisation'

Subject Group:

- The Total Organisation

Key Points:

- Main Elements: Data
Processes
People
- Correlation between a Planning and Information System and a Product Manufacturing System
- Application of TQM principles to Data as 'Total Data Quality Management'
- Sustainable DQ requires ownership and responsibility of the Processes and the Data
- Executive support essential

Document 3- Focus:

- Improving the Data/Information cycle at the 'Front-End'
- Identification and elimination of the root-causes of defective Data
- 'Prevention rather cure'
- Database inspection and correction- a 'one-off' process with on-going monitoring- within Docs 3 and 4

Document 3- Process

- Meetings and Focus Groups
- Interviews
- Participant Observation
- Potential for Action Research
- Case Study Analysis

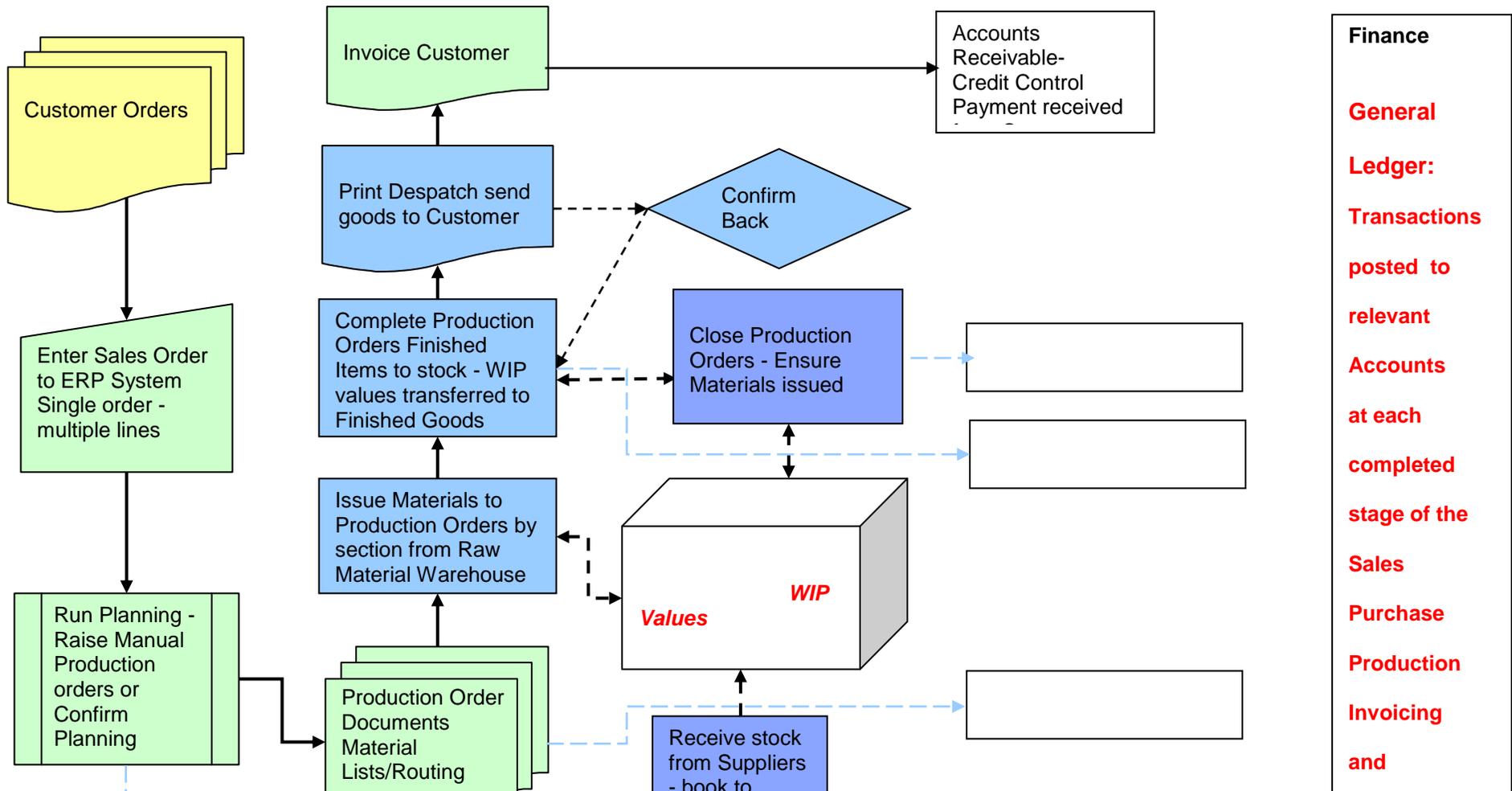
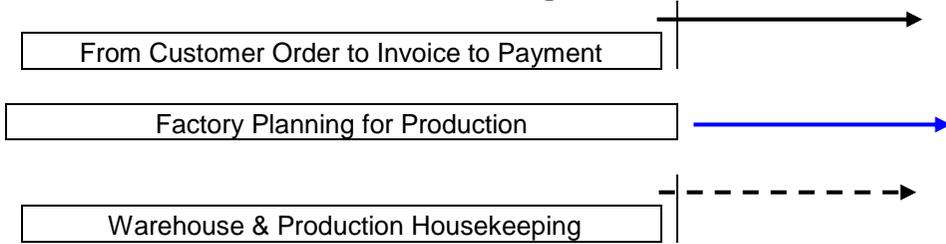
View of Document 4

- Measurement of DQ
- Cost of poor DQ
- Necessary levels of DQ
- Benefits of improved DQ
- Data and Information Profiling, Auditing and Correction

Potential for Document 5

- Review of the above
- Review and integrate the process outputs as Information Products which relate to the requirements of the Information Customers
- Establishment of a Data Governance Process as part of a full Data Strategy Policy

Sale/Purchase/Production Planning & Transaction Processing- with Finance Implications



Appendix 4a

Data Accuracy Key Performance Indicators

What are they?

A set of reports that give 8 Key Performance Indicators. The reports give graphical and numeric data that will enable you to monitor your site, and highlight any issues regarding system maintenance. The reports follow a rolling 12 month period.

How to find them

Login to Cyberquery then follow the relevant path;

For Charts,

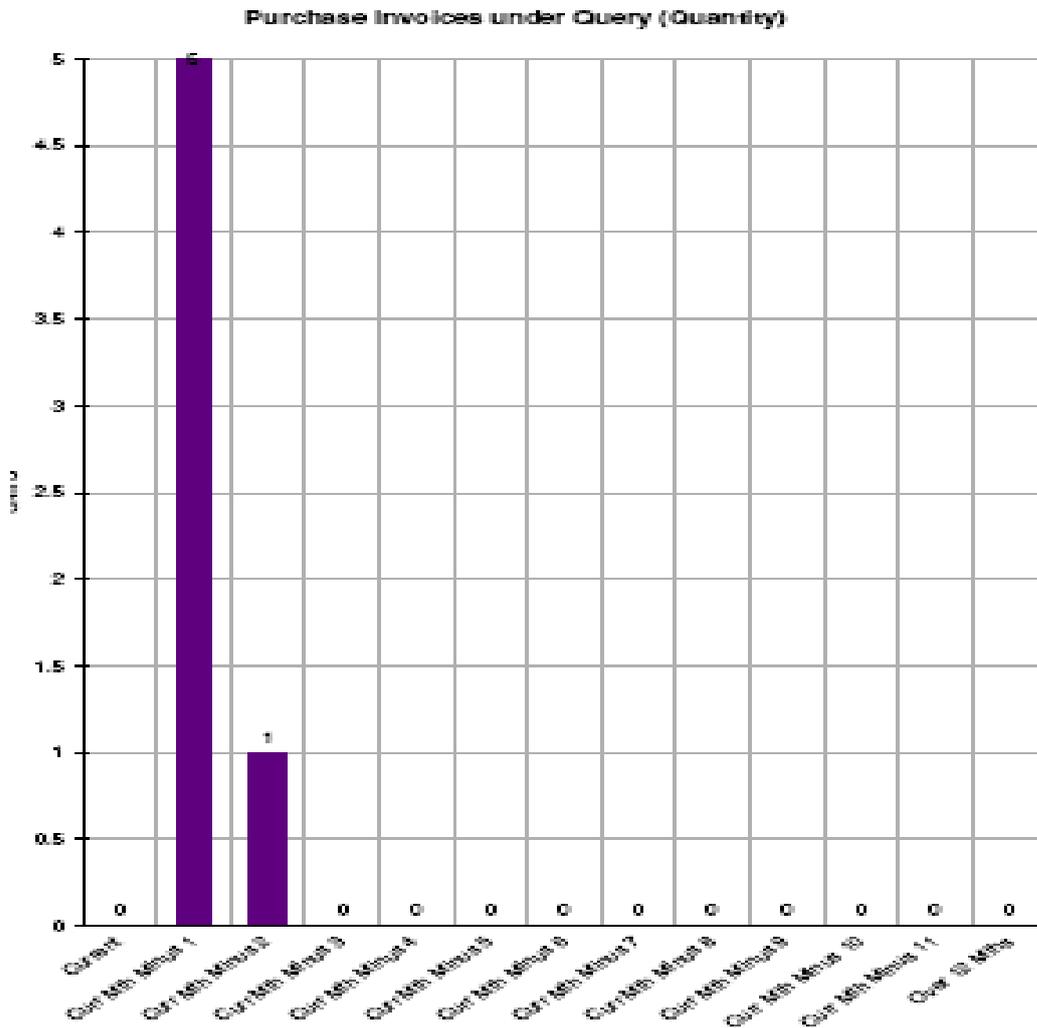
Corporate > Finance > National Businesses > Data Accuracy > Charts > Workscope

You will then be able to click on the KPI and site of interest.

The screenshot shows a web browser window titled "Workscope - Cyberquery Launchpad - Microsoft Internet Explorer". The address bar shows the URL: http://cyberquery:614/remploy_rs/launchpad/Corporate/Finance/National_Businesses/Data_Accuracy/Charts/Workscope/. The page header features the Remploy logo and navigation links for "Home" and "Subscriptions". Below the header, a breadcrumb trail indicates the current location: "You are here: Home > Corporate > Finance > National Businesses > Data Accuracy > Charts > Workscope". A "Show more detail" link is also present. The main content area displays a table titled "All documents in Workscope" with the following columns: "Commands", "Last updated", and "Area of interest". The table lists 18 KPI reports, each with a document icon, a name (e.g., "kpi 1 all", "kpi 2 811"), a timestamp, and the "Workscope" area of interest. A "Report Viewer" section at the bottom left contains a link to download the report viewer.

Commands	Last updated	Area of interest
kpi 1 all	07/06/06 05:14	Workscope
kpi 2 811	07/06/06 05:14	Workscope
kpi 2 813	07/06/06 05:14	Workscope
kpi 2 817	07/06/06 05:14	Workscope
kpi 2 821	07/06/06 05:14	Workscope
kpi 2 829	07/06/06 05:14	Workscope
kpi 2 832	07/06/06 05:15	Workscope
kpi 2 835	07/06/06 05:15	Workscope
kpi 2 836	07/06/06 05:15	Workscope
kpi 2 839	05/06/06 05:19	Workscope
kpi 2 846	07/06/06 05:15	Workscope
kpi 2 848	07/06/06 05:15	Workscope
kpi 2 849	07/06/06 05:15	Workscope
kpi 2 851	07/06/06 05:15	Workscope
kpi 2 856	07/06/06 05:15	Workscope
kpi 2 860	07/06/06 05:15	Workscope

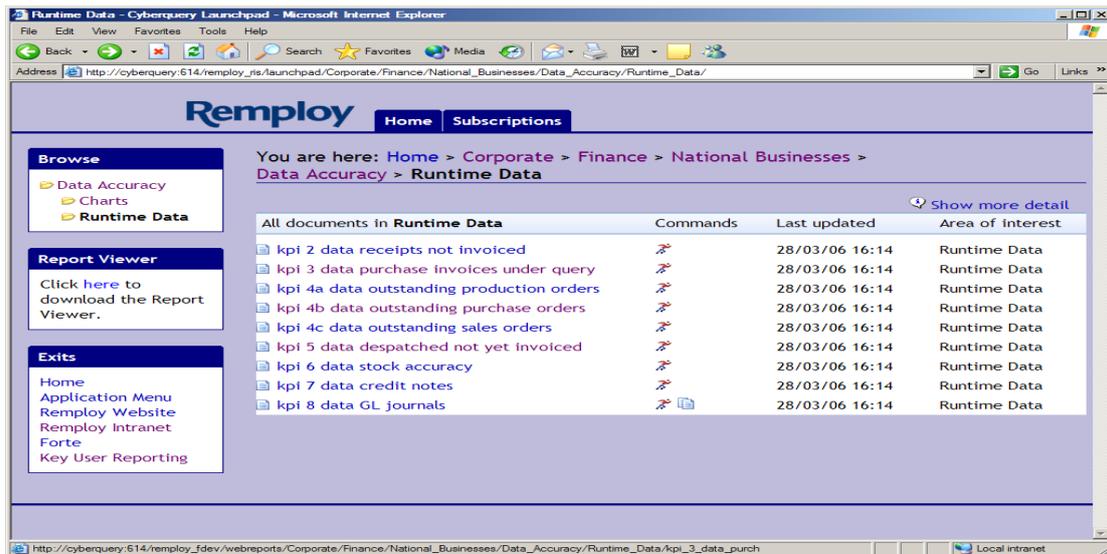
You will be presented with a chart detailing the KPI information for the previous 12 months.



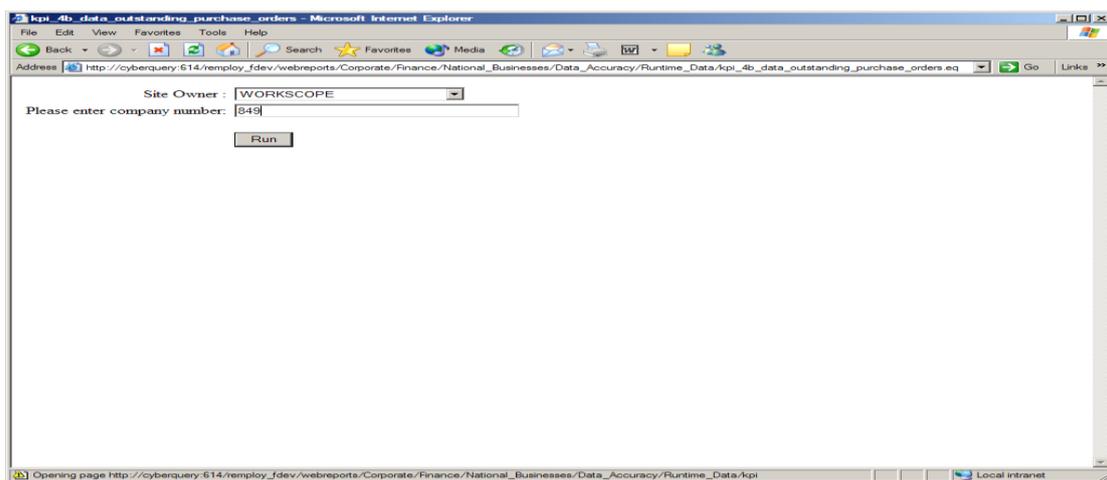
The above shows the amount of purchase invoices under query (KPI3), In this instance there are 5 in the last month and 1 from 2 months ago. For further detailed information go to the Runtime Data.

For specific numerical information,

Corporate > Finance > National Businesses > Data Accuracy > Runtime Data



Click on the KPI required then you will be asked to enter the site owner (Workscope) and the company (Baan) number.



Once entered click on Run to generate the information.

		Purchase Invoices under Query (Quantity)									
<i>Log Co</i>	<i>Trans Type</i>	<i>Doc No</i>	<i>Doc Date</i>	<i>Curr Mth</i>	<i>> 1 mth</i>	<i>> 2 mths</i>	<i>> 3 mths</i>	<i>> 4 mths</i>	<i>> 5 mths</i>	<i>> 6 mths</i>	<i>> 7 mths</i>
832	PUR	10651220	27-Apr-06			1					
832	PUR	10662443	18-May-06		1						
832	PUR	10665168	01-Jun-06		1						
832	PUR	10665194	31-May-06		1						
832	PUR	10665280	30-May-06		1						
832	PUR	10665908	31-May-06		1						
REPORT TOTAL				0	5	1	0	0	0	0	0

The sheet above gives the information as summarised in the previous chart, however you can now see the relevant dates and invoice number

The Data Accuracy KPIs

A. Product Business

1. % Variance: Standard GM v Actual GM.

Compares the level of actual GM against the standard GM (Actual sales less standard cost of sales). Can be affected by inaccuracies in: material standards, purchase order prices, BOM's, stock accuracy, internal trading etc.

Identify the individual variances by reference to Trial Balance GM report

B. Site Owner/Site

2. Aged Receipts not Invoiced- RNIs value & number.

Shows the level of receipts that have been booked into either stock or cost s that have not yet had an invoice matched against it. Can be affected by inaccuracies in: booking in quantities, purchase order prices.

3. Purchase Invoices Under Query - value & number.

Identifies those invoices that cannot be matched & approved against a receipt. Can be affected by inaccuracies in: booking in quantities, purchase order prices.

4. Outstanding Orders:

d. Production

e. Purchase

f. Sales.

Identifies orders that are still outstanding requiring further transactions to be completed. Can be affected by inaccuracies in: quantities booked, poor housekeeping (failure to complete/close)

5. Sales- DNYI

Shows where we have despatched goods, but have not yet invoiced the customer or where the invoicing process is incomplete.

6. Stock Takes (Accuracy) Number of Stock adjustments.

Can be affected by inaccuracies in: stock booking, stock issuing, BOM's (backflushing/issuing), despatching, shrinkage etc.

Note each positive or negative adjustment count as one.

7. Credit Notes- Number & Reason Codes.

Shows the number of credit notes. Can be affected by inaccuracies in: quantity invoiced, price charged, invoice/delivery address VAT etc

C. Site Owner/Product Business

8. Analysis of GL Journals.

Shows the number of manual journal adjustments being made in order to correct data inaccuracies plus. Can be affected by- almost anything!

DATA ACCURACY KPI BALANCED SCORECARD

AS @ 30/08/06

Appendix 4b

Description	Month												Total	Index
	0	1	2	3	4	5	6	7	8	9	10	11		
WORKSCOPE COMPANY :ALL														
KPI2	709	366	273	171	224	243	181	133	63	14	11	8	50	2446
% of total	0.29	0.15	0.11	0.07	0.09	0.10	0.07	0.05	0.03	0.01	0.00	0.00	0.02	
Weighted total	0.29	0.30	0.33	0.28	0.46	0.60	0.52	0.43	0.23	0.06	0.05	0.04	0.27	3.85
KPI3	79	32	10	1	3	6	1	1	0	0	0	0	3	136
% of total	0.58	0.24	0.07	0.01	0.02	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.02	
Weighted total	0.58	0.47	0.22	0.03	0.11	0.26	0.05	0.06	0.00	0.00	0.00	0.00	0.29	2.07
KPI4A	316	146	26	10	10	3	1	0	0	0	0	0	6	518
% of total	0.61	0.28	0.05	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
Weighted total	0.61	0.56	0.15	0.08	0.10	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.15	1.70
KPI4B	428	229	66	49	57	42	114	114	29	55	60	38	444	1725
% of total	0.25	0.13	0.04	0.03	0.03	0.02	0.07	0.07	0.02	0.03	0.03	0.02	0.26	
Weighted total	0.25	0.27	0.11	0.11	0.17	0.15	0.46	0.53	0.15	0.32	0.38	0.26	3.35	6.51
KPI4C	387	27	17	10	9	12	3	3	1	9	2	2	20	502
% of total	0.77	0.05	0.03	0.02	0.02	0.02	0.01	0.01	0.00	0.02	0.00	0.00	0.04	
Weighted total	0.77	0.11	0.10	0.08	0.09	0.14	0.04	0.05	0.02	0.18	0.04	0.05	0.52	2.19
KPI5	68	3	28	0	0	2	0	0	0	0	0	0	14	115
% of total	0.59	0.03	0.24	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.12	
Weighted total	0.59	0.05	0.73	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	1.58	3.06
KPI7	25	24	23	30	25	40	61	74	9	14	21	13	26	385
% of total	0.06	0.06	0.06	0.08	0.06	0.10	0.16	0.19	0.02	0.04	0.05	0.03	0.07	
Rev. weighted total	0.84	0.75	0.66	0.78	0.58	0.83	1.11	1.15	0.12	0.15	0.16	0.07	0.07	7.27
Index for Company ALL														26.65

THE 4TH INFORMATION QUALITY FORUM- DUBLIN

MAINTAINING SUSTAINABLE DATA QUALITY WITHIN A DIVERSE ENTERPRISE RESOURCE PLANNING AND INFORMATION SYSTEM

Tony O'Brien

Presentation Notes

The focus of this short presentation is to be on the 'data' & 'planning' elements to ensure quality information from quality base data. The title should really have a 'question mark' at the end because the intention is not to attempt to provide an immediate solution (I would not be so arrogant) but rather to initiate or stimulate debate.

I'd like to set this 'question' within the context of a semi-unique organisation in the UK namely Remploy. Remploy is the largest provider of employment opportunities for disabled persons in the UK, employing almost 6000 disabled people in 85 individual factories across the entire country, whilst placing over 5000 others into open employment. The Company, which has an annual turnover of £160m, is supported by the UK Government's Department of Work & Pensions and was founded over 60 years ago initially to provide employment for war victims. A Baan/Infor ERP system was implemented over eight years ago and whilst there have been many benefits overall, there is still considerable scope for further improvements, especially within the area of data quality. Maintaining sustainable quality data within any ERP system can be problematical at best, but when one factors in an organisation with 12 individual business streams operating within such diverse areas as automotive, electronics, packaging, PC recycling, healthcare, furniture, in addition to manufacturing nuclear, chemical & biological clothing for the UK military & police, all of which are superimposed within a network of eighty plus separate sites with 1600 users many of whom are disabled in one form or another, the entire picture not only becomes complex, but is strewn with potentiality for data issues and problems of all kinds.

This presentation's aim is placed not only within the context of a business sponsored data improvement initiative, but is also the focus of a doctoral research programme at Nottingham Business School in the form of a 3 year part-time Doctor of Business Administration degree and therefore has both practical and academic connotations. Whilst ideally any academic business research has as its foundation the development of management practice, a strong key theme has emerged that of aligning theoretical and academic concepts within the operating environment of a real life organisation, in order to implement a successful data quality improvement initiative.

We are all aware that an ERP system is a complex animal, or rather should I say a 'beast'. With tentacles in all aspects of a business or organisation from planning, forecasting, purchasing, sales, manufacturing, logistics, supply chain, onwards to HR & its final repository, that of finance. As an accountant one has had many painful experiences where the resultant 'ills' have manifested themselves in 'problems' and 'nasty surprises' in the currency of pound notes (& euros) invariably in the negative. But this should not be so? When do we ever learn?

To illustrate the degrees of complexity within an ERP environment I recall a familiar matrix. For the purpose of today I'm looking at the aspect of data accuracy. I appreciate that it is just one of many data or information dimensions, but it is one that has a distinct resonance within the business community. One asks 'what levels of data accuracy are necessary within a planning system?'

What levels of data accuracy are necessary within material planning?

Demand	60%	100%	100%	100%
Fixed data	30%	90%	95%	97%
BOMS & Routes	90%	95%	99%	99%
Stock accuracy	50%	90%	95%	98%
Order accuracy	50%	90%	95%	97%
Overall accuracy	4%	68%	84%	91%
Error rate	24 in 25	1 in 3	3 in 20	1 in 12

Goodfellow (1994: 18)

Goodfellow, R. (1994) Manufacturing Resource Planning MRPII. High Wycombe, England: Manufacturing Business Excellence: 51.

The above familiar matrix from an MRPII handbook illustrates dramatically the levels of accuracy required. These levels are hard enough to attain in a single-site operation but when applied to a multi-business/multi-site environment with system inter-actors with varying degrees of disability the complexity can multiply.

It has long been recognised that there is a correlation between the concepts of a planning and information system and that of a service or manufacturing system, in that each has definable inputs, processes and outputs. Furthermore the philosophy of TQM can be applied equally to data in the form of Total Data Quality Management. With these principles in place it is obvious that the philosophy of 'prevention rather than cure' is applicable to data and information as much as manufacturing. This ideal of up-front error prevention appears to be blindingly obvious.

But one asks 'how do we make such improvements happen?' Well there are a myriad books, articles, case studies, tutorials, and personal experiences etc that provide countless examples.

But just as importantly we should be asking 'How can we maintain & sustain all or any of these improvement(s)? A subject which, may I say ERP vendors, as well as operators and users hitherto may have largely ignored.

ERP experiences tell us that we train, implement, re-visit, re-train, re-visit, re-train etc etc. But people revert to type when the initial pressure or 'FOCUS' is withdrawn

I can illustrate this point with a number of recent examples within Remploy- when we look at a number of important business KPIs over a period:

Suppliers' purchase invoice queries:

- I. September 2004- 36% error rate
- II. September 2006- 37% error rate

Sales ledger debtor levels:

- III. September 2003- 20%- overdue >30days
- IV. December 2006- 3% overdue >30days

Why the huge variance? One-word 'FOCUS' Debtors reflect a positive cash flow whilst supplier payments have the reverse effect (other than upsetting supplier relations). So where does an organisations priorities lie? No competition- we are talking about- CASH the most important word in business and having shaken hands with a liquidator I'm only too aware of this!! Which leads us back to 'FOCUS' again

We used to think:

'What gets measured gets done'

OK- but more importantly it appears that:

'What gets measured by the 'Exec' gets done quicker'

'FOCUS' again!!!

To return to our example- actions already being taken with Remploy:

Data accuracy KPIs- allied initially to 'housekeeping' elements (open orders etc)

Data Quality Improvement Initiative involving process mapping data flows, within businesses & sites, to identify responsibilities and ownership, leading to a:

A full blown Corporate Data Quality Project with Executive support

Focussing upon those important elements- Data, Processes, plus above all **PEOPLE**- especially within a Remploy type environment.

To achieve the aim of: 'MAINTAINING SUSTAINABLE DATA QUALITY WITHIN A DIVERSE ENTERPRISE RESOURCE PLANNING AND INFORMATION SYSTEM':

It appears that we have to ensure that the same improvement processes that create success when efforts are FOCUSSED- remain when the 'spotlight' is removed- But How?

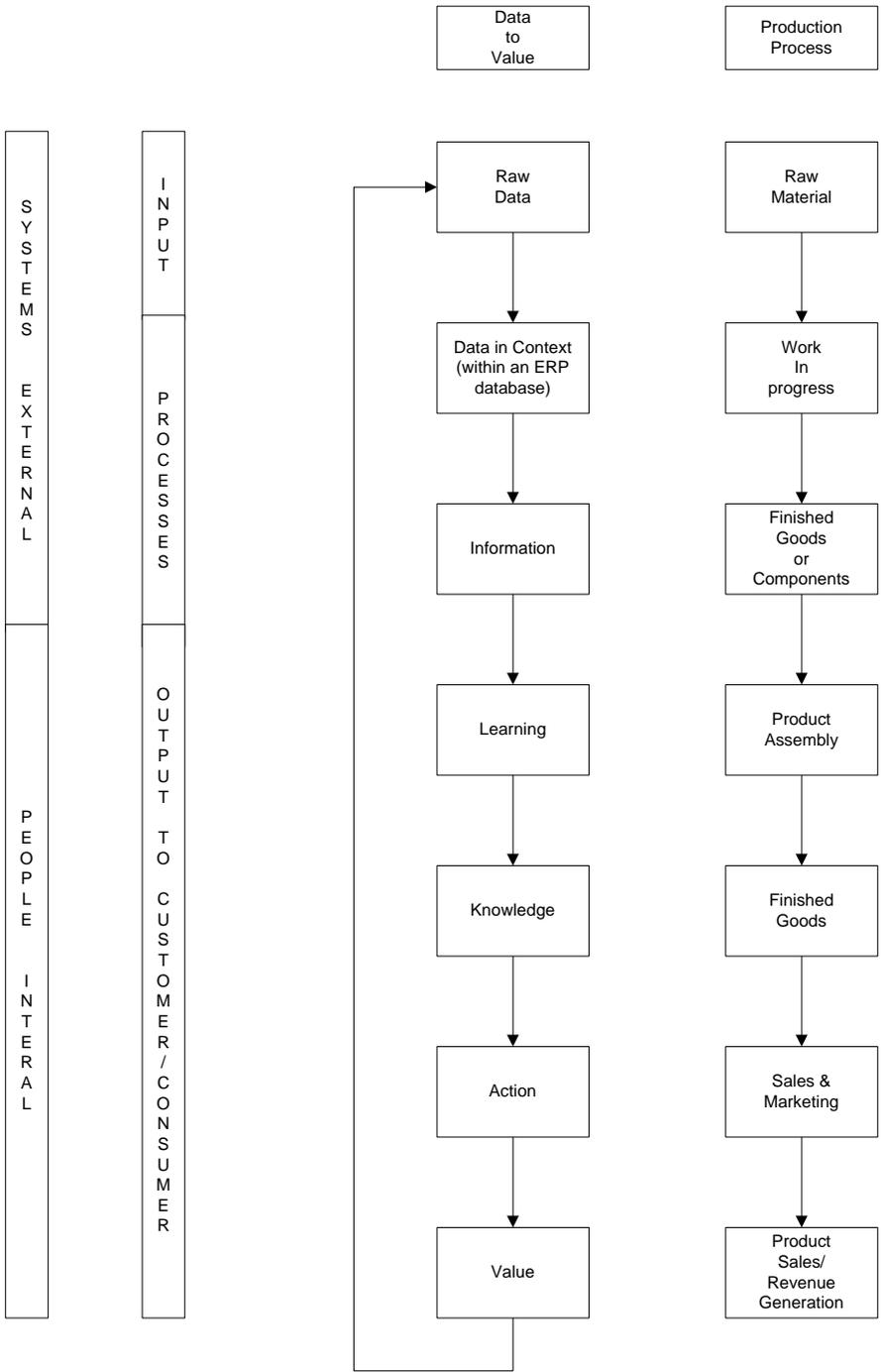
An organisation cannot have eyes everywhere at all times to remain 'FOCUSSED' on all things, nor should it!! It should be part of the corporate culture. But How?

Is the answer down to **'Winning Hearts and Minds'**?

If so... HOW?

Or if not..... What???

So please let us discuss..... to find a solution together



Appendix 7

FOCUS GROUP CHECK LIST

1. Have you devised a clear and comprehensive way of introducing the research to the participants?
2. Do the questions or topics you have devised allow you to answer all your research questions?

3. Have you piloted the guide with some appropriate respondents?
4. Have you devised a strategy for encouraging respondents to turn up for the focus group meetings?
5. Have you thought about what you will do if some participants do not turn up for the session?
6. Have you ensured that interviews will allow novel or unexpected themes and issues to arise?
7. Is your language in the questions clear and comprehensible?
8. Are your questions relevant to the people who are participating in the focus groups?
9. Have your questions been designed to elicit reflective discussions so that participants are not tempted to answer in 'yes' or 'no' terms?
10. Have your questions been designed to encourage group interaction and discussion?
11. Do your questions offer a real prospect of seeing the world from your interviewees' point of view rather than imposing your own frame of reference on them?
12. Are you familiar with the setting(s) in which the interview will take place?
13. Are you familiar with and have you tested your recording or audio-visual equipment?
14. Have you thought about how you will present yourself in the session, such as how you will be dressed?
15. Have you devised a strategy for dealing with silences?
16. Have you devised a strategy for dealing with participants who are reluctant to speak?
17. Have you devised a strategy for dealing with participants who speak too much and hog the discussion?
18. Have you devised a strategy for how far you are going to intervene in the focus group discussion?
19. Do you have a strategy for dealing with the focus group if discussion goes off at a tangent?
20. Have you tested any aids that you are going to present to focus group participants (eg visual aids, segments of film, case studies)?

Bryman and Bell (2003: 382-383)

Bryman, A. and Bell, E. (2003) Business Research methods. Oxford: Oxford University Press.

**BEHAVIOURS RELATING TO THE REMPLOY VALUES
APPENDIX 8**

	VALUE IS:	VALUE IS NOT:
OPENNESS	<ul style="list-style-type: none"> • Providing people with all the information that they need to do their job • Listening to others' points of view with an open mind • Sharing learning with other people • Being truthful • Being approachable/available • Giving information that may be uncomfortable for you to give • Avoiding hidden agendas – telling it as it is • Trusting people's personal integrity. 	<ul style="list-style-type: none"> • Saying something that you don't believe because you think its what people want to hear • Keeping information to yourself • Protecting yourself by not telling the truth

	<ul style="list-style-type: none"> • Honesty and communication at all times • Receive bad news with support to find a solution 	
RESPECT	<ul style="list-style-type: none"> • Treating others as you would wish to be treated • Confirming your attendance/non attendance • Recognising that different people have different skills and styles and welcoming this • Responding to development needs • Listening to all points of view • Recognising others may have a better way • Arriving on time for meetings • Listening to other people's views • Taking action on other people's ideas • Finding ways of be supportive and understanding others needs. • Recognising the importance and value of each individual • Showing and acting respectfully to everyone in the organisation. • Listening to and responding to in a timely manner. • Give and receive feedback • Encouraging others to recognise their importance and the contribution they can make 	<ul style="list-style-type: none"> • Arriving/starting late • Ignoring other people's points of view • Criticising people behind their backs • Not providing support to colleagues • Arrogant that you know best • Interrupting people • Undermining what people say to others • Punishing people for telling the truth
KEEPING PROMISES	<ul style="list-style-type: none"> • Treating every action agreed as a commitment • Doing what you say you'll do • Not doing what you say you won't do • Delivering on time to customers • Sticking to a decision even when it turns out not to be in my best interest. • Needs no explanation – see above 	<ul style="list-style-type: none"> • Missing deadlines • Being late for meetings • Not delivering to customers when you say
PROFESSIONALISM	<ul style="list-style-type: none"> • • • • • • Consistently setting yourself high standards and striving to achieve them • Demonstrating high standards in everything you do and say • Attending to the details • Being persistent in looking for right solutions • Always doing your best • Looking for ways to improve what you do • Always doing my best, • Striving to improve and encouraging and helping others to do they're best and improve. • Always striving to do the best job regardless of what it is. • No job too small to achieve professionalism • The phrase 'not my job' not entertained. 	<ul style="list-style-type: none"> • • • • • • • • Doing a job sloppily just to "tick it off" • Relying on other people to carry the team • Not completing what you start • Not communicating the progress/lack of progress • Knowingly doing something wrong

	<ul style="list-style-type: none"> • Expecting high standards of others as well as yourself 	
PASSION	<ul style="list-style-type: none"> • Making your contribution really count • Being enthusiastic • Seeing challenges and opportunities rather than threats • Enjoying the challenge • Really caring about the outcome • Your enthusiasm encouraging others • A high level of <u>genuine</u> enthusiasm for the company, the job, the people or anything else involved in. • Always being dedicated to the cause • Showing real enthusiasm and drive constantly. • Work hard to change other culture 	<ul style="list-style-type: none"> • Being afraid to stand up for what you believe is right • Being a "clock-watcher" • Accepting defeat without a fight • Loosing interest in the actions • Shrugging your shoulders

Appendix 9

DATA QUALITY INITIATIVE WORKSHOP

A. Learning from the two initial workshops at Newcastle and Barrow

The overall corporate focus is to be on the 'Management of Quality Data and Information'. Look at the process flows as they relate to the data and Baan. That is the 'Source Data' with related 'Risks' and the resultant 'Baan Processes'

Out of this will come other issues not related *directly* to the Data Quality Initiative but are still important or critical and therefore must not be lost. Experiences during the first two projects indicate that we cannot address all issues and 'ills' and therefore we must focus. The 'other non-data/Baan elements will be captured and addressed subsequently by the relevant

Business and Site with responsibilities assigned. This may be achieved at each workshop by listing such issues on a separate flipchart to be followed up.

For the purposes of the project the expression 'Data Quality' will apply generically to encompass both the quality of the data and the quality of the information within an enterprise resource planning and information system. An all-embracing definition would be one that encompasses all the data definitions but this would be far too complex, therefore a simpler definition that appears to fit the project is:

"Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise"

B. Data Quality Initiative Process

(1) General Overview illustrating the process and highlighting what we want to achieve.

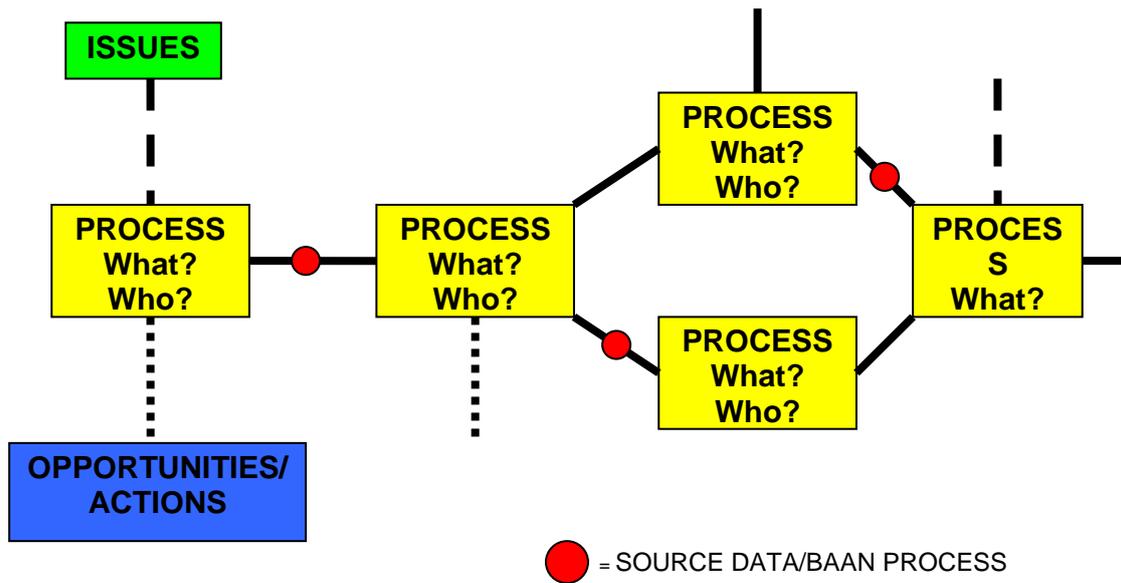
This incorporates a discussion and question session on required % accuracy in order to achieve certain outcomes in terms of accurate information.

(2) Introduction to the Process

- Talk about the site KPI – good/bad/comparisons.
- Talk about a typical process at a site i.e.
 - Customer makes an enquiry
 - Prepare estimate for quotation
 - Order Intake
 - Check if FG exists
 - Raise the sales order
 - Run MRP (if applicable)
 - Check stock
 - Issue Production order
 - Raise purchase order
 - Receive RM's
 - Manufacture the Finished Product
 - Raise Despatch note
 - Invoicing
- Give thoughts and discussion as to how this (process mapping) might/could work here.

Intention is to map the entire process end to end initially.

Explain and show diagram of proposed process map structure:



Pin-up the objectives of the meeting/workshop. If the discussions are too detailed or not relevant, this can be used to pull people back to 'where we want to be' at the end of the session. This and the overall aim is:

WHAT WE WANT TO ACHIEVE

- MAP OUT THE PROCESS
- INTEGRATE RELATIONSHIPS WITH SOURCE DATA/DOCUMENTATION AND BAAN PROCESSES
- IDENTIFY RELATED RISKS AND ISSUES AT ANY STAGE
- IDENTIFY OPPORTUNITIES/ALTERNATIVES AT ANY STAGE
- DEVELOP ACTIONS/SOLUTIONS
- PRIORITISE & ASSIGN RESPONSIBILITY
- ANY ADDITIONAL ISSUES/POINTS WHICH ARISE BUT NOT DIRECTLY ASSOCIATED TO THE DATA QUALITY INITIATIVE TO BE NOTED DURING THE SESSION & ACTIONED BY THE BUSINESS AT A LATER DATE.

Overall aim is.....

"Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise"

(3) Devise Work Process Map by the site team.

- Give some time
- First map out process – Yellow
- Majority of this work will be done by site team
- Ask questions, why/what/when/where

- Mention that whilst the process is being mapped, the whole group should note down issues and opportunities in the process.

(4) Once done invite the whole group and discuss

- Ask site team to explain main process
- Get the rest of the team engaged.
- Re-arrange the process if required

- Add/delete processes

(5) Next: Data & Process Identification.

- Once the process is firm, a red label should be placed along the process flow diagram where a task is performed and data is used to perform a process.
- Number these and chart them in the format below:

Data Identification

	TASK	SOURCE	PROCESS	ISSUE	OPPORTUNITY
1	What is the task being performed?	What is the source data that the task will be using?	Is this a Baan, manual, on-line etc process?	Any issues with this task/process?	Are there any opportunities for improvement at this stage?
2					
3					
4					
...					
...					
...					

(6) On-going and during discussion: Any Issues with the process.

- First ask site where there are likely issues in the process and with Baan interventions.
- Discuss areas where the KPI's are weak and possible reasons why. Analyse KPI information and establish reasons.

(7) On-going and during discussion: Ask group to discuss opportunities which could help resolve or reduce these issues – Get everyone involved.

(8) Split group into 3 teams to list the:

- Interventions
- Issues
- Opportunities
- Get team to write out the 'keys' for each area i.e. B1, I1, O1 on post-it notes.

Hang lists on the wall near each group.

(9) Transfer these lists to Priority Matrix – Relevant group first and then all involved.

Talk about a priority matrix, draw one out etc.

Standard:

HIGH	1	2
BENEFIT	2	3
LOW	EASY	HARD
	SOLUTION	

Baan Interventions:

HIGH	2	1
RISK	3	2
LOW	LOW	HIGH
	FREQUENCY	

Issues

HIGH	2	1	
INTENSITY	3	2	
LOW			
	LOW	FREQUENCY	HIGH

Opportunities

HIGH	1	2	
BENEFIT	2	3	
LOW			
	EASY	IMPLEMENTATION	HARD

- Get teams/group to discuss ownership, potential actions and priority

(10) Action Planning

- Most difficult part i.e. trying to get what we've just done into a useable format and actions.
- Explain the fact that some solutions could resolve many issues (domino effect)
- Tick off on the lists which actions cover which items on the list.

DATA ACCURACY KPI INDEX COMPARISON BY SITE

Appendix 11

Site	Business	07/01/07	22/01/07	04/02/07	18/02/07	04/03/07
Index for Company 892 Oldham_Windows	Building Products	52.00	52.00	52.00	52.00	52.00
Index for Company 897 President_Windows	Building Products	52.00	52.00	52.00	52.00	52.00
Index for Company 834 Sheffield	Furniture	44.93	43.55	44.54	46.45	47.14
Index for Company 803 RMS_Co_803	Managed Services	25.89	26.79	25.62	25.96	38.33
Index for Company 710 Interwork_Co_710	Interwork	30.01	30.63	25.73	27.22	30.85
Index for Company 843 Southampton	Electronics	36.37	31.50	31.54	32.59	29.73
Index for Company 879 Stirling	Textiles	24.43	21.30	23.73	25.40	28.44
Index for Company 891 Redruth	Healthcare	26.77	28.73	38.13	29.69	27.71
Index for Company 836 Pontefract	Workscope	21.07	21.08	21.76	24.00	25.50
Index for Company 869 Manchester	P&P	24.93	22.64	20.89	22.71	24.91
Index for Company 819 Norwich	P&P	32.19	33.00	30.61	24.72	24.36
Index for Company 863 Ashington	Healthcare	31.19	28.17	28.34	28.61	23.99
Index for Company 841 Barking	Electronics	25.66	24.84	23.58	25.16	23.89
Index for Company 849 Stockport	Workscope	31.50	21.95	21.32	21.15	23.83
Index for Company 852 Leicester	ECycle	48.46	55.01	39.19	24.07	23.46
Index for Company 878 Leven	Textiles	30.48	23.92	24.85	27.76	23.44
Index for Company 874 Hillington	Workscope	16.58	15.88	18.84	25.45	23.13
Index for Company 875 Clydebank	Textiles	27.35	25.21	21.61	21.61	23.13
Index for Company 821 Acton	Workscope	21.53	21.20	21.76	22.61	22.52
Index for Company 829 Wigan	Workscope	29.13	24.88	24.92	24.37	22.45
Index for Company 889 Aberdare	Healthcare	23.44	21.27	21.74	22.01	22.33
Index for Company 893 Chandlers_Ford	ECycle	35.82	38.36	31.55	28.66	22.30
Index for Company 854 Chesterfield	Healthcare	20.99	17.73	20.30	20.06	22.29
Index for Company 864 Huddersfield	Manufacturing	35.72	33.12	24.40	29.18	22.19
Index for Company 865 York	Textiles	18.38	18.73	18.62	21.94	22.02
Index for Company 831 Preston	ECycle	44.03	40.57	40.40	44.03	22.01
Index for Company 818 Holloway	Electronics	25.31	19.94	20.07	23.93	21.99
Index for Company 848 Leeds	Workscope	25.69	14.74	18.37	19.33	21.80
Index for Company 896 Orthotics_Warehouse_Aberaman	Healthcare	24.50	20.82	21.00	22.98	21.78
Index for Company 840 Coventry	Manufacturing	30.47	21.87	19.32	22.78	21.29
Index for Company 873 Springburn	Healthcare	27.04	24.38	23.09	24.36	21.15
Index for Company 837 Oldham	Building Products	24.79	21.66	21.46	22.50	20.83
Index for Company 853 Newcastle-under-Lyme	Public Sector	34.01	22.18	21.42	22.33	20.81
Index for Company 850 Radcliffe	ECycle	28.69	25.76	25.33	20.51	20.62
Index for Company 872 Bolton	Electronics	19.05	20.58	18.77	23.74	20.25
Index for Company 825 Bridgend	Manufacturing	17.89	19.64	19.26	22.04	19.95
Index for Company 870 CCU	Workscope	25.31	26.89	22.66	25.55	19.64
Index for Company 510 Furniture_Co_510	Furniture	23.75	21.51	20.16	21.76	19.44
Index for Company 855 Derby	Manufacturing	21.56	26.08	18.76	22.28	19.42
Index for Company 847 Penzance	Healthcare	22.06	25.60	25.28	25.68	19.32
Index for Company 859 Jarrow	Manufacturing	15.77	23.14	24.05	28.54	19.29
Index for Company 822 Medway	Electronics	33.05	29.03	23.34	24.74	18.74
Index for Company 839 Brixton	Workscope	21.30	21.10	17.72	18.42	18.67
Index for Company 824 Portsmouth	P&P	21.85	18.34	17.83	19.86	18.54
Index for Company 832 Lanarkshire	Workscope	32.56	18.03	17.94	20.87	18.47
Index for Company 815 Sunderland	P&P	23.53	18.93	18.33	18.54	18.44
Index for Company 857 Pinxton	Textiles	26.03	20.61	18.29	22.95	18.36
Index for Company 861 Halifax	Public Sector	22.53	21.27	21.11	19.35	18.15

Index for Company 813 Edinburgh	Workscope	22.47	17.93	17.43	18.25	17.58
Index for Company 820 North_Staffs	P&P	19.79	18.42	17.45	20.85	17.13
Index for Company 890 Poole	Textiles	19.33	19.82	17.76	19.90	16.70
Index for Company 844 Abertillery	Manufacturing	26.80	16.26	16.22	18.35	16.51
Index for Company 880 Woolwich	ECycle	29.58	28.74	27.77	19.48	16.30
Index for Company 828 Croespenmaen	P&P	17.47	18.21	16.85	18.43	16.05
Index for Company 826 Bristol	Offiscope	59.75	46.21	42.82	16.86	16.02
Index for Company 867 Aintree	Workscope	16.38	16.93	15.21	17.49	15.86
Index for Company 816 Spennymoor	ECycle	23.67	22.01	19.27	23.68	15.72
Index for Company 856 Mansfield	Workscope	25.20	23.28	15.27	16.51	15.42
Index for Company 830 Burnley	P&P	17.24	17.66	16.85	17.95	15.19
Index for Company 811 Barrow	Workscope	16.59	16.48	14.76	17.56	15.17
Index for Company 810 Birmingham	Manufacturing	26.08	25.56	23.94	25.31	14.79
Index for Company 860 Newcastle-on-Tyne	Workscope	21.19	18.16	19.19	17.24	14.67
Index for Company 802 Central_Co_802	Central	16.11	15.69	14.88	15.53	14.45
Index for Company 814 Aberdeen	Offiscope	45.77	48.88	47.94	14.64	14.31
Index for Company 845 Lydney	Community Enterprises	30.11	30.26	29.32	28.99	14.30
Index for Company 877 Dundee	Textiles	25.93	19.36	19.19	15.68	14.23
Index for Company 835 Gateshead	Workscope	15.43	13.47	14.73	15.93	13.91
Index for Company 833 Bradford	ECycle	26.76	27.80	18.28	13.78	13.88
Index for Company 827 Porth	ECycle	39.18	41.21	40.96	27.65	13.13
Index for Company 817 Hartlepool	Workscope	16.53	12.84	13.42	12.10	13.06
Index for Company 898 St_Helens	H&T	14.24	12.97	12.60	14.80	12.94
Index for Company 846 Hull	Workscope	15.14	12.87	11.74	15.51	12.94
Index for Company 885 Swansea	Furniture	16.29	15.87	13.41	13.25	12.80
Index for Company 871 Birkenhead	Workscope	13.54	14.20	13.22	13.81	11.90
Index for Company 842 Southend	ECycle	31.73	32.98	29.72	30.21	11.43
Index for Company 887 Wrexham	Furniture	14.15	12.24	12.53	13.78	11.25
Index for Company 823 Leatherhead	ECycle	14.09	15.17	15.50	16.37	10.15
Index for Company 876 Cowdenbeath	Textiles	15.64	10.90	9.75	11.75	9.39
Index for Company 809 Textiles_Subcontracting	Textiles	10.75	9.63	8.62	10.25	9.08
Index for Company 808 Wisbech	Community Enterprises	23.04	21.36	21.31	23.50	9.00
Index for Company 858 Barnsley	Furniture	10.74	5.86	7.28	7.25	8.06
Index for Company 851 Worksop	Workscope	12.40	10.90	9.51	8.94	7.97
Index for Company 812 Cleator_Moor	Textiles	13.29	10.67	9.86	16.00	6.50
Index for Company 886 Treforest	Furniture	4.00	5.00	5.00	6.00	6.00
Index for Company 862 Stockton	Offiscope	39.17	38.65	38.46	6.05	5.37

Key

30 & above

16-29

Below 16



Document 4

Survey Based and Statistical Research

DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

Data Quality

Creating and sustaining Data Quality within a diverse Enterprise Resource Planning and Information System with particular regard to organisations employing disabled people

Document Four

Tony O'Brien

Document Four is submitted in part fulfilment of the requirement of Nottingham Trent University for the degree of Doctor of Business Administration

January 2008

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Abstract

The first three documents of this project establish firmly that quality data was an necessity for all organisations, none more so than those operating enterprise resource planning and information systems. Certain concepts emerged from the research, supplemented by the author's own experiences collected over time, which were seen as key to creating a quality data environment. Document 4 attempted to test the validity of these concepts by way of a survey based self-administered questionnaire distributed to data quality professionals using NTU's web-based survey tool Autoform. The resultant data from the survey was then analysed using the SPSS package supplied by NTU. Whilst the number of replies was well below initial expectations, there is reason to believe that the overall response rate was no worse than similar surveys carried out within this field. A summary of the findings indicates a high level of positive replies in support of the concepts, but one has to balance this against the low response levels. Notwithstanding this the author feels that results 'indicate' that there is a substance to their overall validity. The research questions were re-assessed again and a plan was developed for undertaking Documents 5 and 6. The overall title of the project was amended to focus more strongly on the fundamental elements of both creating and sustaining quality data.

1. Introduction and Objectives

Introduction

The paramount importance of quality data as an absolute pre-requisite for any enterprise resource planning and information system was established firmly within the first three documents. Document 1 identified and developed the concept of data quality per se and then proceeded to place this within the context of an enterprise resource planning and information system encompassing a multi-business/multi-site operation, employing disabled people. Within Document 2 a conceptual framework was developed based upon a strong and thorough review of the related literature combined with the author's own experiences. It also re-affirmed the correlation between the concepts of a planning and information system and that of a real life product or service manufacturing system, in that both comprise inputs, processes and outputs. Document 3 expanded these concepts further with particular regard to the basic principles of total quality management examining the concepts of improving data quality by combining data cleansing with the quality management principles of initial error prevention, by the identification and elimination of the root causes of data defects. Research was carried out at a number of sites within the author's own organisation, Remploy, to study the Company's business processes and to determine how data interacted with these processes, in order to provide information to assist in detecting data and process problems and in identifying the ownership and responsibility for the data. In addition all three documents have focussed on three elements seen to be key to any data quality programme namely: People, Processes and Data.

The author has also decided to amend the overall title of the project from 'Data Quality- A fundamental element in creating a world class Enterprise Resource Planning and Information System within a multi-site disabled employment organisation' to 'Data Quality- Creating and sustaining Data Quality within a diverse Enterprise Resource Planning and Information System with particular regard to organisations employing disabled people'. The reference to 'world class' appears to be somewhat of an indeterminable nature and raises the questions 'what is world class? How can it be defined? And how does one know when or if it has been achieved at all? This alteration, whilst not changing the overall, emphasis or direction, does remove any potential perceived vagueness and also focuses on the objective of *sustaining* quality data.

Data Quality Project

Any attempt to improve the quality of data within any organisation must be centred on *people* whether data suppliers, processors or information customers; the *processes* that receive, handle, action and pass on data and information; as well as the *data* itself where ever it sits within the data cycle of input, process and output. Data quality improvement is not just about fixing data or improving quality within a single business application or process, but by taking a

forward-looking enterprise-wide approach, addressing cultural issues, winning *peoples'* heart and minds at all levels, initiating long term *process* and procedural improvements by a step-by-step incremental approach, whilst ensuring that the *data* conforms to appropriate specifications. In this way any improvement initiative has an opportunity to be sustained. This project therefore has not only a strong academic base but has major practical implications which leads to a further key theme, that of aligning strong robust theoretical and academic concepts, within the operating environment of a real life organisation, in order to implement a sustainable data quality improvement initiative.

The Generic Process Model

Strong parallels have been drawn in all the documents between an information/ERP system and a manufacturing system. A further examination of the principles of this Generic Process Model is certainly worthwhile in order to compare and contrast the elements of both:

Generic Process	Manufacturing System	Generic Information System	ERP Environment
Input	Raw materials	Raw data	People- Processes- Data
Process/ Operations	Assembly line	Information system	ERP Database
Output	Physical products	Information products	Information-People

Whilst the 'Factory' analogy is a useful model with which to take a conceptual over-view of both generic manufacturing and information processes, one needs to be aware that the relevant outputs' ultimate uses may have differing effects.

Manufacturing model

The physical output of a manufacturing system has a finite number that can only be consumed once - ie that quantity of finished goods or components produced. If this output is 'bad' arising from either poor raw materials or poor processing, the effects should be somewhat limited, with a possibility that they could be recalled if there is adequate traceability. Some longer-term detrimental effects may occur including customer dissatisfaction etc, but overall, these are to a great extent time-constrained.

Information System/ERP model

The output in the form of data or information has infinite uses and users. Poor data can be 'viral' in the way it can penetrate all areas of information possibly unseen, flowing into organisational results, mergers and acquisition decisions, national statistics and budgets etc, with both current and long term implications. Customers can normally identify poor quality physical outputs early within the cycle, whether they are internal or external transactions, but 'bad' data can lie hidden for years. Simon (1971) identified that 'information expands with use' leading to possible 'information overload' and 'information pollution' evolving as Davenport and Beck (2002) suggest, into 'information assault' within an attention economy. Whilst data

is similar to physical outputs in that it can degrade over time, it is possible for the data from one application to be loaded in another & used for purposes for which it was not initially intended and/or be based upon standards, which differ as it migrates across different systems. The use of the 'Factory' analogy within the context of this project is focussed mainly upon the way in which quality principles can be applied to the *inputs* and *process* elements and also towards ensuring that information products in the form of *outputs* conform to the requirements of their relevant customers.

At this stage it will be beneficial to replicate the developing conceptual framework as outlined in Appendix 1 to re-iterate how the three key elements of people, processes and data, fit with the 'generic process system' concept of input, process and output, intertwined with the quality principles of up-front error eradication by prevention rather than cure. The first three documents provided extensive literature support to substantiate this stance. This approach was further endorsed by a number of high level presentations made at The Data Management and Information Quality Conference 2007 (2007) which the author attended and will be referred to in more detail later in this document.

Review and Development of the Research questions

The research questions from Document 3 are reproduced again, together with an indication of where and when they are to be addressed. The questions themselves have evolved during the research process. Questions one to three emerged from the proposal and planning process within Document 1, whilst questions four to six were developed from the literary review and conceptual framework in Document 2. The total quality management philosophy of getting it right first time is a guiding principle that has influenced the author's approach to this subject, namely that data should be of the requisite quality at the time of input into the system as raw data; from this principle two further detailed research questions, seven and eight, emerged during Document 3:

1. What are the attributes of data quality with particular reference to ERP?
 - d. What is data quality? (Doc2-5)
 - e. How does it impact upon enterprise resource planning? (Doc2-5)

2. What is the range of factors that impinge on data quality?
 - e. What are the elements that effect data quality? (Doc2-5)
 - f. How can data quality be measured? (Doc4/5)
 - g. What levels of data quality are necessary? (Doc4/5)
 - h. What do organisations need to do to improve and sustain data quality?
(Doc3-5)

3. Are there specific factors that apply to these in the context of Remploy and related organisations?

- c. How can the study be best related to Remploy? (Doc3-5)
 - d. Does Remploy's position make it unique or can common practices be applied with or without modifications? (Doc3-5)
4. What is the impact of poor quality data?
- a. What is the true cost? (Doc 4/5)
 - f. What are the benefits of improved data quality? (Doc3-5)
5. How can the concept of 'World Class' be related to ERP and Information?
- c. What is world class and how can it be achieved? (Doc4/5)
 - d. Is world class feasible or cost-effective? (Doc4/5)
6. How can a data quality improvement programme best be implemented with regard to?
- e. The management of organisational change (Doc 3-5)
 - f. The management of organisational politics and culture (Doc 3-5)
 - g. The education, training and development of people (Doc 3-5)
 - h. Remploy-specific issues (tie in with 3 above) (Doc 3-5)
7. How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source? (Doc 3-5)
8. How can an organisation maintain and sustain any improvement identified and implemented from the answers to the above question? (Doc3-5)

As stated within the introduction, the reference to 'World Class' in question 5 above has been answered in the negative and all reference has been removed from the project title. However the author feels that the process of generating the initial research question, examining its validity within the context of the overall research and then rejecting it for the reasons already given, has been a legitimate exercise leading to a more focussed and relevant outcome.

Working definitions

It will also be beneficial at this time to revisit and review the working definitions agreed within Document 2 evolving from the detailed review of the literature O'Brien (2006a: 50) and re-affirmed within Document 3.

The process was to formulate working definitions for the key concepts that fit within the overall context of the project. It became evident that it was impractical to attempt to determine true and precise definitions because of the complexity of the subject, coupled with the fact that there appears to be a lack of overall consensus within the literature with regard to many of the key elements. This ambiguity within the literature with regard to meaning, underlines the subjectivity surrounding data quality, which may in turn lead to confusion and uncertainty

within organisations and could be in part responsible in part for a seeming lack of enthusiasm with regards to the extensive employment of data improvement initiatives.

Data Quality

For the purposes of the project the expression Data Quality will apply generically to encompass both the quality of the data and the quality of the information within an enterprise resource planning and information system. An all-embracing definition would be one that encompasses all the data definitions but this would be far too complex, therefore a simpler definition that appears to fit the project is:

“Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise”

Being an amalgam of the Redman (2004: 2), Redman (2005: 1), Deloitte Consulting LLP and Hyperion Solutions Corporation (2006: 1), Griffin (2005: 2) and Williams and Beyer (2006: 2) definitions.

Data

The concept of data as raw material for an information manufacturing system fits the project and is best represented by the English (1999: 468) definition:

“The representation of facts, the raw material from which information is produced when it is put in a context that gives it meaning”

Data in an ERP Database- Data in Context

Data in context is data within the database and is no longer raw data, but it is not yet information. By residing within an ERP system it is easily identified as such whether it is master or transactional data.

Information

To paraphrase the work of a number of the leading authorities, an adequate definition of information is considered to be:

“Data that is presented in an external form which has meaning, relevance and purpose”

Knowledge

Knowledge is not considered to be a ‘key’ concept in so far as it resides outside the scope of an enterprise resource planning and information system, but is included within this section for balance and completeness. The Davenport and Marchand (2000: 165) definition:

“Knowledge is information in peoples’ minds”- encapsulates succinctly the spirit of knowledge within a few words.

The author accepts that the above working definitions evolved during the literature review within Document 2 and as such they will be need reviewed in detail within Document 5 in tandem with the further literature review.

2. Enterprise Resource Planning

This project is looking at the elements of data quality as they interact within the dynamics of an enterprise resource planning and information system, the principle aim of which is to support the overall business strategy. Documents One to Three identified this correlation and it will be beneficial to re-iterate these relationships and interdependencies once again.

A diagram contained within Document 1 O'Brien (2006b: 9), taken from Davenport (1998: 124) highlights the integrated nature of an ERP structure or an Enterprise System as referred to by Davenport. He claims that a good ES is a technological tour de force with a single database at its core coordinating and supporting virtually all of a company's business activities and warns that if a company's systems are fragmented, its business will be fragmented also.

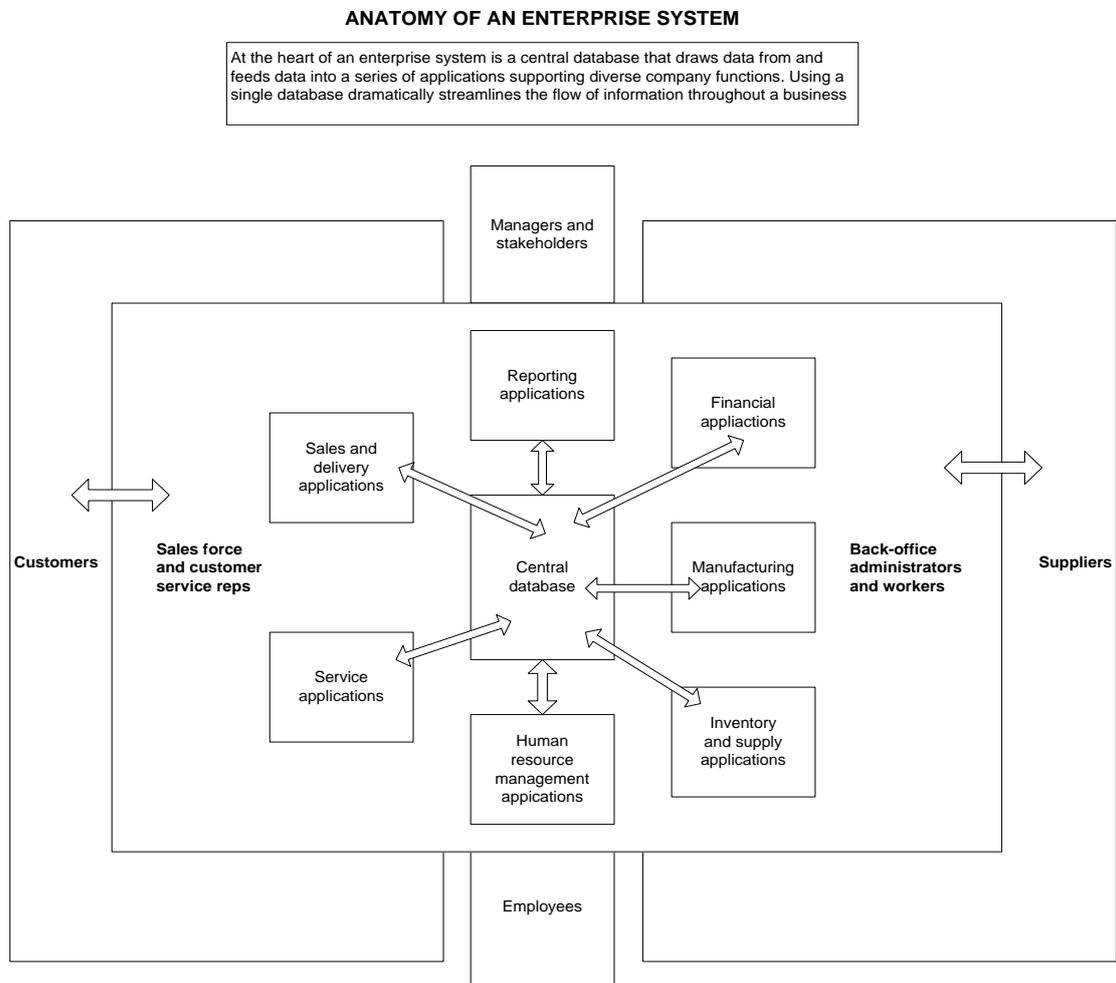


Figure 1. The Anatomy of an Enterprise System

Davenport (1998: 124)

The complex nature of the model with its integrated modular processes and activities attempts to serve all the departments within an enterprise from a single database, in order to provide a single version of the truth throughout the entire organisation by means of a unified system. Within the context of the Conceptual Framework as depicted in Appendix 1, the ERP database resides within 'Data in Context' being the 'Process' that converts the raw 'Data' input into one of numerous 'Information' product outputs.

The above model illustrates how the functions of the organisation are interrelated whereby the effect of a single transaction has a knock-on effect within or between departments of the enterprise. An ERP system operates horizontally across an enterprise working within and between functions, departments and businesses, whereas most organisations manage and control vertically. This potential management misalignment may cause control problems if not recognised and eliminated as tasks within a process move from one department or function to another, consequently there has to be ownership of the data or information that is passed or forwarded onwards. Organisations must recognise this potential misalignment and manage the data and information to match the required processes and flows. This should be viewed as a supplier/customer relationship with the same responsibilities towards customer relations and satisfaction as exists or should exist in external commercial relationships. The model can become even more complex where the ERP system encompasses more than one organisation across numerous countries with differing currencies and time zones. Managing such complex data flows and processes is paramount.

At the heart of most ERP systems are commercial transactions involving the supply of goods or services, encompassing sales, purchasing, manufacturing and distribution, all of which have financial implications. A customer order for a manufactured product will progress from an initial enquiry to final completion and payment. The physical processes of order satisfaction, inter-act with the data flows and processes within the ERP environment. In many ways the 'system' drives the physical processes, indicating what, when and how, to supply, manufacture, purchase and distribute products to enable the each customers' requirements to be satisfied. An aspect of the research carried out for this project will be an attempt to identify the impact of these elements upon the quality of the overall data. This model can apply equally to the provision of services whether in a commercial or not-for-profit organisation.

3. Remploy

It has been emphasised throughout the first three documents that the fundamental aim of any DBA project is to add to and develop the pool of knowledge within management practice and this project is no exception. There is also the subordinate aim of applying the principles and practises learned and developed to practical use within the disabled employment community, not only Remploy but also other similar organisations across the World. Whilst it has been decided that the survey-based research conducted for this document will not be undertaken within Remploy, for reasons discussed later, it is still important to place the document within the overall context of Remploy's environment. This section provides background information and indicates how the Company is positioned within the scope of the overall project and its connections with similar enterprises.

This subordinate aim has not changed, indeed its importance, within Remploy specifically, has increased considerably within the last twelve months. The Company carried out a fundamental strategic review of its entire operations, in collaboration with its single shareholder, the Department of Work and Pensions and other stakeholders including employees and unions during 2006 and 2007. The final outcome as endorsed by the DWP will result in considerable structural and strategic change within the Company during the next twelve months, including the withdrawal from unsustainable operations and vacating a third of the operating sites to produce a new working model for those remaining businesses, whilst growing the 'Employment Services' operation, its disabled person recruitment, rehabilitation, learning and external placement business, by a factor of four. These overall changes will place enormous strain on all areas of the Company and require considerable change-management/change leadership resources, skills and support. The implications for quality systems, quality data and quality information are enormous. It is intended that this project will assist the Company during this period of fundamental change. A number of initiatives have already been implemented during the last year and appear to be generating improvements and it is envisaged that they will make a considerable contribution in managing and controlling this process of change.

Remploy's Mission

To expand the employment opportunities for disabled people in sustainable employment within Remploy and the communities it serves.

Remploy's Principles

The company's objective is to provide equal opportunity and to promote the independence of disabled people by creating the widest possible spectrum of employment opportunities accompanied by appropriate training and development.

ERP History

Remploy is the largest provider of employment opportunities for disabled persons in the UK, currently employing almost 6000 disabled people in 85 individual factories across the entire country, whilst placing over 5000 others into open employment. The Company, which has an annual turnover of £160m, is supported by the UK Government's Department of Work and Pensions and was founded over 60 years ago initially to provide employment for war victims. A Baan/Infor ERP system was implemented over ten years ago and whilst there have been many benefits overall, there is still considerable scope for further improvements, especially within the area of data quality. Maintaining sustainable quality data within any ERP system can be problematical at best, but when one factors in an organisation with twelve individual business streams operating within such diverse areas as automotive, electronics, packaging, PC recycling, healthcare, furniture, in addition to manufacturing protective clothing against nuclear, chemical and biological threats for the UK military and police, the overall picture can become very complex with a high potential for errors and problems. This position is complicated even further when it is then superimposed within a current network of eighty plus separate sites with 1600 users many of whom are disabled in one form or another, all of which is about to be subjected the greatest change and upheaval in the organisation's history.

Accessibility

'Accessibility' refers to the hardware and software technologies that have been developed in order to assist visually or physically disabled persons gain access to information technology either for personal use or within a work environment. Fundamental to this has been the development of the concept of 'assistive technology'. Within an IT sense this refers to specialised keyboards and mouse devices, voice recognition, screen magnifiers and Braille printouts etc. In a non-IT environment the term can encompass any aid to promote greater independence for disabled persons. The Company employs an IT specialist whose responsibility is to develop assistive technology where appropriate. A part of the project will be to investigate whether further developments within this area will assist in improving data quality.

Workability

Remploy is an influential member of 'Workability International' the world's largest body representing providers of work and employment services to people with a disability. More than two million people with disabilities are engaged in work programmes delivered by the 66 Workability member organisations in some 27 different countries. The organisation is registered in the UK. Its Secretary General, based in France, is a former employee of Remploy and access to information from within the organisation to assist this research project has been agreed. The author has also been in communication with the Secretary of Workability Europe and it is envisaged that this may be a potential area of research that may be useful for Document 5. It is anticipated that the benefits emanating from this project will be transferable to other members of Workability International where applicable. The author is

hoping to make a presentation on Data Quality at the Workability Europe Annual Conference in May 2008.

4. Research Focus for Document 4

The initial intention of Document 4 as outlined in the conclusion of Document 3, O'Brien (2006a: 48), was to focus on the analytics of Data Quality by establishing methods by which the quality of data can be measured, the costs of poor data quality ascertained, the benefits of making improvements evaluated, as well as determining the levels of quality necessary to be maintained in each area. In addition it was intended to examine the subject of data and information profiling and auditing both in general terms and in relation to Remploy's ERP environment, whilst focusing upon those aspects of data inspection, correction and cleansing in relation to the Baan database. This is still considered to be valid and to advance these aims a number of important data initiatives have been developed within Remploy.

Data Quality Analytical Measurement Identification and Improvement Processes

The author has introduced a number of detailed analytic-type reports, extracted direct from the Baan ERP database and aimed specifically at the key areas of sales and purchase transactional processing. As an example of the historical rigidity in attempting to tackle such issues, a survey conducted over three years ago identified that over a third of all purchase invoices had some form of data quality issue. Further surveys conducted during late 2006/early 2007 confirmed that there had been no real improvement. To focus specifically upon the areas of purchase and sales invoice problems, it was decided to implement an identification and eradication reporting process, to focus upon problematical purchase invoices and sales credit notes and allocate appropriate codes to identify the issues and reasons and report on these. The intention is to focus on 'problem' identification processes to provide a formal recognition and reporting mechanism, which will enable data quality issues and problems to be detected, documented, quantified and valued with both the sources and reasons identified. The intention is to enable improvements to be developed and measured on an ongoing basis, founded on the concept of root cause error identification and eradication.

An internal based data-profiling programme has also been developed aimed initially at the item, customer and supplier master data files. Within Remploy's Baan ERP system, item master data has 85 different data fields ranging from item code and description, units of measure, planning and reorder points, to sales and production data and to add further complexity, this number excludes the data held in any related bills of material and production routings. In a similar vein customer master data has 62 separate fields and supplier data 66. When one factors in the fact that there are thousands of customers, hundreds of suppliers and literally hundreds of thousands of individual items, the potential for data errors to occur is very high. As an initial approach, a detailed report has been developed to survey areas of potential inconsistency and incompatibility specifically within the item master data files and also to examine conditions that in the past have contributed to data problems. This has been rolled-out and is in current use. It is appreciated that may be considered to be somewhat

limited but it represents a more than useful first step. Also this approach does not preclude the use of external profiling and auditing tools in the future.

These initiatives are intended to work in tandem with the established Data Accuracy KPI graphs and index introduced within the last year, which has proved very successful in focussing attention on data issues and raising the profile of data quality. A set of 8 Key Performance Indicators was introduced comprising graphical and numeric data to enable both individual businesses and factories to monitor and highlight issues relating to both data and accuracy system housekeeping within its operations. An index based upon the concept of the Balanced Scorecard, Kaplan and Norton (1992) was also incorporated to monitor and summarise results from the number of disparate measures within the KPIs. The feedback has been very positive and the index now forms part of each businesses' budgeting and reporting process and is monitored by the company executive on a quarterly basis at each of the business' periodical reviews. During the first twelve months of operation the overall index shows an improvement of almost 40%. The old maxim 'what measured gets done' may be extended to 'what gets measured by the exec...gets done quicker'

The importance of providing detailed analytical reports in all areas of an organisation's data has become evident and is supported by Davenport (2006) which highlights examples of major benefits accruing from the provision of detailed information in all areas of a business. The initiatives described above will provide rich information of a practical nature as well as supporting the areas of research as identified in the original plan for this document.

Research Process for Document 4

From the above it may be seen that the intended approach to this document as outlined in Document 3, of measurement, inspection and auditing, is to a considerable extent already being progressed within a 'live' organisation. As a consequence it is intended that Document 4 will focus on taking the base core concepts derived from the research carried out within the first three documents, supplemented by the author's own experiences collected over time and test these by reference to a questionnaire directed at data quality practitioners and experts. One cannot survey all of the data quality 'expert' community per se as the population is far too large and predominantly unknown. Therefore it has been decided to focus on a smaller sample comprising mainly members of the International Association for Information and Data Quality (IAIDQ) together with other members of data quality related organisations and bodies with which the author has communicated within the scope of this project. The IAIDQ represents a body of individuals who possess the interest and enthusiasm to join an organisation whose aim is to promote the ideal of data quality. As a consequence the membership may not be truly representative of all data quality practitioners but this in itself does not invalidate the findings but actually ensures a higher overall level of knowledge and expertise. It is appreciated that a portion of the literature review has been constructed after reviewing the writings of a number of the members of such bodies, but this should not

invalidate the survey, indeed it may confirm the author's comprehension and interpretation of the information contained in such literature.

Survey Based Research Approach for Document 4

It is intended to undertake a survey by way of a questionnaire circulated mainly within the membership of the International Association for Information and Data Quality (IAIDQ), a four hundred plus worldwide professional association for persons interested in improving business effectiveness through quality data and information. To assist in this process the author has contacted a number of senior members and officials of the IAIDQ within the UK, Ireland and the US who have agreed to sponsor and support the research by adding emphasis within the membership overall, one of whom, is a founder member and advisor to the organisation. In addition the author has been in discussion with a fellow Doctoral student, an IAIDQ member who has recently conducted a Delphi study as part of a PhD programme at the University of South Australia. Targeting the IAIDQ provides the project with a source of expert opinion, knowledge and subject related experiences.

Document 3 focussed entirely on an internal people-based qualitative approach within Remploy and the statistical database study and measurement, identification and improvement initiatives identified above also have a strict internal focus. Therefore it is considered appropriate that this document should provide balance by having an external focus outside of Remploy. This aspect is important not only from a mere attempt to balance the focal point of this research, but also to circumvent the current 'political climate' within the Company following the announcement of the Modernisation Programme, which may not be totally conducive to further detailed person-based research at this time.

Certain questions emerged and these comprise an initial draft survey questionnaire and are detailed in Appendix 2- Initial Draft Questionnaire. These have been subsequently revised and developed and will be discussed further in later sections.

5. Methodology

Research itself, whether of a quantitative or qualitative nature falls within a stepped process identified by Bell (2005), comprising the choice of topic, purpose of the study, access to data, data collection methods, ethical implications, analysis and collect of the data, interpretation of the results, culminating in the writing up of the findings and conclusions, all within a specific time frame. As indicated in the previous section this document is intended to focus upon the base core concepts that have emanated from previous research and to test these within a data quality expert environment. The very nature of this process lends itself to a quantitative research strategy employing survey-based and statistical research methods.

Quantitative Research

This intended research process is totally compatible with the concepts of quantitative research in that is taking a deductive approach to the concepts or hypotheses have been gathered by the author from readings, experiences and previous research by testing them within a suitable environment to ascertain whether they are valid or otherwise, That is, the testing of hypotheses and theories by confronting them with empirical data which is collected and analysed (Gill and Johnson 2002:36). The author feels that the foundations for 'creating' data quality need to be understood and be confirmed before any real data quality improvements can take place and this is emphasised by it being the first word in the overall title of this project. All efforts to create elements of permanency or sustainability, the other key overall aims of this project, are of course dependent upon that strong foundation of theory upon which the author can place some reliance. At the outset the author has a 'strong' opinion as to the validity of the concepts that have emerged from the prior work but is very much aware of the necessity to ensure that these assumptions hold credibility within the data quality fraternity. The philosophy of data quality is not an exact science, the multiplicity of definitions around the subject, provides evidence of that, but in the same way as the author produced a set of basic working definitions in Document 2 which have been reviewed and reaffirmed in subsequent documents, then similar working assumptions need to be verified and it is on this premise that this document is based.

The core focus of the research is the gathering of raw data from people with an emphasis on 'numbers' rather than solely on 'words' as was the case on Document 3. The process entails the application of a structured survey research process. This may employ a number of research methods: interviews where the researcher uses a pre-prepared script with answer options; a questionnaire essentially pre-coded with/without tick boxes with only a little room for additional information; observation research by activity sampling; documentary research focussing on key words, phrases or themes in particular using electronic means; and the use of structured panels in particular the Delphi technique which obtains opinions from a panel of independent experts over two or more rounds of research. This latter method is in stark contrast to the focus group form of panel research employed with the qualitative research approach used in Document 3.

The nature of qualitative research may be characterised as a linear progression commencing with a theory and then working up to ultimate findings and conclusions. Bryman and Bell (2003: 69) identify a very useful generic process, which can be adapted to suit varying forms of quantitative research whether in its entirety or part thereof.

The Generic Process of Quantitative Research

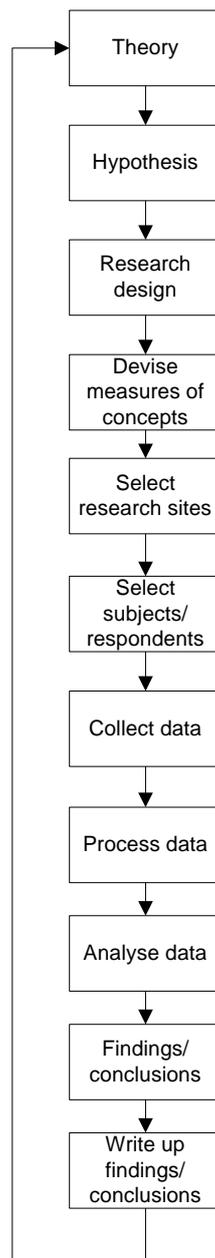


Figure 2. The Generic Process of Quantitative Research. Bryman and Bell (2003: 69)

Commencing the process with a theory and then a hypothesis implies the deductive nature of the research that distinguishes it from the qualitative 'emerging theory' approach adopted in Document 3. Phillips and Pugh (2005: 50) imply that hypotheses can arise by guesswork, imagination, deduction, inspiration or an amalgam of all of these, but once formulated they must be rigorously tested using the appropriate methodology based upon a deductive argument which leads to the form of research termed 'hypothetical-deductive'. Fisher (2004: 37-39) identifies a similar stepped process commencing with the identification of the research question; leading to the development of the key concepts and conceptual framework; from which testable hypotheses are developed; which are capable of being measured to test their validity; test data is then collected by appropriate methods; which is then subjected to analysis, to ascertain whether the hypotheses is true or false. If the former result emerges then the process moves on but if the latter result materialises then the reverse loop depicted in Bryman and Bell (2003) above returns the whole process to the beginning again with a search for a new hypotheses which generates a further research cycle. In the event of unsupported hypotheses the research process cannot be considered a failure because the truth has prevailed, finds are worthwhile and knowledge has been increased.

If one is carrying out research of a quantitative nature relating to certain concepts or theories then it is important that the results are measured. The measurement process enables researchers to identify fine or minute differences between objects, create a benchmark or derive a consistent measurement /yardstick with which to calculate relationships between these concepts. Such concepts are the building block of models and theories which form the basis for the research Bryman and Bell (2003: 71), Fisher (2004: 101) which in themselves come together to form the eventual conceptual framework.

Research Design

Bryman and Bell (2003: 39-62) identify research design as the framework for the collection and analysis of data comprising five different types:

- Experimental design- a hypothesis that is tested between two or more variables where an experimental group is exposed to 'treatment' and compared against a control group, which does not receive the treatment. The variables are measured and analysed both before and after the experimental process to ascertain any differentiation. Experimentation is considered rare in business and management research.
- Cross-sectional design- involves the collection of data covering a number of variables at a single point in time to ascertain relationships. Also known as survey research, data is collected predominately by questionnaire or structured interview. It can be utilised within both quantitative and qualitative research strategies.

- Longitudinal design- a process where data is collected on a sample at two or more points in time in order to identify and map the changes and developments that have taken place between the various data collection dates.
- Case study design- entails the detailed and intensive analysis of one or a small number of cases to provide deep and intensive understanding within a focussed environment. Whilst particular circumstances in one particular case may not be fully representational, generalisations may be made (Fisher 2004:52). A large amount of the literature surrounding enterprise resource planning is based partially on case studies.
- Comparative design- entails the comparison of two or more contrasting cases using identical methods. Examples of this design exist in cross-cultural or cross-national research and also in the form of multiple-case studies.

Research Methods

Research methods are the techniques used to collect data for research comprising interviews, questionnaires, panels, observations, and documents including electronic databases. Each method may be used in both quantitative and qualitative research in that any of the research methods may be used in any research approach. Different methods can be used for different purposes in a study, ensuring that the important issues are addressed, whilst acting as a control mechanism for data validation. Saunders, Lewis and Thornhill (2000: 98-99) recognises this a 'multi-method' or 'triangulation' approach that often may prove to be beneficial. Bryman and Bell (2003: 291) identifies the use as a process of crosschecking findings derived from both quantitative and qualitative research.

The quality and credibility of the research findings are paramount and the major criteria for evaluating management and business research are:

- Reliability/Replication- whether the results of a study are repeatable on different occasions and/or by different researchers
- Validity- the integrity of the conclusions

Saunders, Lewis et al. (2000: 100-101) Bryman and Bell (2003: 33)

At all times one must be aware of the ethical considerations relating to research, which by their nature should govern all the research activities relating to this project. This will be discussed in greater detail within Section 7.

6. Chosen Research Method

The chosen research method to test the theories and concepts, which have emerged from the readings, experiences and the previous research, is a survey based self-administered questionnaire distributed to a data quality expert community for completion using NTU's web-based on line survey tool Autoform. Autoform enables researchers to generate a survey questionnaire, collect and collate the data, which is then emailed to the researcher for further analysis. The resultant data from this survey is then analysed using the SPSS package supplied by NTU.

Survey Based Research

Statistical research surveys are seen as means of collecting data from numerous respondents, with potential for engaging very large samples. They enable the researcher to validate and determine the reliability of the data, together with its statistical significance. They are flexible in their ability to collect vast amount of information to enable very detailed analysis to be carried out to study beliefs, values, attitudes as well as past behaviours. They can be easy to administer and their standardisation can mean that they are not as susceptible to certain types of errors as other research methods. The focus provided by the standardised processes mean that the researcher is more able to concentrate on questions related directly to the important elements of the research, avoiding irrelevant issues. However surveys are dependent upon the respondents' ability to supply meaningful data and be motivated to provide honest and accurate answers rather than putting forward answers, which are intended to ingratiate themselves with the researcher, or to provide the answers the researcher expects. Closed-question structured surveys may lack validity with particular regards to the teasing out of hidden data. Non-responses may generate bias errors in particular where those who do complete the survey hold a differing view from those who do not. There is also potential danger with answer-choice questions, as in a Likert type survey, that questions may be open to different interpretation by each respondent and as a result the answers may prove to be rather subjective.

Surveys can be applied to both quantitative and qualitative research projects and may be conducted in a number of methods: By telephone: they are fairly cost effective, comprising mainly traditional telephone interviews, computer assisted telephone dialling or computer assisted telephone interviewing. By mail: the costs of administration can be very low but there can be possible delays due to poor response times. Online surveys: the web or email can be used but the former is preferable because an interactive HTML link can be employed; such electronic surveys are often inexpensive to administer, producing very fast results, with ease of modification, but potential security problems may exist if the process is not password-protected. Personal in-home surveys: as implied by the title, respondents are interviewed at home and whilst the response rates may be good, the costs can be very high. In addition results may also be easy to manipulate & skew. Personal intercept surveys: where shoppers

in malls & shopping precincts are interviewed; these appears to be fast and easy method to complete, with potentially easier access to respondents who feel more at ease than they would do if the survey was undertaken in their own home. Similar to in-home surveys results may be easy to manipulate & skew.

Self-Completed Questionnaires

The main objectives in designing a questionnaire Wai-Ching (2006) are to maximise the proportion of subjects answering the questionnaire ie their response rate and to obtain accurate relevant information for the survey. A questionnaire may be defined as a collection of questions administered to respondents; but when employed without the direct interface of the researcher, it is termed a self-completion questionnaire (Bryman and Bell 2003:573). The benefits compared with other forms of surveys are that they can be cheaper and easier to administer, requiring less effort than telephone or face-to-face surveys and when they use standard answers they tend to be easier to compile and analyse. The standardised approach should ensure that questionnaires are more objective than interviews. They are also quicker to complete and enable the researcher to gain access to larger numbers of responders, although the potential downside is that returns tend to be lower than one-to-one interviews. Whilst questionnaires tend to be standardised, the very nature of the standardisation may mean that it may not always be possible to explain all relevant to points which may lead to misinterpretation, although this can be overcome by adequate piloting or by providing means to obtain clarification. Open-ended questions may generate vast amounts of data requiring extensive processing and analysis and in addition there is always the risk of the questionnaire being over-long by asking too many questions. It is also useful to explain the purpose of the survey to overcome any respondents' potential reluctance (Learning Technological Dissemination Initiative 2006)

Self-completed questionnaires tend to be less expensive than interviews and do not normally require a large number of skilled interviewers, enabling them to be administered in quantity from a single source at one time, permitting speedier processing and analysis especially if the researcher is able to utilise computer-based analysis packages. The greater privacy and anonymity should encourage more honesty and openness placing less pressure on respondents. From a negative perspective there is potential danger for respondents to fail to complete fully the questionnaire. The non-existence of an interviewer/facilitator means that there is no immediate source for answering questions or for clarification or explanation, although this may be overcome by the provision of a telephone or email query resolution facility or effective piloting. There may also be instances of respondents from extreme ends of the sample (outliers) generating biased responses.

There are processes and techniques that may be employed to improve or increase response rates. The document may be structured in as simple a format as possible using the minimum

number of pages or forms. Monetary incentives in terms of payment in advance of or after completion may be offered. Non-monetary incentives may take the form of commodity giveaways (pens, note-pads etc); entries into a draw or lottery; discount coupons; promise of a contribution to a charity. Advance planning will assist by preliminary notification; personalised introductions (emailed etc) with follow up requests. Relating the survey to universities, research establishments or charities etc, where justifiable may add credibility. Attempts to convince the respondents that their response will make a difference & together with the offer anonymity where applicable may also prove beneficial.

The advantages and disadvantages of survey research and electronic based data collection together with the related research guidelines from a number of sources have been studied and a number are detailed and referenced in Appendix 3 General Guidance Notes

Figure 2 on page 19, derived from Bryman and Bell (2003: 69), depicts the generic process of quantitative research. This blueprint has now been developed to relate directly to this document and illustrated in Figure 3 below. Each element of the initial generic process has been linked to the relevant step within the research cycle for this document to indicate visually how the entire process will be undertaken.

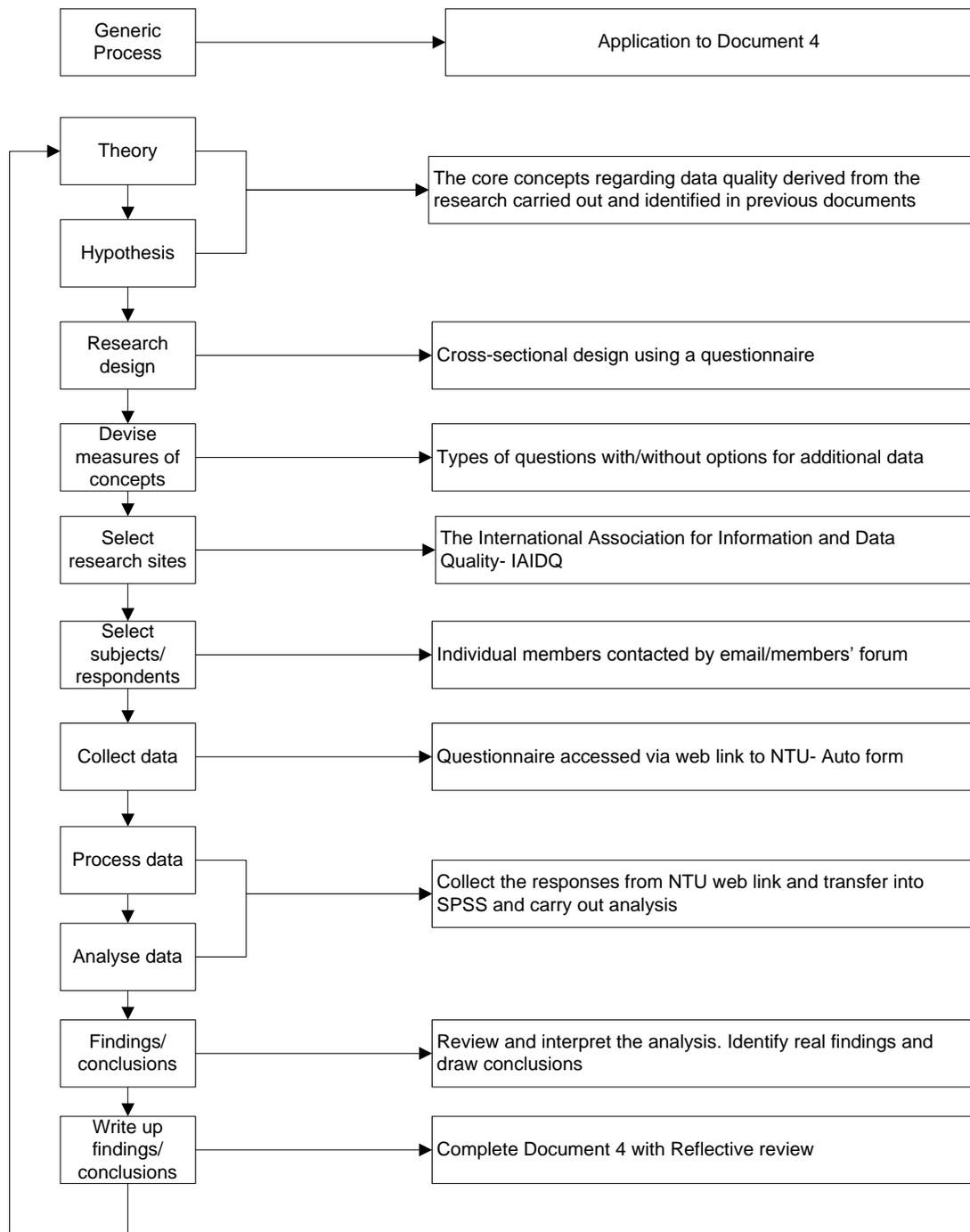


Figure 3. The Process of Quantitative Research as applied to Document 4

Adapted from Bryman and Bell (2003: 69)

7. Ethical Aspects of Quantitative Research

There are a number of generic ethical guidelines that relate to all forms of research, in particular adherence to legal requirements including the Data Protection Act, organisational procedures, confidentiality and anonymity, the keeping of promises together with the obtaining of permission to publish. Bell (2005: 45-46) emphasises the principle of 'informed consent' referring to prior preparation involving explanation and consultation in advance of the actual data gathering and reaching agreement about the use, reporting and dissemination of any results.

The Economic and Social Research Council (2006: 7) refers to research in general as any form of inquiry whose aim is to contribute to a body of knowledge or theory; and research ethics in particular as those moral guide-lines or principles which should govern research, from its commencement to the final publication of results and even beyond. These overall guide-lines, Economic and Social Research Council (2006) constitute a set of generic minimum standards intended to encourage good ethical practice in social science research encapsulated within certain key principles: the research should be designed, reviewed and undertaken to ensure integrity and quality. All the researchers and subjects must be informed fully about the purpose, methods and intended potential uses of the research, the extent of their participation in the research, together with the risks if any, that are involved. Within this context the confidentiality of information supplied by research subjects and the anonymity of respondents must be respected and the participants must participate in a voluntary way, free from any coercion and possible harm. Finally the independence of research must be clear, and any conflicts of interest or partiality must be explicit.

In support of this the American Sociological Society (1999) echoes the sentiments and principles stated elsewhere within this section, but in particular emphasises the importance of professional and scientific standards. American Sociological Society (1999: 5) requires researchers to adhere to the highest standards that are reasonable and attainable and that they rely upon scientific and professional knowledge, whilst acting with honesty and integrity, avoiding any untruths, deceptions and unsubstantiated or undocumented statements, in undertaking research activities. This of course may take many forms but the author believes that total openness, honesty and integrity are fundamental in relation to all of the specific guidelines. Fisher (2004: 55-56) also identifies certain ethical dilemmas surrounding, negotiating access within organisations: embracing the terms of reference; the right to privacy; access to sensitive records; and the collection of data and the reporting of findings. The areas of confidentiality and anonymity attract considerable comment. Confidentiality refers to the practice of not revealing one's sources Fisher (2004: 57) and the promise to keep the identity of the respondents hidden at all times but particularly within any publication, whilst anonymity implies that nobody even the researcher is aware of the respondents identity

(Bell 2005:48). The latter of course has implications further down the data collection process in that it eliminates any possibility of follow up communications.

Ethical issues within the sphere of quantitative research

Gill and Johnson (2002: 122) raise an ethical issue in relation to survey research aimed at testing hypotheses. The implication is that by stating in advance that the researcher is looking to confirm or refute certain hypotheses, infers that this may lead participants to respond more in accordance to what they feel the researcher wants to hear rather than their own real opinions. They counter this, however by arguing that the objective of any survey research should not under normal circumstances be concealed. This is congruent with the author's stated principles of openness and honesty. This issue is not considered to be critical within the context of this piece of research, as the author is attempting to gather opinions from recognised 'experts' who by their very nature are unlikely to be persuaded to alter their stance by any explanations. In addition it is crucial to the outcome that the intention of the survey, to confirm or refute the author's own views and opinions, is made clear.

Bryman and Bell (2003: 548) identify that ethical issues exist between the researcher and the potential participants and in particular relate to any possible transgressions relating to harm to participants; lack of informed consent; invasion of privacy and deception. In so far as these elements are seen as critical to the legitimacy of any research the author will place these with the context of this document. It is not envisaged that any physical or psychological harm will occur to any participant, the very nature of the mode of research means that informed consent in relation to questionnaires may be seen as implicit by the very act of the participant completing and returning the survey Fisher (2004: 55) and as regards to privacy, the author uses the IAODQ formal communication channels to contact potential participants who have willingly subscribed to this format and each has the option of anonymity by their decision whether or not to provide their name and email address. Finally there is no attempt at deception as the author is totally open as to the object of the research, as already discussed above.

The use of internet-based research compared with the more traditional modes of communication brings with it certain approaches. Nosek, Banaji and Greenwald (2002) identify ethical issues relating to the absence of the researcher, potential exposure of confidential data and/or identity to a third party and lack of detailed de-briefing facilities. They also highlight related security questions surrounding confidentiality and anonymity, security of data transmission and data storage, the tracking of participants over period of time and the possibility of miss-behaviour by participants intentional or otherwise. The author recognises these issues but feel that they are not entirely applicable in the context of the research for this document.

8. Data Collection

The quantitative research process attempts to test within a data quality 'expert' community the basic concepts and assumptions that have emerged from previous research and experiences. A web-based questionnaire survey conducted amongst data quality professions is seen as the most appropriate vehicle with which to collect the data. The author chose as his research sample the membership of the International Association for Information and Data Quality (IAIDQ) of which he is both a student and an active member, together with other data quality professionals and academics with whom he has been in contact. The latter category comprises certain high profile academics at MIT and North Carolina State University, namely Stuart Madnick, Diane Strong both of whom have written extensively on data quality issues and have assisted the author earlier within Document 2 and Blanton Godfrey who in the past has collaborated with Joseph Juran on quality management issues; together with professionals within the fields of data quality software suppliers, analysts and consultants. The author also contacted directly by email the co-founders of the IAIDQ Larry English and Tom Redman, who have also contributed to this project at various stages. All are accessible either via direct email or periodical newsletter where the survey can be publicised and a web link provided. Fisher (2004: 159) identifies those obstacles that can prevent a researcher generating an adequate sampling frame particularly in terms of access to mailing lists, and encountering data protection legislation. This survey does not have these problems, as the sample has already been identified and ring fenced by their connection with the author. In addition by the very nature of the source of the sample either as a member of the IAIDQ or as selected by the author individually there is an assumption that each recipient will have the necessary level of knowledge and expertise to provide some level of quality reply. The survey was promoted via the fortnightly IAIDQ electronic newsletter distributed to all members together with personal emails to non-IAIDQ participants both containing a direct link to the Autoform web site. Subsequently Larry English also publicised the survey with an accompanying link on the B-Eye-Network Information Quality Newsletter.

Questionnaire Design and Format

Oppenheim (1992: 7-8) emphasises the importance of adequate preparation and planning prior to undertaking any survey and identifies the essential steps in overall design from the initial generation of aims and objectives through to the writing up and publication of the final report. These are presented in more detail within Section 1 of Appendix 3. Schonlau, Frickerer and Elliott (2002: 41-53) also offer strong guidelines in dealing with the design and implementation of Internet surveys involving the actual questionnaire design, automation techniques together with the implementation and fielding of the survey. Further details are contained in Section 9 of Appendix 3. Schonlau, Frickerer et al. (2002: xiv-xv) also recommend that an Internet survey may be preferable to mail or telephone surveys in circumstances where the researcher has a list of e-mail addresses for the target population, the target population itself represents a small slice of the total population and the sample size

is moderately large. Furthermore the Internet may be relevant if the survey contains questions of a particular sensitive nature with a large number of important open-ended questions and has multimedia or interactive elements. It is appreciated that not all of these points relate directly to this survey.

The author's choice of a web based survey is justified by Bryman and Bell (2003: 511) contending that an electronic survey is advisable when resources are limited and the target population suits an electronic survey approach. Bryman and Bell (2003: 512) produce an argument for and against online surveys compared to postal surveys, which are detailed further with Appendix 3 Section 10.

The Data Capture Process

The questions themselves were based upon the criteria required to validate the author's concepts as described above, to quantify the adequacy of the elements of an ERP system relating to both *processes* and *people*, to identify the root causes of *data* problems and issues in terms of sources and reasons and then to determine the main principles of error resolution. The author chose a mixture of semi-dichotomous questions, which have a 'yes' or 'no' response but with a default of 'no answer'; multiple-choice questions involving Likert scales with a five-point span ranging from very high through to very low, together with other required specific answers from a drop-down menu. A decision was made to put the demographic questions at the beginning to lead the recipient into the full process. It is appreciated that the popular view is that such questions should appear at the end but demographic questions are considered to very important in this survey with particular regard to being able to evaluate the responders' responses in the light of their experience, job role, organisations' size, business sector and all round level of status within the data quality community.

The survey also looked at the levels of responsibility for data quality within an organisation first in an ideal environment and then in an actual workplace situation within the respondent's own organisation. In a similar fashion the question of the measurement of the quality of data was addressed initially in an ideal situation and again in reality. The question of disabled data suppliers, processors and customers was addressed and the use of assistive technology (the hardware and software technologies that have been developed in order to assist visually or physically disabled persons gain access to information technology either for personal use or within a work environment) was introduced. The author's definition of Data Quality ("Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise") was also examined as an open question with a text box for responses as it was consider appropriate that this 'composite' definition should be examined. Finally an open question text box was provided to enable respondents to add any additional relevant comments relating to the survey.

Many of the questions have an 'other(s)' option with an accompanying box to provide elaboration rather than keeping all questions totally closed. Whilst it is appreciated that the questionnaire is basically a piece of survey based statistical research using a quantitative research strategy, space was provided for textual input as it was considered that the potential level of subject expertise available within the sample, has considerable potential to enrich the overall project and therefore warranted the facility to 'trap' this potential additional knowledge.

Every attempt was made to plan and pilot the questionnaire thoroughly. An initial draft was created in Microsoft Excel and circulated to half a dozen work colleagues and a number of prominent members of the IAIDQ. The quality of the feedback was extremely good particularly from the latter as one would expect. The document was refined a number of times as a result both for errors missed during the initial proof reading but more importantly for slight structural changes and additions which enhanced the overall presentation and data collection. The author has retained copies of the feedback as further evidence of the learning process.

The final refined questionnaire was then positioned into NTU's Autoform, a fairly simple process to learn and grasp but this proved somewhat problematical with its inability to edit or save one's work, which required the compiler to complete the whole exercise in one session. This proved somewhat difficult with network and access problems but was finally achieved. A number of the pilot respondents were then asked to test the final questionnaire within Autoform. The overall feedback indicated that it was accessible and easy to understand and complete.

The questionnaire was launched to the targeted respondents by way of:

- Survey set up on Autoform on 12th November 2007
- Individual emails sent to those data quality professionals and academics identified at the beginning of this section on 14th November 2007 and re-circulated to non-respondents on 30th November 2007. In addition a number of the author's colleagues who have considerable experience in ERP and information systems were also invited to participate.
- The IAIDQ Membership Update-November 2007, an email newsletter circulated to all four hundred plus members on 29th November 2007 with an attached HTML link to the NTU Autoform questionnaire.
- The IAIDQ Forum, an unmoderated mailing list designed to serve as a discussion platform for the data and information quality community. An email was distributed to all 80 plus subscribers on 9th December 2007 with an attached HTML link to the NTU Autoform questionnaire

- The survey was also publicised in Larry English's B-Eye-Network Information Quality Newsletter distributed via email on 10th December 2007 with an accompanying link, which according to Larry English "goes out to a large audience"

A copy of the survey questionnaire is attached in Appendix 4

A copy of the IAIDQ Member Update- November 2007 is attached in Appendix 5

A link to the NTU Autoform questionnaire is below:

<http://ess.ntu.ac.uk/sutton/formfiles/n0131866/ntutobdq1.htm>

9. Summary Analysis and Findings

Response Rates

This analysis is being carried out seven weeks after the survey was created in Autoform and just over a month after it was published in the IAIDQ Update and a total of twenty nine responses have been received of which two were duplicates, leaving twenty seven useable responses. The chronological sequence and source of the replies are depicted in Figure 4 below.

Events	Date	Author's Contacts		IAIDQ Update	IAIDQ Forum/ B-Eye-Newsletter	Total	%
		Colleagues	DQ Prof's Academics				
Survey set up in Autoform	12-Nov	4				4	15%
Emails sent to contacts	14-Nov		4			4	15%
Link to survey published in IAIDQ Update	29-Nov		1	3		4	15%
Reminder emails sent to contacts	30-Nov			1		1	4%
Link to survey published in IAIDQ Forum	09-Dec						
Link to survey published in B-Eye-Network IQ Newsletter	10-Dec	3	1		10	14	52%
Total		7	6	1	3	10	27
%		26%	22%	4%	11%	37%	100%
Duplicates		1			1	2	
Grand Total		8	6	1	3	11	29

Figure 4. Analysis of responses as at 31st December 2007

The above analysis does not attempt to convey that the number of responses against each event was generated solely by that event, ie that three came from the IAIDQ Update and ten jointly from the IAIDQ Forum and B-Eye-Network Newsletter, but identifies that they were received within the time frame following that event. It should be noted that the responses from the author's colleagues and the data quality professionals contacted at the London conference were both 100% from those asked. The last response was received on 21st December and it was decided to undertake the analysis and findings as at 31st December 2007 as the final submission date had been agreed as 11th January 2008.

The analysis attempts to track the responses from the various invited parties as they were received following each of the survey's publications. Whilst the initial intention was to focus on data quality professionals and academics and not necessarily involve the author's colleagues, the lower than anticipated response rate from the former sources has meant that the latter comprises a far higher proportion than envisaged. The author believes their contributions are valuable and are included not just to 'make up the numbers'. The initial reaction is that the overall response to the survey has been disappointing. The author anticipated at least a 10-15% return from the four hundred plus IAIDQ membership, which together with the personal contacts made at the recent Data Management and Information Quality Conference and various academic sources meant an overall response level in excess of 60 was hoped for.

The author communicated with a number of contacts within the IAIDQ in an attempt to obtain some feedback with regards to response levels. O'Brien (2007) replied "There is always a risk of the email not being read or being trapped in spam filters so a multi-channel approach is probably the best... stick it out on the forum as well by all means. Also the time of year may be a factor... people are possibly pushing to finish projects before the holidays and aren't reading their email". English (2007) replied, "I can't vouch for anything within the IAIDQ. As you can tell from the B-eye-Newsletter, my IQ Newsletter just went out today. It goes out to a large audience. Again, I can't vouch for how many will see the survey link and do the survey, but I do feel that it had a good place in the Newsletter if people do read the Newsletter and take action on items within it"

To put the response levels in perspective the author also contacted a fellow member of the IAIDQ, Yonke (2007) one of the original founding members and an advisor to the Board of Directors who has recently coordinated a survey on Data Governance. This survey conducted during the autumn of 2007 was promoted very widely across a number of data and information quality organisations and web sites in an attempt to reach 'thousands of people'. In addition a draw was offered to participants with prizes comprising; a complimentary registration to the 2008 Annual Information and Data Quality conference organized by IAIDQ together with three complimentary annual memberships of the IAIDQ. The deadline for completion was also extended by two weeks to increase responses. In spite of the size of the target population, the incentives offered and the extended period, only 224 responses were received. Yonke (2007) also commented 'Your 27 is not bad at all. Most people just ignore surveys'

Identification of the variables

In order to ensure that the survey variables are analysed correctly, each question has been identified and its variable type determined to ensure that the appropriate analytical techniques are applied. The guidelines in Bryman and Bell (2003: 240-241) have been used and are detailed below:

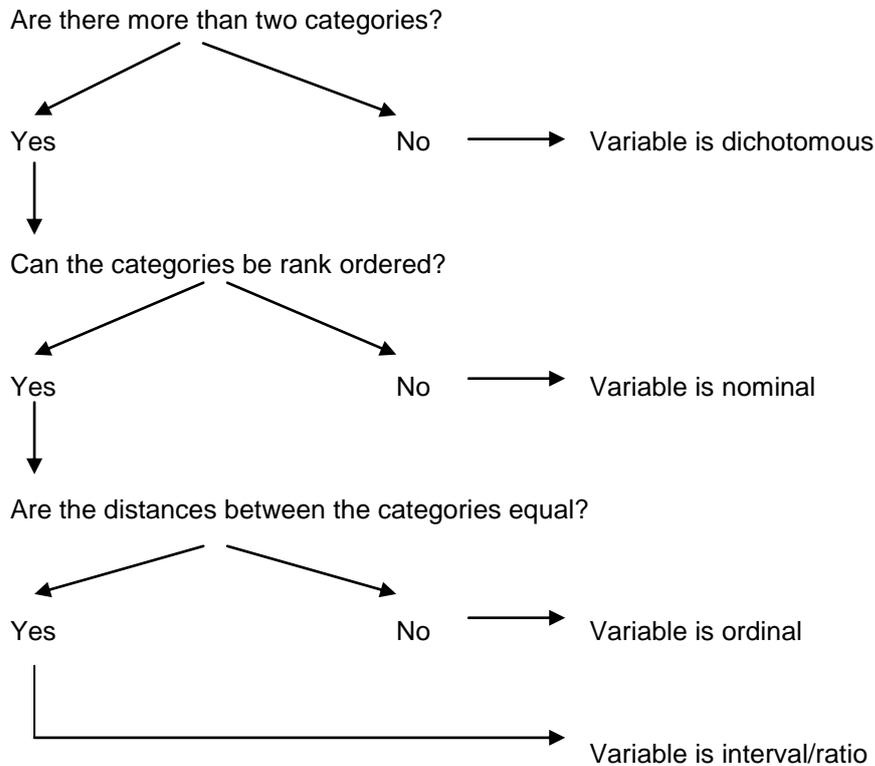


Figure 5 Identifying the Types of Variables

Bryman and Bell (2003: 240-241)

- Dichotomous: Variables containing data that have only two categories. It should be noted that Autoform allocates to the 'yes'/'no' response questions, a default of 'no answer'. The author considers that such questions are semi-dichotomous.
- Nominal: Variables whose categories cannot be rank ordered
- Ordinal: Variables whose categories can be rank ordered but the distances between the categories are not equal
- Interval/Ratio: Variables where the distances between the categories are identical across the range. For the purpose of this survey the two types do not require separation.

Appendix 6 identifies the relevant variable type allocated to each question in line with the above criteria.

Analysis and Comments

It is appreciated that the initial intention was to conduct the survey amongst data quality professionals and therefore the author is aware that the inclusion of a number of colleagues however experienced in business has potential to dilute the process slightly. To guard against any bias arising from this, the responses have been measured against both the original twenty seven contributors and a further sample of twenty two, after excluding five Remploy colleagues who have no direct experience of data quality improvement processes, other than as part of their overall responsibility as managers. Appendix 7 contains a frequency table providing a summary comparative analysis of the responses. Whenever figures or percentages are quoted below, the value(s) relating to the twenty seven responses are given first, followed by the ex-Remploy comparative where this is deemed relevant. Note that all percentages are 'valid' percentages relating to actual response numbers excluding 'no answers'. A full frequency table encompassing all responses including textual input has been produced and is available in Appendix 8. It should be noted that the data supporting the analysis and findings is held in the two frequency tables- Appendices 7 and 8 rather than as individual tables or graphs within the text, as this will allow the discussion to flow more freely without interruption.

Demographic Characteristics

The respondents are predominately from the UK (48%/36%) and US (33%/41%) with membership of the IAIDQ at 63%/75%, as one would expect given the survey's intended focus. 9 of the respondents are also members of other data quality related bodies, with The Data Management Association (DAMA) being the most common with 6 members. There appears to be a solid wealth of experience amongst the contributors with around two thirds having spent five years or more in the field and a third with more than fifteen years experience. Job roles, functions and employer organisations appear to have a well-balanced spread across the ranges. Senior and Business Management and IT roles are well represented in both samples together with elements of finance, marketing, operations and consultancy. Organisational size in both turnover and number of employees cover all the categories but in particular in the lower (less than \$5m turnover and 50 employees) and upper (more than \$1 billion turnover and 10000 plus employees) groupings, especially when excluding Remploy colleagues. No single industrial category is predominant but it is worthwhile noting that general manufacturing is only represented within the total population reflecting the Remploy influence. This point is also evident in those organisations that operate an enterprise resource planning system (54%/45%) and is even more emphatic when measuring the number of sites within those organisations that operate ERP systems. From a detailed analysis of the demographic data the author is confident that the full sample provides a true reflection of overall attitudes and there is no apparent bias by including all the Remploy contributors, in fact it may be seen as a positive contribution especially given their experiences in the areas of manufacturing and in the use of ERP systems. From the above the author feels that the demographic data reflects a well-balanced level of response in terms

of geography, functional experience, job roles, organisational size, industrial focus, together with systems knowledge and experience. The fact that only around half the respondents have direct knowledge of ERP systems is not considered to be too much of an impediment as this appears to be compensated by high levels of experience in the field of data quality in general.

Analysis of Responses Received

The results of the responses to each of the questions will be analysed from the data in the frequency table Appendix 7 referred to above. The author feels that it will be beneficial to cross tabulate these results against at least one demographic category and intends to use data from 'number of years experience in the field of data quality' as this is potentially the most important in terms of influence and credibility.

How highly will problems in the following areas impact the overall quality of data within your organisation's systems? (Likert Scale)

Master Data Entry:

50% of the respondents rated this as very high with a further 38% as high. Those with more than 15 years experience, the single highest category, supported this.

Transactional Data Processing:

27% rated this as very high, 42% as high and 23% as medium. The corresponding figures for those with 15ys or more experience were 11%, 55% and 34% respectively.

System Housekeeping:

Only 15% rated this as very high, with 58% high and 15% medium. The more experienced respondents largely supported this.

Others:

A number of other elements were suggested including integration with other legacy systems, lack of customer insight, system misalignment, user errors and education and training issues

Comment:

The greater emphasis on master data issues points to support for the concept of ensuring that the data is correct at source. It may be worth noting however that system housekeeping issues probably have greater relevance to ERP processes than other systems and only half the respondents have current ERP experience.

How highly do you evaluate the impact of the following on the quality of data within your organisation's data systems? (Likert Scale)

Data Suppliers:

42% of respondents rated this as very high, 35% as high and 8% as medium. The more experienced respondents largely supported this.

Data Processors:

The figures are similar to Data Suppliers at 44%, 32% and 12% respectively with the more experienced users again in line.

Data Customers:

24% rated this as very high 8% as high and 44% as medium. Experienced respondents gave this a slightly higher priority.

Others:

The point was also made that ERP vendors too have a responsibility and often sell high and deliver low without full reference to customer needs.

Comments:

On the whole the responses were in line with what one would expect with a greater emphasis 'upstream', although it must be stated that it should also be the responsibility of data customers to insist that the information they receive is based upon quality data.

What level of impact will problems in data processes and procedures have on the quality of the data? (Likert Scale)

75% of the respondents rated this as very high with a further 21% as high, figures borne out totally by those with 11 or more year's experience.

Others:

Valuable other comments: "With an integrated system poor quality data will have a knock on effect and magnify...as it runs through the system". "All data/information is generated by a process and if we have problems with data its due to an issue with the process". "Lack of edits and controls is a major source of poor quality"

Comment:

This question produced greatest single support for any individual 'very high' reply within the survey and relates to an area that has considerable resonance within the overall project.

Please rank the following as potential sources of data quality problems (Likert Scale)

Employees:

46% rated this as very high, 31% as high and 15% as medium, basically in line with the views of experiences respondents.

The remaining choices comprising- Customers, Suppliers, External data sources, Processing errors, External systems all fell with the range of 16%-23% as very high and apart from and System errors which registered only 9%. In all cases medium to very low registered over half the responses

Comment:

This appears to emphasise the importance placed upon the 'people' issue and there appears to be far less regard for those elements external to the organisation.

Please rank the following as potential reasons for data quality problems (Likert Scale)

Poor Data Entry:

58% of the respondents rated this as very high with 23% as high and 12% medium.

Lack of Data Quality knowledge, training and education:

54% rated this as very high, 15% high and 19% medium

Poor processes:

54% rated this as very high, 31% as high and 12% medium

Poor management:

A more even spread with 35% very high, 31% high and 23% medium

Comment:

Overall there was probably greater emphasis placed by those respondents with 10 years or less experience particularly amongst the Remploy ERP users.

Please rank the following in terms of their effectiveness in resolving data quality problems (Likert Scale)

Maintain up-front error prevention and Identify and clean at source:

Both had very similar response levels at 56% very high, 32% and 28% high and 8% and 12% medium.

Identify and clean within the process (ie downstream):

12% of the respondents rated this as very high 32% as high and 36% as medium

Identify and correct errors in reports:

Only 8% rated this as very high, 16% as high and 24% as medium

Take no action:

Virtually no support with 96% rating this as very low

Others:

Additional valuable comments included: "An option is missing, improving the work processes that create the bad data to begin with". "In some cases we are not able to make changes to the root causes for a number of reasons". "Use data quality software in a Service Oriented Architecture".

Comments:

The results reflect a level of consensus across all the levels of experience, although one would have expected that the 'upstream/source' error prevention would have received greater support.

The final questions are of a comparative nature and these will benefit from being expressed in some tabular form:

At what level should the responsibility for data quality sit within an organisation? /At what level does the responsibility sit within your organisation?

An analysis of the responses indicates:

The level of responsibility for Data Quality within an organisation

	Ideally	Actually
	%	%
Director	41	26
Senior executive	30	22
Business manager		11
Site/Unit manager	7	4
IT department		7
Finance department		4
Data quality manager	11	11
Others- see below	11	15
Total	100	100
Others:		
Data provider	2	3
Everyone	3	
Everywhere	2	
CEO	2	
Data stewards	2	
Finance		4
None		4
Users		4
Total	11	15

Comments:

An ideal response may be to say “all of the above” in that everyone has a responsibility for the data they receive, process and pass on. In addition senior management cannot relinquish responsibility for the quality of the overall data any more than they can in respect of any other organisational asset.

How often should one measure the quality of data? /How often does your organisation measure the quality of data?

An analysis of the responses indicates:

The frequency of measuring Data Quality

	Ideally	Actually
	%	%
Daily	30	26
Weekly	11	15
Monthly	26	26
Quarterly	4	4
Annually		4
Others	29	25
Total	100	100

Others:

Often as needed	10	
Continually	3	
Weekly/monthly	4	
Depends on the context	12	12
Never		6
Every two weeks		3
All of the above		4
Total	29	25

Comments:

It may be seen from the above table that reality reflects the ideal to a considerable degree, although it may be the case that reality de facto becomes the ideal by necessity. The comment 'Depends on the context' certainly has relevance in that certain data may require daily matrices and KPIs whilst other less important data fields may require less monitoring.

Does your organisation employ disabled people in the roles of data supplier, manufacturers or customer? /Does your organisation employ the techniques of 'Assistive Technology (Hardware and software techniques developed in order to assist visually or physically disabled persons gain access to information technology within the working environment)?

An analysis of the responses indicates:

Employment of disabled people & use of Assistive Technology

	Disabled	Assistive
	Employees	Technology
	%	%
Yes	56	37
No	15	15
No answer	29	48
Total	100	100

Comments:

The large discrepancy between the level of disabled employment and the use of assistive technology may reflect the fact that a number of organisations employ only small numbers of disabled workers or are either not aware of or do not consider assistive technology to be important. The high level of 'no answer' to the latter question should be noted. The devices specified included large or magnified screens, specific software, customised keyboards, customised input devices- scanners/bar code readers, special mouse devices, modified working areas and listening aids.

Definition of Data Quality

Finally an attempt was made to test the validity of the author's definition of Data Quality, as "Having the right and correct data in the right format, in the right place, at the right time, by having one single version of the truth across the enterprise", by asking respondents to comment upon this:

Of the 17 replies received, 12 were basically supportive with comments including: "It's a pretty good definition, but would add...meets the needs of downstream data customers", "It makes sense, however its very hard to achieve a single version of the truth", "I like it", "I agree", "Yes good, perhaps...add everyone in the organisation owns and trusts", "I think your definition captures part of the vision of the subject", "It's a good idea", "Feels ok, but potentially easy to read and not drive into action". A further 5 replies provided alternative or additional definitions: "Data quality is a strategy...there is no such thing as a single version of the truth", "I prefer a simpler definition...data fit for the purpose", "Is a single version of the truth achievable?" "The definition is not taking into account that different customers may have different requirements", "Your definition does not cover security or sensitivity".

Comments:

This appears to be quite a positive and supportive response given the rather subjective and emotional nature of the subject. There were also some further useful comments that should prove valuable.

When these results are cross tabulated the against the respondents' data quality experience levels the following profile emerges which may initially question the positive view placed upon the responses, given that fact that all the alternative comments originate from contributors who appear to have considerable experience in this field.

Analysis of the DQ definition by experience

	Supportive	%	Alternative	%
Less than one year	1	8%		0%
1 to 4 years	3	25%		0%
5 to 10 years	5	42%		0%
11 to 15 years	1	8%		0%
More than 15 years	2	17%	5	100%
Total	12	100%	5	100%

However further examination reveals that four of the five respondents who provided an alternative definition have no direct experience of ERP systems whilst the fifth did not answer the related question.

Findings and Discussions

The stated intention of the survey was to take the base core concepts derived from the research carried out within the first three documents, supplemented by the author's own experiences collected over time and test these by reference to a questionnaire directed at data quality practitioners and experts. At this stage it will be useful to re-examine these concepts to ascertain whether these have indeed been adequately tested. Appendix 2 outlines these concepts in the form of the material for the initial draft questionnaire, which attempted to validate the concepts of:

- The Total Quality Management principles of root-cause error prevention.
- The applicability of the overall Project's conceptual framework comprising People, Processes and Data etc
- The working definition of 'Data Quality' as "having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise"

The survey did in fact cover all of the above points and the author is attempting to determine whether the results provide evidence of support or otherwise from the respondents for these concepts and an analysis of the 'positive significant' responses are detailed in the table below. The author's criteria for claiming significance is where response value(s)- 'Very High' is over 50% and/or 'Very High' and 'High' are over 75%. To maintain balance, the results were also analysed to ascertain whether the responses to any question fell within the area of 'negative significant response' ie where response value(s)- 'Very low' is over 50% and/or 'Very low' and 'low' are over 75%. The only such occurrence related to the option- 'Take no action' to the question 'Please rank the following in terms of their effectiveness in resolving data quality problems'.

When one applies the results of the significant response test as detailed below to the concepts one finds that:

- The total quality management principles of root-cause error prevention as applied to data quality is supported by the responses to: The importance of Master Data (88%), Up Front Error Prevention (88%), Identify, Clean at Source (88%), Poor Data Entry (81%) and above all Processes (96%) when applied to the principle of 'getting it right first time'
- The applicability of the overall project's conceptual framework comprising People, Processes and Data is supported by all the significant responses

The final concept relating to the working definition of 'Data Quality' as "having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise", discussed above has a positive response of twelve out of the seventeen replies received. This provides a 71% support rate and whilst this is below the 'significant' criteria it does provide a positive perspective towards the definition.

Analysis of significant responses- ie where response value(s)- 'Very High' is over 50% and/or 'Very High' and 'High' are over 75%

	Very High	High	Total	Elements
Master Data	50%	38%	88%	Data
Poor Data Entry	58%	23%	81%	Data/People
Data Supplier	42%	35%	77%	Data/People
Data Processor	44%	32%	76%	Data/People
Up Front Error Prevention	56%	32%	88%	Data/People/Processes
Identify and Clean at Source	56%	28%	84%	Data/People/Processes
Employees	46%	31%	77%	People
Lack of DQ knowledge & Education	54%	15%	69%	People
Processes	75%	21%	96%	Processes
Poor Processes	54%	31%	85%	Processes

All of the discussion and comments above should be placed within the context of a very low level of response given the widespread distribution of the survey. From this one needs to be cautious not to claim more than can be justified and to question the extent one can place onto the validity of the findings, analysis and interpretation. It maybe more prudent to claim that the results 'indicate' that there is a substance to the overall validity of these concepts.

10. Conclusions

Research Process

The research process attempted to focus on taking the base core concepts derived from the research carried out within the first three documents, supplemented by the author's own experiences collected over time and test these by reference to a questionnaire directed at data quality practitioners and experts. It was decided to focus on a small sample comprising mainly members of the International Association for Information and Data Quality (IAIDQ) together with other members of data quality related organisations and bodies with which the author has communicated within the scope of this project. The chosen research method to test the theories and concepts, was a survey based self-administered questionnaire distributed to the IAIDQ membership via a periodical newsletter, together with specific email invitations, each containing a link to NTU's web-based on line survey tool Autoform.

The initial response was well below expectations and the survey was then widened to include a number of the author's colleagues, together with additional links to other data quality practitioners. In spite of this only twenty seven replies were received. The resultant data was then analysed using the SPSS package supplied by NTU and the results, findings, analysis and interpretation have already been covered extensively in Section 9. A summary of the findings indicates a high level of positive replies to the concepts, but one has to balance this against the low response levels. Notwithstanding this the author feels that results 'indicate' that there is a substance to the overall validity of these concepts. Finally the author believes that this experience and the lessons learnt will assist in the completion of Document 5.

Review and Development of Research Questions

The research questions from Section 1 above are reproduced again, together with an indication of where and when they are to be addressed. The questions themselves have evolved during the research process encompassing all four documents. Questions one to three emerged from the proposal and planning process within Document 1, whilst questions four to six were developed from the literary review and conceptual framework in Document 2. The total quality management philosophy of getting it right first time is a guiding principle that has influenced the author's approach to this subject, namely that data should be of the requisite quality at the time of input into the system as raw data; from this principle two further detailed research questions, seven and eight, emerged during Document 3:

1. What are the attributes of data quality with particular reference to ERP?
 - What is data quality? (Doc2-5)
 - How does it impact upon enterprise resource planning? (Doc2-5)

2. What is the range of factors that impinge on data quality?
 - What are the elements that effect data quality? (Doc2-5)

- How can data quality be measured? (Doc4/5)
 - What levels of data quality are necessary? (Doc4/5)
 - What do organisations need to do to improve and sustain data quality? (Doc3-5)
3. Are there specific factors that apply to these in the context of Remploy and related organisations?
- How can the study be best related to Remploy? (Doc3-5)
 - Does Remploy's position make it unique or can common practices be applied with or without modifications? (Doc3-5)
4. What is the impact of poor quality data?
- What is the true cost? (Doc 4/5)
 - What are the benefits of improved data quality? (Doc3-5)
6. How can a data quality improvement programme best be implemented with regard to?
- The management of organisational change (Doc 3-5)
 - The management of organisational politics and culture (Doc 3-5)
 - The education, training and development of people (Doc 3-5)
 - Remploy-specific issues (tie in with 3 above) (Doc 3-5)
7. How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source? (Doc 3-5)
8. How can an organisation maintain and sustain any improvement identified and implemented from the answers to the above question? (Doc3-5)

Reference to Question 5 'How can the concept of 'World Class' be related to ERP and Information' has been removed, as this is now no longer applicable for reasons already explained.

Given the fact that the outcomes of the research for this document have substantiated the previous conclusions, progress towards achieving the project title 'Data Quality- creating and sustaining Data Quality within a diverse Enterprise Resource Planning and Information System with particular regard to organisations employing disabled people' may be seen to be encapsulated totally within questions 7 and 8. The other questions whilst all relevant, appear to be subordinate or supportive of the former two questions.

Data Quality within Remploy

The reporting processes to identify quality issues within sales and purchasing transactions described in Section 4 are producing valuable data. With seven month's data collected, it may be seen that over half of the sales credit notes generated appear to result from pricing errors or product quality issues both of which have considerable implications for overall customer satisfaction and retention. It has also become evident that data quality management appears to have a higher profile both in reporting terms and executive exposure and attention, than product quality management. Further data quality successes have become apparent with significant improvements in the incidences of problems relating to the processing of purchase invoices also referred to in Section 4, in that between the end of October and late December the overall error rate improved by a third. The ongoing challenge is to ensure that this is not only sustained but also improved upon. It is not within the terms of reference of this document to comment on this other than to re-iterate the point that 'what measured gets done' to 'what gets measured by the exec...gets done quicker' or indeed gets done at all. Also with the quickening of pace of the Modernisation Programme, the data quality measurement processes are becoming valuable control and risk measures overseeing the whole restructuring programme.

Overview of Documents 5 and 6- The Thesis and Critical Reflection

The change of project title to 'Data Quality- creating and sustaining Data Quality within a diverse Enterprise Resource Planning and Information System with particular regard to organisations employing disabled people' has helped to clarify the whole project. The real emphasis of this and preceding documents has been to establish a concept of quality data, and to determine how best to create a quality data environment, although the necessity to maintain and sustain data quality initiatives and disabled employment agencies, in particular Remploy, has figured in all documents. Within Document 5 it is intended to carry out further more detailed research into the second and third elements of the project relating to sustainability and the projects application to disability organisations using both qualitative and quantitative strategies.

In Document 5 the intention is to re-examine the overall topic and review the literature particularly in the light of the new found knowledge acquired during Documents 3 and 4 as well as ascertaining whether new literature has emerged over the last couple of years not previously 'discovered' within these latter two documents. There should also be an opportunity to determine whether there are any gaps within the current literature. The research questions will be reviewed further especially in the light of their re-emphasis described above, together with the way in which the work in Documents 2, 3 and 4 has brought the author to the current position, précising the key findings, not just a 'cut and paste' exercise, but to put them in perspective as to why the questions are being asked, discarding ones which are no longer relevant and adding further questions that may emerge. The conceptual framework has remained robust especially in the light of the of the author's

experiences, discussions and presentations viewed at the recent The Data Management and Information Quality Conference 2007 (2007) but again this will be reviewed. As detailed above the working definitions developed within Document 2 will be reviewed in detail as it is felt that whilst they have been useful during the progression through to Document 4, firmer and more precise definitions may be required.

The intention is to investigate via qualitative research how process improvements can be sustained per se not just within the field of data quality, but also encompassing all types of process improvement initiatives. In this way any successes will benefit all areas of related organisations. In addition it is planned to integrate the aspect of data quality research within the disabled employment community specifically within the membership of Workability International by way of quantitative survey amongst the member organisations. It is hoped that this latter research will be augmented by the author's proposed presentation at the Workability Europe annual conference next year.

It is also considered that it will be worthwhile extending the data quality measurement and analytic processes to encompass an element of determining the actual cost of poor data quality (COPDQ). In addition there may be an opportunity to examine the use of actual third party data quality tools to assist in data profiling, matching, cleansing and enrichment. The Gartner Research (2007) report into data quality tools will assist in examining the market offerings and the sources available from both long term suppliers and new entrants. It will also be useful to consider the degree to which such data quality tools contribute towards building a real quality data environment.

The document will also build upon the work undertaken within each of the preceding four documents. The different research approaches carried out in documents two, three and four will be consolidated to ensure a triangulation approach. In addition the data quality improvement initiative taking place currently within Remploy will be reviewed with particular regard to the way in which this project has contributed to and received inputs from it.

It is appreciated that there has been a substantial learning process during years one and two that will necessitate a full reconsideration of the all the research outcomes within year three as Document 5 is progressed. A reflective review has already been produced for Documents 1 to 4 and this will be continued within Document 5, which will identify the author's learning and development experiences and personal feelings as they have emerged during the process of working through each document. These will then be consolidated together with an overall personal appraisal of the way the whole DBA experience has affected the author within Document 6.

11. Reflective Review

The approach to Document 4 evolved and took a totally different direction in terms of the research that was envisaged when the plan was developed and submitted within Document 3. This is entirely in keeping with the philosophy that the DBA is a fluid event and the avid researcher must be prepared to re-position one's direction should events change. Similarly the change in the project's title has assisted in establishing a greater focus on the ultimate desired outcome(s).

I commenced the DBA thinking I was a positivist and stated in Document 1 O'Brien (2006b: 14) "The author has an initial preference for the structured approach". And "The author has a preference towards the deductive approach with particular emphasis towards Realist research". This I suggest relates to a considerable degree to a 30 plus year finance background, however by the end of Document 3 I felt far more open-minded. Within Document 3 I enjoyed the opportunity to allow concepts to both crystallise and emerge from the research process, not from a 'blank sheet of paper' or a grounded theory perspective, but more from a coming together of events that one had encountered during the research and also from the recounting of one's own personal experiences.

Document 4 has proved to be the most difficult document so far in coming to terms with what is required and within which areas one should research. Where and why did I have problems? Initially coming to terms with deciding which concepts or hypothesis to focus on, which target sample to approach and which research method to employ. This is not an indication that one is vacillating but more a case of horizons widening and a greater realisation that one should expand one's views to accept this; further evidence of the ever-changing view of research.

Document 4 has also brought home the hard realities faced by researchers in obtaining access to data and particularly in relation to potential respondents with whom one has no direct relationship. The research process for Document 3 was 'easy' in comparison, in that one had access to a relative captive audience of colleagues, most of whom one knew and in themselves were positive towards the research process that was being carried out. This document by comparison has required more of a 'cold call' approach in the majority of cases, attempting to solicit information from people by asking them to give up time in their already busy lives. At the commencement of the process I did not appreciate the enormity of the task, anticipating that the 'data quality professionals' would respond to a fellow member and research student who was attempting to expand the body of knowledge in an area to which they appeared to subscribe. In hindsight this may appear to be somewhat naïve, especially given the poor response to the IAIDQ Data Governance survey discussed earlier. The fact that one achieved a virtual 100% success rate from those persons with whom one had face-to-face contact also puts this in perspective. Nevertheless the learning experience has been an important lesson, which I can take into Document 5. It also has to be appreciated that the

survey may have been conducted at a time, pre-Christmas, that was not conducive to undertaking such a survey and to expect a significant level of response. Timing also appears to be an important factor. In hindsight an October publication may well have been more beneficial although the comments made by Yonke (2007) "Your 27 is not bad at all. Most People just ignore surveys" still resonates. Sax, Gilmartin and Bryant (2003) contribute to an interesting discussion on response rates albeit within an educational environment.

At this stage it will be worth commenting upon the methods and techniques used to analysis the raw data, generate the findings and interpret the results as outlined in Section 9. I analysed the data within SPSS using frequency and contingency tables and then used cross-tabulation to test these against what one considers to be, the most important demographic category. The results were then commented upon within the text. Certain of the questions also benefited by having their results analysed in tabular form to enable adequate comparisons to be made. I then attempted to collate my findings in a format that would enable me to be able to interpret then and produce some worthwhile conclusions. For this I used a simple table analysing those responses that I felt were of a level significant enough to interpret and make some form of rational decision with whatever caveats were deemed necessary. In carrying out this task I employed my own methods and techniques of data analysis, presentation, interpretation and decision making that I have use successfully within my own working environment for a considerable period of time and with which I am extremely comfortable. I also felt that this was adequate for the task. I appreciate that there are more sophisticated methods available particularly to measure levels of significance and to this end I did carry out Mode, Median, Range calculations but would question their relevance here, together with Chi-squared tests, symmetric measures involving Phi and Cramer's V, together with nonparametric correlations involving Spearman's rho. I did not feel entirely comfortable using such seemingly complex measures, totally new to me, to process the results of what I consider to be a fairly basic survey and to this end I decided to stay in my own zone of comfort. In addition one feels more at home presenting information in the form of numbers rather than using graphical representations. This might find some resonance within Sayer (1993: 200) which talks of the 'exaggeration of the power of quantitative methods'.

A number of events have put the DBA in perspective, in particular, one's improved ability to communicate both verbally and via the written word, which from recent personal experience is invariably in the form of email and short reports. I feel more confident of putting down my thoughts and feelings in sentences and paragraphs than ever before in a coherent and succinct manner. This increased confidence has also manifested itself in seemingly improved verbal communications. All of this is probably the result of acquiring new skills and developing greater self-confidence and self-awareness. One started off concerned about the 'daunting' prospect of producing Document 1 with a target word count of 5000. Presenting a major piece of work is by no means an easy process, but I now feel I can see the 'end' with Documents 5

and 6 in sight. Document 5 will be more focussed- relating to the honing down of experiences, expectations, training, education or an amalgamation of all of these plus greater confidence in one's own abilities to present this major piece of work. Reflecting back to Document 1, I appreciate that the learning curve has continued almost subliminally with step-change improvements.

During the final session of the September 2007 Workshop each individual was asked to provide examples of their personal development arising from the Programme so far. As evidence of my development I identified:

- The example I gave in Document 2 O'Brien (2006a: 56) of an 'epiphany' moment which arose after reading a chapter covering data integrity in Wallace and Kremzar (2001: 202) a good book covering ERP implementations, which turned around my thought processes. In the section relating to inventory cycle counting it states that the justification for inventory counting is to identify inventory errors and then take action to eliminate them, the actual correction of records being far less important. The priority being to discover and eliminate the problem NOT just 'correct the error to get the books right', but rather to prevent the symptoms arising rather than just cure them.
- Better quality prose in both academic and commercial writing- feeling more fluent in the matter of expressing myself both verbally and in writing- as discussed above

The author feels fortunate in the manner in which the DBA programme has assisted both in personal and career development. The DBA and the working environment have both benefited immensely from this interactivity bringing an academic and a practical perspective to a business problem in the true spirit of the DBA concept. I feel really thrilled the way in which data quality management has gained much more prominence within Remploy from a virtual 'zero' position two years ago prior to the commencement of this DBA, to now being an essential part of mainstream company reporting and control.

One feels extremely gratified about the apparent robustness of the Conceptual Framework developed within the first twelve months of the programme and the way this has stood up to scrutiny at every level and equally by the way it depicts all aspects of, not only this project, but data quality improvement processes in total.

One has read and digested a large amount of literature around the subject of surveys, questionnaires etc, covering advantages, disadvantages, guidelines, hint, tips and notes in general. I decided that the main text should focus upon the salient points and arguments and not be 'padded' with a mere list of supporting evidence however valuable it may be in the overall context of this document. However I felt that it is important that I recognised the literature that has helped me in undertaking this document and which I feel is significant not

only for its contribution but also as evidence that the subject area has been widely addressed. To balance the aims of focus and recognition, I have therefore referenced a good deal of the support material within Appendix 3 General Guidance Notes, in list form arranged within relevant sections relating to surveys, questionnaires and online surveys, with a reference from the main text.

My membership of the International Association for Information and Data Quality (IAIDQ) during the last year has proved to be extremely beneficial and influential. It has provided a means of obtaining information, meeting like-minded individuals, making a short presentation at the Information Forum in Dublin in February 2006 and having access to a source of expertise on which to draw support, whilst being part of the premier professional organisation for data and information quality. A body of members who appreciate that information and data quality is a core competency in today's realised Information Age. The purpose of the Association is to create a worldwide community of people who desire to reduce the high costs of low quality information and data by applying sound quality management principles to the processes that create, maintain and deliver data and information. Furthermore the Association's mission is to:

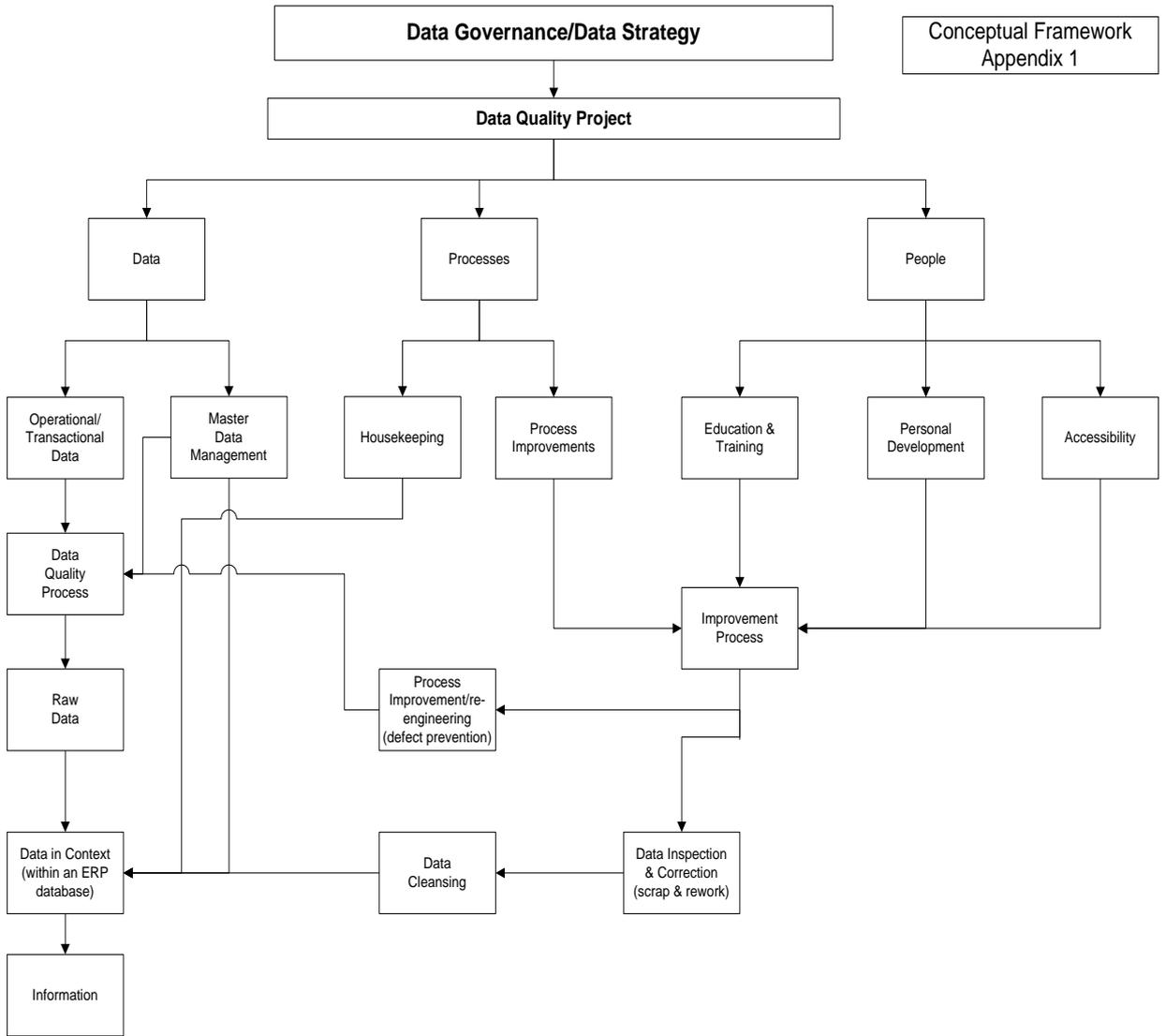
- Increase the awareness of the impact of poor quality data and information.
- Help leaders understand that the high losses can be dramatically reduced.
- Provide a network for members to exchange tips and techniques for quality improvement.
- Provide opportunities to learn critical skills for making quality information and data a reality.

I can associate myself with all of those aims, ideals and aspirations all of which are totally compatible with my own philosophy, which incidentally was developed prior to encountering the Association. This should be no surprise because they capture those sound business principals, processes and working practices to which every organisation should aspire.

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APPENDIX 2

Initial Draft Questionnaire

It is considered that a valid approach will be to attempt to test the main concepts & hypotheses that have emerged from the first three documents, the initial outcomes of the DQ initiative within Remploy, together with the author's own experiences over time, by devising a series of questions and/or statements encompassing elements of each.

Using a:

1. Likert-type scale comprising categories:

Strongly agree

Agree

Uncertain

Disagree

Strongly disagree

2. Rating scale 1 – 5

3. Ranking scale 1 or 2 or 3 etc

1. To validate the concepts of:

- a. The Total Quality Management principles of root-cause error prevention.
- b. The applicability of the generic process model to a data and information system
- c. The applicability of the overall Project's conceptual framework comprising People, Processes and Data etc
- d. The working definition of 'Data Quality' as "having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise"
- e. Possibly review other working definitions?

2. To quantify the adequacy of ERP systems:

- a. Overall data quality
- b. Master data quality
- c. Transactional data quality
- d. System 'Housekeeping'

3. To identify the root-causes of data problems and issues

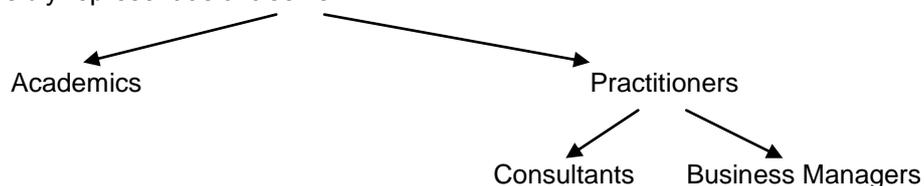
- a. Sources
 - Employees
 - Customers
 - Suppliers
 - External systems interfaces
 - System errors

- External data sources
 - Etc
 - Potential for above to be sub-divided further
- b. Reasons
- Poor data entry
 - Lack of user knowledge, training and education
 - Poor processes
 - Poor management
 - Etc
 - Potential for above to be sub-divided further

To be developed further with possibility of the questions being semi-open by providing adequate space for additional comments where appropriate.

Points:

1. Need Substantive & Demographic data
2. Critical framework adds a flavour of bringing order to things
3. I can use an in-house organisational database
4. Compare with my analysis of Remploy site workshops in Doc 3
5. Test my hypotheses- Concepts 1 a-c ties into research question definitely No 7
6. Make it clear that the membership/population of IAIDQ is not only the source but will make a significant contribution because of the commitment to improve practice- peoples' opinions
7. Look at the limitations of the study
8. Also look a 'soft data' approach
9. Use a little demographic material to assess the features of the respondents- ie, position; type & size of business/function; institutional affiliation/position; gender; sex; experiences etc & weight the responses accordingly. How far are they removed from real businesses?
10. Possibly represent as a 'tree' ie:



11. Rating (1 to 5) or scaling (each allocated a different number- 1 or 2 or 3 etc) both 'Ordinal'
12. See Colin's book p164
13. Cost of poor data quality (COPDQ)
14. Incremental improvements- tie in research questions to the above in particular 7 & 8
15. Look out for jargon

DOCUMENT 4 GENERAL GUIDANCE NOTES**A. Surveys****1. Survey Design**

Oppenheim (1992: 7-8)

The actions that should ideally take place at the very beginning of the research process:

- a) Decide on the aims of the study and possibly the theories to be investigated
- b) Review the relevant literature with interested organisations
- c) Undertake a preliminary conceptualisation of the study, followed by the development of research objectives
- d) Decide on the design of the study, assess its feasibility and limitations and revise if necessary
- e) Decide upon the hypotheses to be investigated ensuring that they are appropriate to the situation
- f) Design or adapt the necessary research instruments and methods
- g) Pilot the agreed research instruments
- h) Agree the sample to be used ensuring that it is representative
- i) Select the sample to be researched
- j) Carry out the fieldwork, involving data collection, control of the operation and the collection and checking of the returns
- k) Process the data
- l) Carry out the statistical analysis
- m) Assemble the results and test the hypotheses
- n) Write up the research report

2. 20 Top Tips to Writing Effective Surveys

We Poll (2007)

- a) What is the purpose of the survey?
- b) Title the survey
- c) Don't make the survey longer than it needs be
- d) Use plain English avoid jargon & acronyms, maintain consistency & avoid questions, which could give ambiguous answers. Make sure the questions are clear
- e) Avoid long questions, use short sentences
- f) Ask one question at a time
- g) Avoid influencing the answer
- h) Ensure the answer format allows the respondent to answer the question being asked
- i) Consider how the data will be analysed
- j) Ensure the questionnaire flows, group questions into clear categories
- k) Target your respondents- a specific group, cross section etc
- l) Allow the respondents to expand or make comments
- m) If the survey is to be confidential ensure your pledge is upheld

- n) Weigh up the benefits of allowing respondents to be anonymous or identifiable
- o) Give careful consideration to the best response format
 - Consistency
 - Radio buttons
- p) Give the respondent an idea of how much time the survey will take

- q) Inform the respondent of the survey end date
- r) Pilot the survey
- s) Before publishing the survey proof read several times
- t) Remember to say thank you

B. Questionnaires

3. A General Introduction to the Design of Questionnaires for Survey Research

(University of Leeds)

Burgess (2001)

- a) Define your research aims
 - Review the literature carry out preliminary research
 - Select relevant, clear, concise and efficient question to maximise the response rate
- b) Identify the population and sample
 - Population- all members of the group one is interested in
 - Sample- a sub-set of the population as the total may be far too large. Should be representative of the overall population
 - Sample frame- a randomly chosen list
 - Sample size- work back from the number of responses required times the anticipated response rate
- c) Decide how to collect replies
 - Structured interviewing
 - Self-administered- distribute by mail, email attachments, via a web site
- d) Design your questionnaire
 - Determine questions to be asked
 - Decide on a layout and sequence- group together all questions of a similar nature
 - Make the flow logical and simple
 - Question types- open v closed questions, single v multi response, ranked and rated responses
 - Question wording- concise and unambiguous, avoid double questions or those containing negatives, ask for precise answers and avoid leading questions

- Confidentiality and ethics- beware of personal questions & taking offence and the Data Protection and Human Rights legislation. Only use the data for its intended purpose and avoid misleading the respondents
- e) Run a pilot survey
- Test on a small sample of the intended subjects
 - Refine questions as appropriate, converting open questions into close if necessary
- f) Carry out the main survey
- Identify respondents and keep track of status
 - Number each questionnaire
 - Delivery- decide upon method of distribution, deadlines and reminders
- g) Analyse the data
- Data from the questions will be in the form of variables and any question may have more than one variable (or variable characteristics) attached to it
 - Variable may be measured in levels in the following order of sophistication: Nominal, Ordinal, interval Ratio (the latter two may be grouped together under title 'scale')

4. How to design a questionnaire

Wai-Ching (2006)

- Advantages

Open format- Allows exploration of the range of possible themes arising from an issue and can be used if a comprehensive range of alternative choices cannot be found.

Closed format- with a quick and easy to complete questions enabling easier comprehension especially for those persons who are less articulate or literate. They are easier to code, record, analyse and report.

Self administered- Cheap and easy to administer in a standardised format, whilst enabling the respondent to complete the questionnaire at their convenience and at the same time preserving their confidentiality

Interview administered- Enables the research to answer any queries the respondent may have and provide clarity and is particularly useful in situations where the sample includes illiterate persons.
- Format of Questions

Use short and simple sentences asking for just a single piece of information at any time, avoiding any negativity if at all possible. The questions should be precise and to the point asking for the specific level of detail required whilst ensuring that the recipient has adequate knowledge of the subject matter. One should always be vigilant voiding potential bias in the questioning or inviting the respondent to reply in what may be deemed a socially acceptable way. Questions can be worded to generate open or closed responses or a

mixture of both by employing a series of optional replies with a final option of 'other' complete with a space for an explanation. The length of the questionnaire depends upon the circumstances but evidence suggests **that** short simple questionnaires normally generate higher response rates than longer more complex ones.

- Order of Questions

It is suggested that it will be beneficial to list the questions ranging from general to particular, easy to difficult, initially employing closed questions, dealing initially with the main subject and concluding with demographic and personal questions.

5. Designing and Administering Questionnaires- Check List

Bell (2005: 150-153)

- a) Make sure you have approval to proceed before you move too far on with your preparation. Never assume it will be 'all right'
 - Check requirements of your ethics, research and any other committees which have responsibility for approving the research
 - Approval may take time, plan ahead
- b) Decide what you need to know and list all items about which information is required and consider why it is needed. Avoid irrelevant items
- c) Is a questionnaire the best format for obtaining the required information?
 - Consider that information is required
 - Is another method more appropriate?
- d) If you decide a questionnaire is best, begin to write down word questions on separate cards or pieces of paper to assist ordering.
- e) Check the wording of each question for ambiguity, imprecision or assumption. Will the respondents be able to understand and answer the questions do they have the knowledge?
 - Look for leading, presuming, hypothetical or offensive questions
 - Keep the language simple and which respondents can understand
 - Beware of technical language unless one is dealing with a professional group
- f) Decide on the question type, whether it be verbal, list, category, ranking, scale, quantity of grid; each of which requires a different analysis
- g) When you are satisfied that all questions are well worded and of the right type, sort them into order, leaving sensitive questions until the end
- h) Write out instructions to be included on the questionnaire. Respondents must be quite clear about how they are to answer (tick boxes, circle items, yes/no etc)
- i) Consider layout and appearance with instructions clearly prominent. Decide on form of analysis to be used prior to finalising structure and layout
- j) Word process the questionnaire

- k) Decide upon the sample. Try to select the sample as close to the final population as possible, explain reasons
- l) Always pilot the questionnaire. Ideally to members of the selected sample or one's colleagues
- m) Try out the intended methods of analysis
- n) Make adjustments in the light of the responses from the pilot.
- o) Decide as to how the questionnaire is to be distributed and returned
 - With or without anonymity and confidentiality
 - Distribution by mail, email, web link, personal approaches etc
 - Consider mechanism by which they will be returned
- p) Specify preferred completion and return dates. Maintain records of distribution and receipts
- q) Decide upon policy for dealing with non-respondents
- r) Record responses as they are received
- s) Beware of using complicated statistics without a thorough knowledge

6. Tips for Developing an Effective Questionnaire

Pollmanager (2007a)

- a) Write a good introduction
 - Objectives
 - Instructions
 - Estimate of time to complete
- b) Ask questions that provide the information & satisfy objectives
- c) Ask important questions first, demographic questions last
- d) Organise questions into logical groups
- e) Use easy to understand plain language- test to ensure comprehension
- f) Avoid technical terms, jargon and acronyms
- g) Use even number of responses, avoid 'neutral' answers
- h) Randomise the order in which the responses are displayed, removes order
- i) Avoid unnecessary graphics & embedded components
- j) Be sensitive to the respondents, test the survey
- k) Thank the respondents
- l) Keep it short, simple & to the point

C. Online Surveys

7. How to Conduct Effective Online Surveys

Pollmanager (2007b)

- a) Identify & understand your objective
- b) Identify what information do I need to achieve the objective

- c) The quality of the questions will determine the results & the effectiveness of the survey
- d) Test for feedback
- e) Provide the URL to take people directly to the survey
- f) Tell recipient how to contact you if they have problems
- g) For online surveys most people will respond within 72 hours of receiving the invitation
- h) Send out reminders
- i) Relate analysis back to the objective

8. Web-based Questionnaires Online Survey User Guide

lap (2006)

- a) Web based surveys assume that respondents have access to a computer and are to a certain extent computer literate. In addition those with certain physical disabilities may encounter difficulties. However 'assistive technology in the form of specialised devices may overcome such problems.
- b) The availability of graphic design features may enhance the formatting of the questions and the overall appearance but should not be over done so as to distract from the main purpose of the process
- c) Response format:
 - Use matrix questions sparingly or with caution as they can place an extra burden on respondents especially when represented on a screen or terminal. Further there may be inconsistencies between individual web browsers. Use a simple approach at all times
 - Radio buttons require precise clicking and are most appropriate for 'select one only' type questions
 - Check boxes- can be used but may be preferable to use a matrix if there are numerous options
 - Drop-down boxes should be used sparingly and are most appropriate for long lists. It should be noted that they require up to three mouse actions compared with one for other formats, free typing may be quicker. Avoid multiple selection questions and also consider use of 'drop-up' boxes as an alternative
 - Text input- ensure that there is sufficient space to the full required text, not easy to validate therefore clear instruction must be provided as to the required format particularly re dates ie DD/MM/YY etc. Take care about scrolling
- d) Questionnaire layout
 - The colour and the multimedia facilities can enhance the overall appearance but use graphics sparingly

- Logos should be placed in the top left, with all menus, questions and answers having a full left alignment
 - Try and avoid the requirement for excessive scrolling by having a number of questions per page, have a balance between too cramped a style and one too expansive this will assist in optimising respondent attention and ensure a greater overall response.
 - Commence with a question that is interesting and can be easily understood and answered, ensure all subsequent questions are in a constant format with particular regard to layout, numbers, spaces and answers. Structure the questions so they form a logical pattern. Eliminate unnecessary questions.
 - Ensure that adequate instructions are provided, with an email address to report problems, ask questions or request clarification.
- e) Control and Security
- Password or pin-protect the survey to avoid duplications, secure confidentiality and control access to specific respondents. This will also ensure respondents' privacy.
 - Computer controlled web-based surveys enable automatic error checking and validation processes to be built in, provide calculations and generate output into statistical manipulation tools.

9. Guidelines for Designing and Implementing Internet Surveys- summary

Schonlau, Frickerer and Elliott (2002: 41-53)

- a) Questionnaire design
- List only a few questions per screen
 - Eliminate unnecessary questions
 - Use graphics sparingly
 - Be aware of how respondents may interpret questions in the light of accompanying graphics
 - Use matrix sparingly
 - Reduce response errors by restricting response choices
 - Force answers only on rare occasions
 - Make error or warning messages as specific as possible
 - Always password-protect web surveys
 - Ensure that respondents' privacy and their perception of privacy are protected
 - Provide some indication of survey progress
 - Allow respondents to interrupt and re-enter the survey
 - Carefully handle respondents who fail to screening test
 - Give respondents something in return in return

- Take advantage of the media's presentation capabilities
- b) Automating the survey process
- Automatic skip patterns
 - Automatically validate input, if possible
 - Take advantage of the electronic media's ability to track respondent behaviour
 - Take into account the cost of automation
- c) Implementing and fielding the survey
- Thoroughly test the survey
 - If a large number of respondents are contacted via e-mail, stagger the e-mail invitations
 - Enable respondents to report problems
 - Anticipate potential changes while the survey is in the field
 - Make sure that researchers or survey sponsors can access the Web survey during the fielding
 - Remember to follow up on the incomplete surveys

10. The advantages and disadvantages of online surveys compared to postal questionnaire surveys- summary

Bryman and Bell (2003: 512)

a) Advantages

- Low cost
- Faster response
- Attractive formats
- Mixed administration
- Unrestricted compass
- Fewer answered questions
- Better response to open questions

b) Disadvantages

- Low response rate
- Restricted to online populations
- Requires motivation
- Confidentiality issues
- Multiple replies

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From: Tony O'Brien
Sent: 30 December 2007 10:46
To: Tony O'Brien
Subject: RE: IAIDQ November Member Email Update

Appendix 5

-----Original Message-----

From: IAIDQ Member Communications [mailto:webmaster@iaidq.org]
Sent: 29 November 2007 12:32
To: Tony O'Brien
Subject: IAIDQ November Member Email Update



International Association for Information and Data Quality

IAIDQ Member Update - November 2007

Dear IAIDQ Members,

Welcome to the November Member Update email.

Despite Conference Fatigue and Election Fever, it has been another busy month for the IAIDQ, with new members joining, new Communities of Practice being suggested and work progressing on a number of other Strategic programmes.

On behalf of the Board of Directors, I'd like to take this opportunity to welcome our new members, including our latest Corporate Member, PricewaterhouseCoopers in Ireland.

1. Election Update
2. Communities of Practice updates
3. Sponsorship of Ballou-Pazer IQ PhD Award
4. Academic Research Support
5. IQ Forum Relunched
6. The Blog Carnival of Data Quality
7. World Quality Day 2008
8. Information/Data Governance Survey
9. Ask-The Expert / Book Club
10. 2008 Information and Data Quality Conference
11. ...And Finally

Election Update

The closing date for ballots for our Board of Directors Elections is looming. If you have not already voted please do so soon. If you have not received an

email ballot or if you would prefer to cast your vote via an alternate means to our web- based voting, please contact the [Elections Committee](#). Your vote helps shape the makeup of the Board and is important. Polling is open until **December 14th**.

Communities of Practice Update

Geographic Community of Practice

IAIDQ member Milan Kucera is seeking to establish a Community of Practice covering the Czech Republic and Slovakia. Milan is an experienced consultant in the field of Information Quality and is extremely passionate about the field. If you are living in, working in or are connected to either the Czech Republic or Slovakia then please email Milan at Milan.Kucera@id2i.cz.

Find us on LinkedIn

To help build our Community of Like Minded People, I've set up a Group on LinkedIn.com, the Professional Networking site. To join the IAIDQ Group on LinkedIn, just [follow this link](#). You need to be registered on LinkedIn to join the group. This is just another way we are seeking to help IAIDQ members in common geographic locations, industries or with shared areas of interest connect and get to know each other.

Irish Community of Practice pre-Christmas get together

The Irish Community of Practice (the IQ Network as it's known locally) is planning a small informal get together for members on the 6th of December. At the risk of falling into a cultural stereotype, the meeting point is Kennedy's Pub on Westland Row from 19:00hrs. All IAIDQ members are welcome to join us if you are in Dublin. Please email Daragh.O'Brien@iaidq.org for further details and to confirm attendance (and if you can't make that night I'm sure we can plan a repeat!)

Sponsorship of Ballou-Pazer IQ PhD award

IAIDQ Advisor Dr. John Talburt recently presented a cheque for US\$1000 to the Programme Committee for the Ballou-Pazer Information Quality PhD award which is presented as part of the MIT ICIQ Conference.

This award was formally launched this year and Dr Talburt made the announcement and presentation of the IAIDQ's sponsorship at the opening session. Don Ballou personally accepted the cheque on behalf of the Ballou-Pazer Programme committee.

[Click this link for more information about the Award, and about Don Ballou and Harry Pazer for which it is named.](#)

"Academic study of the tools, techniques and practices in Information Quality is an important contribution to the Body of Knowledge in the field and must be encouraged and recognised." says Lisa Dodson (President IAIDQ). "The IAIDQ was honoured to be invited to contribute to the seed fund for this award and we look forward to supporting the Ballou-Pazer award in future years".

Speaking of which....

Academic Research Support

One of the many roles the IAIDQ plays is as a supporter of research and study in the field of Information/Data Quality. We've supported a number of research programmes this year, with the following being one of them. Rather than hog the limelight, I'll let the Researcher, Tony O'Brien (British Isles CoP) tell you about things himself:

I am a student on the Doctor of Business Administration programme at Nottingham Trent University in the UK and a student member of the IAIDQ. My doctoral research is focussed upon 'Creating and sustaining data quality within a diverse Enterprise Resource Planning and Information System with particular regard to organisations employing disabled people'.

I have carried out a review of the subject literature which together with certain research carried out within my own organisation plus my experiences over time, has enabled me to develop certain concepts, which I would like to explore and test within a data quality 'expert' community. My aim is to conduct a web based questionnaire survey amongst DQ professionals, with a view to examining the validity of these concepts and collecting any feedback you are able to provide. The content of this questionnaire is confidential and will be used for doctoral research purposes only. It will not be presented in any format that could be related to any specific individual or organisation.

Tony's survey is short and to the point and he would greatly welcome input from IAIDQ members. Copies of the final summary report will be made available to respondents. To fill out Tony's survey and contribute to this research, [please click on this link to the survey...](#)

IQ Forum Relaunched

As part of our recent move of our website to new servers, Grant Robinson (VP Web Services) has completed an upgrade of the IQ Forum mailing list. This has given the IQ Forum list some more 'customer friendly' features.

- Security is improved - Mailman will set a password. It will remind you of your password each month. And Mailman knows you by name, not just email address.
- More options on how you receive the email - you can choose to receive all posted emails one at a time, or in a daily digest.
- Increased Self Service - Mailman allows you to change a range of settings including your email address, password and options about how you send and receive forum emails.
- Community - you can see who else has subscribed to the IQ Forum.
- Better Archive support - for when you are absolutely you saw the answer to your question there a few months ago...

"We are continually seeking to deliver stable and reliable improvements to our web services", says Grant, "The change of servers gave us a chance to have a 'quick win' by switching to Mailman. However we are evaluating and working on other enhancements for the future to improve our supports for members."

The IQ Forum can be found under ["Services and Products" on the IAIDQ Website](#)

Blog Carnival of Data Quality

An interesting email came across the IAIDQ Publicity Office desk this month telling us about an activity called "The Blog Carnival of Data Quality" which is being organised by Vincent McBurney (who is a regular contributor to ITToolBox.com and has a refreshing take on information/data quality topics). Vincent's intent with the Blog Carnival is to get people who blog on Information Quality topics to connect (hey... that's OUR idea!!).

What is a 'Blog Carnival'? Well according to [blogcarnival.com](#):

A Blog Carnival is a particular kind of blog community. There are many kinds of blogs, and they contain articles on many kinds of topics. Blog Carnivals typically collect together links pointing to blog articles on a particular topic. A Blog Carnival is like a magazine. It has a title, a topic, editors, contributors, and an audience. Editions of the carnival typically come out on a regular basis (e.g. every monday, or on the first of the month). Each edition is a special blog article that consists of links to all the contributions that have been submitted, often with the editors opinions or remarks.

For more information on the Blog Carnival of Data Quality (due out 30th Nov) visit

[Vincent's blog on ITToolbox.com](#). Tell him we sent you!

World Quality Day 2008

Right folks, this is the first warning.

The Thursday of the second week of November 2008 is the **13th of November**. That means that *World Quality Day* is on the 13th of November in 2008.

I will be posting a regular count down to this date during the coming months as this is a wonderfully neat target date for us each to do something or to have something done by in the field of Information Quality.

If there is something that members would like to do collectively, collaboratively or continuously during the week leading up to World Quality Day please let the Board know your ideas and we will work to develop and deliver on them with you.

Information/Data Governance Survey

The survey is now closed. IAIDQ and the MSIQ Program at UALR would like to thank the hundreds of people who contributed to this survey. A report on information/ Data Governance based on the survey responses is now being compiled and will be ready in January 2008. We will also be randomly awarding the four incentive prizes to survey participants shortly and will be notifying the winners in early December.

Ask-The Expert / Book Club

There will be no meeting in December. Many thanks to all of you participated in the excellent sessions we had in 2007! Looking to meet with you again virtually at our January 2008 session.

2008 Information and Data Quality Conference

Please mark you calendars and budget some time and money to attend the 2008 Information and Data Quality Conference, to be held at San Antonio, Texas, 22-25 September 2008.

Plans are already under way to make it another successful event.

...And Finally

I seem to be getting in the habit of letting myself get late with these email updates. But that is because we are entering such an interesting time with regard to Information Quality and the evolution of the IAIDQ as the leading organisation for people working or researching in this field.

The initiative of Vincent McBurney in setting up the Carnival of Data Quality shows how important it is for us to start connecting with each other to build the Community of Like Minded people we are seeking. The bridges we are building with the MIT IQ community is part of that Community building. The efforts of members like Milan in the Czech Republic, Bryn Davies in South Africa and Keith Underdown in the British Isles (and let's not forget the crazy Irish) are examples we can all work from. If **we** build it then *WE* will come!

Thanks,

Daragh O'Brien

VP Publicity & Recruitment, IAIDQ

Email: daragh.obrien @iaidq.org

URL: iaidq.org

Click [here](#) to report this email as spam.

--

This email has been sent to all current members of the International Association for Information and Data Quality (IAIDQ). Website: iaidq.org

You are subscribed to IAIDQ with the following email address:

tony.obrien@remploy.co.uk

If you have forgotten your members zone password please contact webmaster@iaidq.org. If you need to change your password or email ID, please contact the IAIDQ office at info@iaidq.org

If you have any queries about this email list, please contact the list administrator at:

webmaster@iaidq.org

If you wish to correspond by ordinary mail, our office address is:

International Association for Information and Data Quality,
19239 N. Dale Mabry Hwy, #137
Lutz, FL 33548
USA

	Types of Variables	Appendix 6
TONY O'BRIEN		
SURVEY ON DATA QUALITY		Types of Variables
1. Please enter your name	<input type="text"/>	Personal information
2. Email address If you would like a copy of the final summary please indicate	<input type="text"/>	Personal information
3. Country	<input type="text"/>	Personal information
4a. Are you a member of the IAIDQ?	Yes <input type="checkbox"/> No <input type="checkbox"/>	Semi-Dichotomous
4b. Are you a member of any other data quality related body?	If yes please specify <input type="text"/>	
5. No of years experience within the field of data quality	Less than 1 year <input type="checkbox"/> 1 to 4 years <input type="checkbox"/> 5 to 10 years <input type="checkbox"/> 11 to 15 years <input type="checkbox"/> More than 15years <input type="checkbox"/>	Ordinal
6. What is your main job role?	Accounting/Finance <input type="checkbox"/> Business End-User <input type="checkbox"/> Business Manager <input type="checkbox"/> Consultant <input type="checkbox"/> HR <input type="checkbox"/> IT Manager <input type="checkbox"/> IT Staff <input type="checkbox"/> IT Vendor <input type="checkbox"/> Lecturer <input type="checkbox"/> Others (Specify) <input type="checkbox"/> Sales/Marketing <input type="checkbox"/> Senior Executive/Director <input type="checkbox"/> Other (please specify) <input type="text"/>	Nominal
7. What is the approximate turnover of your organisation? (NB: value in US\$)		Ordinal

0-\$5million	<input type="checkbox"/>
6-\$10million	<input type="checkbox"/>
\$11-\$50million	<input type="checkbox"/>
\$51-\$100million	<input type="checkbox"/>
\$101-\$500million	<input type="checkbox"/>
\$500million-\$1billion	<input type="checkbox"/>
More than \$1billion	<input type="checkbox"/>
Not sure	<input type="checkbox"/>

8. How many people does your organisation employ?

Less than 50	<input type="checkbox"/>
50-99	<input type="checkbox"/>
100-499	<input type="checkbox"/>
500-999	<input type="checkbox"/>
1000-4999	<input type="checkbox"/>
5000-9999	<input type="checkbox"/>
More than 10000	<input type="checkbox"/>
Not sure	<input type="checkbox"/>

Ordinal

9. The Industry/Sector in which your organisation operates:

Computer Manufacturing/Distribution	<input type="checkbox"/>
Computer Services	<input type="checkbox"/>
Computer Software	<input type="checkbox"/>
Consulting/Business & Professional Services	<input type="checkbox"/>
Education	<input type="checkbox"/>
Financial Services/Banking/Insurance/Legal	<input type="checkbox"/>
Government- Local	<input type="checkbox"/>
Government- National	<input type="checkbox"/>
Healthcare	<input type="checkbox"/>
Manufacturing (Non-computers)	<input type="checkbox"/>
Retail/Wholesale/Distribution	<input type="checkbox"/>
Telecommunication	<input type="checkbox"/>
Transport/Distribution/Logistics	<input type="checkbox"/>
Others (please specify)	<input type="checkbox"/>

Nominal

10. Does your organisation operate an Enterprise Resource Planning System?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

Semi-Dichotomous

11. If so within how many sites does the ERP system operate?

Interval/ratio

Very High

12. How highly will problems in the following areas impact the overall quality of data within your organisation's data systems? (including non-ERP systems)

Master Data entry	<input type="text"/>
-------------------	----------------------

Ordinal

Transactional Data processing
 System Housekeeping
 (processes that ensure that
 system orders and processes are
 kept clean and up to date)
 Others
 Please specify

13. How highly do you evaluate the impact of the following on the quality of the data within your organisation's data systems? (Including non-ERP systems)

Ordinal

Data Suppliers (persons who
 provide data)
 Data Processors (persons
 involved in processing data)
 Data Customers (persons who
 use the data output)
 Others
 Please specify

14. How large an impact will problems in data processes and procedures effect the quality of the data? (including non-ERP systems)

Ordinal

Any comments, please specify

15. How highly do you rate the following:

a. The likelihood that these will be potential sources of data quality problems

Ordinal

Employees
 Customers
 Suppliers
 External data sources
 Processing errors
 External systems
 System errors
 Others
 Please specify

b. The likelihood that these will be potential reasons for data quality problems

Ordinal

Poor data entry
 Lack of DQ knowledge, training,
 education
 Poor processes
 Poor management
 Others
 Please specify

c. The effectiveness of methods to resolve data quality problems

Ordinal

Maintain up-front error prevention

--

Identify and clean at source
 Identify and clean within the process (ie downstream)
 Identify and correct errors in reports
 Take no action
 Others
 Please specify

16. At what level *should* the responsibility for data quality sit within an organisation?

Nominal

Director
 Senior executive
 Business manager
 Site/Unit manager
 IT department
 Finance department
 Data quality manager
 Others (please specify)

17. At what level *does* the responsibility for data quality sit within *your* organisation?

Nominal

Director
 Senior executive
 Business manager
 Site/Unit manager
 IT department
 Finance department
 Data quality manager
 Others (please specify)

18. How often *should* one measure the quality of the data?

Ordinal

Daily
 Weekly
 Monthly
 Quarterly
 Annually
 Others (please specify)

19. How often *does your* organisation measure the quality of the data?

Ordinal

Daily
 Weekly
 Monthly
 Quarterly
 Annually
 Others (please specify)

20. Assistive Technology

(Hardware and software techniques developed in order to assist visually or physically disabled persons gain access to information technology with the working environment)

Does your organisation employ disabled people in the roles of Data Suppliers, Manufacturers or Customers (as defined above)?

Yes
No

Semi-Dichotomous

Does your organisation employ the techniques of 'Assistive Technology'?

Yes
No

Semi-Dichotomous

If so will you please provide details

21. Working definition of Data Quality

To assist me with my ongoing research, I have attempted to define a working definition of 'Data Quality' which I feel encapsulates the mood of the literature and ultimate vision of the subject

"Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise"

I would welcome any comments you may have on this definition:

Any additional comments with regard to this survey will be most welcome:

Document 5

The Thesis

DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

**Sustaining Data Quality-
Lessons from the Field**

**Creating and Sustaining Data Quality within diverse Enterprise
Resource Planning and Information Systems**

Document Five

Tony O'Brien

Document Five is submitted in part fulfilment of the requirement of Nottingham Trent
University for the degree of Doctor of Business Administration

February 2011

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List of Abbreviations

BPR	Business Process Reengineering
DAMA	The Data Management Association
DBA	Doctor of Business Administration
DMAIC	Define, Measure, Analyse, Improve and Control
DMBOK	Data Management Book of Knowledge
DWP	Department for Work and Pensions
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
GRC	Governance, Risk and Compliance
IS	Information Systems
KPI	Key Performance Indicator
NTU	Nottingham Trent University
PC	Personal Computer
PDCA	Plan, Do, Check, Act
POP	Purchase Order Processing
R&D	Research and Development
SOP	Sales Order Processing
TBA	To Be Agreed
TQM	Total Quality Management
UK	United Kingdom

Acknowledgements

I would like to thank my supervisors Professor Carole Tansley and Professor Alistair Mutch for their advice, support, encouragement, patience and expert guidance without which I would not have completed this programme. Thanks also go to the staff of Nottingham Business School for their support and in addition my fellow members of Cohort 7, in particular those who have stayed the course, in the hope we will remain firm friends for life.

I would also like to acknowledge the contribution of my colleagues within Remploy, in particular Nigel Hopkins who has provided fantastic support throughout this entire programme.

I am also grateful for the assistance provided by fellow members of the International Association for Information and Data Quality (IAIDQ), together with other members of the data/information quality fraternity.

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ABSTRACT

This research has identified a gap in the literature surrounding the process of improving and sustaining the quality of data within enterprise resource planning and information (ERP) systems. The study not only established firmly that quality data is an absolute necessity for all organisations, none more so than those operating ERP systems, but identified that for any improvement process to be worthwhile it must gain some degree of sustainability. For this reason this study has attempted to discover the means by which the quality of data can be improved but more fundamentally become embedded within an organisation. A detailed review of the literature was undertaken which unearthed rich material in particular around the concept of data quality and its application within business systems, from which a correlation was established between the concepts of a planning and information system and that of a product manufacturing system. A conceptual framework was then developed based upon three conceptual elements seen to be key to any data quality programme namely: *people, processes and data*.

A qualitative study was undertaken within the researcher's own organisation Remploy, employing an action research/focus group approach aligned to a data quality improvement initiative that was already in place within the organisation. A series of site meetings and conference calls took place embracing forty eight of the fifty four factories together with seven business groups. A quantitative survey was then undertaken using a web-based self-administered questionnaire distributed to a number of the researcher's colleagues within Remploy. The findings from both the qualitative study and the quantitative survey provided unique material in terms of key findings and themes. A number of principle findings then emerged relating to: the significance of the role of a 'champion' at various levels within a project; the importance of measurement, reporting and feedback relating to any improvement process; the necessity for systems and the people that use them to be allowed to mature; and the manner in which peoples' perceptions and attitudes toward data and data quality can have considerable degrees of inconsistency.

In conclusion it is felt that the outcomes of this study have the potential to both improve and sustain quality data within enterprise systems when applied to practical business and professional settings, whilst also providing the academic community with the promise of a contribution to the body of knowledge

1. INTRODUCTION AND OBJECTIVES

Introduction

There has been extensive interest in the nature of knowledge within the literature, largely related to the growth of the knowledge economy (Davenport and Prusak 1997; Davenport, De Long and Beers 1998; Hislop 2005; Orna 2005; Mutch 2008). The focus of a great deal of this investigation into knowledge management and the learning organisation has been related mainly to tacit forms of knowing Lave and Wenger (1991); Nonaka and Takeuchi (1995); Wenger (1997) and within this arena of the research, the question of *data* has tended to be rather overlooked. Other forms of enquiry however have attempted to address this issue particularly within the context of management planning and information systems (Davenport 1998; Davenport, Harris, De Long and Jacobson 2001a; Galliers and Newall 2001; Davenport and Harris 2002; Newall, Huang, Galliers and Pan 2002; Davenport, Harris and Cantrell 2004). From this research a realisation has grown that organisations that are able to collect, analyse and act on data in a strategic manner, are in a position to gain a competitive advantage within their industries, leading in some cases to domination in these areas (Davenport 2006a). This form of information management known as 'analytics' stresses that successful organisations are those that take action from their information to inform their strategic decision making Davenport (1998); Davenport, Harris, De Long and Jacobson (2001); Davenport (2006a); Davenport and Harris (2007) Davenport (2009), establishing along the way a 'fact-based culture' (Harris 2005a; Harris 2005b; Harris 2007). If this ever expanding focus on 'intelligent' business intelligence and management information is so crucial to organisational strategy, then the requirement to have quality data becomes even more paramount in manufacturing planning Gustavsson and Wanstrom (2009: 326) as well as information systems (Davenport, Harris and Cantrell 2004: 23; Stenmark 2004: 1; Economist Intelligence Unit 2006: 2, 16; Foley and Helfert 2010: 477; Davenport, Harris and Morison 2010: 1).

Extensive literature has identified the high costs of low quality data and the cost of poor data quality (COPDQ) (Redman 1995; English 1998; Redman 1998; Loshin 2001; Redman 2002; Redman 2004; English 2009). Redman (2001: Table 8.1) identified that firms may lose upwards of 10% of revenues due to poor operational data, together with other serious consequential effects relating to tactical decision making and strategy generation. A report from The Data Warehouse Institute estimated that data quality problems costs US business \$600 billion a year (5% of the American GDP) in postage, printing and staff overhead costs alone, whilst the majority of the senior managers in those companies affected remained unaware (Eckerson 2002: 3). Findings from the PricewaterhouseCoopers Global Management Survey, published at the end of 2004, identified that 75% of those surveyed reported major problems resulting from faulty data, half reported incurring additional costs resulting from the need to carry out extra internal control work, whilst a third had been forced to delay new system implementations (Ifomatica 2005: 2). There were also predictions that

during 2006/2007 more than half the data warehouse projects would have only limited success at best (Informatica 2005). A report published jointly by Dun and Bradstreet and the Richard Ivey School of Business (2006: 1) forecasted that critical data within at least 25% of the Fortune 1000 companies would continue to be inaccurate and that “every business function will have direct costs associated with poor data quality” (Dun and Bradstreet and the Richard Ivey School of Business 2006: 2). A survey conducted by the Economist Intelligence Unit on behalf of SAP and Intel reported that 72% of the survey respondents said their data was sometimes inconsistent across departments Economist Intelligence Unit (2006: 9) and that workers frequently made poor decisions because of inadequate data (Economist Intelligence Unit 2006: 21). More recently English (2009: 4-15) outlined a catalogue of corporate disasters emanating from poor quality business information amounting to ‘One and a Quarter Trillion Dollars’ (English 2009: 15). During 2009 a survey of 193 organisations sponsored by Pitney Bowes, 39% of which had revenues in excess of US \$1 billion, reported that a third of the respondents rated their data quality as poor at best, whilst only 4% reported it as excellent (Information Difference 2009: 4). A further survey found that less than one third of organisations regularly monitor data quality (Hayter 2010: 22). A Gartner report stated that “Through 2011, 75% of organisations will experience significantly reduced revenue growth potential and increased costs due to the failure to introduce data quality assurance” (Fisher 2009: 6). Conversely an Accenture study suggested that companies who are able to gain a better understanding of their customers, may be in a position to enhance their operating margins by up to six percent (Davenport and Harris 2002: 30).

The Focus of this Research

All the research carried out within this study, together with one’s personal and professional experiences, substantiates the premise that data quality is of paramount importance to the efficiency and effectiveness of any organisation, none more so than those operating enterprise resource planning and information systems. For this reason this study will attempt to discover the means by which the quality of data can be improved, but more fundamentally, become embedded within an organisation. Without the latter, any gains emanating from the former will be merely marginal or short term at best.

Data encompasses all organisations and enterprises, together with all aspects of everyday life and therefore its quality has serious implications for everyone. Document One identified and developed the concept of data quality per se and then proceeded to place this within the context of an enterprise resource planning and information system encompassing a multi-business/multi-site operation, employing disabled people. Within Document Two a conceptual framework was developed from a comprehensive review of the literature, combined with one’s own experiences. A correlation was also identified between the concepts of a planning and information system and that of a real life product or service manufacturing system both

comprising inputs, processes and outputs. Document Three expanded upon these concepts by examining further the quality management principles of initial error prevention, the identification and elimination of the root causes of data defects, combined with data cleansing and housekeeping processes. Research was carried out at a number of sites within the researcher's own organisation Remploy employing the use of focus groups in conjunction with an action research approach utilising process mapping, to study the manner in which data interacted with business processes to provide information to assist in detecting data and process problems and in identifying the ultimate ownership and responsibility. Document Four attempted to test the validity of these concepts by way of a self-administered questionnaire distributed to over four hundred data quality professionals across the world. Whilst the number of responses (29: 7%), was below initial expectations, there was reason to believe that the overall response rate was no worse than similar surveys carried out within this field. A summary of the findings indicated a high level of positive replies (76%-96%) in support of these concepts and whilst one has to balance this against the low response level, it was felt that the findings 'indicated' that there was substance to their overall validity.

Data Quality Defined

The definition of *Data Quality* employed within this research, was developed during Document Two from an extensive review of the literature as; "Having the right and correct data in the right format, in the right place, at the right time, by having one single version of the truth across the enterprise"- being an amalgam of (Redman 2004: 2; Redman 2005: 1; Griffin 2005: 2; Deloitte: 2006: 1; Williams and Beyer 2006: 2). A fundamental element of the survey conducted during Document Four, was the attempt to validate this definition. Of the seventeen specific responses, twelve (71%) were supportive whilst the remaining five provided alternative or additional definitions. This definition was also tested again within the survey conducted for this document- Section 15 Page 101. Of the twenty responses, fifteen (75%) were in agreement whilst the remaining five sought to add remarks and observations on accuracy and quality. There were no negative comments received. As in Document Four the replies were essentially positive and supportive. The placing of this definition within the overall context of data and the management of data is also discussed later within this document. It must be stressed that within this research the term 'data quality' as defined above, applies generically to both the quality of data and the quality of information. The concepts of data and information together with knowledge will also be discussed in detail in later sections.

Enterprise Resource Planning

Having established the objective of this research, as the attempt to determine the means by which quality data can be created and sustained within a diverse enterprise resource planning and information system, it is essential that an overview of enterprise resource planning as an entity be framed.

“An enterprise resource planning (ERP) system is a packaged business software system that allows an organisation to automate and integrate the majority of its business processes, share common data and practices across the entire enterprise and produce and access information in a real-time environment” (Deloitte 1999: 2). Figure 1 below highlights the integrated nature of an ERP structure or an ‘enterprise system’ Davenport (1998: 124), a model which is basically a series of generic business solutions which attempt to reflect how businesses potentially operate Davenport (1998: 125), seen by some as a political programme for organising change (Pollock and Williams 2008: 95).

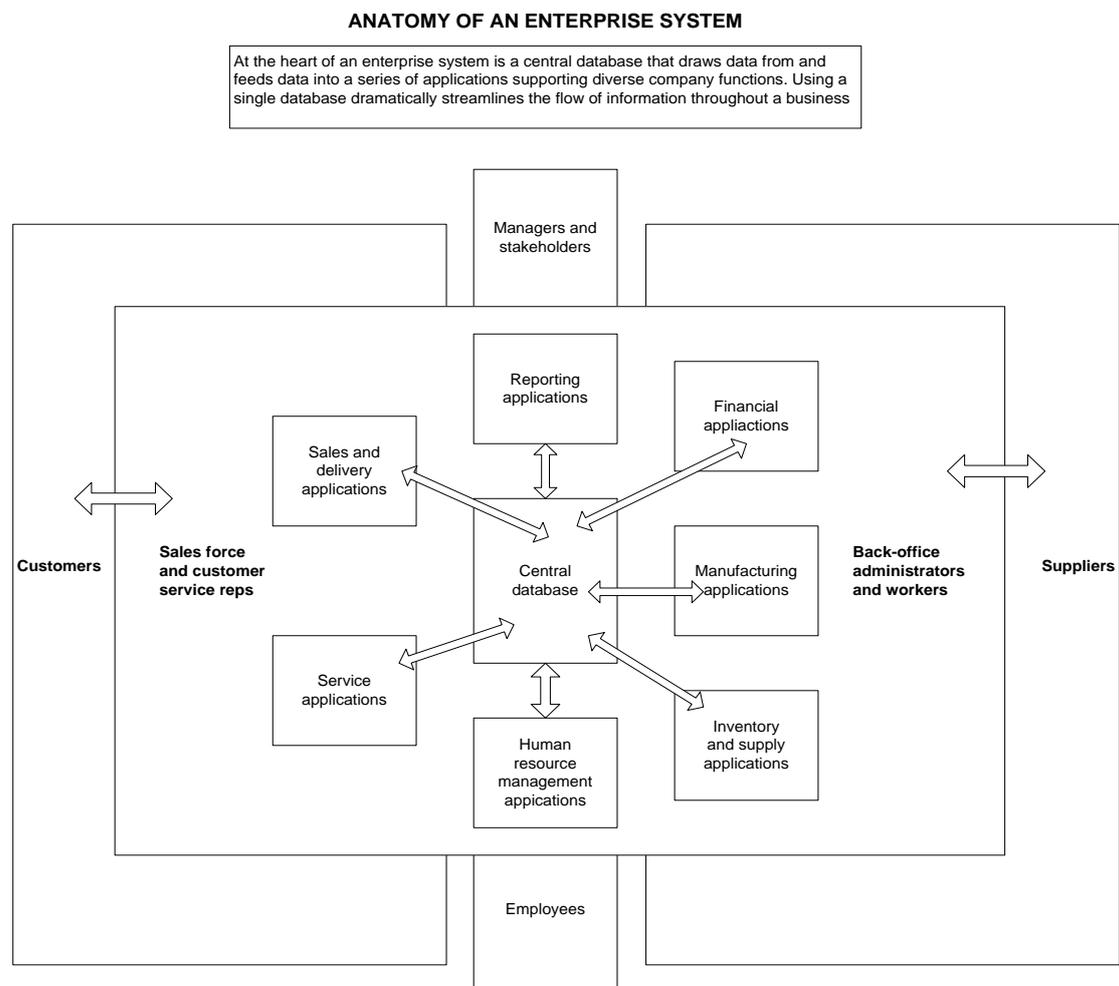


Figure 1. The anatomy of an enterprise system

Davenport (1998: 124)

Davenport (1998: 123) claimed that a good enterprise system can act as a technological tour de force with a single database at its core, coordinating and supporting virtually all of a company's business activities, but warned that if a company's systems are fragmented, its business will be fragmented also. Diverse or 'multi-site' ERP systems can be complex applications operating across multiple locations, incorporating strategic business structures, intricate software configurations, working on multiple technical platforms all of which provide organisations with serious management challenges Markus, Tanis and Fenema (2000: 43-46), requiring strong executive management and decision making (Mann 2003: 32-33).

Enterprise resource planning as a subject figures prominently within the literature; in generic terms, Klaus, Rosemann and Gable (2000); Al-Mashari (2003); Shehab, Sharp, Supramaniam and Spedding (2004); Botta-Genoulaz, Millet and Grabot (2005); Jacobs and Weston (2006); within implementation strategy and issues, Ross (1999); Markus, Tanis and Fenema (2000); Al-Mashari, Al-Mudimigh and Zairi (2002); Ho, Wu and Tai (2002); and post implementation improvements, (LaMonica 1999; Wallace and Kremzar 2001; Willis and Willis-Brown 2002; Nicolaou 2004; Outten 2005). However within this context, any in-depth focus upon the quality of the data appears to be rare (Vosberg and Kumar 2001; Wallace and Kremzar 2001; Willis and Willis-Brown 2002; Nelson 2002; Xu, Nord, Brown and Nord 2002; Davenport, Harris and Cantrell 2004: 23; Gustavsson and Wanstrom 2009: 325). This extreme bias within the literature towards initial-phase related ERP research is perhaps best illustrated by Pollock and Williams (2008:84) and Williams and Pollock (2009:3) who highlighted the fact that over ninety five per cent of the six hundred plus articles contained in *the ERP Research Group* online bibliography may broadly be described as ERP implementation studies. Such has been the fixation with 'early stage' ERP, that most of the research has focussed mainly on single site operations Williams and Pollock (2009: 2), of a short term impact, snap shot type studies of fleeting durations which lack real maturity and as a consequence may have severe limitations (Pollock and Williams 2008:84 and Williams and Pollock 2009:3). Even the literature which embraces enterprise resource planning within the themes of total quality management (TQM) and business process reengineering (BPR), which will be discussed in detail later within this study, neglected to emphasis the importance of data quality (Akkermans and van Helden 2002; Schniederjans and Kim 2003; Laframboise and Reyes 2005). One has to question whether this is a serious omission on behalf of the authors of the articles who continually fail to identify the significance of data quality within an ERP/TQM concept, or the failure of the data quality fraternity to get its message across to ERP and TQM researchers. Galliers and Newell (2001: 613) did suggest a refocusing on the management of data within ERP systems rather than concentrating on knowledge per se, especially within diverse and dispersed organisations, but omitted to make any direct reference to data quality.

The complex nature of the 'Davenport model' illustrated above with its integrated modular processes and activities, attempts to serve all the departments within an enterprise from a

single database, providing a single version of the truth throughout the entire organisation by means of a unified system; a form of processual behemoth. The model illustrates how the functions of the organisation are interrelated whereby the effect of a single transaction has a knock-on effect within or between departments of the enterprise. An ERP system operates horizontally across an organisation working within and between functions, departments and businesses, whilst in contrast most organisations manage and control vertically. This potential management misalignment may cause control problems if not recognised and eliminated, as data and information move from one department or function to another. Consequently there has to be ownership of this data or information that is passed or forwarded onwards. Organisations must recognise this potential incongruity and manage the data and information to match the required processes and data flows. This should be viewed as a supplier/customer relationship with the same responsibilities towards customer relations and satisfaction as exists or should exist in external commercial relationships. The model can become even more complex where the ERP system encompasses more than one organisation, crossing numerous countries with differing currencies, languages and time zones. Managing such complex data flows and processes is paramount. It is essential that these issues are addressed at the optimum level highlighting the absolute necessity for having some form of Data Governance policy.

Whilst the 'ERP model' is expanding further and further into multifarious organisational types, the heart of most enterprise systems are commercial transactions involving the supply of goods or services, encompassing sales, purchasing, manufacturing and distribution, all of which have financial implications. A customer order for a manufactured product will progress from an initial enquiry to final completion and payment, as the physical processes of order satisfaction, inter-act with the data flows and processes within the ERP environment. In many ways the 'system' drives the physical processes, indicating what, when and how, to purchase, manufacture, supply and distribute products to enable customers' requirements to be satisfied, in addition to recording all of the financial transactions and results. An aspect of the research carried out for this project has been the attempt to identify the impact that these elements have upon the quality of the overall data. It is intended that this model will apply equally to the provision of goods and services in both commercial and not-for-profit organisations.

Remploy

A considerable portion of the detailed research undertaken as part of this entire study has been carried out within the researcher's own organisation, Remploy. Whilst the fundamental aim of this entire research is to add to and develop the pool of knowledge within professional and management practice, it will be useful to place the company within this overall context.

Remploy is the largest provider of employment opportunities for disabled persons in the UK, currently employing over three thousand disabled people in over sixty individual factories and offices across the entire country, whilst placing over 10,000 others into external open employment, a figure which may expand by up to a factor of seven over the next five years. A Baan/Infor ERP system was implemented over ten years ago and whilst there have been many benefits overall there is still considerable scope for further improvements especially within the areas of data quality and system complexity. Maintaining sustainable quality data within any ERP system can be problematical at best, but when one factors in an organisation with twelve individual business streams operating within such diverse areas as automotive, electronics, packaging, PC recycling, healthcare, furniture, in addition to manufacturing protective clothing against nuclear, chemical and biological threats for the UK military and police, the overall picture can become very complex with a high potential for errors and problems. This position is complicated even further when it is then superimposed upon the current network of over fifty separate factories with over 800 active users, over 500 of which are disabled in one form or another. This level of complexity within an organisational structure, together with such a unique ERP community, provides a valuable environment within which to undertake this research, generating knowledge to benefit both the management and professional communities in general, as well as similar disabled employment organisations. A more detailed description of the company including its mission, principles, ERP history and IS strategy, together with its relations with similar organisations throughout the world, is contained within Appendix 1.

Review and Development of the Research Questions

The ways in which the research questions have evolved during this study reflects the maturing nature of the research. Questions one to three emerged from the proposal and planning process within Document One, whilst questions four to six were developed from the literary review and conceptual framework in Document Two. The total quality management philosophy of 'right first time' is a guiding principle that has influenced one's approach to this subject and from this two further questions, seven and eight, emerged during Document Three: They are all reproduced below to provide a vision of this evolutionary process

1. What are the attributes of data quality with particular reference to ERP?
 - What is data quality?
 - How does it impact upon enterprise resource planning?

2. What is the range of factors that impinge on data quality?
 - What are the elements that effect data quality?
 - How can data quality be measured?
 - What levels of data quality are necessary?

- What do organisations need to do to improve and sustain data quality?
3. Are there specific factors that apply to these in the context of Remploy and related organisations?
 - How can the study be best related to Remploy?
 - Does Remploy's position make it unique or can common practices be applied with or without modifications?
 4. What is the impact of poor quality data?
 - What is the true cost?
 - What are the benefits of improved data quality?
 6. How can a data quality improvement programme best be implemented with regard to?:
 - The management of organisational change
 - The management of organisational politics and culture
 - The education, training and development of people
 - Remploy-specific issues (tie in with 3 above)
 7. How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?
 8. How can an organisation maintain and sustain any improvement identified and implemented from the answers to the above question?

A further question- No 5 'How can the concept of 'World Class' be related to ERP and Information?' was rejected within Document Four as being too vague and imprecise.

Given that the stated aim of this study has been the investigation as to how data quality process improvements can be sustained per se, then a review and refining of these research questions is of vital importance. The research questions have so far been depicted in somewhat of a linear nature, but now it is felt that a degree of structure and prioritisation needs to be applied together with a pruning of those questions which are not seen as totally fundamental to the final focus of this document. Document Three inspired the development of research questions seven and eight and Document Four confirmed these as the main priorities at that time. However it is worthwhile debating the validity of both these questions in the light of ongoing research and experiences. Question seven states "How can an organisation improve data quality by preventing problematical or erroneous data from entering the data flow at source?" This encapsulates the total quality concepts "getting it right first time", "up-front error prevention", "up-stream solutions", data defect prevention" and "root cause analysis and prevention". However poor source data is not the only cause of data

quality problems. It is appreciated that this question may be geared more towards the 'intrinsic' data dimensions relating to accuracy/validity, believability and objectivity, rather towards timeliness, relevancy, accessibility or security and those data quality problems can pervade the entire dataflow chain, not just at the beginning. Whilst one is fully aware of the dangers of attempting to take a too wide a view within a single research project, one can argue that question eight "How can an organisation maintain and sustain any improvement identified and implemented from the answers to the above question?" is too restrictive and the final critical research question may be better stated as:

"How can an organisation create an environment where data quality improvements can be sustained?"

A diagrammatical representation of the way in which the research questions interact and are subordinate and/or supportive to the primary aim is set out in Appendix 2

People, Processes and Data

Fundamental to the progress made so far has been the identification, within Document One, of three conceptual elements seen to be key to any data quality programme namely: People, Processes and Data. This was then developed further within Document Two to form the basis of the conceptual framework- Figure 2 page 18. This research has so far indicated that there are a myriad of methods and solutions to improve *data* quality in both the areas of transactional and master data at various levels embracing both *process* and *people*, with varying consequences and degrees of success. Nicholaou (2004:44) identified that lack of people training and failure to recognise the effects of an ERP system on current business *processes* are the most important culprits in problematical implementations. Whilst all such initiatives have enormous merit in themselves, they will not generate long term success or influence unless they can be embedded. This study takes note of these theories and practises that can improve and create quality data, but the main focus will be on attempting to identify how an organisation may be able to create an environment where such data quality improvement initiatives may be sustained. In this it accepts that there must be a climate where such improvements should be sought-after, generated, supported and implemented with adequate resources.

Theory and Practice

The objective of any DBA is to improve business, management and professional practice, by developing the students' personal, intellectual and academic abilities, together with their personal managerial practice, by studying work based issues or problems (NTU DBA Course Members' Handbook 2005: 6). By acquiring new knowledge, the student is in a position to bring about professional change, which in turn has the potential to create new *organisational*

knowledge. This is unique to the 'professional' doctorate, but there is in fact further potential to reciprocate the process by making such findings available to be incorporated into the body of *academic* knowledge. Over forty years ago Simon (1967) argued that business schools have a dual mission, to develop new knowledge that advances science and improves practice Simon (1967:1) and to address the problem of bridging the gap between the social system that develops scientific knowledge and that which consumes it, i.e. professional practice (Simon 1967:16). Attempts to bridge this gap between the fields of theory and practice have generated considerable discussion within the literature. Rynes, Bartunek and Daft (2001: 340) described the wide gap existing between research and management practice, arising from the reluctance of organisational executives to take account of academic research findings and the unwillingness of academics to undertake practice-related research. Van de Ven and Johnson (2006a) focussed on the relationship between theory and practice and proposed a method of 'engaged scholarship' Van de Ven and Johnson (2006a: 803) to enable practitioners and researchers to co-produce knowledge that can advance both theory and practice. This was debated further by McKelvey (2007) and Van de Ven and Johnson (2006b) culminating in Van de Ven (2007). One believes that this research has identified a gap in the literature and therefore has the capacity to add to the current body of managerial and professional knowledge within the realm of planning and information systems. This will be discussed later in this document. There is also an intention that such new knowledge should also be made available to benefit academic and science theory.

The first four documents have unearthed and developed certain essential key concepts and frameworks and it is now essential that these be defined, as they will form the basis for the further research and the development of the final findings, conclusions and recommendations.

individuals' behaviour and to bring about this, there has to be cultural and organisational change mainly through the interaction of leadership and management at all levels. The conceptual framework has therefore been updated to place 'Cultural and Organisational Change' in a position to influence the concepts of 'People' and 'Processes' as well as the overall 'Improvement Process' element. The framework also identifies how the process of producing quality information derived from quality raw data has parallels with a generic product manufacturing process. This useful analogy between a production process and an information system also has strong roots in the literature (Strong, Lee and Wang 1997:104; Wang 1998: 59)

Major Concepts

People, Processes and Data

The fundamental inter-relationship between People, Processes and the Data, which has been a guiding principle from the very start, requires that any attempt to improve the overall quality of data within any organisation must be centred on *people* whether data suppliers, processors or information customers; the *processes* that receive, handle, action and pass on *data* and *information*; as well as the *data* itself where ever it sits within the data cycle of input, process and output. Data quality improvement is not just about fixing data or improving quality within a single business application or process, but also about taking a more expansive and forward-looking enterprise-wide approach. This must involve addressing cultural issues, initiating both short and long term *process* and procedural improvements by a step-by-step, incremental approach, whilst ensuring that the *data* conforms to appropriate specifications or requirements. In this way any improvement initiative has an opportunity to be sustained. It has to be appreciated that there cannot be a 'one size fits all' remedy to embedding organisational improvements at all levels, but rather to identify appropriate solutions to fit individual situations and circumstances. One accepts that data quality problems are not created intentionally by *people*, but more by the failure of the surrounding *processes* whether these are system related or individual related involving lack of education, training, personal developments or purely the person being placed in a position for which they are not suited. There is strong evidence to indicate that solutions exist to improve the quality of data, emanating from both the academic fraternity and the commercial world and this project attempts to embrace both these arenas in the true spirit of a DBA. This research therefore has not only a strong academic base but also has major practical implications which leads to a further key theme, that of aligning robust theoretical and academic concepts, within the operating environment of a real life organisation, in order to implement sustainable data quality improvements. Both Van de Ven and Johnson (2006a) and Van de Ven (2007) focussed on this relationship between theory and practice and how each discipline may inform and thereby benefit the other, within a single project. It is also recognised that research

in this specific area may have implications for other functional sectors where process improvements programmes can be applied.

Generic Process Model

As indicated earlier, strong parallels have been drawn in the previous documents between the concept of a planning and information system and that of a manufacturing system (Strong, Lee and Wang 1997:104; Wang 1998: 59 and latterly Pham Thi and Helfert 2007: 6). The principle elements are highlighted below within what may be termed a Generic Process Model to compare and contrast the various elements:

Generic Process	Manufacturing System	Generic Information System	ERP Environment
Input	Raw materials	Raw data	People- Processes- Data
Process/ Operations	Production line	Information system	ERP Database
Output	Physical products	Information products	Information-People

The ‘Manufacturing’ or ‘Factory’ analogy is a useful model in that it takes a conceptual overview of both generic manufacturing and information systems to identify ways in which established quality principles may be applied to the input and process elements ensuring that information products in the form of outputs conform to the requirements of their relevant customers. Strong, Lee and Wang (1997:104) identified three key roles within a data manufacturing system:

Data Producers:	Generate data
Data Custodians:	Manage, store and process data
Data Consumers	Use data and information

Within this context, however, one needs to be aware that the end products from manufacturing and information systems have differing implications, with the information production process viewed as potentially a more complex process than its physical equivalent (Pham Thi and Helfert 2007: 6). The outputs from a factory are unique one-off products which can be consumed only once, whether they are finished goods or components requiring further work. The overall effects of poor manufacturing are somewhat limited, normally requiring a scrap and re-work operation. Some longer-term detrimental implications may occur including customer dissatisfaction or product contamination, but even these will normally be relatively localised and time-constrained. Output in the form of data or information products can be consumed in an infinite number of ways and be re-cycled continually. Poor data can act like a virus infiltrating all aspects of an enterprise’s operations, re-occurring again and again, or lay hidden undetected within sub-systems in perpetuity. Data may also be used in ways for which

it was not created or intended, causing potential misalignment, errors or misinterpretations, resulting in potentially dangerous or catastrophic decision making (Senge 1992: 7; Orna 2005: 44, 144-150; Mutch 2008: 53).

Working definitions

Within the literature there are numerous studies that fail to discriminate between *data* and information Helfert (2001: 1), indeed a number of articles Strong, Lee and Wang (1997: 103); Wang (1998: 59); Wang, Allen, Harris and Madnick (2002: 1) stated specifically that the terms data and information may be used interchangeably. In a recent article, Madnick, Wang, Lee and Zhu (2009), this debate was once again discussed, affirming that there was still no real consensus between the two terminologies, although a tendency exists to use *data* to refer to technical issues and *information* to be applied to non-technical issues (Madnick, Wang, Lee and Zhu 2009: 2:2). However, whilst it has been established within the context of this research that the term 'data quality' refers to both the quality of data and information, it is important to establish working definitions for these individual integral elements to avoid confusion and to place them in their true context. The Generic Process Model above also identifies where data and information reside within the ERP and Information System models.

Data

Fox, Levitin and Redman (1994: 11-12) identified a number of definitions on the notion of data, citing: Blumenthal (1969); Fry and Sibley (1976) who both defined data as a set of facts. Davis and Rush (1979); Yovits (1981) referred to the way it can be obtained, as the results of measurement and observation; Dorn (1981) defined data as "the raw material from which information is developed", whilst Langefors and Samuelson (1976) and Burch (1983) referred to data as 'symbols'. The article, Fox, Levitin and Redman (1994: 11-12), then focused on the approach developed by the database research community citing the works of Mealey (1967); Kent (1978); Tschritzis and Lochofsky (1982) and Loebel (1990) from which a framework of 'data items' were devised, comprising entities, attributes and values. Davenport and Prusak (1997: 9) defined data as "simple observations of the world, easily structured, captured, transferred and quantified" and Davenport and Marchand (2000: 165) as "signals about human events and activities". Whilst according to Brackett (1999: 2) data may be viewed as individual raw facts out of context, without any meaning. Within the context of this research, data is viewed as the raw material for an information manufacturing system and is best represented by the English (1999: 468) definition:
"The representation of facts, the raw material from which information is produced, when it is put in a context that gives it meaning"

Data in an ERP Database (Data in Context)

Data in context is data within the database and is no longer raw data, but it is not yet information. By residing within an ERP system it is easily identified as such whether it is master or transactional data. Brackett (1999: 2) described data in context as facts comprising raw data that can readily be understood, but unlike information has no relevance or time frame. It is data that is arranged and labelled.

Information

An article published in 1948 by Claude Shannon, 'A Mathematical Theory of Communication', helped establish the discipline of information theory, centring on the engineering problems of transmitting information over noisy communication channels or telephone lines (Wand and Wang 1996: 87; Sveiby 1998: 2). Shannon viewed information as merely the quantitative measure of communicative exchanges, concentrating solely on the transmission of messages within a telecommunication system environment, attempting to ensure that the message received by the recipient was exactly or as close as possible to that transmitted by the sender from the source (Losee 1998: 274). The focus of Shannon's study was centred upon the accuracy of the transmission and reception rather than the accuracy of any perceived meaning and subsequent understanding. Working within the fields of electronics and information science Losee (1998: 258) defined information as the transmission of knowledge produced by the interaction of processes, representing the sum of the value of the characteristics of these processes (Losee 1998: 259). This process theme is depicted in Figure 3 where the value of the output is informed by the input and its process Losee (1998: 265) mirroring the Generic Process Model discussed earlier.

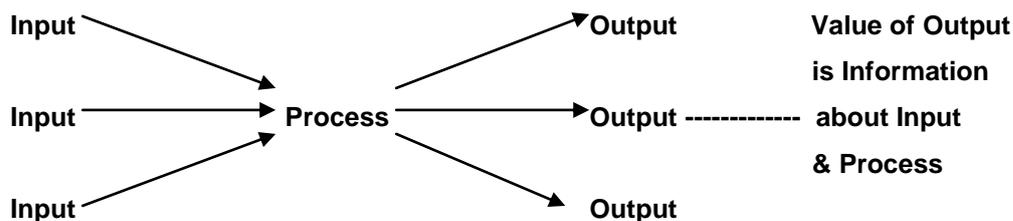


Figure 3. Information as an output of a process

Losee (1998: 265)

Peter Drucker has been credited with defining information as “data endowed with relevance and purpose” Davenport and Prusak (1997: 9), whilst Marchand (2000: 4) described information as the way people in business express, represent, communicate and share their knowledge with others to accomplish their activities and objectives. Davenport and Marchand (2000: 165) suggested that information is the outcome of the data as humans interpret and contextualise it, whilst Brackett (1999: 2) viewed information as a set of data in context that is

relevant to one or more people at a point in time or for a period of time. Boland, Tenkasi and Te'eni (1994: 459) identified the correlation between information and meaning as”the task of information systems is to support human inquiry as a process of subjective, interpretive, meaning making” and extends this further by stating that “Inquiry is the act of producing knowledge” (Boland, Tenkasi and Te'eni 1994: 462). Mutch (1996: 58) and Mutch (1997: 381) identified earlier definitions from Boland published in 1987 that information “is not a resource to be stockpiled as one more factor of production. It is meaning, and can only be achieved through dialogue in a human community”. Also “Information is not a commodity. It is a skilled human accomplishment” and “information is a thing to be searched for, stored and identified” (Mutch 1999: 327). Marchand (2000: 25-27) identified four ways that companies may use information to create value for business by: minimising risks particularly in the areas of marketing, finance, operational and legal; reducing costs by improving processes and transactions; adding value to customers and markets; and finally creating new realities by way of innovation and R&D.

Data can be stored in a system database but information cannot. The data becomes information when it reaches the public domain, that is, in the possession of the recipient from which one is then able derive relevance, meaning, purpose and knowledge.

Knowledge

Knowledge is internal within a person and only people can derive understanding and only people can be aware of meaning. Knowledge exists only in people’s minds and reflects the outcome of the connectivity between a person’s experiences and skills, with incoming information messages.

Checkland and Howell (1997: 86-92) proposed a single model encapsulating the process of turning data into knowledge detailed in figure 4 below.

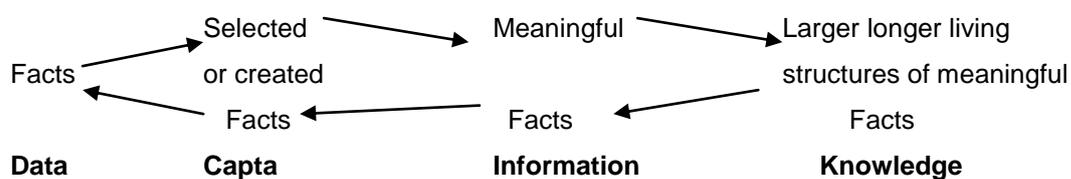


Figure 4. Data, capta, information and knowledge- three step process

Checkland and Howell (1997: 86-92)

The three-step process commences with *data*, comprising a mass of raw facts, from which part of the data is selected for attention as being useful and relevant and thereupon becomes known as ‘*capta*’ (meaning ‘to take’); this is then converted into *information* by having some form of meaning in context attributed to it albeit of a short term nature; the process is completed when information gains a degree of longevity within the mind of the recipient in the form of *knowledge*. The example can be used to model any data-to-knowledge environment.

The act of creating information and knowledge is seen as a human act, outside the scope of any machine. When applied to the context of an enterprise resource planning, or any other database system, it is only the processed *capta* (selected data) or (data in context as described above) that resides within the database. The model is useful in that the 'capta' stage provides a clear division between raw data and information particularly within a non-database environment, where the distinction may otherwise become blurred. It should be noticed that the higher arrows move the reader from the left (data) to the right (knowledge), then the lower arrows continue this clockwise motion returning the reader leftwards from knowledge back to data Checkland and Howell (1997: 86-92). In a similar way Mutch (2008: 63) suggested that it is *knowledge* that guides the researcher towards the *data* that is required and the *information* that will be extracted from it.

"Today's economy runs on knowledge" (Wenger 2002: 139). "Knowledge is information combined with experience, context, interpretation and reflection and is a high-value form of information that is ready to be applied to decisions and actions" (Davenport, De Long and Beers 1998: 43). Knowledge is information in peoples' minds Davenport and Marchand (2000: 165) or "valuable information from the human mind, including reflection, synthesis and context" Davenport and Prusak. (1997: 9), whilst Marchand (2000: 3) defined knowledge as "our experiences, skills, expertise, judgement and emotions".

Knowledge can be 'tacit' reflecting the knowledge within an individual or a collective such as an organisation and is often contained within the subconscious. It cannot easily be shared but has been found to be a strong foundation within the process of creativity and innovation. Explicit knowledge on the other hand is knowledge that can be articulated and shared and also it is claimed can be codified, stored and written down in manuals and procedures. Nonaka and Takeuchi (1995: 62) recognised that knowledge is created through the interaction between tacit and explicit knowledge comprising four modes of knowledge creation namely; Socialisation (Sympathised Knowledge), Externalisation (Conceptual Knowledge), Combination (Systematic Knowledge) and Internalisation (operational Knowledge) (Nonaka and Takeuchi 1995: 72). The interactions between the four modes can invoke a 'knowledge spiral' to create 'organisational knowledge', fundamental to which is the process of learning (Nonaka and Takeuchi 1995: 72).

Lave and Wenger (1991) described a learning process whereby individuals work and learn together in an informal way to achieve their common goals. This interactivity they term as 'Communities of Practice'. Every individual is a member of some form of community of practice whether they appreciate it or not Wenger (1997: 38), which will be essentially unstructured without necessarily a beginning or an end. The common bond between the participants is an informal shared passion and commitment towards a common joint

enterprise Wenger and Snyder (2000: 139) evolving into 'Communities of Action' Wenger and Snyder (2000: 140), being an effective vehicle for knowledge-sharing and knowledge creation (Hislop 2005: 70). According to Wenger (1997:38) "Learning is the engine of practice and practice is the history of learning". One may suggest that if this concept of learning and practice develops new knowledge to inform and improve individuals' and organisations' practice, then there may be opportunities in turn to inform theory in the manner suggested by 'engaged scholarship' (Van de Ven and Johnson 2006 and Van de Ven 2007).

Practical examples of the way the data to knowledge relationship can impact upon corporate performance may be seen where organisations use ERP transaction-driven data, coordinated with human-based information, to directly improve their marketing and enhance their knowledge about their customers, to generate improved business results (Davenport and Harris 2002:31). Davenport, Harris, De Long and Jacobson (2001b: 5) suggested a model for turning transaction data into knowledge and results, by way of three elements comprising: context, being the core organisational ingredients of strategy, skills, culture, and data; which are then passed through the transformational element where the data is analysed to assist in decision making; leading to the final outcome where action is taken to bring about change and effect results.

Research Focus

This discussion is extremely beneficial in establishing the interrelations between data, information and knowledge and in that context, enriches this research. However it should be noted that the literature tends to concentrate predominately on the outcomes, of information and knowledge whether tacit or implicit. This is also the case with references to business intelligence and management information applications which tend to be preoccupied with the ability to be able to slice and dice information in a myriad of different ways. In contrast there appears to be less interest in ensuring that the initial source material, data, and the processes that generate the 'outcomes', are of sufficient quality and robustness to provide recipients with meaningful enlightenment. This study attempts to take note of these discussions whilst placing them within the context of the overall research focus, that of creating and sustaining quality data within management, planning and information systems. Whilst highlighting this apparent imbalance in the focus of the related research, one has to acknowledge that a rich vein of material does exist around data quality, much of it unearthed during the literature review. In the context of this study it will be useful to return to this area.

Important aspects of the initial Literature Review revisited

As stated, Document Two carried out a thorough review of the literature surrounding data quality. The process proved very enlightening in that it identified valuable and meaningful

material which has provided the strong foundation upon which one has been able to build, to support this ongoing project; consequently a number of these articles are worthy of re-iteration. Wang and Strong (1996) examined data quality through the concept of data dimensions with particular regard to the requirements of data and information users, customers and consumers. Wand and Wang (1996) analysed data quality in terms of measuring deficiencies between two views of what is seen as the real world, comprising a view of the world as seen through a direct observation of events and a view inferred from the information system. Strong, Lee, and Wang (1997) identified the concept of a 'data manufacturing system' and the notion of data producers, custodians and consumers. Wang (1998) built upon this research in terms of an information system with inputs, processes and outputs, whilst Lee Strong, Kahn and Wang (2002) proposed a methodology termed AIM quality (AIMQ), using a 2x2 framework model to identify what quality means to information consumers and managers. The methodology is useful in identifying problems, prioritising areas for improvement and monitoring progress. Data quality was viewed by Pipino, Lee and Wang (2002) as a multi-dimensional concept requiring a quality assessment process which reflects such diversity using appropriate measurement, metrics and analysis. Assessing an organisation's data quality requires both a subjective and objective assessment. Both Orna (1996) and Wang (1998: 59) described the final output of a data manufacturing system as an 'information product', being the visible vehicle by which information is presented for use either on paper, in electronic form or in any other media, the 'telling' end of the scale (Orna 2001). A number of these articles were referred to by Madnick Wang, Lee and Zhu (2009) who presented an overview of certain examples of academic data and information quality research carried out over the preceding twenty years.

Sustainability

It will be beneficial at this stage to determine what is meant by 'sustainability' and define the context within which the term will be used. In general it may be seen as the ability to maintain the balance of a certain process or state in any system, viewed as either a 'journey' or a 'destination' within that system (Milne, Kearins and Walton 2006). The dimensions of sustainability are normally taken to be environmental, social and economic and within these three 'pillars' Adams (2006), they can be evaluated by means of quantitative reporting measures amongst them indicators, metrics, benchmarks, indices and audits (Hak 2007).

The above definition refers to 'maintaining the balance' which therefore leads the discussion as to what is intended by 'maintain' and 'balance' when applied to data quality improvements. By using any form of measurement one is implying that any result must be evaluated whether against a goal, target or even a general expectation, otherwise the metric is meaningless. Within the context of this study 'maintaining the balance' or sustaining improvements within this context has two possible meanings:

- Maintain the *actual* improvements made so far, from which there should be no decline, based upon the current measured result. A stake in the ground as such. This may be viewed as the 'destination' referred to above.
- Maintain the *momentum* of the improvements made so far, by continuing the trend and thereby looking to improve the current measured result further in the future. An incremental process and part of a 'journey', as against a final 'destination'.

The latter definition which is seen as a continual process, best fits the basic initial premise of this research.

Considerable discussion has already taken place within this study around the relationships between Data, Processes and People. It will be beneficial at this stage to examine the elements of each of these key fundamental concepts to analyse their drivers and enablers. Whilst *data* as an entity, has been debated above, the following section will place *Data* and the 'Management of Data' and Data Governance within the context of this overall research.

3. DATA, THE MANAGEMENT OF DATA AND DATA GOVERNANCE

Considerable discussion took place within the previous section around data, information and knowledge as entities and the efforts to develop explanations, sense and meaning to further clarify each of these elements. This section takes a narrower perspective looking specifically at the way *data* should be handled within organisations to ensure that it is both recognised as an enterprise-wide asset and managed accordingly to release its full potential and thereby maximise benefits to each organisation .

One view of data management is that it comprises all the disciplines related to managing data as a valuable resource. The Data Management Association (DAMA Data Management Body of Knowledge- DMBOK) DAMA (2009: 7) defined *data management* as “the development, execution and supervision of plans, policies, programmes and practices that control, deliver and enhance the value of data and information assets”. The DAMA Framework includes: Data Governance; Data Architecture; Data Development; Database Management; Data Security Management; Data Quality Management; Reference and Master Data Management; Data Warehousing and Business Intelligence Management; Document Record and Content Management and Meta Data Management (DAMA 2008:11). Within the context of this research, one accepts that the Framework encompasses a great deal of the aspects surrounding ‘Data’ but believes that ‘the term ‘Data Management’ is subordinate to the ‘higher level’ concepts of the ‘Management of Data’ and specifically Data Governance itself.

One has played a major role in the restructuring of Remploy’s Data and IS strategy; in particular drafting the initial Data Governance and Master Data Management policies and it will be useful to place within the setting of this document, the paper setting out the basic concepts (Table 1 below). This initial policy document passed through a number of iterations prior to being approved by the Company’s Executive, having been reviewed by Gartner Inc (Ted Friedman) with the comments: “Overall we believe your document is generally in line with industry trends and best practices for defining a data governance program” (Gartner 2009: 2). It is now intended that these principles will be developed and applied across all of the Company’s applications. The concepts behind these policies can also be applied to any organisation.

The Management of Data and Data Governance

The Management of Data

Data is both an organisational resource and an enterprise-wide asset, as valuable as any physical, financial or personal asset and therefore must be managed appropriately. Its sole purpose is to serve the organisation to enable Remploy to attain its corporate objectives and goals.

Data takes two main forms:

Master Data

Data about the core business entities:

People: Customers, Suppliers, Employees, Partners, Clients

Things: Products, Items, Assets (including Buildings and Plant), Financials

Places: Factories, Offices, Branches, Employers

Concepts: Contracts, Licences, Policies and Procedures

Transactional Data

Data relating to our operations as we conduct business around sales, deliveries, purchases using the master data created above

Financial: Orders, Invoices, Payments and Revenues.

Work: Plans, activities

Logistics: Deliveries, Receipts

Employment Services: Job Progressions

For the purposes of this paper we are referring only to that data that interacts with any of our IS systems

Guiding Principles

We need to establish first and foremost guiding principles around the management of data.

To be really effective we also need to identify and focus on those data sub-sets that hold real value and/or potential risk, rather than attempt to manage ALL of the data fields, much of which will be of low priority. This should be undertaken by establishing:

Ownership: Who has actual 'ownership' or 'custody' of the data on behalf of the organisation as a whole and thereby has responsible for the 'quality'

Responsibility: Those persons who are directly involved in any way with the entry, extraction, manipulation of any part of the data (as data suppliers, processors or consumers)

Management: Ensuring operational availability, security and business continuity- IS Department

Accountability: Everyone within the organisation

Data Policies: To be set by the organisation together with the 'owners' or 'custodians'

To ensure we follow these established guiding principles and work towards achieving our objectives we need to create a culture of Data Governance

Data Governance

The policy of treating data as an enterprise-wide asset assists in establishing a data governance strategy. The concept behind adopting a data governance approach is to enable an organisation to create an environment within which data is controlled and co-ordinated. As with most successful enterprise-wide initiatives, data governance requires a mandate, ideally in the form of sponsorship from a leading executive (Russem 2006: 19). Without a strong mandate for change, a data governance policy and indeed a data quality initiative, cannot hope to be successful. Data governance refers to the overall management of the data within an organisation involving, not only the security and risks associated with the data, but also determining who are the true owners and custodians of the enterprise's data assets, procedures, policies and processes; establishing the approach towards data quality and instilling a culture of data stewardship and quality through out O'Brien (2006:40); Russem (2006: 19), providing data quality and other data management practices with consistency, efficiency and a mandate within the enterprise (Russem 2006: 22). *Data stewardship* is the process of taking the data governance policies and initiatives and implementing them within the organisation at a task and operational level. In addition a comprehensive data governance programme should include other dimensions, specifically life-cycle management (Russem 2006: 19), incorporating archival, retention and disposal of data assets; privacy closely allied to security and data standards relating to the agreed policies. This is not just a data cleaning exercise but a culture change; the policies and initiatives need to be institutionalised so that they become part of the organisational fabric. However with this come the dangers of 'corporate politics' and inherent resistance to change, which can de-rail the entire process, if the mandate for change is not strong (O'Brien 2006: 40; Russem 2006: 19).

Data Governance Functions

<p>People Data Council Data Owners Data Stewards Analysts Developers Architects Data Suppliers Data Processors Data Consumers</p>	<p>Policies & procedures Data Quality Management Data Security & Risk Management Data Privacy Exception Handling Data Stewardship Define Stewardship Guidelines Life-cycle Management Specific Data Policies & Procedures Specific Data Standards</p>
<p>Standard definitions Data Definitions Technology Standards Enterprise Data Model Master /Reference Data Management Transaction Data</p>	<p>Technology Data Integration Data Profiling Data Cleansing Metadata Management Data Modelling Archiving Security Privacy</p>

Table 1a Data governance functions

(Developed from a presentation witnessed at (Informatica 2009).

Initial Data Standards

Initial gateway requirements for each project/application:

- Identify where the Ownership, Responsibility and Management of the data lies and ensure that this is communicate and accepted by all relevant people
- Establish effective procedures for cleansing and migrating data to any new application
- Identify the points where the project/application integrates with other applications. Communicate with the other projects to establish a clear strategy, procedures and governing rules as to how the data is to be integrated
- Establish KPIs and a monitoring process to measure the ongoing quality of the data

Master Data Management

The practice of acquiring, improving and sharing master data:

- There must be designated Business/Department/Personnel covering the Ownership and Responsibility for those elements of master data that are seen as being of value and/or potential risk.
- Those important fields must be identified and their implications understood. There should be a scoping exercise to identify these and those of low priority should so designated.
- Some tables cover more than one function- ie Customer & Suppliers have financial, logistical and analytical related fields. These must be identified separately
- It is appreciated that every field may not be mandatory but any 'blank' field must be designated and agreed as such.
- All of the above must be fully documented, approved by a designated authority (TBA) with a copy deposited within a central repository with revision control
- There must be an agreed common and consistent approach to address field content and avoid duplications
- This will form the basis of related operational processes and procedures

Examples

Master Data Tables

Table	Ownership	Responsibility
Existing Finance/ERP		
Customers	SSC/Business	Shared Service Centre
Suppliers	Purchasing/Business	Shared Service Centre
General Ledger	Central Finance	Finance Systems Team
Finance Tables	Central Finance	Finance Systems Team
Items	Relevant Business	Central Team (to be agreed)
Logistics Tables	Relevant Business	Central Team (to be agreed)

Manufacturing	Relevant Business	Central Team (to be agreed)
Distribution	Relevant Business	Central Team (to be agreed)
Employees	Relevant Business	Central Team (to be agreed)
CRM	To be agreed	To be agreed
New Applications		
Finance	As above	As above
ES Case Management	To be agreed	To be agreed
HR People systems	To be agreed	To be agreed
Transactional Data		
The same process of identifying ownership and responsibility must also be applied to transactional data around:		
<ul style="list-style-type: none"> • Need to ensure everyone is fully aware of the implications of their actions • A complete understanding of the underlying system principles and requirements • Being able to address root causes of issues and problems to ensure upfront error prevention • Identify the personnel dealing with each type of 'order' and agree who does what with responsibilities for each process 		

Table 1 The management of data

Data Dimensions

A considerable amount of discussion took place within the initial literature review within Document Two surrounding data dimensions in particular around the study carried out by (Wang and Strong 1996). A detailed appreciation of the concepts surrounding data dimensions can provide significant assistance in improving data quality with particular regards to root cause analysis and process improvement. Tayi and Ballou (1998: 56) support this point by emphasising that data quality problems cannot be resolved without a thorough understanding of data quality dimensions. It will be beneficial to place the main data dimensions identified by Wang and Strong (1996) within the context of the one's preferred definition of data quality in Figure 5 below.

"Having the **right** and **correct** data in the right **format**, in the right **place** at the right **time**, by having one single version of the truth across the enterprise"

Right	Reputation; Objectivity; Value Added; Amount of Data Covered
Correct	Accuracy; Believability; Relevancy; Completeness
Format	Interpretability; Consistency; Understanding; Concise
Place	Accessibility; Access Security
Time	Timeliness

Figure 5 Data dimensions related to the definition of data quality

Kimball (2007:4) paraphrasing Michael Hammer in his 1994 book 'Re-engineering the Corporation' stated. "Seemingly small data quality issues are, in reality, important indications of broken business processes". This highlights the nature of data quality issues in that they easily mask wider significant process problems which can seriously affect a company's ERP system. The following section discusses the *Process* concept from both an 'operational' and a 'quality' perspective.

4. PROCESSES

This research has established the overriding importance of having quality processes in place within any organisation and this section places this concept within the context of enterprise resource planning, as well as generic business systems and discusses means by which they may be improved and enhanced.

Davenport (2005: 102) referred to processes as related tasks an organisation performs in order to carry out its work. Processes may be comprehensive and cross-functional, taking the form of a total end-to-end business process, for example a total 'order to pay' sales order processing operation (SOP), or they may have a much narrower perspective as a sub-process of the overall order processing operation. In a standardised format, processes may be viewed as individual building blocks brought together within a workflow to perform an overall task, with the exact number varying, depending upon the simplicity or complexity of the required outcome. Effective integrated processes are essential if an organisation is to derive full benefits from any application especially complex enterprise systems (Hammer and Stanton 1999: 111). This intricacy has potential to be further exacerbated in multi-location environments with high levels of inter-site activity as is the case in Remploy. Nicolaou (2004: 44) recognised the strategic advantages that can be achieved from enhancing business processes within enterprise systems, in the form of improvements in the availability and quality of information.

A standardised sub-process should ideally be the most efficient and effective method of performing the appropriate task and have synergy with its other related sub-processes to come together to bring about the overall result. In this way effective sub-processes can be chained together to create a situation where the whole is greater than the sum of the individual parts. One has to be mindful however that a total end-to-end process can cross functions and management fiefdoms with potential to generate conflict between the direct interests of a particular function and the overall interests of the entire process, leading to possible sub-optimisation. It is recognised that there is potential for such incidences to exist within Remploy and one's experiences have identified situations where this has occurred. It is hoped that one corollary of this research will be to waken peoples' awareness as to the consequences of such events and provide greater visibility as to where such incidents may occur.

Processes support an organisation's mission, strategy, goals and objectives and comprise a series of enablers all of which impact on performance (Sharp 2006). These enablers or levers can also be manipulated to bring about improvements. They comprise: workflows- those steps and sequences as to what is to be done, when and by whom; information systems using data processing applications; motivation incentives allied to measurement, with reporting indicators tied to reward systems; human resources, to engage the people

perspective via recruitment, training and development; business policies and rules, to govern the organisation and avoid sub-optimisation; and the facilities, relating to the actual physical environment where the work takes place (Sharp 2006: 8).

This research has identified two types of processes within the context of this study. 'Operational' processes, relating to the way in which master and transactional data within enterprise systems interact to both drive and react to the physical business operations as discussed above; and 'Quality' processes, essential activities that need to be in place to both improve and sustain the quality of the data overall. This study seeks to identify ways to cultivate and enhance the former whilst identifying, implementing and inculcating the latter. Whilst a great deal of the discussion within this section relates to generic processes, the principles can be applied equally to data and information, especially with regard to the objectives of this research.

Organisations have methodically monitored and evaluated process performance via a myriad of measurements either financial or non-financial to establish a guide as to the overall quality or as an indicator of the levels of change following any process improvement initiative. This information should then be disseminated across the relevant process owners to enable them to focus on their relevant areas. The process of measure, publicise and incentivise, can be very powerful especially if this is then tied to monetary or non-monetary rewards.

Process enhancement and change initiatives normally come under two, sometimes inter-related, categories. Quality management, often referred to as total quality management (TQM), is an incremental on-going/open-ended approach focussing on continuous improvements, sometimes involving minuscule ameliorations, which collectively can bring about large-scale improvements. In contrast re-engineering or business process re-engineering (BPR) normally takes the form of radical changes carried out within a fixed time frame and usually geared to resolve specific issues or problems (Davenport and Beers 1995: 58). The procedure may well involve a full root and branch review with a consequential mandate for change within all areas of an organisation (Hammer 1990: 112). The implications for TQM and BRP to influence this research are discussed in later sections.

Process improvement initiatives using 'double loop learning' utilising the format of action research have been in existence for a considerable period Argyris (1977) and was the focus of the research for Document Three. Loop One is the 'Performance Loop' which attempts to monitor day to day process performance, analyse and resolve problems and monitor trends; whilst the second 'Relevance Loop' looks to ascertain the significance and importance of the process and determine what changes if any are required (Davenport and Beers 1995: 63). The former takes a single dimensional view of the situation, whilst the latter attempts to observe from a wider and more strategic perspective.

The fact that small data quality issues are indicative of problems within business processes, as discussed in the previous section Kimball (2007: 4) enables us to focus our attention on the source of the data quality problems and identify paths to possible solutions. Whilst data quality problems tend to relate more to process issues, it is important to examine the *People* perspective and how this inter-relates with both *Data and Processes*.

5. PEOPLE ISSUES

The research carried out within Document Two, and evidenced by the conceptual framework (Figure 2 18) established the *People* related elements of Education and Training, Personal Development and Accessibility as fundamental to the success of any data quality project and this key concept will be discussed further within this section.

In common with a number of other observers Jantz (2001); Chen and Popovich (2003); Andress (2004); Morgan and Liker (2006); Whitehead (2006: 2) referred to the alignment between *people*, *processes* and *technology*. The author prefers to use the term *data*, as data quality does not require the medium of technology to make it relevant. Whitehead (2006: 7) observed that *people* are essentially unpredictable unlike the more controllable process flows. *People* need to change behaviour to bring about improvements and in this they can only be influenced and encouraged to generate the required motivation, especially within the environment of this study where human behaviour cannot be controlled. The dynamics of human behaviour all come into play, relating to an individual's personality, learning styles, conflict styles and means of communication to inter-relate with the over-arching organisational culture to attempt to bring about cultural alignment.

People as 'Users'

It will also be useful at this juncture to consider the term 'user' in reference those persons who interact directly with enterprise systems and IT applications in general. There has been some debate within the literature which contends that the expression 'user' may undervalue the skills and roles associated with such people whether they be data producers, custodians or consumers, with the implication that *data* is a mere commodity rather than the lifeblood of an organisation. English (2009: 42), quoting Peter Drucker and Stephen Covey, referred to the term 'Knowledge Workers' as well as 'Information Customers'. Bannon (1991:25-44) also sought to elevate the 'human factor', to rethink the concept of 'users', employing the term 'human *actors*' to imply less of a passive and more of an active controlling role. Lamb and Kling (2003:199) also challenged the 'user' concept, proposing a 'social *actor*' model to better facilitate future IS research (Lamb and Kling 2003: 224). Possibly a more relevant title may be 'system *actor*'. However the term 'user' appears to be inculcated into both the culture of Remploy as well as within parts of the literature, therefore within the strict confines of this study, eschewing the term is not considered to be a high priority.

People and ERP

All ERP implementation and optimisation programmes are ostensibly *people* projects and their biggest challenge is not related to technology, but to the *people* issues (Deloitte 1999: 10). The Deloitte (1999: 17) survey conducted amongst 99 large corporations, 90% of which

had annual revenues exceeding US\$1 billion, found that 57% of the issues and obstacles were *people* related, most noticeably change management and the quality of staff and training. The necessity for effective change management figures predominantly in this study, identifying that success in this area is partly dependant upon adequate education and training. Training covers the basic skills that are necessary to use the system correctly, but education progresses this further by identifying, how the system will help the organisation (and thereby themselves) become more effective. This assists buy-in by enabling all individuals to see where they fit within the entire context of the system and how each can contribute to the overall success. If people understand their roles they are more likely to embrace rather than resist change. From that aspect of the literature which focuses on the more practical aspects of enterprise system implementation, optimisation and development, Goodfellow (1994: 46) identified education as the single most essential factor in determining successful or unsuccessful projects; similarly Wallace and Kremzar (2001: 16) recognised *people* as the key, the most important element within an ERP system and that it is those *people*, who are trained to use the right tools and to work together as a team, that can make the difference between success and failure (Wallace and Kremzar 2001: 142). Mohamed and McLaren (2009: 13-14) emphasised the importance of the 'soft skills' associated with ERP implementations, in particular strong change management, performance measures and rewards, employee morale and resistance, much of which tends to be overlooked within ERP education programmes. Discussion into these areas figures prominently in later sections.

Information Politics and Culture

Davenport, Eccles and Prusak (1992: 64) recognised that managing the politics of information is difficult, complex and time consuming, requiring detailed management attention together with changes in organisational culture. Five models of information politics were identified as being representative of the practices employed within information environments and are detailed below in order of increasing effectiveness (Davenport Eccles and Prusak 1992: 56; Davenport and Prusak 1997: 69):

Technocratic Utopianism: A heavily technical approach to information management stressing categorisation and modelling of an organisation's full information assets, with heavy reliance on emerging technologies.

Anarchy: The absence of any overall information management policy, leaving individuals to obtain and manage their own information.

Feudalism: The management of information by individual business units or functions, which define their own information needs and report only limited information to the overall corporation.

Monarchy: The definition of information categories and reporting structures by the firm's leaders, who may or may not share the information willingly after collecting it.

Federalism: An approach to information management based on consensus and negotiation on the organisation's key information elements and reporting structures.

The key is to match the organisation to the political structure that provides the best fit (Davenport and Prusak (1997: 68), by ascertaining which model is currently in ascendancy within the organisation and to which model the organisation should be moving (Davenport, Eccles and Prusak 1992: 62). At the commencement of this study one's thoughts were that Remploy was hovering around the monarchy model with elements veering towards feudalism. Over the last five years there appears to have been a growing acceptance that quality data is important together with a need to conform to standards and one can now detect aspects of the federalism model emerging in all levels of the organisation. One feels that this study has assisted in this process.

Davenport and Prusak (1997:84) defined information culture in terms of the attitudes and patterns of behaviour that identifies an organisation's approach towards information. Culture has an important influence on how an organisation views and uses information (Davenport and Prusak 1997: 68). One has always viewed culture as 'the way we do things around here' involving beliefs and values. Corporate values themselves play an integral part in the development of an information culture. Remploy's 'five values'- keeping promises, respect, openness, professionalism and passion, by their very nature should support any change management initiatives directed towards data and information improvements.

Remploy has a proven track record within learning, education and training and each year all employees undergo a personal appraisal and development review, an essential part of which comprises a detailed learning and development plan, which is reviewed throughout the year. One area that has not been covered comprehensively, relates to Baan system training and the necessity for a Baan related education and training review has been identified. Such a programme was carried out within the implementation phase during the latter 1990s but has not been followed up fully on a regular basis. Over the intervening period key personnel have left and their replacements have been often 'trained' by others passing on bad habits and faulty work practices in some cases. This has also been further exasperated by the effects of the Modernisation Programme referred to in Appendix 1.

Implementing Improvements and the Management of Change

Data and information are very emotive subjects even within a static environment, but when one factors in elements of change, the climate becomes even more volatile. The finest data improvement initiative will flounder unless the process is managed correctly. Human and organisational factors are commonly identified as causes and contributors to failures and difficulties in implementing planned change. A study carried out by Lewis (2000: 151)

identified that personal communication or the lack of it, plays a fundamental role in the success or failure of programmes of change and that around this central core of communication, four key themes emerged relating to: creating and communicating a vision to highlight the purpose and intent of the change and to promote a shared understanding amongst those effected; sense making around the mission and the provision of adequate feedback facilities; establishing legitimacy for the change programme to important stakeholders; and communicating goal achievements, both as a means of publicising successes, and providing evidence of continued progress towards targets and milestones.

How do others implement change? A more detailed assessment of the aspects of organisational culture, politics and change management relevant to this study is discussed in the following section.

6. SUSTAINING IMPROVEMENTS AND THE MANAGEMENT OF CHANGE

The concept of sustainability has already been defined in Section 2 to mean an on-going journey of improvement where a continual upward momentum is maintained. One could use the phrase 'Continuous Improvements' although this may be interpreted by many to refer to the 'continuous improvement' *policy* known as Kaizen, the strategy of constantly introducing small changes in a business in order to improve quality and/or efficiency. Whilst this may be relevant to improving data quality it is viewed as a means to the end rather than the overall concept itself. This section proposes that any element of sustainability is predicated on being able to manage change successfully. In this context Helfert (2009: 949) identified that managing change effectively is fundamental to the success of business process management improvement programmes.

Zairi (2005: 4) defined sustainability as "the ability of an organisation to adapt to change in the business environment, to capture contemporary best practice methods and to achieve and maintain superior competitive performance" referring to the Quinn (2000) definition that sustainability is a "development which meets the present without compromising the future" Zairi (2005: 3). One appreciates the basic principles of the former definition particularly regarding the strong strategic ideals around best practice and improved competitiveness, but believes that it is not specific enough to meet the detailed requirements of this document, whilst the latter definition better supports the strong conviction that any short term initiative must never sub-optimize the future.

Any improvement process requires some form of change and all change needs to be managed. It is here where the triple concept of *people*, *processes* and *data* and the inter-relationships, has great significance. One can change a *process* (process change), but for this to become effective *people* are required to follow the new process (behaviour change). Where legal implications are present then enforced behavioural change may be required, but for the great majority of business change situations, further forms of acceptance and compliance are necessary. The greatest long term challenge facing any improvement change initiative is to ensure it becomes sustained, especially when this requires people to behave in new or different ways. The requirements for process change, behaviour change and the consequential culture change all have direct relevance to the conceptual framework

Depending upon the size and scope of the change, different strategies may be employed to engender acceptance and compliance. Boulton and Eaton (2008) suggested: generating a belief that the proposed change is worthwhile and that the situation will improve; employing forms of temporary enforcement; measuring, analysing and providing feedback to ensure continued compliance; obtaining 'buy in' to generate individual ownership and belief; creating an environment which encourages and supports the new practices and celebrate successes; and building the changes into individuals' objectives, especially where this is allied to a

reward system. Additional management practices may be employed including the identification of the objectives, risks and benefits, with adequate communications to reinforce the messages to provide two-way feed back; involving all interested parties, canvassing their opinions; ensuring adequate training and development is delivered where applicable and making the necessary environmental improvements to equipment and facilities, to ensure returning to the old ways of working are deterred or prevented. Whatever strategy is put in place it has to be recognised that it is not a one-off event but a continuous on-going process.

There is a requirement to align the organisation behind any significant change and to become aware of this need to change, to accept the consequent responsibility and then to generate the necessary actions to adopt the new practices. Behavioural change requires adapting to these new habits and practices. This may be best initiated by focusing upon a few achievable goals with a sympathetic and willing audience, to test the viability and then to push forward with relevant interested groups, establishing and publicising relevant measures in order to build improvement with positive reinforcement.

Theoretical Models for Change

The literature has provided a number of theoretical models which have been developed to assist in making change programmes successful.

Formula for Change

The Formula for Change model attributed to Richard Beckhard and David Gleicher attempted to identify the chances of successfully implementing change in a given situation. The original formula was 'simplified' to make it more accessible for organisations to use Jacobs (1994: 122) and rewritten as:

$$\mathbf{D \times V \times F > R}$$

If the combined elements of:

D = Dissatisfaction with the current situation

V = Vision of what can be achieved

F = First steps that can be taken to commence the change process

is greater than the initial:

R = Resistance to change

then within this climate there is a possibility that change can be implemented, but conversely if one or more of these elements are missing or deficient, then success is unlikely, as the resistance will overcome the attempt.

An organisation can develop the D, V and F elements by identifying and highlighting the critical negative effects and implications of the current position (D), creating an image of the

new future as a desirable and achievable goal (V) and identifying quick wins to get the process up and running immediately (F). Likewise the factors that comprise the resistance (R) can be identified and worked upon and in that way their effects may be lessened. Resistance can take a number of guises. There can be organisational resistance where the inherent culture works against any change or where there is seen to be other alternative options with greater priorities. Resistance may also be viewed as an organisational cost either in financial, time related or psychological terms where individuals fear change. Whichever implementation strategy is chosen it must continue to be employed until the change is fully inculcated.

Stages of Change Model

The Stages of Change model also known as the 'Transtheoretical' model was developed in an attempt to promote successful health related life style changes (Prochaska and DiClemente 1982). It focused upon the route to successful behavioural change and attempted to predict whether an individual can successfully change their habits and identified the potential inhibitors that may exist along the way. The model identified six to seven stages, from total inactivity, to a successful stable conclusion (Prochaska and Velicer 1997). In the first stage, 'pre-contemplation', there is a total lack of awareness and no intention to change. In the second stage, 'contemplation', there is awareness but no firm commitment exists. At the third stage, 'preparation', action is intended or planned, which leads to the fourth stage, 'action', where some change has been initiated. The fifth stage 'maintenance' represented that important phase where the initial up-front enthusiasm gives way to business as usual and with it the temptation to revert to type may exist, which can lead to a sub-stage of 'relapse', which if occurs, will necessitate a return to the 'action' stage to recommence the process once more. The final stage, 'termination', exists when the individual has finally inculcated in full, the essences of the new practice without any desire to return the 'old' ways.

Although the original model concerned itself initially with health related changes, since its publication it has been used within far wider ranging research environments and is now an established part of organisation theory and research to assist in bringing about sustainable change by training and support (Harris and Cole 2007: 778).

Kotter's Eight-Step Change Process

A change management model was developed by Kotter (1996), which encompassed an eight-step process, designed to cement change initiatives into an organisation's structure. The eight steps comprise: establishing a sense of urgency, to identify potential threats and opportunities, whilst obtaining management 'buy in'; creating the guiding coalition, to convince everyone that change is necessary; developing a vision and strategy, that everyone can understand and empathise with; communicating the change vision, in order to attract peoples'

attention and acceptance; empowering employees for broad-based action, to remove obstacles and identify areas of resistance; generating short term wins, to gain immediate momentum whilst also; consolidating gains and producing more change, by also taking a wider long term perspective of the overall project objective; and finally anchoring new approaches in the culture, to embed the change so that it becomes part of the organisational fabric (Kotter 1996 (33-158)).

Management of Change

All change programmes will encounter disappointments and setbacks especially after the initial enthusiasm and euphoria has lapsed. It is vitally important that this is not allowed to derail the overall initiative. Fluctuations in results exist in all forms of life and improvement initiatives and change management programmes are no exception. It must be accepted that set backs and periods of stagnation will occur naturally as outside influences come to bear on any programme and this has to be accepted. The important thing is to put these into perspective and avoid overdue pessimism at all levels. Most change processes attempt to affect human behaviour, therefore psychological influences exist and feelings of pessimism, disappointment and negativity can produce damaging consequences. A positive solution-focussed approach may be employed to overcome such dangers and the programme champion or leader has to exemplify all of these positive characteristics. Any project has to accept that temporary set backs are the norm and that one should not become discouraged. None more so than within this study where this aspect will be discussed in later sections.

As part of a study into 'extreme value theory' Baum and McKelvey (2006: 166) investigated the daily closing prices of the Dow Jones and NASDAQ stock market indices from 1990 to 2005. They found that whilst there were daily fluctuations some with huge negative results, across the entire period there had been a continual positive upward trend. Applying this principle to the concept of managing change, one should not anticipate stagnation, but if it occurs one should focus upon the achievements made so far and continue to apply those principles that have worked in the past. This may require a re-focussing of the whole team with action plans and targets to generate further positive momentum. One also has to acknowledge however that not all improvement programmes will achieve any modicum of success. Some fail for various reasons and it is important to identify when this happens and then rethink the entire strategy.

A major study of organisations that experienced huge improvements in performance pointed to a common theme that of a build-up and break-through experience (Collins 2001: 165). The image of a flywheel was employed to illustrate the way that transformation is a continuous, cumulative process with no one defining moment, no single action, killer innovation or

revolutionary instance; but instead a step upon step, action upon action, decision upon decision, turn upon turn of the flywheel to bring about spectacular sustainable results.

Generic change management and sustainable improvement programmes can provide valuable lessons and examples for such initiatives within the field of data quality. Strong programmes are adaptable to numerous applications in many fields. Success is not easy. Research carried out by the Henley Management College indicated that around £25bn is wasted annually on UK improvement programmes and further research identified that upwards of 80% of such programmes fail to meet expectations (Eaton and Phillips 2006). One solution advocated having a defined methodology which outlines the proposed journey, communicates this clearly to all parties to specify the actions to be taken to create the necessary organisational environment, to enable the improvements to take hold. The organisation should then align itself behind these changes providing the necessary support to encourage and motivate both the individuals and the teams within which they operate (Eaton and Phillips 2006).

The change leader becomes the key, needing to have the respect of all related parties and be able to lead with passion. Change management programmes have to be seen to be alive and proactive, embracing emotions and exuding this passion, to stimulate acceptance and involvement so essential to win the necessary hearts and minds. Regular measurement, monitoring and reporting is also essential, as is the regular communication of the actions taken and progress made, towards the goal, whilst constantly reminding everyone of the criticality of the initiative so as to position the programme within the overall context of the organisation's objectives.

Having established the significant principles underpinning managing change to create a climate where improvements can be sustained, it is now important to place this discussion within the field of quality management together with data and data quality in particular..

7. SUSTAINABILITY AND THE PRINCIPLES OF QUALITY MANAGEMENT

This study has identified that there appears to be a gap in the literature surrounding the research into sustaining data quality improvement initiatives within an enterprise resource planning environment. There is a myriad of rich material embracing data quality per se and enterprise resource planning in general and its procurement and implementation programmes in particular. Likewise quality management and specifically total quality management, figures significantly in both academic and practical publications. The previous section identified that sustainable quality improvement initiatives involve managing change and these related principles are relevant to all forms of quality improvement whether product, service or data related.

This section examines quality management literature relating to sustainability with particular relevance as to how this may best be applied to planning and information systems. A number of the most relevant articles published over the last ten to fifteen years have been identified and their significance is reviewed below.

Dale (1996: 49-51) identified three key features relating to sustainability in the context of total quality management. In principle these related to: the relevant elements of TQM, amongst them leadership, infrastructure, quality systems and tools and techniques, measurements and communications; the continual process of improvement; and an organisation's ability to hold onto improvement gains. In a further article Dale, Boaden, Wilcox and McQuater (1997: 372), 'sustaining' was defined as 'the maintaining of a process of quality improvement'. The study identified certain important pitfalls around the lack of adequate leadership, management and problem-solving skills; failure to follow through on projects; the inability to keep teams together; and the lack of essential physical and technical resources, information and analysis.

Buch and Rivers (2001: 371) emphasised the importance of leadership and culture to the success of any TQM initiative, in partnership with training, reward and support systems to combat the natural tendency to revert to type in the face of both internal and external influences. This was echoed within an article published by the journal *Strategic Decision* (2002) which acknowledged that sustaining any new culture is extremely difficult and that leadership is crucial to the success of any new initiative, to ensure continued support and focus across the organisation and thereby influence the outcomes of the planned changes.

Wood (2004: 20) identified that achieving any degree of sustainability within a supply chain environment, required the direct involvement of those people who could make the changes with each accountable for their results. Allied to this was the requirement to provide a clear vision of the future, with targets and action milestones, supported by regular measuring and monitoring to provide feedback. In addition a number of enablers were recognised as having significance at an operational level namely: the formal documentation of all ideas and

suggestions for improvement; enabling teams to make local operational decisions; allowing time for daily housekeeping and improvement activities; with management staying focussed upon the overall improvement activities. The concept of enablers was developed further by Bateman (2005: 274), initially a process improvement approach was developed, which then evolved into continuous improvement programme to provide sustainability. Tactical and operational improvements at shop floor level were then implemented and integrated within the wider business scene, allied to a more organisational perspective.

A study by Balding (2005: 286) using an action research approach within a healthcare environment, found that when senior management were able to create a suitable culture to enable the middle management structure to become far more empowered and as a consequence more directly involved, this enabled the middle management team to take ownership and accountability for their part of the project, building upon their values to allow them to establish positive message within their teams. This helped counter major negative attitudes and thereby increased the opportunity for sustaining the organisation's quality improvement implementation.

Goyal and Patil (2009) described the building of an organisational quality mindset to bring about sustainable improvements. They identified that Lean Manufacturing, Six Sigma and TQM implementations may all suffer deterioration after the completion and handover of the breakthrough improvement unless the correct processes were put in place. The quality mind set proposed a programme of continuous improvement supported by: root cause analysis and prevention; regular management reviews by both local and senior management; institutionalisation of processes; daily measurement, monitoring and reporting; developing greater team work; all reinforced by the continual support of the top management. A strategic view provided by Svensson (2006: 25-29) used the term 'Sustainable Quality Management' to propose a 'circulation approach' which was seen basically as a chain or series of business improvement operations across three of total quality management's major components namely: core values, techniques and tools. The study also questioned whether the short term nature of these three components could conflict with the longer term aims of the organisation.

Zairi's (2005) study concluded that sustainable improvements can only be achieved by cultural and transformational change, with commitment and participation by everyone towards continuous improvement, developing skills, learning from experiences, celebrating success, all within an environment supported and reinforced fully by management at all levels. The entire process should be evolutionary, emphasising an organisation's critical success factors, supported by regular measurement and feedback, to develop a total quality management philosophy throughout the organisation.

Within the information system arena, Helfert (2001: 2) identified the importance of applying the principles of total quality management to inform the concept of a 'method-based data quality management' approach to improve the quality of data within data warehousing projects. This relationship between total quality management and data/information quality was developed further by Levis, Helfert and Brady (2007) identifying that whilst the majority of TQM researchers tended not to mention information quality explicitly, high quality data and information was critical to the success of quality management programmes. In a reciprocal manner it was also concluded that the principles of data/quality management are strongly underpinned by the concept of TQM (Levis, Helfert and Brady 2007: 9).

Sustainability and Enterprise Resource Planning

Whilst it has been identified that there is a gap in the literature relating to process improvement sustainability within ERP systems, certain articles have been published which contribute to the overall ERP/Quality Management debate. Laframboise and Reyes (2005) described research into the integration of ERP implementations and total quality management (TQM) systems. They identified that historically ERP and TQM had never been viewed as an essential pair and that there had been very little academic research carried out on ERP other than on procurement and implementation, which coincides with one's own findings. One relationship that was identified as being essential to both ERP and TQM was the critical support of top management and the devoted involvement of every employee. Whilst TQM and business process re-engineering (BPR) are both mentioned widely, there was never any reference made to 'data quality' as such. One questions whether this is a serious omission on behalf of the authors of the article who fail to identify the significance of data quality within a TQM concept, or the failure of the data quality fraternity to get its message across to ERP and TQM researchers.

Akkermans and van Helden (2002) debated the merits of two alternative methods to bring about ERP system improvements, comparing a 'strategic leap' approach akin to business process reengineering, with that of continuous improvement which (quoting Upton and McAfee (1997: 3) they defined as "a series of small steps whose individual impact might be small, but which cumulatively delivers substantial performance gains over time" (Akkermans and van Helden 2002: 4). The study compared the two alternative methods which were both employed within a specific ERP implementation, revealing that the use of the 'strategic leap' caused a major crisis within the organisation, which was only resolved when a 'continuous improvement' approach was employed. The article concluded that a continuous improvement process approach can have significant positive influences for both ERP implementations and post-implementation success (Akkermans and van Helden 2002: 19). Once again no direct reference was made to data quality which makes one question not only the ERP researchers and the data quality fraternity per se, but also the failure of the academic community's to take

any real interest in such an important topic, leaving an apparent void within this part of the literature

In a further study, Schniederjans and Kim (2003) examined the sequencing of business process reengineering and total quality management initiatives within a number of ERP implementations. Their research indicated that where BPR preceded the ERP implementation and was followed by a TQM initiative there was a fair element of success. This success was also mirrored in instances where the sequence TQM/BPR/ERP was employed. Reference was also made to 'Lewin's Three Phased Organisational Change Model' which may be characterised as 'unfreezing, changing, re-freezing' and how this model could be applied to their research. One appreciates that the very existence of any form of effective process development can act as a catalyst for a successful improvement programme. Worley, Chatha, Weston, Aguirre and Grabot (2005) studied the implementation and subsequent optimisation of an ERP system within a university, concluding that effective optimisation requires adapting business processes so that they align with the attributes of the human resources. Tasks and responsibilities have to be defined clearly, within consistent and optimised processes, taking account of the roles, competences, knowledge, requirements and potential of the workforce.

Davenport (2004) identified that organisations can derive significant benefits from enterprise systems implementations, provided they continue to optimise business and management processes. This may be achieved by establishing a continuous business change infrastructure with management involvement, working on a prioritised action plan, focussed towards ongoing process improvement; by standardising the operations, using best practices to ensure that they fit and flow effectively across the business, with appropriate measures and related accountability, to generate organisational value.

A study commissioned by Deloitte (1999: 21-23) found that successful companies demonstrated a number of best practices for maximising and sustaining the benefits of enterprise resource planning. Amongst these were: aligning the whole business behind the original vision and use the business case as an ongoing management tool; focusing upon the capabilities and benefits that have been identified from an ongoing perspective; ensuring that the most effective working *processes* are balanced with the new technology, to support the *people* who have been motivated, trained and developed; establishing clear lines of responsibility and ownership at all levels; together with the provision of measurements and metrics to evaluate progress against system performance targets and budgets. The study, termed 'ERP's Second Wave', also identified a series of generic steps to support ERP optimisation, to promote the benefits along with long term sustainability. These comprised a programme to: confirm the destination, where the organisation wishes to go; determine the progress made to date, where are we now?; develop a plan to continue the 'journey', with actions to be taken to achieve the goal(s); organise progress throughout the journey and

implement the action plans; create a means for tracking progress, measure, report and feedback the results, to determine whether the overall objective were being met. This may be seen as a derivation of the change management process of Plan, Do, Check, Act.

These last two sections have identified strong collective recurring themes arising from research within the generic Change Management, TQM, Lean Manufacturing and Six Sigma arenas some of which related to ERP environments. It should be noted that this literature review has focussed principally upon quality management and TQM mainly to the exclusion of business process re-engineering (BPR). One feels that this approach is valid because data quality is an ongoing life-time philosophy, more akin to the principles of quality management, rather than a collection of focussed, one-off or short term events to resolve business problems as is the case with the majority of BPR initiatives.

Key Recurring Themes

The key recurring themes have been summarised, referenced and grouped into a number of broad headings aligned to the main structure of the conceptual framework, in Table 2 below. Whilst the categorisation is not prescriptive and there may be some grey areas and elements of duplication, the analysis provides a summary of the main arguments and premises surrounding the notions of both change management and quality improvement, derived from the review of the relevant literature. This analysis will be revisited in Section 16 as part of the discussions emanating from this entire research.

Cultural/Organisational

Leadership:

Executive and Management support and sponsorship

Dale (1996); Kotter (1996); Buch and Rivers (2001); Davenport (2004); Zairi (2007); Goyal and Patil (2009)

Establish a clear vision with targets and milestones

Beckhard (1989); Kotter (1996); Deloitte (1999); Lewis (2000); Wood (2004)

Importance of Leadership and Culture

Dale (1996); Kotter (1996); Buch and Rivers (2001); Balding (2005)

Align the Organisation

Kotter (1996); Deloitte (1999); Eaton and Phillips (2006); Strategic Decision

Focus upon achievements

Kotter (1996); Lewis (2000); Zairi (2005)

Celebrate successes

Lewis (2000); Zairi (2005); Boulton and Eaton (2008)

Management:

Improvement requires change which has to be managed
Kotter (1996); Lewis (2000); Bateman (2005)

A belief that change is worthwhile and necessary
Kotter (1996); Boulton and Eaton (2008)

Manage the change
Kotter (1996); Deloitte (1999); Bateman (2005); Zairi (2005)

Identify risks, benefits and overall objectives
Boulton and Eaton (2008)

Plan and identify required actions
Deloitte (1999); Davenport (2004); Wood (2004); Eaton and Phillips (2006)

Measure, monitor with reporting and feedback to support accountability
Dale (1996); Davenport and Beers (1995); Deloitte (1999); Wood (2004); Zairi (2005); Boulton and Eaton (2008); Goyal and Patil (2009)

A continual on-going process
Dale (1996); Akkermans and van Helden (2002); Davenport (2004); Balding (2005); Zairi (2005); Boulton and Eaton (2008); Goyal and Patil (2009)

Accept that there will be set backs
Baum and McKelvey (2006)

Avoid undue pessimism, stay focussed and be positive
Balding (2005)

Identify potential pitfalls
Dale, Boaden, Wilcox and McQuarter (1997)

Manage any potential short term and long term conflicts
Kotter (1996); Sharp (2006) Svensson (2006)

Align the processes behind the people
Worley, Chatha, Aguirre and Gabot (2005); Eaton and Phillips (2006)

Establish clear channels of communication
Kotter (1996); Lewis (2006); Boulton and Eaton (2008)

Manage the relationship between the way data interacts between the processes and the people
Deloitte (1999); Worley, Chatha, Aguirre and Gabot (2005); Whitehead (2006)

Processes:

Best practices within the right environment
Hammer (1990); Zairi (2005)

Continual process reinforcement
Dale (1996); Davenport (2004)

Elements of quality management principles in all forms
Schniederjans and Kim (2003)

Continual process improvements
Akkermans and van Helden (2002); Davenport (2004); Bateman (2006); Goyal and Patil (2009)

Root cause analysis and error prevention
Goyal and Patil (2009)

Concept of People, Processes and Data
Deloitte (1999); O'Brien (2006); Whitehead (2006)

Align the processes behind the people
Deloitte (1999); Worley, Chatha, Aguirre and Gabot (2005); Whitehead (2006)

Identify and document the process enablers
Wood (2004); Bateman (2005); Sharp (2006)

People:

Obtain buy-in, ownership and belief
Boult and Eaton (2008)

Involve everyone
Kotter (1996); Worley, Chatha, Aguirre and Gabot (2005); Boult and Eaton (2008)

Build targets into peoples' objectives with a reward mechanism
Sharp (2006) and Boult and Eaton (2008)

Importance of education, training and development
Deloitte (1999); Buch and Rivers (2001); Wallace and Kremzar (2001); Sharp (2006); Harris and Cole (2007); Boult and Eaton (2008)

Importance of ownership and responsibility
Balding (2005)

Teamwork
Wallace and Kremzar (2001); Goyal and Patil (2009)

Tendency for people to revert to type
Prochaska and Velicer (1997); Buch and Rivers (2001); Boult and Eaton (2008)

Concept of People, Processes and Data
Deloitte (1999); O'Brien (2006); Whitehead (2006)

Align the processes behind the people
Deloitte (1999); Worley, Chatha, Aguirre and Gabot (2005); Whitehead (2006)

Table 2 Key recurring themes

It has already been established in Section 2 that there is a correlation between the concepts of a manufacturing system and that of planning and information system and as such, one believes that the basic quality management principles and practices that have emanated from the manufacturing environment, much of which has been described above, have strong potential to assist in whole or in part, to manage effectively the quality of data within an ERP system. That being said, implementing and sustaining data quality initiatives requires processes, techniques and tools which will vary according to individual circumstances. One

size will not fit all, but these established generic quality principles and practices have the potential to be capable of being applied successfully across varied and diverse environments. This study will compare these strong themes emanating from the research detailed above, with the results derived from the qualitative and quantitative research, carried out within this project.

Data Quality Software Tools

This study focuses upon the manner in which *processes* and *people* interrelate around the *data* flows to impact upon the quality of an organisation's *data*. One is fully aware of the numerous software tools available which purport to improve data quality and there is considerable evidence that these tools do provide solutions in certain circumstances. However it is considered that such software tools are best applied once the basic principles of data quality management have been addressed and sustainable improvement processes are in the process of being applied. Therefore they are not considered to be part of this research.

The main research question for this entire study asks: "How can an organisation create an environment where data quality improvements can be sustained?" The ongoing review of the literature conducted for this research, has yielded rich material as to the notion of data quality as evidenced in detail in Document Two and in Section 2 of this document. Also the means by which quality improvement programmes in general may become embedded within organisations has been discussed in detail within Sections 6 and 7 above. This wealth of material combined with one's own professional and personal experiences has been used to frame the further research carried out for this study, in the form of both a qualitative study and a quantitative survey conducted within one's own organisation Remploy. Section 1 above contained a brief background into the Company, supplemented by Appendix 1. The next section places into context the concept of data and data quality within the organisation and how this has developed over the last decade.

8. DATA AND DATA QUALITY WITHIN REMPLOY

As a prelude to the practical research undertaken for this study, this section presents a background to the way in which the organisation has approached the question of data quality and then provides an account of the improvement initiatives which have taken place over the last five years.

The Requirement for Quality Data

There has long been awareness within Remploy of the necessity of having accurate data within all aspects of the organisation, although for a period of time this was more of an aspiration than a reality. Following the implementation of the Baan/Infor ERP system between 1997 and 1999, data quality improvement efforts tended to concentrate on short term problem resolution in the form of on-the-spot, one-off training sessions and corrective actions as problems were discovered, together with data clean up exercises relating mainly to item, customer and supplier master data, all of which tended to be focussed on reactive problem fixing.

As the Company reorganised to move away from a historical structure of factory based businesses, to focus on a more product based structure with factories operating across two or more product businesses with far greater inter-factory trading it became more apparent that there were real data quality inadequacies. Superimposed upon this was the introduction of a far tighter month-end closure and reporting timetable. Originally ten working days, this was reduced to two and a half days over a period of four years restricting any time for the 'traditional monthly data clean up' exercise. This then led to a growing realisation of the need to 'get the data right first time'. Greater improvements in company reporting with the introduction of a new business intelligence reporting and budgeting tool led to a greater demand for structured reporting from a single source and a move away from individual ad hoc spreadsheet reports. This recognition of the need for far more accurate data emanated initially from within the Finance function where all the data ills tended to manifest themselves and with management frustration around the mistrust of the information contained within important operational and finance reports. New financial and non-financial reports and key performance indicators (KPIs) were introduced alongside quarterly business reviews to enable the Executive and each business management team to meet to review both past and more importantly future performance. With a far greater emphasis being placed on budgeting and forecasting, the need for accurate robust data was seen as paramount.

During the period 2002 to 2005 a number of initiatives were commenced around process improvements, one of which incorporated a partnership with Ashridge Business School under the title of '3X Project' embracing the 'Theory of Constraints' principles Goldratt and Cox (1984), which provided a basis for achieving dramatic improvements in factory performance.

The project was rolled out across thirty or so factories with varying degrees of short term and long term success. In certain sites it was met with indifference and resistance, whilst in others the changes were welcomed and acted upon. From the views of some of those involved, the deciding factors appeared to relate to; the ability of the project team to 'sell' the concept, the attitude and willingness of the local sites to accept fully something new, the degree of senior management sponsorship and open support (which did not appear to be prominent) and the lack of any ongoing measurement of progress and publication of results. The project itself had a finite existence but there is still evidence to suggest that in certain areas, improvements have been maintained over the last five to six years. It is felt that this was down mainly to cultural aspects of the individual sites where there was an immediate buy-in and in certain circumstances where actual physical changes to the factory layout prevented a return to the 'old' ways of working. This provided some interesting lessons around the subjects of process improvement and the management of change.

During the summer of 2005 the concept of data quality achieved a far higher prominence within the Company as an integral part of a new initiative, the Business Optimisation Project, supported by the Executive, the *raison d'être* of which was to coordinate the functions of manufacturing, HR, finance and IT to further optimise the operations of the whole organisation. Within this context quality data was seen as prerequisite to ensure that the existing Baan ERP system and allied applications should move from a support and control tool into one that could be used for the positive advantage of the businesses in providing accurate, timely and easily accessible data to allow the Company to better manage its assets and achieve its objectives. In hindsight this may be seen as the first real strategic awakening as to the importance of data quality to the organisation.

Data Quality Improvement

An initiative to raise the awareness of the essential requirement for quality data and instigate improvements across all businesses was launched at a finance department conference during the autumn of 2005 under the auspices of the author and the overall sponsorship of the Director of Finance. The various business finance managers agreed to act as conduits to drive forward the concept of data quality improvement within the areas of their responsibility. To assist in this, a small project team was assembled to initiate the improvement programme as part of the Business Optimisation Project described above. It should be noted that the term 'accuracy' was to be used instead of 'quality' and whilst it is recognised that accuracy is only a single element of the data quality concept as indicated in the section on data dimensions above, the entire finance team felt that the term 'accuracy' would have greater resonance within the business community and therefore have a better potential take-up and understanding. All of this in no way precluded the other elements of the data dimensions and the data quality definition from being integral parts of the programme. Over the intervening

period the level of awareness, focus and all-round general acceptance of the concept justifies this decision.

An initial approach was made across a number of fronts to attempt to promote education and training; documentation of procedures; the acceptance of responsibility, ownership and accountability at all levels for processes and data; together with better management of master data. In addition the identification and implementation of 'quick wins', together with selling the importance of the project up and down the corporate structure was also seen as being fundamental to raising and integrating the profile of data quality. Recognising that accurate source data was essential, it was agreed that the initial focus should be directed at the operational and factory level, concentrating on the essential operational and commercial activities from customer order receipt to final completion and payment and it was seen as imperative that these should be measured, monitored and controlled.

Remploy Data Accuracy Key Performance Indicators

To this end seven key performance indicators (KPIs) were established around the order fulfilment process, historically the sources of many of the data quality issues. The KPIs were chosen specifically to reflect the salient elements of these essential commercial operations. Two external facing measures were chosen relating to customers and suppliers, four others relating directly to processes within each factory and a final one involving both the sites and the central finance Shared Service Centre which oversees the Accounts Receivable and Accounts Payable functions. The KPIs were designed to reflect the view of the world as seen through the lens of the ERP system, compared with an *actual* view which could be obtained by direct observation of the actual physical order process. In other words how closely the 'system' (*data* within the ERP system) reflects reality in the manner described by Wand and Wang (1997: 94), whilst also providing a measure of the quality of the actual *data* and the related *processes*. Over and above this the information provided the company with the ability to track order fulfilment targets and identify late orders in the form of purchase receipts, production completions, sales despatches and invoice generation all of which have related data quality connotations with potentially serious financial implications. The KPIs have been used to monitor the levels of data quality over the past four years in particular to measure the success of the various data quality initiatives which are tied closely to this study, therefore it is important that their detail and implications are understood.

External Facing KPIs

The following KPIs attempt to identify potential problems emanating from customer/supplier trading which can affect not only the quality of the company data but also the inter-relationship between the company and its external trading partners.

Customer Credit Notes- The number of credit notes as a proportion of customer invoices. This measure can reflect inaccuracies in invoiced quantities, pricing, VAT charges, customer master data, delivery problems as well as product quality issues.

Purchase Invoices Under Query- This measure identifies those supplier invoices that cannot be matched and approved against a receipted purchase order. This process can be affected by inaccuracies in receipting goods and services, invoice pricing, supplier master data, failure to raise purchase orders, order line data and supplier invoicing errors.

Internal Facing KPIs

Site specific KPIs

The following KPIs relate to order fulfilment, identifying transactions that have not been completed on time and may have a serious impact not only on data quality but also potentially customer/supplier relationships.

Outstanding Orders: Production, Purchase and Sales- Identifies orders that are still not complete requiring further transactions to be carried out. These can be affected by inaccuracies in quantities booked, poor housekeeping (failure to complete/close orders), completion of back orders, failure to maintain receipts, record production and post despatches, as well as the effects of actual late order fulfilment.

Despatches Not Yet Invoiced- Indicates where goods have been despatched to a customer without an invoice being raised or where the invoicing process is still incomplete.

Site/Shared Service Centre KPI

This KPI relates to the inter-functional relationship between the various sites and the central Shared Service Centre. This measure identifies potential issues that can affect the quality of the overall data and relationship between the company and its suppliers.

Receipts Not Invoiced- Identifies the level of receipts that have been booked into stock or charged against costs that have not yet been matched against a supplier invoice. This can be affected by inaccuracies in booking in quantities or recording product returns, invoice matching, purchase order prices, supplier master data, or an incorrect supplier chosen. Whilst the overall responsibility lies with the originating site and business, the very fact that a portion of the transaction interfaces with the central Shared Service Centre means that there is an element of shared responsibility. The circumstances are further complicated by the fact that when a receipt is made, a financial liability is created which under current accounting standards means that any legitimate receipt must be retained as a liability for a minimum of six years unless otherwise agreed.

Measurement Process

When using any form of key performance indicator one has to ensure that it is viewed purely as a measure to monitor a given situation and not as the situation or problem itself. The KPIs

indicate a given position in this case the quality of the inherent data. The KPIs are intended to measure the improvement or otherwise in the quality of the data, the processes and the employees' activities. There is strong evidence to suggest that actions have been taken in some sites solely to 'improve the score' which have subsequently proved detrimental to the sites' overall performance. Such actions which sub-optimize business performance must be outlawed.

The source data is extracted straight from the Baan ERP system each evening into a data mart from which the management reporting tool updates the KPI reports overnight in order that they always reflect the previous day's position. The reports take the form of numeric and graphical data. Although graphs and charts are useful in depicting trends, the main attention has focussed upon the numeric data which takes the form of detailed aged listings of each of the individual transactions which comprise each category and are reported by site, business and total company. It was accepted that the majority of recipients were not acquainted with the detailed workings of Baan so it was decided at the beginning, to set the data within the business intelligence reporting tool alongside the other factory and business reports for easy access, with the ability to view and print at any time. The detailed KPI reports were developed and constructed during late 2005 and early 2006 and were first made available in April 2006.

The importance of being able to measure progress was appreciated fully, especially as the seven components are somewhat disparate and so therefore it was decided to create a table to summarise all seven reports within a weighted index incorporating the concepts of the Balanced Scorecard (Kaplan and Norton 1992). The weighting was based upon the age of each transaction aggregated into thirteen monthly periods relating to the Company's annual accounting timetable, commencing with the current period, with the thirteenth containing transactions twelve months old and over. Each successive period was allocated a higher weighting in recognition of fact that transactions are more significant the older they become. The exception to this was the report covering credit notes as it was agreed that the position should be one of improvement and as a consequence the weighting was reversed with the newer periods receiving the higher weighting than older ones. After the end of each accounting period any outstanding transactions are then subsequently aged by a month. A separate index was produced for each site with an aggregated one for each business.

KPI Roll Out and Development

Initial Development

The KPIs reporting process was first made available initially from April 2006. In tandem, the weighted index was also being developed and finally completed in July of the same year. A very rigorous testing programme was carried out within all facets of the reporting mechanism. As part of this process individual pilot operations were run with a number of the businesses to

test the validity of the data, ease of use and understanding of both the results and the weighting mechanism. This process took a considerable period of time, recognising that it was imperative that any instrument designed to measure the accuracy of any data, MUST be totally error free, or all credibility in the measurement process would be lost forever. It was also appreciated that to ensure continuing on-going use and acceptance, the reporting should also be easy to use and understand from both the data source and the implications of the outputs. A copy of a generic KPI weighted index may be found in Appendix 3.

Initial Reporting Process

The formal reporting process commenced in September 2006 with the publication of the weighted index initially on a fortnightly basis circulated to the senior members of the Finance Department and the Director of Finance by way of an email attachment. In addition, detailed guidelines were also published outlining the background and justification, together with instructions for use. It was agreed that each finance manager would be the focal point to cascade the initiative throughout their individual businesses and obtain the necessary buy-in at all levels. The reporting consisted of two high level summary reports comprising an overall index for each business and another providing the information by site within each business. A more detailed summary report was also added at certain times. During this initial period the researcher visited a small number of the business offices and sites to support the initiative.

Extension of Reporting Process

In September 2007 the circulation list was extended to incorporate the Business Managers and an additional member of the Executive Team, which raised the profile further. Every effort was made to try and ensure that this was viewed by all as a company-wide initiative and not a financial, IT or corporate project. Emphasis was placed on the fact that the data was *owned* by the businesses and that they were therefore responsible for its quality. Whether or not this was accepted at the time is a moot point. The reporting was further expanded in September 2008 to take in both the individual businesses' operations managers and the recently formed Operations Forum, a format to discuss operational issues and share ideas and best practice. One attended a number of these meetings where data accuracy was discussed. Further business penetration took place in January 2009 when all the individual factory and site managers were added together with certain relevant supervisors. Within this period the KPI Index was elevated in terms of management and exec reporting. In January 2008 it was included in the Quarterly Business Review meetings between the Exec and each business and in December 2008 individual quarterly targets were set and agreed for each business and measured on a monthly basis. A summary of the roll out is set out in Figure 6 below

Roll out of the Data Accuracy KPI Reporting

September 06	Finance Community and Finance Director
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September 07	Added Business Managers and Exec member
September 08	Added Operations Managers and Operations Forum
January 09	Added Factory and Site Managers and certain support staff
January 08	Included within the Quarterly Business Review meetings (Business Management Teams and Exec)
December 08	Quarterly Index targets set for each Business

Figure 6 Data Accuracy KPI Index roll out

Review of the Reporting Process

The programme of expanding the circulation and overall corporate exposure depicted above may be considered to be somewhat ad hoc in that it did not conform to any initial detailed pre-determined agenda; rather, it developed and evolved over the period, in line with the researcher's own learning process, both as part of this study and as further development of one's practical business experiences. With hindsight the process may have been accelerated a little but the overall aim has been to inculcate rather than inflict the concept. It was also felt that it was important that it be seen as a cross-functional business-wide project rather than a centrally imposed reporting and control structure.

The Data Accuracy KPI Index is essentially a barometer of the effectiveness of the related processes they measure and not an end in itself. Any lasting improvement is predicated on the effectiveness and quality of the processes and the way in which any persons interacting with the processes adhere with the agreed requirements. If the processes are right the improvements in the KPIs should fall out as a direct result.

It was appreciated that this roll out was essentially a top-down process attempting to engage all the relevant elements of each business via the normal management channels of communication. The initial phase saw a high degree of success, which continued in a number of areas due mainly to the enthusiasm of certain managers who were really passionate about the subject seeing real practical merit in what was being attempted. It became evident in 2008 that not everyone was on board and that the real message had not been delivered deep into all the factories and business offices. In addition the Modernisation Programme described in Appendix 1 had taken place with the closure of a third of the sites and the restructuring of a number of businesses, coupled with certain key staff choosing to accept or volunteer for redundancy, all of which took place within a six to eight month period from March 2008.

Whilst the Modernisation Programme achieved its strategic, financial and operational targets, a natural outcome was the understandable re-focussing of everyone's objectives onto the new structure and the related business development projects. As a result the data quality

initiative found itself competing for peoples' focus with other equally if not more personally pressing priorities. A consequence was a rapid decline in the overall quality of the data as measured by the data accuracy KPIs and a general concern that the overall momentum had somewhat dissipated. It became evident that a re-launch was required and this would be best achieved by attempting to communicate at a factory and business office level with the relevant business and site managers and their relevant teams. This was seen not just as a means of promoting the data accuracy reporting, but as an opportunity to engage with those individuals who acted as the 'data producer/custodians' in addition to 'data consumers', to promote the ideal of data quality and obtain their views, input and feedback into the overall concept of data quality and its sustainability. This process formed the internal qualitative study using an action research approach detailed below in Section 11. Site visits had taken place previously on a number of occasions on an ad hoc basis, but not as part of any comprehensive, planned project. The progress made through the initial two years of the programme indicated that whilst there was enthusiasm in many areas towards the concept of data quality, such interest was mainly tacit. This meant that real progress towards creating any degree of sustainability faced many challenges. This research has attempted to identify and explore these challenges to determine ways to create an environment for enduring quality data.

Having established the context within which the research is to be conducted, the following section explores the approaches to both the qualitative and quantitative research.

9. THE OBJECTIVE OF THIS RESEARCH

The objective of this research is to discover the means by which the quality of data can be improved, but more fundamentally, become embedded within an organisation. This study used a dual research approach employing both qualitative and quantitative research strategies focussed within the researcher's own organisation. Such multiple methods of enquiry are capable of knitting together different types of evidence Williams and Pollock (2009:14) to produce more robust and richer understandings (Williams and Pollock 2009:15).

Internal Qualitative Study

Action Research

It was decided to employ a qualitative site-based action research approach to involve and engage with those colleagues who interact with and influence the quality of the data at source, being the method most likely to produce the essential insights into peoples' perceptions (Eden and Huxham 1996:82). Action research, as the title implies, focuses upon action to promote and manage change, based on the philosophy of learning, planning and then taking action in order to change a part of reality (Jarvinen 2005: 13). Lewin (1946: 42) saw action, research and training as a triangle, emphasising that to improve the actions one must first train the personnel. Lewin (1946: 38) identified research as 'fact-finding' or 'reconnaissance', a means of ascertaining whether one is moving in the right direction and at what speed, involving four stages to: evaluate the action; gather new insights; plan the next step; as a basis for modifying the overall plan. This was seen as part of a 'spiral of steps', each "composed of a circle of planning, action and fact-finding about the result of the action" (Lewin 1946: 38). Kemmis (1993:3) suggested that action research provides a way for people to enhance their lives through a research process that widens their social structures and related processes, being a pragmatic approach which looks to come to terms with the world (Baskerville and Wood-Harper 1996: 239); Fisher (2004: 45-46) emphasised the aspects of learning from experiences, by taking action and monitoring the consequences and then developing and promoting improvement and change within an organisation. Bryman and Bell (2003: 304) identified action research as a real life experimental process enabling an organisation to solve problems through a process of identification, planning, action and evaluation. This may then lead to the re-education and the changing of peoples' patterns of thinking via action through participation, thereby contributing to both academic theory and practical action Bryman and Bell (2003: 304), This link between theory and practice then becomes relevant to both the practitioner as well as an academic audience Eden and Huxman (1996: 83), simultaneously assisting in practical problem solving and expanding scientific knowledge (Baskerville and Wood-Harper 1996: 239). This again echoes the sentiments of 'engaged scholarship' developed by (Van de Ven and Johnson 2006; and Van de Ven 2007). Indeed Van de Ven (2007: 281-2) identified action research directly as a form of engaged scholarship.

Action Research within Planning and Information Systems

Action research is not a unique approach within ERP systems, however the majority of the literature has followed the established trend and focussed upon ERP procurement and implementation Akkermans and van Helden (2002); Stefanou and Revanoglou (2008); Walsham (2006); Beyon-Davies, Baker and Williams (2008); Deep, Guttridge, Dani and Burns (2008); Bohorquez and Esteves (2009) and system enhancement Klueber and Alt (2000); Adams, Baker, McFadzen, Miller and Smith (2004), without any real focus upon the quality of the data.

Whilst action research figures within the information systems literature Baskerville and Wood-Harper (1996); Baskerville and Wood-Harper (1998); Baskerville (1999); Lau (1999); Kock, Davison, Dias Figueiredo and da Cunha (2002); Stirling, Petty and Travis (2002); Kock (2003); Baskerville and Myers (2004); de Vries (2007); DeLuca, Gallivan and Kock (2008), there is a distinct lack of any direct reference to data quality. The use of action research approach within information systems research is considered to be “very appropriate” Baskerville and Wood-Harper (1996: 235); “the most scientifically legitimate approach available” Baskerville and Wood-Harper (1996: 240); “a rewarding experience” Lau (1999:170); “a potential avenue to improve the practical relevance of IS research” Baskerville and Myers (2004: 239); whilst DeLuca, Gallivan and Kock (2008: 66) anticipated an increase in the use of action research over the following ten years. The potential for action research to contribute to theory and practise is also emphasised (Baskerville and Wood-Harper 1996: 239; Lau 1999:170; Kock, Davison, Dias Figueiredo and da Cunha 2002: 1; Baskerville and Myers 2004: 330; Jarvinen 2005: 4; de Vries 2007:5; DeLuca, Gallivan and Kock 2008: 66).

The Application of Action Research within this Study

One must not underestimate the potential tensions that exist when employing an action research approach, in particular where research projects are being carried out by part-time students working within their own organisation in a work-based environment. This is further exacerbated within this study by the fact that this research is not being undertaken purely for academic purposes but alongside an actual ongoing operational improvement programme, making this study very much a form of ‘participatory’ action research. Coghlan (2007:335) discussed such ‘practitioner doctorates’ where middle or senior managers carry out doctoral research within their organisations, employing an action research approach, combining work and study. Within this context Bryman and Bell (2003:305) described three interrelated issues associated with, the pre-understanding of the setting, role duality and organisational politics. Coghlan (2007) and Roth, Shani and Leary (2007) discussed these issues in detail within the framework of research into *insider* action research. Being an ‘insider’ with a pre-understanding of the organisation, the researcher may be too close to the data Roth, Shani

and Leary (2007: 47), finding it difficult to stand back (Coghlan 2007: 339). The dual roles of organisational member and researcher also have the potential to cause conflict (Coghlan 2007:339; Roth, Shani and Leary 2007: 51). Roth, Shani and Leary (2007: 51) also identified a third role, that of an 'internal consultant'. Organisational politics also play a part with the potential to undermine or block planned change (Coghlan 2007: 340). The 'internal researcher' or 'political entrepreneur' Coghlan (2007: 340); Roth, Shani and Leary (2007: 44), has to appreciate and understand the workings and culture of their organisation Roth, Shani and Leary (2007: 58) and have credibility to be able to achieve 'buy-in' from colleagues (Roth, Shani and Leary 2007: 58).

Whilst one appreciates the reservations and caveats discussed above, one feels that a researcher working within their own known professional environment has the opportunity to generate rich and valuable findings to benefit both the research outcomes and the organisation as a whole. Within this study, role duality was not considered to have negative consequences; it was felt that a 'sympathetic' pre-understanding of the setting, knowledge of the organisational politics and a reputation for providing help and advice in the past has the capacity to make the process credible, to generate considerable buy-in from participants, avoiding conflict, and thereby make change and learning possible. Whilst it is accepted that being 'close' to the data with the inherent difficulties in being able to 'stand back' may cause possible problems, it is felt that this should be overcome if the researcher is aware of such potential issues and allows the participants freedom to become involved and contribute fully. Every effort was made to ensure that this happened.

Given that this study employed an insider action research approach where the researcher had intimate knowledge of both the business processes and the Baan application, there was a distinct danger that one could become the 'major source' of the solution. To guard against this, one made every attempt to ensure that as many participants as possible had the opportunity to make a contribution. There were occasions where one's advice and opinion was sought as part of the general discussions and in such circumstances a response was provided. Every effort was made to ensure one remained objective and that one's views were never imposed upon the proceedings. The positive responses from each meeting appear to be evidence that everyone felt that they had made a positive contribution.

Whilst undertaking work-based research one must also place this within the areas of theoretical inquiry. Both Bryman and Bell (2003:304) and Eden and Huxman 1996: 80) suggested that there appears to be little difference between the roles of an academic researcher and a management consultant and action research and consultancy. (Eden and Huxman (1996: 79) also identified and discussed two groups, the 'consultant as researcher' and the 'researcher as consultant', both reflecting a practical orientation although satisfying different audiences. The former, which seeks to bring about improvement by forms of

'tweaking' to improve practice Eden and Huxman (1996: 79) is viewed as closest to this research, although in the light of a previous discussion, the term 'practitioner as a researcher' may be more apt. Whilst action research does not lend itself to repeatable experimentation and has not traditionally been seen as an ideal means for the rigorous testing of theory Eden and Huxman (1996: 80), it does have the powerful potential to generate rich data around people and their actions Eden and Huxman (1996: 80) especially within this context, where it may be seen to have enhanced this research, as will be discussed further in Section 17.

Within this study the process of action research is seen as the means of developing a deeper understanding of the organisational conditions within which the quality of data can be improved, by colleagues working together towards a common accepted goal in terms of a 'collective involvement' to manage organisational change (McNiff 2002: 27). In this context the action research process leads to individual learning not only by the researcher but by all participants in the form of 'organisational learning' (McNiff 2002: 28). Without this element of collaborative action learning any improvements would have little chance of any degree of permanency. Action research may be seen as the external collective 'We' element whilst action learning relates to the internal 'I' allowing the external experiences to become inculcated.

In Figure 7 below McNiff (2002: 7, 11-12) provided a generic action research model, depicted diagrammatically in black, which underscores the salient points surrounding action research and also provides a very practical action plan for applying the concepts. This has then been adapted to relate more closely to this study as detailed in blue, to which has been added a 'return loop' in red to represent each subsequent site/business meeting following similar processes, hopefully learning from the prior experiences. One may also see a direct correlation with the quality management cycles of Plan, Do, Check, Act (PDCA- TQM) and Define, Measure, Analyse, Improve, Control (DMAIC-Six Sigma).

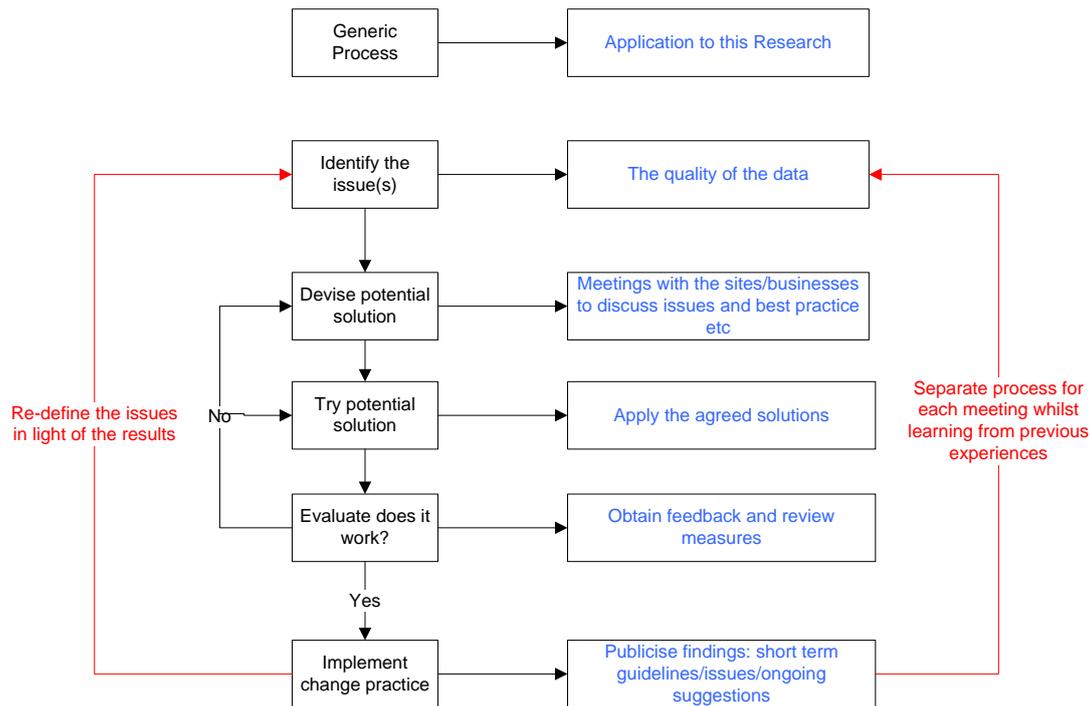


Figure 7 Applied model of action research for Remploy

Based upon McNiff (2002: 7, 11-12)

The practical application of this model is detailed within Sections 11 and 12

As highlighted within Section 8 this qualitative study had a distinct practical origin relating to the re-launch of Remploy’s data quality initiative following the completion of the initial phase of the Modernisation Programme which saw a rapid decline in the overall quality of the data as measured by the Data Accuracy KPIs.

One of the main aims of this project has been the attempt to highlight the importance of getting the data right first time by the application of root cause analysis and correction of data errors at source. The qualitative study was viewed very much as a two-way education and learning process by which the site and business teams would be able to become more acquainted with the data quality initiative and all that entailed, but even more importantly be able to provide rich feed back, utilising the concepts of collaborative action research (Miles and Huberman 1994:9). It was intended that this would enable best practices to be developed and communicated, important issues and problems to be identified and solutions worked upon, along with the development of longer term principles and guidelines.

Internal Quantitative Survey

The quantitative survey, in the form of a self-administered web-based questionnaire was distributed to the one hundred and eleven recipients of the Data Accuracy KPI reports during the summer of 2009 using NTU's own survey tool Autoform. This was viewed as an essential development of the overall data quality initiative not just as a follow-up to the site visits, but to complement this process, as a further means of measuring peoples' views and perceptions of the quality of *their* data and to gain additional valuable insight from all levels of the organisation. The cultural climate was also seen as appropriate. Just as one chose to carry out an external quantitative survey for Document Four during the run up to the Modernisation Programme, the post Modernisation period was seen as ideally suited to a re-appraisal of those important ideals and concepts of which data quality was viewed an essential element.

Each of the two research processes is described in detail within forthcoming sections, however prior to undertaking any form of research, one has to be mindful at all times of the ethical implications of the researcher's actions. The next section discusses this topic in detail with particular reference to the research carried out as part of this study.

10. ETHICAL ASPECTS OF THIS STUDY

Remploy's Ethical Standards

The main research undertaken for this document has been carried out with the author's own organisation. Remploy has developed a code of moral practice allied to its five key values, which guides the organisation's very existence and dictates its moral climate, without which it would find it impossible to operate. These values of Professionalism, Passion, Respect, Openness and Keeping Promises, again echo the moral principles of total openness, honesty, respect for others and integrity. Within the context of Remploy, the author has executive approval to undertake this project and has been a member of the organisation for over sixteen years working closely within all aspects of the business, not only within Finance and IT. This enabled the researcher to build up a network of colleagues over a number of years, gaining their respect and support which has assisted considerably in gaining access and facilitating the qualitative and quantitative research detailed here. The Company's values and associated culture, together with the enduring relationship one has developed with both the Company and one's colleagues helped formulate the ethical principles employed throughout this entire research. One has then been able to build upon these professional relationships, a number of which were able to set up further contacts within their own individual areas. It was recognised however that this places even greater pressure on maintaining those moral principle of total openness, honesty, respect for others and integrity not only to maintain one's own moral and ethical integrity and reputation, but to ensure that none of the supportive colleagues were let down.

There are a number of generic ethical guidelines that relate to all forms of research, in particular, adherence to legal requirements including the Data Protection Act, organisational procedures, confidentiality and anonymity, the keeping of promises together with the obtaining of permission to publish. From previous research, certain key moral values and principles emerged which can be applied equally to both business and life ethics. The detailed code of practice published by the Economic and Social Research Council within its Research Ethics Framework Economic and Social Research Council (2006), encapsulates a great deal of the literature on the subject. It constitutes a set of minimum generic standards which encourage good ethical practice in social science research encapsulated within certain key principles in that the research should be designed, reviewed and undertaken to ensure integrity and quality.

This section will focus and evaluate those ethical elements which appertain directly to the research undertaken as part of this project. This area of investigation embraces both the practical challenges of undertaking this specific research together with a review of the related literature. The intention is to identify the principles that should be followed and also in more detail the implications and challenges that have emerged.

Security

The questions of confidentiality and anonymity have been highlighted, which then leads onto a discussion as to how these elements may be controlled. The issue is not just about the researcher ensuring that research details are not disclosed directly to other parties for example by word of mouth, but heavily involves the matter of data security and its storage in either hard copy or electronic format. The author ensured that only summary data was being kept as a hard copy without any direct reference to any research contributor. The exception to this is where an individual is referred to within any of the six documents (other than as a published literature reference), but this is only made with the explicit authority of the person quoted and is used in support of a particular relevant position or stance. Some of the detailed information containing direct references to individuals, was gathered from face to face meetings and written down, but this data will not be retained as a hard copy, but committed to electronic applications such as Word or Excel. The original material will be disposed of securely (using Remploy's document disposal service) after the completion of this research.

Electronic Security

The questions of security around the various electronic formats pose far more complex problems. The entire data is held on the author's own company laptop, essentially in Word, Visio, SPSS and Excel files secured by special encryption software. This data is also stored upon a back-up media within the Remploy IS network as part of the company's back-up and disaster recover policy and procedure. Detailed person-sensitive data is also held externally on NTU's web based survey tool Autoform which has been used to carry out two electronic questionnaires. Satisfactory evidence has been obtained to indicate that the data held within the Remploy network and NTU's Autoform environment, meets acceptable storage and access requirements to provide adequate security. Details of these responses are contained within Appendix 4a and 4b.

Ethical Aspects of Qualitative Research Relating to this Study

Action research relies upon total openness amongst the participants with the respondents in particular feeling able to make a contribution without fear of any repercussions. Likewise the researcher must ensure that no one is ever placed in a position where this is likely to occur. Each site visit was designed to both provide information and gather data by enabling open discussion to take place within a positive blame free environment with each party able to share thoughts and ideas around a common goal. The researcher also tried to ensure that the respondents were revealing their own opinions and not those which they thought that should be given. In line with this policy of openness, all the notes taken by the author at each

meeting were circulated to all participants in bullet point form with a request for confirmation and feedback.

Gill and Johnson (2002: 93-94) referred to certain ethical issues relating to action research including the acceptability of the client/project to the researcher, the values relating to the parties and the confidentiality and the protection of respondents. They further identified that there may be circumstances where respondents wish to remain anonymous which in practice may prove very difficult, in addition some business may be happy to be identified in any subsequent publications whilst others may require anonymity. Miles and Huberman (1994: 290-297) identified certain specific ethical issues surrounding qualitative research: the worthiness or value of the project; the competency and expertise of the researchers; obtaining informed consent; the benefits/costs trade-off; potential harm and risk; trust and honesty; privacy, confidentiality and anonymity; research quality and integrity; and the use and misuse of the results and potential conflicts, dilemmas and trade-offs. The author is aware of these issues and concerns but feels that these potential problems were not present within the study. In many cases an invitation came directly from the businesses and throughout the proceedings there appeared to be no evidence of any negative attitudes or consequences.

Ethical Aspects of Quantitative Research Relating to this Study

Gill and Johnson (2002: 121) discussed the circumstances of survey research conducted within a single organisation commissioned by an interested party. The salient points recognised that, consultation should take place as to the purpose of the survey, with the opportunity for fellow colleagues to have input into the survey design, together with an acknowledgement that the results could have implications for all concerned. All these points were accepted and taken into consideration within this study.

The use of internet-based research compared with the more traditional modes of communication brings with it certain concerns. Nosek, Banaji and Greenwald (2002) identified ethical issues relating to the absence of the researcher, potential exposure of confidential data and/or identity to a third party and lack of detailed de-briefing facilities. They also highlighted related security questions surrounding confidentiality and anonymity, security of data transmission and data storage, the tracking of participants over a period of time and the possibility of miss-behaviour by participants, intentional or otherwise. These issues are all well founded but have been dealt with earlier within this section.

Having established the ethical principles governing the research for this thesis, the following section describes the qualitative research process that was employed.

11. INTERNAL QUALITATIVE STUDY

The qualitative research for this document has been built upon the experiences and lessons learnt from the research carried out within Document Three. This involved the use of focus groups in conjunction with an action research approach utilising process mapping, to collect data around processes and procedures within Remploy's operational and manufacturing environment. This was aimed at obtaining a better understanding of the data flows and assist in deriving a greater appreciation of the data as it interacts with people within the relevant processes. The qualitative element of the research for this document took the format of a series of discussion-type focus group meetings sharing experiences, ideas, issues, problems, successes, around a basic flexible agenda, whilst still employing an action research approach. This approach was less formal excluding the use of process mapping as the main intention was to generate discussion and interaction to discover peoples' real feelings and attitudes towards *their* data. Such "local qualitative research may provide better tools for drawing out intricacies...opening up new understandings of novel and emerging phenomena" (Pollock and Williams 2008:110). This section places this interactive process of data collection, within the overall context of focus group and action research, whilst relating the direction of the meeting agenda to previous discussions within this study.

As stated previously, the researcher decided that a re-launch of the data quality improvement initiative was necessary and this would be best achieved by working together with those colleagues who were actively undertaking the vital 'customer order receipt.....to final payment' processes, at factory and business office levels. At the outset there was not a specific plan in place to visit the majority of factories, but to concentrate initially on around a dozen. These were intended to be a mixture of those that were viewed to have performed well during the initial two years and those that had performed less well, in an attempt to ascertain the factors behind the variations in performance as well as to reinvigorate the entire initiative and instil a degree of sustainability. Also after attempting to engage the businesses from a 'top-down' perspective, it became apparent that more balanced method involving a 'bottom-up' approach would prove more beneficial. This was also seen as a key factor in part to overcome instances in a number of the businesses where it was claimed that the 'message' had never been cascaded down to all levels. There was also a realisation that this was the 'right thing to do', in that it provided an opportunity to engage with those individuals who acted as the 'data producers', 'data custodians' and 'data consumers', to promote the whole ideal of data quality and obtain their views, input and feedback into the overall concept of data quality and its sustainability. These practical aspects dictated the nature of the qualitative research for this document, but to complement this, the recognition of theoretical and academic research principles helped to enrich the overall outcomes. This is a further example of the congruity between theory and practice

Focus/Discussion Groups

It was decided to eschew the more formal focus group/process mapping approach, used in Document Three, in favour of a more informal process engaging those individuals who were actually responsible for the factory and business processes. Remploi is essentially a mini conglomerate and whilst not every location is identical, in size or complexity, the basic functions of production, purchasing, sales and administration exist in varying degrees in all sites and the representatives covering each of these functions together with the relevant management and/or supervisory personnel were the obvious colleagues to involve. It was felt that a more informal atmosphere would generate a more relaxed environment to enable more free and frank discussions to take place, although it was acknowledged that this would depend greatly upon the mood and tone set by both the researcher and the local management team (Pearce 1998: 72).

Whilst an informal discussion approach was considered the most appropriate, one must not lose sight of the fact that these 'inter-active engagements' were conducted within a focus group type environment, in the form of free flowing open discussion on a focussed topic Bryman and Bell (2003: 368, 570); Fisher (2004: 45), attempting to 'tease' out facts and information from the participants to construct meaning (Bryman and Bell 2003: 371). Within a well constituted focus group, participants are able to discuss issues and topics that are important and significant to them, whilst engaging in an open dialogue where each can share, argue and challenge each other's views (Bryman and Bell 2003: 369). Such an environment can assist individuals to define their issues and problems and work together to identify and apply potential solutions (Bryman and Bell 2003: 369). In this way focus groups can help group norms and cultural values, encourage open conversation, facilitate the expression of ideas and experiences, encouraging participants to generate and explore their own questions and experiences, by tapping into a wider form of understanding (Kitzinger 1995: 302). Focus groups are sometimes criticised because of the unsystematic nature of the sampling process and the potential difficulties of replicability and reliability (Bryman and Bell 2003: 371). However in this study, this approach is seen as both a strength and an advantage, because the resultant participation and unpredictability of the outcomes, particularly where strong personal interaction takes place, was the most appropriate method for this particular topic (Eden and Huxham 1996:82).

The Data Capture Process

The data capture process took the form of a series of face to face meetings carried out at a number of the Company's factories and business offices, supplemented by conference calls used where either sheer distance or time precluded a physical meeting. The meetings were arranged in a number of ways; by the author contacting individual sites, upon the receipt of an

invitation from a site, or a number of visits organised via a member of a business management team. As the process developed the majority of the further meetings were requested either by individual sites or by a site-owner business. A generic agenda was developed to focus each event and identify the main points of discussion, whilst still being flexible enough to tease out any other relevant issues. These agenda points embraced:

- Discussion on the overall Corporate Data Quality Improvement Initiative with particular regards to the Data Accuracy KPIs and the way in which these support the overall process
- Implications for the site and business
- The Site/Business KPIs
- Priority areas
- Short term actions
- Medium term approach
- Ensuring that everyone is aware of the implications of their actions and responsibilities
- Any further relevant points

This generic agenda encapsulates also the recurring themes around *Processes* and *People*, together with the Cultural/Organisational themes relating to measurement and reporting, communication, change management and short and long term priorities, identified from the review of the literature as detailed in Table 2 on pages 50-52.

As stated the initial plan when commencing this study was to cover around a dozen sites, but it became apparent immediately from the outset, that there was a distinct appetite, across all levels within the manufacturing businesses, for better quality data as sites and businesses rapidly requested a visit. This gathered a momentum, which led one to decide to expand the initiative to encompass as many sites as possible. This valuable additional access has not only widened the improvement process within the organisation, but has expanded the researcher's insight, to further identify understanding around this subject.

Every effort was made to ensure that this was not viewed as 'a visit from Head Office' or as just another training session, but as a two-way information exchange. Notes were taken by the researcher and were then written up in bullet point form, usually within twenty four hours, to a predetermined format and circulated to all attendees for their comments and feedback. An example of the feedback document is attached in Appendix 5. These outcomes were then analysed and the findings generated as lessons learnt and to be learnt, reproduced in the form of key findings, short term guidelines, issues and ongoing suggestions for improvement as described in the following section.

12. QUALITATIVE STUDY- ANALYSIS AND FINDINGS

This section summarises the actual research process, analyses the results from this research, identifies related key findings and then proceeds to provide guidelines as to best practice, recognising certain issues and problems and finally offers suggestions for future progress.

The Research Process

The main thrust of the process took place between December 2008 and April 2009. In all, forty eight of the fifty four factories and seven business operations and sales teams were covered. Thirty four separate locations were actually visited, a number of these events comprised representatives from two or more factories in the form of regional cluster meetings, to speed up the process, reduce travelling and share experiences. In addition three conference call meetings were also held where it was not possible to arrange for all the participants to be together at the same time. Four of the factories also received a second visit after a specific request. Over this time the author travelled almost eight thousand miles. The process is summarised below in Tables 3 and 4:

Analysis of the meetings

Meetings covered by:	Site Visit	Joint Meeting	Conference Call	Total
Factories	30	12	6	48
Operations Teams	4		2	6
Sales Teams		1		1
Additional meetings	3		1	4
Total	37	13	9	59

Table 3 Analysis of the meetings

Timescale of the meetings

Oct 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	Sep 09	Total
1	13	18	3	15	8	1	59

Table 4 Timescale of the meetings

The number of attendees at each meeting (excluding the researcher) varied between one and six in respect of the pure site factory visits and up to nine in the case of business operations/sales meetings. There was also quite a breadth of job roles represented, from sales, procurement, finance, administration and well as operations and in total in excess of 130 people took part.

Every attempt was made to include all participants in the discussions whenever possible, although there were occasions where some attendees' natural reticence may have prevented them from participating fully. In these circumstances one had to rely upon the local manager and other colleagues to compensate. The ability of the researcher to gain full access to such a wide and diverse contact base added considerably to the overall richness of this research. This is reflected not only in the volume of the sites covered and people interviewed, but also the extent to which virtually everyone appeared eager to participate fully and attempt to make a contribution. The overall feedback proved to be very positive and one did not detect any real degree of negativity. Some very interesting comments emerged particularly relating to the roll out of the Data Accuracy KPIs themselves. A number of managers and their staff stated that they had never previously been aware of their existence. This immediately brought into question the method by which this and other initiatives had been implemented, raising uncertainty as to the quality and effectiveness of employing purely internal top-down communication processes.

Analysis

The initial meetings followed the basic format of the generic agenda described above, but additional related priorities quickly began to emerge alongside the original aim of re-launching the data quality initiative, on the back of re-focussing attention onto the Data Accuracy KPIs. The wider perspective emerging from the research, with regard to sustainability, became a real objective, mirroring the progression of this entire study. Whilst the term 'sustainability' was only mentioned briefly, discussions revolved around; 'what data quality means', 'why it is so important?', 'how the KPIs fit in with and contribute towards this concept', 'what has gone well and what has gone poorly in relation to this?', 'what are your problems and issues?', 'what are your suggestions for improving things?', 'how can each factory and business make a considerable contribution towards improving data quality?'. It was also recognised that four of the seven KPIs were within the direct control of each factory but the remaining three required input from other sources both internal and external to the Company. The format of the discussion evolved to encompass:

- Re-focussing the Data Accuracy KPIs within the perspective of the overall data quality landscape
- Identifying and highlighting good and bad practice

- Identifying issues and problems
- Developing best practices within both the short and medium terms
- Determining how best this may be implemented
- Learning from the above to improve on-going practice- (Action Research/Learning)

The discussions were captured and recorded by the researcher in bullet point form as shown in the example in Appendix 5 and circulated around all attendees as soon as possible after each event. Feedback was requested and any resultant comments were noted and added where applicable. In all thirty seven separate events were recorded in this way. This process generated two hundred and fourteen points of discussion, a number of which were repeated on several occasions as one would imagine.

These principle themes noted from each meeting, were then analysed further within Framework 1- Appendix 6a. For example those points recorded from the meeting detailed in Appendix 5 are shown on the first line in Framework 1

The data was arranged in columnar form analysed by:

- Site/Department) Although for the purposes of this document
- Business) individual personal, site and business information
- Date of the meeting) has been excluded to preserve anonymity
- The detailed agreed discussion points relating to each site/business meeting

The discussion points were then analysed into five major categories colour coded to aid identification:

- Current actions and policies- The way we are doing things currently
- Issues and problems- Issues and problems identified
- Actions to be taken going forward- What we are going to do in the short and medium term
- Current culture- Current inherent thinking, attitudes and behaviours
- Future culture- Intended inherent thinking, attitudes and behaviours

These categories were chosen to reflect the nature of the action research approach employed, in that a review of the current actions and policies would help to recognise both the good and poor practices, from which the issues and problems could be identified, leading to actions going forward to promote and further embed better practices across the entire business in a form of action learning. Current cultural and behavioural issues were examined to determine whether they were enablers or restrictors, to be developed or eliminated and thereby assist in developing future positive cultural practices to facilitate ongoing progress.

Framework 2- Appendix 6b then proceeded to consolidate the discussion points within each separate category and in the case of the current culture and current actions and policies, classified further as being identified as a positive (+) or a negative (-) influence. Table 5 below summarises the results.

	Current Culture	Current Actions and Policies	Issues and Problems	Actions Going Forward	Future Culture	Total
Total	27	25	52	82	11	214
Positive	19	23				
Negative	8	2				

Table 5 Framework 2

Both Framework 1 and 2 were developed to consolidate all the various conversational strands in an attempt to identify related topics and ideas. From the outset certain important notions and impressions emerged from the discussions and this analysis and these were subsequently developed as key findings. It was felt that these fell in three broad categories relating to: *lessons learnt* that should be put in practice at all sites, involving basic quality management principles, ownership, responsibility and support, together with measurement and reporting; positive personal *motivational factors* which help to engender commitment from individuals, relating to internal competition and targets, an acceptance of best practices and how these relate to one's ideas and principles; together with organisational; and cultural *environmental elements* essentially involving leadership and management issues. A detailed analysis of these key research findings appear in Appendix 12A. These generic findings will be discussed further within Section 16, as part of the consolidated review of the research outcomes.

Recommendations for Action

At the end of March 2009, with 85% of the meetings completed, a detailed appraisal of the whole procedure was carried out, taking into consideration the meeting process, the discussions that ensued and their subsequent analysis in Frameworks 1 and 2, the key findings, together with a review of the performance of the Data Accuracy KPI Index during the period of this qualitative study. A number of guidelines, issues and suggestions for future best practice were distilled from the evidence of these deliberations. The researcher decided that it was important to communicate the salient action points emanating from the meetings, to re-enforce ongoing practices, provide guidance towards optimising processes and procedures and to identify problems to be resolved. In addition it also provided all participants with

evidence that the information sharing process was real and that everyone's contribution was considered important and had received due attention.

In line with this consideration, on 30th March 2009 a report was circulated to all recipients of the monthly Data Accuracy KPIs, comprising suggested short term action guidelines which could be applied to bring about immediate improvements, the identification of issues and problems which need to be addressed, together with longer term improvement initiatives of a more cultural element. This data quality improvement report is detailed in Table 6 below.

Data Quality Improvement Initiative Report

After covering over 80% of the factories and business offices it will be beneficial to share briefly, experiences, examples of good practice and issues which have been identified, to assist us in embedding these improvements to achieve sustainability and getting 'it' right first time.

Long term improvement is down basically to the processes and the training and development of people and as these improve then the index will take care of itself. The index reflects the quality of these elements. We can learn from this corrective process and gain an understanding of the reasons behind the issues and problems and their ultimate resolutions, so as to aid future progress. In this way it can become self sustaining and not merely a cleaning up exercise.

Short Term Guidelines

- Hold a review/planning meeting at least once a week, print off the Index and supporting detailed reports from cyberquery and review overdue items with the members of the team. In this way the reports can also act as an expeditor to identify late receipts and deliveries. Ensure there is adequate cyberquery access
- Provide visibility of the measures and monitor progress over time
- Focus initially on the four key site-specific elements of- Goods Despatched Not Yet Invoiced and overdue production, purchase and sales orders. If necessary generate action plans with target dates
- Review Receipts Not Yet Invoiced but with particular regard to returns. There does not appear to be any formal process within the Company to ensure that purchase returns, whether goods or services, are either:
 - Off-set against a compensating receipt where is this is a corrective action
 - Matched against a credit note from the supplier. There are many items of considerable value months or even years old which may necessitate write-offs

- Ensure that orders are dated with the anticipated receipt/manufactured/despatch date and not the default date which is 'today' which will automatically make them overdue the following day.
- Rather than raise single production orders for large volumes covering a long time period, set up orders for smaller quantities with shorter lead times
- Hold monthly conference calls with each business's Op Team to monitor progress and issues

Issues

- There are training requirements and gaps in people's knowledge especially following Modernisation
- The 'Super User' concept not yet followed up fully
- Some sites have no identified business-specific ISBM and have problems obtaining assistance
- Liaison with SSC
- Problems identified in accounting for carriage charges on suppliers' invoices

Ongoing Suggestions

- Need to ensure everyone is fully aware of the implications of their actions
- Better understanding of the underlying principles and requirements
- Ascertain root causes of issues and problems
- Appreciation as to how the KPIs fit within the corporate data and information quality initiative
- Identify the personnel dealing with each type of order and agree who does what with responsibilities for each process
- Build data quality targets into people's objectives

Table 6 The data quality improvement report

The guidelines, issues and suggestions were intended not just to provide feedback, but to focus people's attention upon the salient outcomes of the series of meetings, together with the findings from the literature reviews, to identify the actions that were happening and/or should happen to drive the data quality initiative forward in the future. The discussion on the performance of the Data Accuracy KPI Index within the next section substantiates this.

The Wider Context of this Research

It is appreciated that this study has been carried out entirely within a work-based setting therefore it is important that this is then positioned within the overall context of this research project and the broader issues and concerns that emanate from this, for both practice and theory. In line with this, the organisational-specific short term guidelines, issues and ongoing suggestions described above have been translated into a format that will enable them to be better applied within a wider environment and these are analysed in detail within Appendix 12.B. These generic findings will be discussed further within Section 16, as part of the consolidated review of the research outcomes.

The paramount importance of measurement, reporting and feedback has been stressed throughout this thesis. The following section traces the performance of the Data Accuracy KPI Index over its lifetime from September 2006 to November 2009 and in particular to the period between November 2008 to November 2009, to identify whether there is any correlation between the data quality activities undertaken within this study and the performance of the Index.

13. THE DATA ACCURACY KPI INDEX PERFORMANCE REVIEW

The importance of measurement, analysis, reporting and feedback has been emphasised continually throughout this entire research. Whilst the KPI Index represents a composite view of a what is basically transactional data, there is a strong argument to suggest that it is also indicative of the quality of the data overall and the progress being made towards its continual improvement. The following discussion traces the performance of the Index overall and in particular the period following the commencement of the site visit programme described in the preceding section, to determine whether there is any correlated sustained improvement.

Period of Review- September 2006 to November 2009

This section reviews the Index's performance over this period, analysing the fluctuations, variations and trends and examines the impact of the various external influences both positive and negative. It then attempts to attribute relevant meaning. It was felt that allowing a period of just over six months to elapse from the end of the site visit programme, would permit a degree of maturity to take place and thereby enable a more objective appraisal to be undertaken. Full details of the Index mechanism and the methodology used to roll out the process across the Company, have already been outlined in Section 8.

Table 7 below tracks the movement of the total overall Company Index figure by quarter over the designated period. Columns one and two identify each quarter; column three represents each financial year's (April to March) cumulative percentage movement by quarter; column four represents the quarterly improvements (+/-) in terms of an index with a September 2006 base date; column five presents each quarter in terms of its cumulative percentage improvement derived from column four; whilst column six displays the overall trend.

Data Accuracy KPI Index Improvement Tracker

	Qtr/Yr	Annual Cum Impr %	Moving Index	Index Impr	Trend
06/07	Sep-06		100	0%	0%
	Dec-06	3%	97	3%	4%
	Mar-07	29%	71	29%	8%
07/08	Jun-07	3%	69	31%	12%
	Sep-07	6%	67	33%	16%
	Dec-07	-9%	77	23%	20%
08/09	Mar-08	16%	60	40%	24%
	Jun-08	-15%	69	31%	28%
	Sep-08	-27%	76	24%	32%
09/10	Dec-08	-15%	69	31%	36%
	Mar-09	6%	56	44%	40%
	Jun-09	6%	53	47%	44%
	Sep-09	6%	53	47%	48%
	Nov--09	14%	48	52%	52%

Table 7 Data Accuracy KPI improvement tracker

The data within Table 7 is also depicted below in graphical form in Figure 8 below

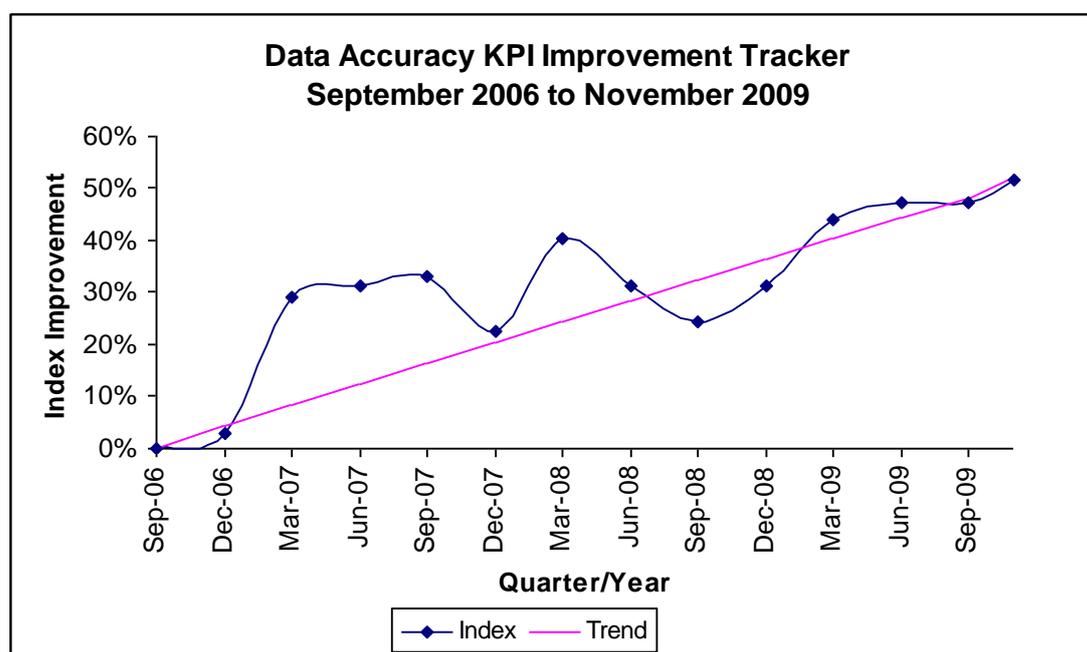


Figure 8 Data accuracy improvement

The improvement tracker was developed as a means of highlighting the periodical movements in the Index on a companywide basis to identify improvements or otherwise and indicate any trends. In this way it was intended to measure the momentum of any improvements to determine whether there was any degree of sustainability in the manner discussed in Section 2 on 26. The figures were based upon the aggregated monthly company index at each quarter end. A quarterly measurement was considered to be preferable in that it provided a better perspective of the overall trend(s) than a more complex monthly measurement. The tracker being the aggregation of all the site and business indices provided a corporate summary of what was actually happening across the businesses

A summary of the progress:

- 29% improvement in the first six months to March 2007
- 33% improvement in the first year to September 2007
- 16% improvement in the year to March 2008
- 40% improvement in the first eighteen months to March 2008
- 27% decline in the eight months to November 2008- which coincided with the Company's Modernisation Programme
- 37% improvement in the year to November 2009
- 52% improvement between September 2006 and November 2009

The initial eighteen month period to March 2008 saw significant improvements (40%), as one would imagine with any new major initiative, especially as there was plenty of opportunity for early 'quick wins' coupled with executive support and constant monitoring and reporting. The above graph also highlights a 'glitch' within this period, in December 2007, which appears to be a seasonal issue, related to Christmas and New Year, as there was a similar occurrence in the preceding year. It is recognised that there will always be fluctuations within any index and that the real measurement of any significance is the overall 'trend'. The steep decline from April 2008 may be attributable solely to the effects of the Company's Modernisation Programme which saw a third of the factories closed, businesses re-positioned, certain employees transferred to new locations, with others leaving the business. The period from March 2008 to September 2008 was certainly a huge hiatus to 'business as usual', as a considerable part of the business re-focussed itself onto more short term pressing issues. Whilst the Modernisation Programme achieved all of its objectives within timescales and budget, there were short term negative impacts which affected certain activities, the Data Quality Initiative amongst them. One accepts this as a matter of course, having been directly involved in the financial aspects of the planning, budgeting and control of the Modernisation Programme. However after the completion of this final phase during the autumn of 2008 it was necessary to undertake the re-launch of the Data Quality Initiative which led ultimately to the qualitative research described in the previous section.

The direct outcomes of the factory and business meetings have already been described and recommendations made for future short and medium term practice. However within this context one has to validate such findings to ensure that they are not mere rhetoric, but have real substance. Table 8 below charts the activity carried out as part of the factory and business programme, superimposed upon the Data Accuracy KPI Index between November 2008 and November 2009 in both month upon month and cumulative format. During this period, quarterly business targets were set in December 2008 and the reporting was also extended to factory and site managers in January 2009, each with the potential to generate additional positive influences.

	Nov 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09
No of Meetings	0	13	18	3	15	8	0	0	0	0	1	0	0
Index Impr % Month	0	9%	7%	-4%	16%	1%	1%	5%	0	2%	-3%	7%	2%
Index Impr % Cum	0	9%	15%	12%	26%	27%	27%	31%	31%	32%	30%	35%	37%

Table 8 Data Accuracy KPI monthly performance

From analysing the above table, it is evident that there was a significant improvement in the Index (27%), following the commencement of the factory and business meeting programme from December to April, in line with the number of meetings carried out. However within this context it also has to be appreciated that in the two preceding years, there had also been considerable improvements during the period from December to March (26% in 2007 and 22% in 2008). That fact is accepted, but it also has to be recognised that as year upon year improvements take place, the scope for further significant improvements become more and more difficult unless a sea change approach is introduced.

In an attempt to ascertain whether any degree of sustainability had taken place within the businesses themselves, it was decided that from April 2009 onwards, the only 'Central' activity would be the publication of the Index reports on a monthly basis. During the summer of 2009 there was a levelling of the rate of improvement, but overall it still remained positive. However during September there was a 3% decline on the August figure and when the Index was measured again part way through October (13th), a further 7% decline had taken place during the preceding two weeks, leading to a year to date 1% reduction overall based upon March 2009. This situation was raised immediately as a high priority matter across the businesses and the support of the Executive Team was enlisted. Two weeks later at the end of October the position had changed dramatically so much so that the 7% decline had transformed to a 7% improvement, which has further enhanced in November by 2% to register an over all 37% improvement in the twelve month period to November, with an overall 52% improvement since the commencement of the entire initiative just over three years previously. There was strong evidence to suggest that whilst a degree of sustainability appeared to be in place as indicated by the overall trend in the KPI tracker, it did not appear to be self-sustaining in that it required the regular involvement of external agencies such as senior management and the constant attention of the project leader to maintain the momentum.

Subsequent Events

Further evidence of the weight and richness of this argument is demonstrated when one examines the performance of the Index over the succeeding four months (December 2009 to March 2010). The first three months indicated seasonal fluctuations in line with the experiences of previous years, followed by a recovery in March to record a 22% year on year improvement, promoting the overall improvement since September 2006 to rise to 56%. This performance is entirely consistent with previous trends contributing further to these findings.

Summary of the Findings

There is considerable evidence to suggest that the progress and improvement described above have real significance leading one to believe that there is potential for real cultural change to take place if improvement initiatives are managed correctly.

This has implications for the wider context of this research as seen by the evolution of the measurement and reporting process which may best be summarised as:

- “What gets measured gets done”
 - A good start, but by whom?
To:
- “What gets measured by the Exec gets done quicker”
 - “A further improvement, but too top-down
Leading finally to:
- “What is measured, communicated, discussed and agreed at all levels has a very good chance of becoming embedded”
 - Bottom-up supported by top-down
 - A potential key to sustaining any kind of change?

There is considerable evidence to claim that any improvement initiative cannot be undertaken in isolation and that everyone needs to become involved. There is also however a caveat, in that at this stage it appears that the level of progress achieved appears to be commensurate with the levels of activity of the internal champions or change leaders, suggesting a climate of ‘controlled sustainability’ rather than ‘self sustainability’. This may be a reflection of the relevant infancy of the overall initiative. This question of time, age and ‘maturity’ is seen as being important in a number of the areas relating to this research and will be discussed within the concluding section together with the involvement of champions at every level.

The above findings are reproduced in Appendix 12.C and will also be discussed further within Section 16, as part of the consolidated review of the research outcomes.

To supplement the qualitative study and to attempt to determine the attitudes and perceptions of one’s colleagues towards data quality, a web-based survey was carried out during the summer of 2009 as described in the following section.

14. INTERNAL QUANTITATIVE SURVEY

To build upon the progress made within the Data Quality Improvement Programme, a web-based survey was carried out during the summer of 2009 amongst fellow Remploy colleagues as a means of determining their views, attitudes, thoughts, feelings and opinions with regard to data quality in general, their perceptions as to the quality of *their* data in particular and their potential commitment towards continuous data quality improvement. Coming immediately after the site and business meetings described above, it was felt that this would also complement this initiative and emphasise that the site meeting programme was not a one-off exercise, but part of a much wider and far-reaching agenda. The process employed is described within this section.

Although the quantitative research undertaken during Document Four experienced a low response rate, the process appeared to function effectively, therefore it was decided to follow this same research mode that of a survey based self-administered questionnaire distributed on this occasion to certain fellow Remploy colleagues, using NTU's web-based on-line survey tool Autoform. This mechanism allows researchers to generate a survey questionnaire and collect and collate the resultant data which is then made available via email. The subsequent analysis was undertaken using the SPSS statistical analysis package provided by NTU. The nature of quantitative research may be characterised as a linear progression commencing with a theory and then working through to the ultimate findings and conclusions. Bryman and Bell (2003: 89) provided a very useful generic process blueprint (in black), which has been adapted to fit the context of this internally based survey (in blue), depicted in Figure 9 below. Each element of the initial generic process has been linked to the relevant step within the research cycle for this document to indicate visually how the entire process has been undertaken. The initial elements of Theory and Hypothesis have been derived from previous discussion and research conducted with in this and previous documents. The next five elements relating to the construction, publication and distribution of the survey are described in detail within this section, whilst the latter four elements covering the processing and analysis of the data and the subsequent findings are detailed within Section 15.

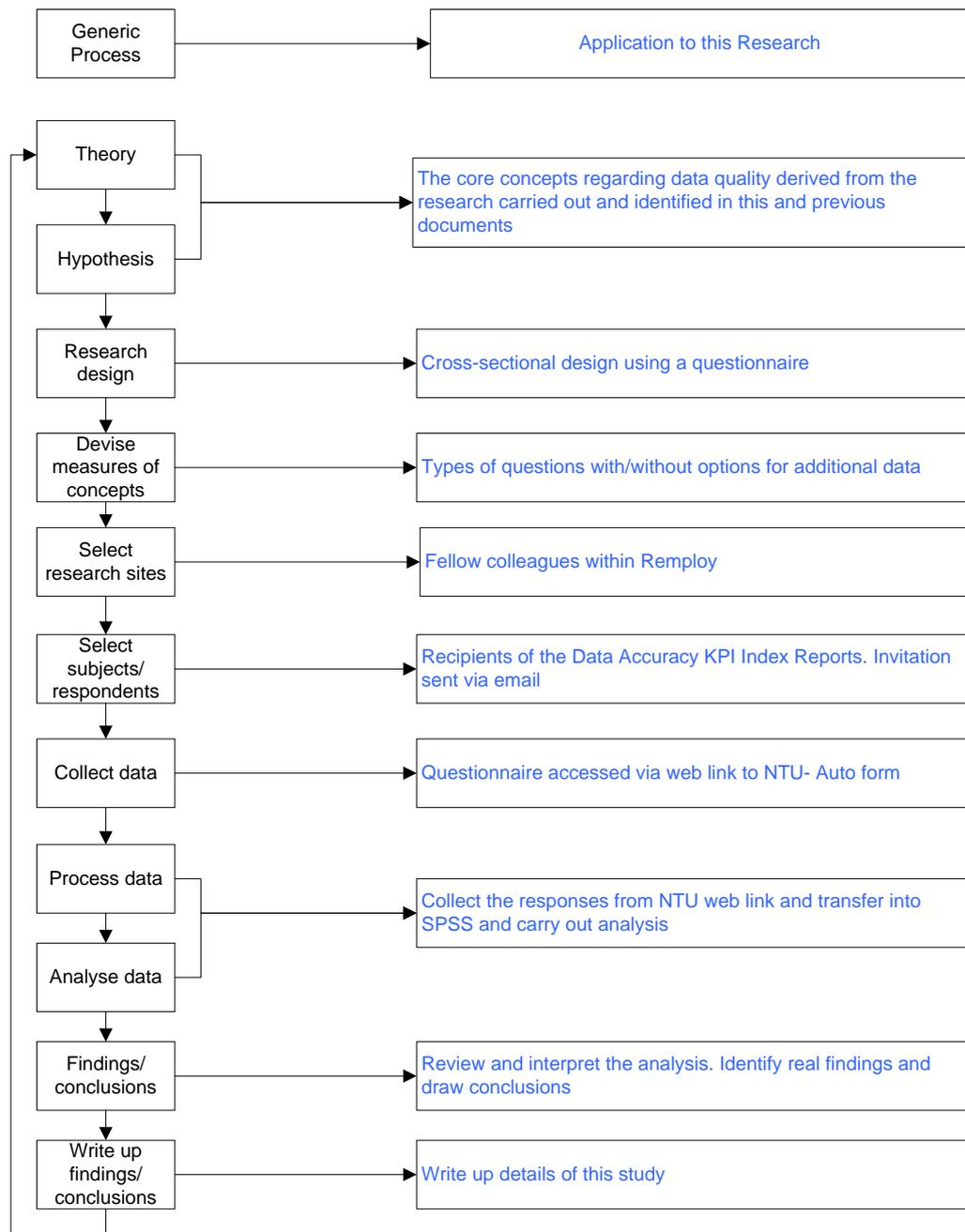


Figure 9. The quantitative research process

Adapted from Bryman and Bell (2003: 69)

Bryman and Bell (2003: 573) defined a questionnaire as a collection of questions administered to respondents; but when employed without the direct interface of the researcher, it is termed a self-completion questionnaire. The main objectives in designing a questionnaire are to maximise the proportion of subjects answering the questionnaire i.e. the response rate and to obtain accurate relevant information for the survey (Wai-Ching 2006). Oppenheim (1992: 7-8) emphasised the importance of adequate preparation and planning

prior to undertaking any survey identifying the essential steps in overall design from the initial generation of aims and objectives through to the writing up and publication of the final report. Schonlau, Frickerer and Elliott (2002: 41-53) also offered strong guidelines in dealing with the design and implementation of Internet surveys involving the actual questionnaire design, automation techniques together with the implementation and fielding of the survey. Bryman and Bell (2003: 509-510) discussed sampling issues around the use of web surveys and their advantages and disadvantages compared with postal questionnaires Bryman and Bell (2006 512) and concluded that “The electronic-only survey is advisable when resources are limited and the target population suits an electronic survey (Bryman and Bell 2003: 511). Fan and Yan (2010: 137-138) provided suggestions for increasing the response rate of web surveys, whilst indicating that the average response rate is approximately 11% below other survey modes (Fan and Yan 2010: 132). This deficiency rate was also supported by (Manfreda, Bisnjak, Berzelak, Haas and Vehovar 2008: 79).

The Data Capture Process

The layout and content of the survey was a mixture of: multiple-choice ‘ordinal’ type questions involving a Likert scale format each having a five-point option ranging from ‘strongly agree’ through to ‘strongly disagree’; other ‘nominal’ type questions requiring specific answers from a drop-down menu; a ‘semi-dichotomous’ type question, which requested a ‘yes’ or ‘no’ response but also had a default of ‘no answer’; and four questions requesting comments to specific questions or statements. A decision was made to insert the demographic questions at the beginning to lead the recipients into the full process. The questions were a mixture of both ‘open’ and ‘closed’, many having an ‘other(s)’ option with an accompanying box to provide elaboration. Whilst it is appreciated that the questionnaire was basically a piece of survey based statistical research using a quantitative research strategy, space was provided for textual input as it was considered that the potential level of subject expertise available within the sample, had considerable potential to enrich the overall project and therefore warranted this facility to ‘trap’ this additional body of knowledge.

The personal data was followed by a section relating to generic questions surrounding data quality in general, relating to the sources and causes of problems and issues and their possible solutions. The remaining part of the main section was focussed within a Remploy context, examining attitudes to the Data Accuracy KPIs, areas of problems and possible methods of improvement, training requirements, overall responsibility for data quality, peoples’ perceptions with regard to the quality of data and their attitudes towards Assistive Technology. There were two final questions requesting respondents’ opinions, firstly towards the author’s own definition of data quality- “Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise” and secondly a request for any additional comments. A number of the questions

relating to generic data quality were identical to those in Document Four, in order to compare and contrast responses.

Every attempt was made to plan and pilot the questionnaire thoroughly applying the lessons learnt from Document Four. An initial draft was created in Microsoft Excel and circulated to a number of colleagues. The quality of the feedback was positive and the document was refined a number of times, for errors missed during the initial proof reading and to make structural changes to enhance the overall presentation and improve data collection. The refined version was then positioned into Autoform and a couple of pilot respondents then tested the final questionnaire in situ. This final feedback indicated that the survey was accessible and easy to understand and complete.

Autoform was considered to be the most appropriate survey tool for this research in that one had had experience of the application within Document Four where it had worked well especially in the collection of the data and the subsequent integration and analysis within SPSS. One had also received assurances regarding its security as discussed in Section 10. It was appreciated that the tool had certain limitations in that it was somewhat rigid in its format, however it was considered that the other benefits outweighed this and therefore consideration as to the use of an alternative tool was not necessary.

A copy of the survey questionnaire is attached in Appendix 7

The target audience selected for the survey were the one hundred and eleven recipients of the Data Accuracy KPI Index reports by way of an email. The survey publication timetable comprised:

- Survey set up on Autoform on 20th May 2009
- Initial email sent to all prospective responders on 28th May 2009 with the link to the Autoform survey attached.
- Reminder circulated to Operations Managers on 8th June 2009
- Reminder circulated to Finance Managers on 11th June 2009

A copy of the survey request email dated 28th May 2009 sent to the target audience, is contained in Appendix 8

The analyses and findings from this survey are described in the following section.

15. INTERNAL QUANTITATIVE RESEARCH- ANALYSIS AND FINDINGS

This section examines the level of responses, analyses the resultant data and then places the findings within the context of the overall research project.

Survey Response

The internal web-based survey was distributed to one hundred and eleven colleagues within Remploy via an email link on 28th May 2009 and by the cut off date of 7th July (the last day any returns were received), forty five respondents had taken part, a response rate of 41%. This was a considerable improvement upon the disappointing return experienced with the Document Four survey. A reasonable response had been anticipated given that it taken place immediately following the series of factory and business meetings described above. A detailed analysis is shown below in Table 9:

Analysis of Responses

Remploy Internal Data Quality Survey May/June 2009

Actions	Date	Cumulative No	Responses %
Publication date	28 May 2009	0	0
	29 May 2009	24	53
	01 June 2009	33	73
	03 June 2009	34	76
	04 June 2009	36	80
Reminder to Operations Managers	08 June 2009	38	84
Reminder to Finance Management	11 June 2009	43	96
	15 June 2009	44	98
	07 July 2009	45	100

Table 9 Analysis of responses

Response Rates

Manfreda, Bisnjak, Berzelak, Haas and Vehovar (2008: 79) and Fan and Yan (2010: 132) both indicated that responses to online surveys tend to be lower than those for more traditional distribution methods. A review of the related literature revealed a very diverse range of average response rates, Cook, Heath and Thompson (2000: 829) reported a 40% success rate; Cobanoglu, Warde and Moreo (2001: 447) 44%; Roster, Rogers and Albaum (2004: 367) 28%; Berger (2007: 12) 'up to 2%'; Poade (2007: 10) '10% or lower'; and Manfreda, Bisnjak, Berzelak, Haas and Vehovar (2008: 90-91) 32%. A white paper published

by (Ipathia (2009: 2) reported that an average response rate of 41% was achieved within 199 separate surveys they conducted for clients across industry and local and federal government primarily in the US and Canada. Whilst contributors to a UK blog forum at econsultancy.com had lower expectations stating that; “Best one I’ve ever seen is 10% but realistically I’d say expect around 0.1%” and “Typically we get anywhere between 0.5% and 10%”.

It is appreciated that this survey was distributed to somewhat of a captive audience who had been prepared for the subject matter and in most cases were aware of the importance and implications. Notwithstanding, the author felt that the overall response level of 41% was an acceptable size on which to analyse and present findings, draw conclusions and make recommendations, especially when compared with the experiences of the majority of other researchers identified above. It was also obvious that a number of managers had also encouraged members of their teams to participate in the survey, something that had been promoted within the survey invitation email. The timing of responses also appeared to be fairly much in line with that experienced by the majority of similar surveys, in that three quarters of the responses were received within the first week and virtually all had completed within two weeks.

Identification of the variables

In order to ensure that the survey variables are analysed correctly, each question has been identified and its variable type determined to ensure that the appropriate analytical techniques are applied. The guidelines in Bryman and Bell (2003: 240-241) have been used and are detailed below in Figure 10:

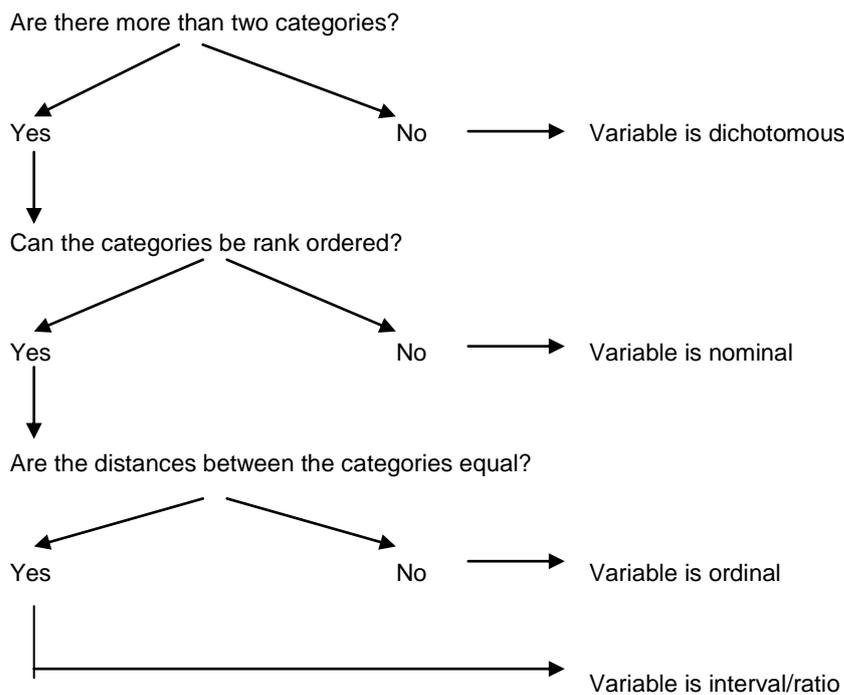


Figure 10 Identifying the types of variables

Bryman and Bell (2003: 240-241)

- Dichotomous: Variables containing data that have only two categories. It should be noted that Autoform allocates to the 'yes'/'no' response questions, a default of 'no answer'. One considers that such questions are semi-dichotomous.
- Nominal: Variables whose categories cannot be rank ordered
- Ordinal: Variables whose categories can be rank ordered but the distances between the categories are not equal
- Interval/Ratio: Variables where the distances between the categories are identical across the range. For the purpose of this survey the two types do not require separation.

Appendix 9 identifies the relevant question type and variable type allocated to each question in line with the above criteria.

Analysis and Findings

The raw data was provided by Autoform via an Excel csv file contained within a secure email from NTU. This data was downloaded into the SPSS analytic tool, subject to the security controls as outlined in Section 10 and Appendix 4. The data was then analysed within SPSS and extracted via Excel xls files. Appendix 10 contains a frequency table detailing all the responses including all textual input, together with a calculation of the level of completeness of each question. All sections averaged between 90% and 100% complete, apart from those relating to 'Training' (76% - 78%). This may be explained in part by the fact that some respondents did not see this section as being directly related to them as they were not a departmental head or did not have any responsibility for staff.

Demographic data was requested around job roles and summarised in the Table 10 below.

Demographic Characteristics

	Invitations	Responses	Response	Invites	Response
Analysis of Invitations/Responses	Nos	Nos	%	Split %	Split %
Executives/Business Managers	10	6	60	9	13
Operations	53	19	36	48	42
Commercial	15	7	47	14	16
Finance	26	9	35	23	20
IS	7	4	57	6	9
Total	111	45	41	100	100

Table 10 Demographic data

This represents a fair cross section of the organisation with all interested parties and functions represented. The response rates vary across the areas with Management, IS and Commercial (which includes supply chain, procurement and logistics) recording the highest rates; however this may be partially explained by the lower number of invitations in these functions and the fact that a greater proportion of the population were more interested or passionate about the subject. Management may also have felt that it had to take the lead and those members of IS who received an invitation had experienced frustration in the past with data quality problems. It has to be stated that the response level from within Finance was disappointing given that the entire initiative had its foundation within a Finance Conference over three years previously. Part of this might be reflected by the fact that the entire function had been reorganised and restructured towards the end of 2008 with the department centralised within one main base in Leeds with a small sub-base in Coventry. Previously it had been distributed geographically across each business. The result of the reorganisation meant that many of those who had participated in the initial stages were no longer part of the organisation. The largest volume of responses was received from Operations, both at factory and business levels as one would expect given that it was the largest population polled. A response rate of 36% was perhaps lower than anticipated, but there may have been some possible cross-over with the Commercial functions, where a factory manager had delegated the responsibility for responding to a colleague who was subsequently categorised within procurement, rather than site purchasing. However this should not have affected the figures by more than two to three percent.

Analysis of Responses Received

The results from each section were analysed from the data within the summary frequency table shown in Appendix 11. The 'ordinal' type questions employed a 'Likert' scale format with five options ranging from 'strongly agree' to 'strongly disagree', with three non-specified points in between. It would have been preferable to title the range 'very high', 'high', 'medium', 'low' and 'very low' but the constraints of Autoform precluded this. For the purpose of the analysis of this document, one chose to aggregate the responses scored as 'strongly agree' and '2' (representing 'very high' and 'high') as indicative of a positive response to the appropriate question. This is also in line with the format used within the Findings and Discussions section of Document Four.

As stated previously this survey endeavoured to gauge the attitudes, thoughts, feelings and opinions of one's colleagues within Remploy, regarding the concepts of data quality and their potential commitment towards its continued improvement. A number of the questions were identical to those used in Document Four, which was conducted within a data quality 'expert' community. This approach is totally consistent, in that this entire enquiry goes to the very heart of 'the quality of data', whether it is in the minds of the academic, the practitioner or the

actual person in an operational delivery chain. This analysis evaluated the responses of the two surveys to these identical questions where applicable, to compare and contrast the attitudes and beliefs of both environments.

Generic Data Quality

This section deals with those critical generic concepts which one believes are paramount to improving the quality of data and it is this area that is common to both surveys with a summary of the results shown below. Each question had an alternative 'Others' option and whilst this has provided interesting and rich material in that it enabled respondents to identify any of their personal issues and priorities, the responses showed wide variations in the numbers received and were not considered relevant for this comparative analysis, but will be used in other reviews outside this study.

Table 11 below takes each section and aggregates those responses that are identified as 'very high' or 'high' in percentage terms, excluding 'nil' or missing returns. In line with the philosophy employed in Document Four the author believes that a result of 75% or over may be considered to be 'significant'. A number of results make an immediate impact. Overall the positive responses to the key issues are quite high and whilst there is considerable similarity in both surveys, one may conclude that the 'attitude' towards data quality conveyed in the current Remploy survey is slightly more positive than that recorded by the previous 'Data Quality Professional' survey. It will also be beneficial to review each section in terms of the key concept of 'data', 'processes' and 'people' which has dominated this entire study.

	Remploy Survey 2009 %	IAIDQ Survey 2008 %
How highly will problems in the following areas impact the overall quality of data within your organisation's data systems?		
Master Data entry	88	88
Operational Data processing	84	69
System Housekeeping	79	73
How highly do you evaluate the impact of the following on the quality of the data within your organisation's data systems? (Including non-Baan systems)		
Data Suppliers (persons who provide data)	79	77
Data Processors (persons involved in processing data)	83	76
Data Customers (persons who use the data output)	56	32

How highly will problems in data processes and procedures affect the quality of the data? (including non-Baan systems)

Level of effect	93	96
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Please rank the following as potential causes of data quality problems

Employees	80	77
Customers	39	44
Suppliers	58	44
External data sources	46	46
Processing errors	80	54
External Systems	31	33
System errors	48	48

Please rank the following as potential causes of data quality problems

Poor data entry	88	81
Lack of DQ knowledge, training, education	88	69
Poor processes	73	85
Poor management	70	65

Please rank the following in terms of their effectiveness in resolving data quality problems

Build targets into peoples' objectives	64	
Root-cause analysis of problems	100	
Maintain up-front error prevention	91	88
Identify and clean errors at source	93	84
Identify and clean within the process (i.e. downstream)	59	44
Identify and correct errors in reports	60	24
Take no action	2	4

Table 11 Generic data quality

Summary of the Results:

- 84% Identified that problems with master data and transactional data seriously impacts a company's operations (Data)
- 81% Identified that people who provide and process data have a serious impact upon data quality (People/Processes)
- 93% Identified that process problems seriously impact the quality of data (Processes)
- 80% Identified that employees and processing errors are major potential causes of data quality problems (People/Processes)
- 88% Identified that poor data entry and a lack of knowledge and training are major causes of data quality problems (Data/People)

- 95% Identified that 'root cause analysis', 'up front error prevention' and 'identify and clean errors at source' are vitally important in resolving data quality problems (Data/Processes/People)

From the analysis above it appears that within many areas of the Company, there exists an appreciation of the generic principles of data quality management, providing a strong foundation on which to consolidate the progress made so far.

Remploy Data Quality

The remaining part of the main section was focussed within a Remploy context

	Remploy Survey 2009 %
Attitudes towards the Data Accuracy KPI Index	
How often do you print and review the Data Accuracy KPIs?	
Daily/Weekly (The comparative figure for the 2008 survey was 41%)	73
Please rank the following KPIs in terms of their impact in improving the quality of the data	
Credit Notes	59
Despatches Not Yet Invoiced	73
Outstanding Production Orders	70
Outstanding Purchase Orders	86
Outstanding Sales Orders	86
Purchase Orders Under Query	91
Receipts not yet Invoiced	86
Please rank the following KPIs as a source of data quality issues/problems	
Credit Notes	61
Despatches Not Yet Invoiced	56
Outstanding Production Orders	63
Outstanding Purchase Orders	75
Outstanding Sales Orders	68
Purchase Orders Under Query	83
Receipts not yet Invoiced	83

Table 12 Data Accuracy KPI response

Given the fact that not every respondent has a direct responsibility for reviewing the KPI Index on a regular basis, the overall attitude is very positive and may be considered significant. Also the focus upon the seven elements of the KPI Index helped to identify those which are seen as the most important. Not all are relevant to every site, but those which are can be easily

identified. The area receiving less attention- Credit Notes, is the one with which the sites have less overall control as other factors exist, which may well explain this variance.

Training requirements

Please rank the system training and developments requirements of your site/department

Sales	32
Purchasing	57
Production	51
Finance	56

Table 13 Training requirements

Training appears to be less prominent than other sections, although a requirement was identified in certain areas during the site and business meetings noted above in Section 12. When one takes into account, 'medium' scores, alongside 'very high' and 'high', then between 71% and 83% register a distinct interest. Further references to training and development appear later in this document.

Responsibility for data quality

At what level should the responsibility for data quality sit within Remploy

Everyone	58
Management	42

Table 14 Responsibility for data quality

It is extremely encouraging to see that almost 60% identified that 'everyone' has a responsibility for the quality of data, although it may be a natural response to allocate authority for a major aspect of any business, to 'management' in general. A couple of interesting comments were also made- "Data is a Company-wide asset & belongs to everyone" and "Everyone who uses the system should have an understanding of the system and how things impact each other".

Perceptions and attitudes

How do you feel about the following statements?

"I am happy with the quality of the data I receive"	26
"I believe I have the ability to influence the quality of the data under my control"	83
"I believe that the quality of the data I provide to others meets their requirements"	81

Table 15 Perceptions and attitudes

This is possibly the most interesting, intriguing and enlightening part of the entire survey and certainly one of the most important. The above responses reveal a great deal about the mindset of the individual respondents. Whilst 82% believe they have the ability to influence the quality of *their* data and provide quality data to *others*, only a quarter believe that the data they *receive* is of equivalent quality, although when one includes those choosing a ‘medium’ response, then the figure rises to 69%. There is however a huge disparity within peoples’ perceptions and attitudes giving rise to a number of questions. Given that data runs horizontally across departments, functions, sites and businesses from provider to recipient and that the survey represents a reasonable cross-section of this model, one can only deduce that there is either a lack of communication between both parties as to what the ‘customer’ requires or that the ‘supplier’ is ignoring such requirements. There is also of course the personal perception that “I am always right and it’s the other person’s fault” or that no one is prepared to admit that they are not providing a good service. One also has to consider that the population, that did not respond or were outside the scope of the survey, may be responsible in part for this apparent disparity. This entire area is worthy of further investigation outside this study, especially around the area of communication.

Assistive Technology

What % of your team’s employees currently use some form of assistive technology?

0-10%	87
11-25%	9
26-50%	2
51-100%	2

How do you find Assistive Technology?

Beneficial to everyone	80
Improve the quality of life for disabled users	98
Improve Data Accuracy	72

Have you ever heard of Access to Work and the work they do funding Assistive Technology to disabled users?

Yes	88
No	12

Table 16 Assistive technology

Accessibility in the form of Assistive Technology (hardware and software techniques developed in order to assist visually or physically disabled persons gain access to information technology within the working environment) appears to have significant visibility within the organisation, but the degree to which it is being applied practically within the areas that matter cannot be determined fully at this stage. The whole concept of Accessibility has now become

far more prominent as an integral part of the new Remploy IS Strategy described in Section 1 and Appendix 1.

Other Questions

The four remaining questions sought to discover attitudes, opinions and perceptions by means of textual responses rather than by choosing an option amongst a number of predetermined answers

Data quality problems and issues

A number of issues were identified and are summarised below:

	No	%
Data Input and System Errors	8	20
Training and Development	3	8
Liaison with the Share Service Centre	2	5
KPIs Credit Notes	5	13
Purchase Orders	4	10
Purchase Invoices	4	10
Receipts Not Invoiced	14	34
Total	40	100

Table 17 Data quality problems and issues

There will be opportunities to follow up on all of these issues

Methods for improving data quality

A number of areas were identified and are summarised below:

	No	%
Review KPIs on a daily/weekly basis	15	48
Identify problems and resolve asap	10	31
Improve processes	3	9
Training and Development	2	6
Others	2	6
Total	32	100

Table 18 Methods for improving data quality

This result is very encouraging reinforcing the message emanating from the site meetings whilst also supporting data quality best practice

Finally two further questions requesting respondents' opinions were asked:

Author's Definition of Data Quality

To assist with ongoing research, we have attempted to define a working definition of 'Data Quality' which we feel encapsulates our ultimate vision of the subject:

“Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise”

As already stated in Section 1, of the twenty valid responses, fifteen (75%) were in agreement whilst the remaining five sought to add remarks and observations on accuracy and quality. There were no negative comments received. As in Document Four the replies appear to be positive and supportive given the rather subjective and emotional nature of the subject.

Additional Comments

A number of interesting comments were received; that there had been great improvements in data accuracy in all areas; the requirement for regular measurement and quantification; the risk of the KPIs driving wrong behaviour; the negative impact of inaccurate data and that there were variations as to the severity of the risks that could effect data quality.

Overall Comment

The overall response to the survey was extremely constructive and encouraging and it identified a significant positive attitude towards data quality in critical areas. Whilst it has to be remembered that less than 50% of the invitees responded and therefore one has to view the results in this context, this level is not inconsistent with similar online surveys as discussed earlier in the section. It is possible that those who did not participate do not view the quality of data in the same way. However, this caveat should not detract from the overall positive results that there appears to be a firm commitment towards Data Quality within Remploy. There is reason to believe that, within a period of three years, data quality now has a profile as high if not higher than that of product quality and health and safety, in terms of publicity, employee involvement and attention and the impetus towards continual improvement. One's personal definition of 'data quality' also received a positive response, but possibly the most significant result appears to be the disparity between peoples' perception of the quality of the data they receive and their own perceived ability to influence and pass on data of sufficient quality to satisfy their customers' needs.

Summary of the Findings.

Whilst it is appreciated that this survey has been conducted entirely within a work-based setting, it is important that this is then positioned within the overall context of this research

project and the broader issues and concerns that emanate from this, for both practice and theory. This sub-section proceeds to summarise the organisational-specific findings into a more 'general' format that will enable them to be applied within a wider environment.

Generic Data Quality

- There is a high appreciation of the influence that People, Processes and Data have on the quality of data
- There is a realisation of the importance of having the data right first time
- The level of positive responses compares very favourably with the previous survey held amongst the data quality community

Remploy Data Quality

- The overall attitude towards measurement, reporting and feedback was very positive
- There was an appreciation of the importance of education and training
- Almost 60% felt that 'everyone' has a responsibility to improve the quality of their own and the organisation's data
- There was a huge disparity between the respondents' perception of the quality of the data they influence (82%) and that which they receive (26%)
- 90% of respondents identified measurement and reporting, problem resolution and process improvement as key elements for improving data quality

These findings are reproduced with Appendix 12.D and will be discussed further within Section 16, as part of the consolidated review of the research outcomes.

This next section brings together the key findings from the entire research, relates them to the key recurring themes from the literature to identify common principles, but then more importantly uncovers those key findings and principle findings which appear to have the potential to inform both professional and managerial practice and the academic community.

16. ANALYSIS OF FINDINGS

Appendix 12 presents in detail, the key findings from this entire research; extracted from the research findings, short term guidelines, issues and ongoing suggestions from the qualitative study; the findings from the Data Accuracy KPI Index performance review; and the summary findings from the quantitative survey. To this has been added further perceived outcomes derived from an appraisal of the entire project over its lifetime, coupled with one's related personal and professional experiences.

Comparison of Key Findings and Key Themes

This section proceeds to take these key research findings and relate them to the concepts of the conceptual framework as depicted in Figure 2 page 18 and the key recurring themes derived from the quality and change management literature review detailed in Table 2 pages 50-52. The initial classification is shown in Appendix 13. The key findings are then compared with the key themes within broad generic common headings in Table 19 below, to identify similarities and variations. Certain key findings have been identified as unique to this research in that there is no related key theme and these are identified in Table 20 below, together with the additional perceived outcomes, to highlight potential additional knowledge on this topic. The concluding part of this section expands further on these key findings and perceived outcomes by examining their implications and potential for informing theory and knowledge as principle findings. Positive practical consequences of this research have already been evidenced by the lasting improvements in the levels of the quality of the data as described by the KPI Index. Section 17 will then establish further that this study has unearthed new insights into the subject whilst adopting a research approach which is certainly not new, but may be considered to be unique within this arena. In this way it is intended to show how new knowledge and unique methodology are able to inform theory and enhance practice and as a consequence improve business performance, in the manner described by Van de Ven and Johnson (2006a) and Van de Ven (2007).

Analysis of the Key Research Findings and Key Recurring Themes related to the Conceptual Framework within Broad Generic Common Headings

Key Research Findings	Key Recurring Themes
-----------------------	----------------------

A. Cultural/Organisational- Leadership/Management

1. Management and Executive Support

<ul style="list-style-type: none">Executive and senior and middle management sponsorship and involvement	<ul style="list-style-type: none">Executive and Management support and sponsorship
--	--

2. Leadership and Culture

<ul style="list-style-type: none">• Explain the underlying reasons behind the improvement programme and how it will support the corporate objectives• Sell the concept up and down the organisation• Cultivate an attitude and willingness to embrace new ideas• Better understanding of the underlying principles and requirements	<ul style="list-style-type: none">• Establish a clear vision with targets and milestones• Importance of Leadership and Culture• Align the Organisation• Focus upon achievements• Celebrate successes
--	--

3. Measurement and Reporting

<ul style="list-style-type: none">• Provide regular visible measures and report progress• Measurement of progress and the publication of results• Continually measure, report and provide feedback• Make the measurement and results visible• The overall attitude towards measurement, reporting and feedback was very positive	<ul style="list-style-type: none">• Measure, monitor with reporting and feedback to support accountability
--	--

4. Managing Change

<ul style="list-style-type: none">• Identify how the 'measures' will influence the quality of the data• Build in system and structural changes to prevent a return to type• There is potential for real cultural change to take place if improvement initiatives are managed correctly.• Focus on the 'key' elements setting objectives and targets	<ul style="list-style-type: none">• Improvement requires change which has to be managed• A belief that change is worthwhile and necessary• Manage the change• Identify risks, benefits and overall objectives• Plan and identify required actions• A continual on-going process• Manage any potential short term and long term conflicts• Tendency for people to revert to type• Elements of quality management principles in all forms
--	---

5. Ownership and Responsibility

<ul style="list-style-type: none">• Identify ownership and responsibilities• The Businesses 'own' the data NOT IT- a paradigm shift	<ul style="list-style-type: none">• Importance of ownership and responsibility• Obtain buy-in, ownership and belief
--	--

6. Communications

<ul style="list-style-type: none">• Improve communications to share ideas• Communicate across the business on a regular basis	<ul style="list-style-type: none">• Establish clear channels of communication
--	---

7. Positive Approach

<ul style="list-style-type: none">• Tackle negative cultural issues	<ul style="list-style-type: none">• Accept that there will be set backs• Avoid undue pessimism, stay focussed and be positive• Identify potential pitfalls
---	--

B. Processes

8. Root Cause Analysis and Improvement

<ul style="list-style-type: none"> • Ascertain root causes of issues and problems and resolve at source • Ensure that potential problem areas are identified • There is a realisation of the importance of having the data right first time • Potential 'problem' areas identified • Ascertain root causes of issues and problems 	<ul style="list-style-type: none"> • Root cause analysis and error prevention
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9. Continual Process Improvement

<ul style="list-style-type: none"> • Ensure that the appropriate processes and procedures are in place- 'one size does not fill all' 	<ul style="list-style-type: none"> • Best practices within the right environment • Continual process reinforcement • Continual process improvements • Identify and document the process enablers
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C. People

10. Education, Training and Development

<ul style="list-style-type: none"> • There was an appreciation of the importance of education and training • Training, education and development requirements not being met fully 	<ul style="list-style-type: none"> • Importance of education, training and development
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11. Objectives, Targets and Reward

<ul style="list-style-type: none"> • Build data quality targets into peoples' objectives and reward success • Build data quality targets into people's objectives 	<ul style="list-style-type: none"> • Build targets into peoples' objectives with a reward mechanism
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12. Involvement

<ul style="list-style-type: none"> • Involve everyone, provide support • Involve everyone • Hold regular reviews with the 'Team' • Any improvement initiative cannot be undertaken in isolation and that everyone needs to become involved. 	<ul style="list-style-type: none"> • Involve everyone • Teamwork
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13. People, Processes and Data

<ul style="list-style-type: none"> • Identify the personnel dealing with each type of order and agree who does what with responsibilities for each process • Concept of People, Processes and Data 	<ul style="list-style-type: none"> • Align the processes behind the people • Manage the relationship between the way data interacts between the processes and the people • Concept of People, Processes and Data • Align the processes behind the people
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Table 19 Comparison of key findings and key themes

As one would anticipate there is considerable agreement and alignment between the findings and the themes in the majority of the headings, although this research appears to focus more on Measurement and Reporting (3) and Root Cause Analysis and Improvement (8), whilst the quality and change management literature places greater emphasis on Managing Change (4). This again is not surprising given their slightly differing focus.

Additional Key Findings and Outcomes

The analysis of this research also identifies a number of key findings which do not appear to relate directly to any of the key quality management themes. These additional key findings are detailed below in Table 20 alongside those positive outcomes that one has developed during this entire research and over one's personal and professional life

Key Findings

Cultural/Organisational

Leadership:

- Have an Internal Champion who has the respect of the audience
- A 'Bottom-Up' approach with 'Top-Down' support
- What is measured, communicated, discussed and agreed at all levels has a very good chance of becoming embedded"
 - Bottom-up supported by top-down
 - A potential key to sustaining any kind of change?
- The level of progress achieved appears to be commensurate with the level of activity of the internal champions or change leaders, leading to a climate of *controlled sustainability* rather than *self sustainability*

Management

- A need for ongoing support in all areas with an internal 'expert' user community
- Requirement for closer liaison between functions
- Appreciation as to how the KPIs fit within the corporate data and information quality initiative
- 90% of respondents identified measurement and reporting, problem resolution and process improvement as key elements for improving data quality

People

- There was a huge disparity between the respondents' perception of the quality of the data they influence (82%) and that which they receive (26%)
- Ensure everyone is fully aware of the implications of their actions
- Take things slowly to ensure everyone is onboard
- Motivational Factors
 - It is the 'right' thing to be doing, it supports one's principles
 - Belief that it will improve efficiency, help control and manage the factory and department
 - Competition between colleagues
 - Peer and Manager pressure
 - 'League Table' Syndrome
 - Requirement to achieve monthly/quarterly targets
 - A distinct movement away from 'I'm going to be in trouble' to 'My life is better for doing it this way'
- Almost 60% felt that 'everyone' has a responsibility to improve the quality of their own and the organisation's data

Additional Outcomes

- The Data Accuracy KPIs and the Index is merely a barometer of the effectiveness or otherwise of the related processes- not an end in itself. Any improvement is predicated on the quality of this process and the degrees of adherence of the related persons' behaviour to follow these processes
- There are two types of processes
 - Operational processes- SOP/POP etc
 - Quality processes- what we need to be done to improve data quality ongoing
- Get the processes right and adhere to them, then the improvement in the KPIs will fall out
- Identify the *processes* (operational and quality) that are required and then change the behaviour (*people*) which needs to take place to ensure the agreed processes are followed continually
- Creating an environment where quality data can be sustained is dependant upon changing the way *people* behave to ensure they follow the most effective and appropriate *processes* and policies to a given situation- process change and people (behaviour) change
- Sustainability requires stability- NOT rigidity
- Identify the changes required to embed a sustainable data quality culture
- From both the qualitative and quantitative studies
 - Emphasise the positive practices (Pros)
 - Review and take action on the issues and problems identified (Cons)
 - Focus on the important cultural environment and ensure that it is place

Table 20 Additional key findings and outcomes

The additional key findings and outcomes described above in Table 20 above have potential to add to the body on knowledge surrounding the sustainability of improvement initiatives per se, however this research is focussed upon a narrower goal, that of 'creating and sustaining data quality within diverse enterprise resource planning and information systems'. Within this overall objective, all of the elements described within Table 19 also come into play, as they all have a potential to impact and influence the ability of all organisations to improve and sustain the quality of their data. This will be discussed in detail below.

Summary of the Key Findings

The conclusions drawn from this study will contend that this research has unearthed new knowledge as to the means by which data quality improvements may be sustained within the environs of diverse enterprise planning and information systems.

Table 19 identifies considerable congruence between the key findings from this research and the key recurring themes emanating from the review of the quality management literature in Sections 6 and 7. A further review of these key recurring themes will testify that a considerable majority of the supporting references identified in Table 2 on pages 50-52 have no direct relationship to ERP or data quality studies. Of those that do focus on enterprise

systems, the majority concentrate on the quality principles of TQM and BPR without any direct reference to data quality and none appear to focus upon its sustainability. From this one feels justified in arguing that the key findings in Table 19 above are basically unique to this study whilst also having generic support from within the quality management arena. This point of uniqueness is extended even further when one considers the findings contained within Table 20 above, none of which are to be found within the quality management literature review. It has to be admitted that none of these key findings are *unique* in themselves when examined in total isolation, however their real exclusivity comes when they are brought together and applied within a specific setting to bring about elements of sustainability. In this way this research brings a new insight into an area largely neglected by the academic community.

Principle Findings

All of these *key findings* in both Table 19 and 20 are important in themselves. They are the series of individual 'actions' that have collectively brought about the changes as witnessed by this research. However from these a number of *principle findings* have emerged which have been identified as those essential elements or concepts that have bound together these individual and potentially disparate actions in order to make these changes happen. The extent to which change becomes embedded and lasting depends upon these principle findings. They are seen as the primary messages from this study.

The 'Cultural/Organisational' heading is a rich vein in terms of achieving a potential knowledge break-through. It focuses upon leadership and management at *all* levels and from this a number of principle findings emerge. The significance of specific project leadership identified as the local *Champion(s)*, together with the extreme importance of continual *measurement, reporting, feedback* with support and encouragement. Intertwined with these threads is the element of *time and maturity*. Sustainability can only be judged in relation to some form of continuum and whilst improvement programmes can go for initial quick wins, *real sustainability* is only achieved when evidenced by its durability and capability to deliver the longer term desired outcomes and values. The 'People' heading also recognises the importance of *maturity* in terms of allowing 'system actors' *time* to come to terms not only with their position within the structure of the organisation and their specific role within an enterprise system, but also to appreciate the importance of data, the purpose of any quality initiatives that may be taking place and the manner in which their own actions can influence the outcomes both positively and negatively. The 'People' category also highlights the most intriguing finding from the quantitative study, that of the differing and inconsistent perceptions as to what appears to constitute quality data as witnessed by the huge disparity between the respondents' *perception of the quality of the data* they influence (82%) and that which they receive (26%). Each of these principle findings is analysed in detail.

Role of the Champion

The critical role of the champion in bringing about change and innovation is well established in the literature (Schon 1963; Howell and Higgins 1990; Powell 1993; Shane 1994a; Shane 1994b; Markham 2000; Howell and Boies 2004). Such a Champion or 'heroic local actor' Williams and Pollock (2009:3), can come in many guises. Here one is not referring to the 'Main Sponsor', 'Exec Champion' or 'Strategic Champion' who can provide corporate focus and support however important that can be, but to those 'Tactical or Operational Champions' who have the essential responsibilities and passionate feelings to make the improvements happen. Without such champions any quality initiative is doomed to failure. Every project requires an overall champion to drive the programme forward. Such a person may have been the initial inspiration behind the programme or may have 'emerged' as the ideal candidate. This 'leader' has the specific role to coordinate and provide the impetus with credibility, not necessarily as an acknowledged expert although this would be advantageous, but with interpersonal skills to inspire and bring others into play. Ideally such inspiration should engender a similar impetus in others in more operational type roles to carry the messages within their own communities. It is here where the real sustainability may grow. These latter individual departmental or site 'champions' do not have the title as such and they are not appointed, rather they 'emerge' and assume the role as data quality becomes part of their everyday jobs, built into what they do. This may imply an element of structure possibly within hierarchical environments, but whatever arrangement is in place it must remain flexible and team-based to enable change to occur. Job titles are not important, whether they be Project Manager, Departmental Head, Factory Manager, Supervisor, Purchasing Clerk, Store Keeper etc. The critical element is the acceptance, attitude and commitment to the improvement process. In this way they personify the role of the *data steward*, but not necessarily with that specific title.

This project has followed this pattern, as unofficial departmental and site champions have emerged many exhibiting the motivational factors identified in Table 20 setting data quality objectives within their teams or for themselves. In other areas however local buy-in has not been as encouraging and this is emphasised as one of the key findings in Table 20:

"The level of progress achieved appears to be commensurate with the level of activity of the internal champions or change leaders, leading to a climate of *controlled sustainability* rather than *self sustainability*"

From this discussion one may conclude that part of the process of evolving from *controlled* to *self sustainability* requires a greater proliferation of 'Local Champions' into all environs of the organisation, working in many instances independent of the 'Overall Champion' but sharing the same ideals.

There should also be a note of caution, regarding the transitory nature of the champion. If a champion leaves then this may create a possible vacuum which may lead to the derailing of the entire initiative. Successful champions may be promoted, headhunted or leave for whatever reason, even retirement. This poses a possible dilemma with potential ethical connotations. How should the outgoing champion relinquish their position where a successor has not been appointed or their replacement is not viewed as adequate to carry on the crusade? This situation may also apply to a lesser extent in the case of the exit of a project's executive sponsor, although this may be protected somewhat by the existence of a financially secure project business case.

Measurement, Reporting and Feedback

This study has already identified references within the quality literature as to the importance of measuring, monitoring, reporting with feedback to support accountability Dale (1996); Davenport and Beers (1995); Deloitte (1999); Wood (2004); Zairi (2005); Boulton and Eaton (2008); Goyal and Patil (2009) which has also been summarised within Table 2 pages 50-52. Whilst this procedure therefore is not *unique* to this study, its *application* may be considered to have some originality in that it has been used not only as a periodical monitoring and reporting mechanism in the format of the KPI Index, but was also made available in a more detailed format to assist in controlling day to day operations. Considerable efforts were made to try and ensure that this was not viewed as purely a further arms-length 'Head Office Measurement Process' but as a dual-purpose instrument with an emphasis on feedback and assistance, as well as monitoring and reporting, to bring benefits to all parties.

Time and Maturity

The consideration of time and the need for maturity has been discussed in detail in various part of this study; in particular to the requirement for time to allow systems to become embedded (Davenport, Harris and Cantrell 2004). Cerpa and Verna (1998) also applied the maturity principle to information systems and strategic planning, whilst Kochikar (2000) identified certain maturity levels within the major prongs of People, Processes and Technology within a framework for leveraging knowledge. Here the human aspect is vitally important to allow individuals to come to terms not only with their position within the structure of the organisation and their specific role within an enterprise system, but also to appreciate the importance of data, the purpose of any quality initiatives that may be taking place and the manner in which their own actions can influence the outcomes both positively and negatively. Equally important is the requirement to allow time for the necessary skills to broaden and develop beyond the strict confines of the technical aspects of any system Benbasat, Dexter and Mantha (1980); Bartol and Martin (1982), aligning both *people and processes*, 'learning

by doing', the process of trial and error to discover and refine ways of using systems more effectively (Pollock and Williams 2008:85 and Williams and Pollock 2009:4).

This study has also benefited by its longevity. This five year doctoral programme has provided an extended timeframe to undertake a longitudinal study overcoming various pitfalls that can befall ERP studies of much shorter duration, which tend to focus on short term impact, snapshot type research which lack real maturity and as a consequence may have severe limitations (Pollock and Williams 2008:84 and Williams and Pollock 2009:3).

Sustainability as a Process

The concept of sustainability within the context of this study has been discussed and defined within a generic context in terms of maintaining the momentum of the improvements by continuing the trend and thereby looking to improve the current measured result further in the future, an on-going journey of improvement where a continual upward momentum is maintained.

Within the context of this research, sustainability may be viewed as a 'state' which can be measured within specific *time* intervals to determine trends as evidenced from a measurement matrix derived from the Data Accuracy Index. In this guise the maintenance of a continual upward trend (notwithstanding intermediate fluctuations) may be taken to imply a state of sustainability. However there may well be a time when the 'improvement curve' may flatten out as incremental improvements become harder to achieve, something which may occur in future to the KPI Index that has seen a 56% overall improvement in the first three and a half years. One then has to weigh the 'marginal cost' of attempting to drive further index improvements, against any 'real organisational 'benefits' that may accrue. It is here where sub-optimisation and the law of diminishing returns may well begin to materialise and one may have to consider an element of trade-off, as has been recognised in other areas of the literature (Helfert, Foley, Ge and Cappiello 2009: 12). Attaining the levels of improvement witnessed so far is considered to be a major achievement and *maintaining* this level of improvement may well be the optimum long term objective of this particular strand of the sustainability process. Previous discussion established that the Data Accuracy Index is not an end in itself, but an indication of the level of public recognition, acceptance and response to the importance of quality data. The longer term focus on sustainability must be to change attitudes, personal cultures and win 'hearts and minds', if the evolution from *controlled* to *self* sustainability is to take place.

Perceptions of Data Quality

The existence of numerous notions as what constitutes 'data quality' and indeed 'data' and 'information' has permeated this entire study, although working definitions were presented earlier within this document. It is therefore not surprising that differing perceptions of 'data quality' exist within the various components of both the qualitative study and quantitative survey. This may best be illustrated by the response to the quantitative research question on perceptions and attitudes on pages 97-98, which was certainly the most interesting, intriguing and enlightening part of the entire survey and arguably the most important, revealing a great deal about the mindsets of the individual respondents. Whilst 82% believed they have the ability to influence the quality of *their* data and provide quality data to *others*, only a quarter believed that the data they *receive* is of equivalent quality, although when one includes those choosing a 'medium' response, then the figure rises to 69%.

This is a huge disparity within peoples' perceptions and attitudes giving rise to a number of questions. Given that data runs horizontally across departments, functions, sites and businesses from provider to recipient and that the survey represents a reasonable cross-section of this model; one could deduce that there is either a lack of communication between both parties as to what the 'customer' requires, or that the 'supplier' is ignoring such requirements. There is also of course the personal perception that "I am always right and it's the other person's fault" or that no one is prepared to admit that they are not providing an adequate service. Although there was a considerable degree of support for one's own definition of data quality, the participants' own view as to what data quality means to them may in many cases take more of a selfish view focussing upon what they *receive*, rather than the requirements as to what they need to *provide* to others. There is also considerable evidence within the literature Laudon (1986); Wand and Strong (1996); Strong Lee and Wang (1997); Giannoccao, Shanks and Drake (1999); Wang, Zhand and Lee (2001); Eckerson (2002); Olson (2003), to suggest that this level of misperception as to data quality within communities, is not unique to this study.

This entire research has been founded upon the robust conceptual framework as described in Section 2 page 18 which brought together the concepts of people, processes and data into a single related model, supplemented by the principles of cultural and organisational change. This has shaped the focus of the entire ongoing research, enabling the outcomes of the literature reviews, qualitative study and the quantitative survey to be brought together within a single structure, allowing the subsequent analysis to draw out those essential key findings and related principle findings which make this entire study unique. These *key findings* and the subsequent *principle findings* discussed above are seen as the main outcomes for knowledge and learning for both practice and theory that have emerged from this research. Within the concluding section below these findings are discussed further within the context of the entire study.

17. CONCLUSIONS AND RECOMMENDATIONS

This study has identified a gap in the literature surrounding the process of improving and sustaining the quality of data within enterprise planning and information systems. This final section builds upon the evidence of this research and in particular the key findings and principle findings in a format that has potential to be applied within practical business and professional settings, whilst providing the academic community with the promise of a contribution to the body of knowledge.

Data as a Key Strategic Resource

This study indicates that the essential principles of sustainable data quality appear to be largely neglected by the majority of organisations. The concept of treating data as an important corporate asset was recognised many years ago Redman (1995: 102); following this Davenport, Harris, De Long and Jacobson (2001b: 1) noted that “Data itself remains one of our most abundant yet under-utilised resources” and in the intervening period there does not appear to have been any considerable change. Latterly Redman (2008: 5) concluded that data and information are essentially being unmanaged, as very few enterprises can claim they meet the necessary criteria to manage their data effectively (Redman 2008: 4). To ensure that organisations are in a position to reap the benefits of data and information as strategic assets, they have to manage them aggressively and professionally as they do their other assets (Redman 2008: 2). In order to achieve this Redman (2008: 2-5) proposed that organisations must focus on the quality of their data, ensuring that it is correct first time, easy to access and understand and protected from misuse. The data must then be put to value-driven use, to assist in making better and more informed strategic decisions. This echoes the earlier works of Davenport (2006a); Davenport and Harris (2007), and Harris (2005a); Harris (2005b); Harris (2007) which centred on the use of ‘analytics’, moving towards a ‘fact-based culture’ to generate competitive advantage by harnessing more effectively the power of quality data. This message has been reiterated latterly by Davenport, Harris and Morison (2010: 1) emphasising the total reliance of any analytic project on complete and high quality data.

A PricewaterhouseCoopers survey found that 70% of executives contacted, considered data to be an important asset, yet only 40% felt they used it effectively (Informatica 2008:6). Given the evidence of Redman (2008) above, together with English (2009) and the other sources described in Section 1, these figures may appear be somewhat optimistic, but they do however highlight a gap between realisation and reality and the failure by organisations, for whatever reason, to gain true value from their data assets. A survey conducted by BusinessWeek and Hewlett Packard highlighted the fact that many organisations will readily agree that their data is an important asset, but fail to take any action (Hewlett Packard 2007: 3). One may speculate as to the possible reasons for this apparent absence of activity. There

may be a general lack of attention to data per se at various organisational levels, or that enterprises do not persevere with those initiatives they put in place. Peoples' perceptions of what is and what causes poor data quality appear to have a considerable effect. The significant findings from the data quality survey described in Section 15 regarding peoples' 'feelings' as to the quality of the data they *manage* and that the quality they *receive* illustrates this point profoundly and will be the subject of detailed discussion later in this section.

This research addresses these issues in that it attempts to ascertain how quality data can be created and then embedded within an enterprise. If an effective data quality initiative is put in place it will possess the propensity to raise the profile of data and its value will become more appreciated. As the overall quality is improved, there will be greater confidence in its validity and people will then find better ways of using the information to inform knowledge more effectively, which will in turn enhance decision making. Such positive results will further strengthen the initiative and increase the opportunities for it to become self-sustaining.

The Data Quality Initiative within Remploy has made considerable progress not only in highlighting the importance of data as *the* valuable organisational resource and enterprise-wide asset, but also in generating actions to improve the overall quality in order that it may be used more effectively. Further progress is dependant upon the company maintaining a focus on the quality of its data together with the extent to which the findings, conclusions and recommendation of this study are developed and put into practice.

Enterprise Resource Planning and Competitive Advantage

The literature contains numerous examples of research examining whether ERP systems can provide organisations with sustainable competitive advantage. A number, Kalling (2003); Beard and Sumner (2004); Lengnick-Hall, Legnick-Hall and Abdinnour-Helm (2004); Laframboise and Reyes (2005), employed a resource-based view approach (RBV), an economic tool designed to determine whether an organisation's valuable resources can be a source of competitive advantage focussing mainly on elements of their uniqueness to the organisation (Kalling 2003: 49). Enterprise resource planning per se is not unique, being used, in one form or another, in a great many organisations and for this reason there appears to be a consensus that "an ERP system can yield at most a *temporary* competitive advantage" Beard and Sumner (2004:148); that "ERP does not provide a competitive advantage on its own" Lengnick-Hall, Legnick-Hall and Abdinnour-Helm (2004: 326) and "ERP systems in themselves do not create a competitive advantage" Moe, Fosser, Leister and Newman (2007:37), but are increasingly seen as a pre-requisite to *stay* competitive (Beard and Sumner 2004:148).

The real value-generation elements emanating from ERP systems are seen to be; the availability, quality and standardisation of data...and...improvements in business processes Beard and Sumner (2004:144); improved cultural and learning capabilities aligned with a superior knowledge base....also a platform for increasing social and intellectual capital Lengnick-Hall, Legnick-Hall and Abdinnour-Helm (2004: 326); Lengnick-Hall and Legnick-Hall (2006 190); an information base to outperform competitors Moe, Fosser, Leister and Newman (2007:37); a source of operational excellence information Bendoly, Rosenzweig and Stratman (2008: 320); enhanced processes Fosser, Leister, Moe and Newman (2008: 8-9); and a source of Business Intelligence (Wing 2010: 29). Koh and Simpson (2007: 73) researching within small and medium-sized organisations concluded that enterprise systems could create competitive advantage by showing responsiveness and agility to change; whilst *The American Machinist August (2009: 49)* concluded, "ERP comes down to improving business decisions and increased profitability. With greater knowledge comes a greater chance to succeed". However Seddon (2005: 283) argued that ERP software is an unlikely source of competitive advantage either strategically or operationally.

The debate within the literature described above appears to argue that competitive advantage cannot be derived from solely by implementing an enterprise system. and that achieving any 'real' advantage is predicated on having the capability to add real value and excellence to an organisation's information products and knowledge base. It is worthwhile discussing this further. The above literature is *not* stating that ERP systems cannot provide an organisation with an advantage or that organisational improvement will not accrue, but that if all one's fellow competitors are operating an ERP system then the uniqueness does not exist. The above research is not comprehensive and may not take into consideration the quality of individual implementations. One may contend that whilst there exists a seeming 'level playing field', in reality a firm may gain a competitive advantage over its rivals, if its ERP implementation, optimisation and subsequent system maturity is superior to that of its competitors. The one single element which can add real value to any organisation's information products and knowledge base, whilst enhancing any system implementation and optimisation, is the quality of the data, the 'real differentiator'.

Whilst one cannot state categorically that Remploy has so far derived a *competitive* advantage from its ERP investment, it can certainly be argued that the company is in a far better position to be able to manage and control all of its diverse operations as the result of its improved ERP landscape. Whether further significant advantages can be obtained will depend upon a number of factors, the most important being the ability to maintain high levels of quality data to both further enhance the business and provide quality strategic analytical information, as the ERP life-cycle moves further into the 'maturity' stage.

Enterprise Resource Planning Maturity Conclusions

To reach the point where an organisation is able to manage its data effectively takes time especially where the complexities surrounding ERP systems are concerned. Before an enterprise can learn *how* to manage its data, it has to learn that data *has* to be managed and this may come as the result of learning from previous failures Scott and Vessy (2002: 213); the enterprise resource planning landscape being littered with implementation disappointments and disasters, resulting from a plethora of causes (Chen 2001; Esteves and Pastor 2001; Murray and Coffin 2001; Grossman and Walsh 2004; Xue, Liang, Boulton and Snyder 2004). Holland and Light (2001: 43) described a three-stage ERP maturity model involving; implementation, widening adoption, leading to strategic exploitation, enabling ERP transaction data to provide high-end strategic value to related applications and information and knowledge systems. Markus and Tanis (2000) developed a similar 'ERP experience cycle', which Markus, Axline, Petrie and Tanis (2000: 264) described as a 'set of processes' which can be of varying and indeterminate length, with numerous dependences. A number of the issues they raised has resonance with the findings from this research, in particular cultural questions relating to resistance to change and management buy-in (Markus, Axline, Petrie and Tanis 2000: 263). Whilst this project is not concerned directly with how enterprise systems should be optimised, it recognises that post-implementation reviews are critical Nicholaou (2004: 46) and in particular the importance of the way human resources interact with consistent and optimised processes (Worley, Chatha, Weston, Augirre and Grabot 2005: 635). In order to reach the level of maturity required to enter the real added-value phase, there has to be a move from the reactive 'data inspection and correction', to a far more proactive 'have the data right first time' approach.

Davenport, Harris and Cantrell (2004: 22) highlighted the requirement for systems to become embedded, emphasising the long term evolutionary process of enterprise system maturity, not just in process improvement, but in the very nature of learning what data is available and how to make best use in order to 'informate' or transform the data into information to provide knowledge to support decision making. From..."transactional data, to good business information" (Davenport, Harris and Cantrell 2004: 24). Davenport, Harris and Cantrell (2004: 23) also stressed the importance of overall data quality in bringing about organisational benefits, incorporating data access, availability, quality, consistency, timeliness and accuracy leading to greater familiarity and insight and thereby creating additional demand for more meaningful information. de Souza Dias and de Souza (2004: 153-156) also identified the association between the maturity of enterprise systems and the generation of competitive advantage. A further example of the long term nature of enterprise system maturity, required to gain real advantage, may be seen from the model for turning transaction data into knowledge Davenport, Harris, De Long and Jacobson (2001b) discussed earlier on page 25. The model is partially predicated on developing the skills and experiences of the staff,

together with detailed knowledge of the data. Both these essential ingredients require time to develop and mature before they can be applied to generate any real success.

Whilst the examples above highlight the significance of system maturity and time, one has to conclude that an appreciation of the importance of time and maturity appears to be lacking in most of the related literature which has tended to focus mainly on single site operations Williams and Pollock (2008: 2), of a short term impact, snap shot type studies of fleeting durations, which lack real maturity and as a consequence may have severe limitations. In contrast Pollock and Williams (2008: 83) and Williams and Pollock (2009: 14) suggested that the consequences of enterprise system implementations and their subsequent evolution may have to be considered in temporal framings of years or even decades.

This issue of time and the necessity to allow for the development of systems, people and processes towards their maturity, in order to bring about the real lasting benefits, has direct resonance to the practical elements of this research. Section 8 described the journey towards improving data quality within Remploy over the last five years and makes particular reference to time in relation to the role out of the Data Accuracy KPI reporting, on page 60. It will be beneficial to reiterate again these main sentiments. *“The programme of expanding the circulation and overall corporate exposure may be considered to be somewhat ad hoc in that it did not conform to any initial detailed pre-determined agenda; rather, it developed and evolved over the period, in line with the researcher’s own learning process, both as part of this study and as further development of one’s practical business experiences. With hindsight the process may have been accelerated a little but the overall aim has been to inculcate rather than inflict the concept. It was also felt that it was important that it be seen as a cross-functional business-wide project rather than a centrally imposed reporting and control structure”*. This learning process can be extended within the overall context of the research to encompass not only the researcher’s own learning, but also the organisation’s learning, commencing with the initial phased Baan implementation during the latter 1990’s, onto the individual business optimisations, leading to the commencement of the Data Quality Initiative in 2005 and then finally to the KPI reporting introduced in 2006. This is also reiterated within one of the additional key findings contained in Table 20 ‘People’ above, “Take things slowly to ensure everyone is onboard”. It can be argued that part of the overall improvement in data quality can be related directly to the fact that each element has been allowed to take hold, embed and mature.

Davenport (2006a: 107) also emphasised the question of time and maturity in developing companies’ analytical capabilities, normally taking several years to come to fruition in resolving technological issues, transactional data refinements, building data warehouses and implementing analytical software. Periods of six or seven years are quoted in order to collect the data, and gain necessary experience to be able to validate the conclusions. In a letter to

the editor of the Harvard Business Review in response to criticism of the slow pace of analytical implementations, Davenport (2006b) argued that analytics is all about slow steady progress...and ...over time making small quantitatively derived advantages which lead ultimately to major gains.

Quality Data as a Competitive Advantage

Whilst the majority of organisations have so far failed to maximise the benefits from their planning and information systems, opportunities do exist to create competitive advantage by managing data effectively. Those firms that are able to derive real competitive advantage are doing so by leveraging their data to generate strategic knowledge. This strategic leap is not made by merely implementing business intelligence applications to produce information, but by providing employees with the means of being able to *learn* from the information so as create valuable knowledge with which to make value-driven decisions, by way of a decision making process termed the 'insight-to-action loop' Harris (2005a). To build such an analytical capability requires a change to organisational culture in order that it becomes 'fact-based'. Such 'insight'-driven companies focus on 'facts' in every area of their enterprise Harris (2005b) demanding complete and high quality data (Davenport, Harris and Morison 2010: 1).

As stated, there is also potential for an organisation to gain an advantage over its competitors by making more effective use of its enterprise system to drive its transactional operations. Enhanced processes and developed and engaged people, aligned to improved planning, are better able to reduce lead times, satisfy customer requirements more speedily, maximise revenues, manage working capital and control costs, to optimise operational performance. All of which is also dependent upon being able to manage the data effectively. In this context 'managing data' involves creating and sustaining a data quality culture within which individuals are able to recognise the value of data, improve the quality, embed such improvements and identify opportunities to derive real long term benefits from its use. Without quality data, any enterprise system cannot function effectively, either as the engine to drive the business transactional processes or as source of the data that fuels the management information and business intelligence applications to provide that winning analytical capability. This study attempts to create the climate where such benefits are able to be realised both within Remploy as well as the wider organisational horizons.

Data Governance and Corporate Governance

This study has affirmed consistently the interrelationship between data quality and data governance as enshrined within the conceptual framework in Figure 2 page 18 and in Section 2. In turn data governance has to be linked to corporate governance via corporate leadership. This essential relationship between data and corporate governance also has roots within the

literature (Cheong and Chang 2007; Pfleeger, Trope and Palmer 2007; Tarantino 2008; Weber, Otto and Osterle 2009). The quality of an organisation's data not only has significant commercial connotations, but it also has serious implications for all enterprises, as they respond to the huge number of regulatory requirements, in the form of record keeping, data gathering and recording and information providing. Failure to comply in full to any request can result in serious financial damage to an organisation or even threaten its very existence, even where fraud, deception or other misdemeanours are absent. This not only relates to prominent laws such as Sarbanes-Oxley and Basel II, but to the myriad of government demands for data, whether they be from HM Revenue and Customs, the Office for National Statistics, or any other governmental agency whether UK or Internationally based. All have potential penalties for late delivery or erroneous information. For any unified governance, risk and compliance (GRC) strategy to be successful, there has to be confidence in the quality of the inherent data (Tarentino 2008: 63-64). Whilst this section has focussed upon the importance of data quality in ensuring compliance with regulatory requirements, one is also aware of the necessity for the activities surrounding information systems should themselves to conform to national and international legal obligations (Khadraoui, Leonard, Pham Thi and Helfert 2009).

This dilemma has long been recognised within Remploy. Corporate policies and procedures have been in place for a considerable period particularly within the areas of Finance and HR to ensure both internal and external regulatory compliance. To further strengthen the environment a new IS strategy was developed in 2009 as outlined in Appendix 1. A fundamental part of this was the establishment of a governance body termed the *Design Authority* whose role is to ensure that all elements of IS are consistent with this strategy, which in turn must conform to the overall corporate strategy and governance. The author as a member of this body drafted the initial guiding principles and standards around the management of data together with the data governance policy, described in detail within Section 3.

As an example of the progress made and benefits derived within this field, the following statement appeared as part of the Annual Corporate Business Report submitted to the Executive of Remploy during April 2010:

“The introduction of a formal Data Governance strategy, allied to improved Data Quality, has strengthened overall Corporate Governance within the Company especially around the elements of Governance, Risk and Compliance (GRC). In addition there appears to be far greater confidence in the quality and value of the information shared and also greater visibility within the businesses, as to their day to day transaction processing”

Summary

The direct operational benefits to Remploy of this study as highlighted by the improved Data Accuracy Index have been referred to in depth, but there is also evidence to suggest that there have also been considerable improvements of a cultural and strategic nature as discussed within this section. Data is not only recognised as a significant resource and a major corporate asset, but actual *resources* in terms of human capital and finance have been expended to support ongoing improvement actions. Further operational and strategic advantages have been derived from enhanced reporting, budgeting and forecasting which may yet be leveraged further to give a real competitive advantage in the future. The myriad of small meaningful ameliorations, both technical and procedural, which have been applied by passionate people during the period since the original Baan implementation, are now gaining greater maturity alongside higher quality data to generate both operational and informational benefits. Finally the recognition of the importance of data in relation to overall governance, risk and compliance has provided enhanced levels of authority and control to identify and mitigate exposure to potential regulatory non-conformities.

Conclusions drawn from the Key Findings and Principle Findings

The analysis of the *key findings* in Tables 19 and 20 pages 102-106 and the subsequent detailed discussion around the *principle findings* which subsequently emerged, are seen as the main outcomes for knowledge and learning for both practice and theory that have emanated from this study. These principle findings have been identified as elements or concepts which assist in binding together those strands of activity that have the capacity to bring about change not only to improve the quality of data but also impart some degree of permanency.

Principle Findings

The *role of the champion* is seen as key to promoting and embedding change and innovation. Within this study local champions have emerged at various levels and from various functions within the organisation embracing the essential cultural and motivational philosophies to make improvements within their spheres of influence. Whilst there has yet to be universal acceptance in all locations there is evidence to suggest that this 'role' is kernel in evolving the programme from 'controlled sustainability' to 'self sustainability'

The concept of *measurement, reporting and feedback* is a prerequisite for any successful change programme. Within this study this element is not viewed as a mere 'central' monitoring and control mechanism, but has been developed into a reporting process to provide sites and businesses with the information to manage their operations on a day to day basis.

The necessity of *time and maturity* has been discussed in detail earlier within this section as well as other parts of this study. This element of 'organisational patience' is important to allow new 'processes', changes and improvements to become accepted and embedded as well as to enable 'people' to accept change, develop themselves, gain experience and learn new skills.

In discussing the concept of *sustainability*, emphasis has been placed upon maintaining the momentum of improvement particularly within the process of measuring the quality of data. One has to be aware however that there may be occasions where the 'costs' of making further improvements within a particular field may outweigh the benefits that may accrue with the risk of sub-optimisation. Within this study the Data Accuracy Index is not an end in itself but an indicator. In a wider context one is looking to *sustain* the improvement in the levels of awareness and acceptance of the importance of quality data.

The quantitative survey and subsequent related detailed discussions have highlighted the huge disparity in peoples' *perceptions of data quality* between the data they influence (82%) and that which they receive (26%). Whilst evidence from the literature suggests that this is by no means unique to this study it raises considerable concerns in general as to the quality of communication and the way people view their roles and their own performance and the performances of others. It was decided that further analysis as to the underlying reasons for this disparity would best be examined as part of a further research project outside the scope of this study, as it was felt that this additional research theme was somewhat extraneous to the final research question. In addition it is appreciated that the misconceptions in general as to the concepts of data and data quality appear to be prevalent and have parallels within the data quality community as to their own definitions of data quality.

However it is appreciated that the above decision to restrict further detailed work may have placed certain limitations on the analysis of the data carried out for this part of the survey which if undertaken may have enriched the outcomes to determine this the reasons for this seeming 'disparity'. An alternative approach may well have used cross tabulation to provide further analysis around the way participants responded to the question as to how they perceived the quality of data they received. An analysis of this data possibly by function, job role, location, business may have added richness to generate further theories. An attempt was made to garner information of respondents by job role but only a third of the respondents supplied this information. The base data did however contain the respondents' contact details which may also have been used (within ethical principles) to generate a secondary questionnaire to tease out further information. Also it may be beneficial to target the recipients at some later date to see if these perceptions had changed in any way, in terms of a

longitudinal survey. However the restrictions of this study precluded this, but it should not prevent a follow up survey being undertaken as part of further research at some later date.

Final Conclusions and Recommendations

It has been demonstrated that this study has identified a gap in the literature with regard to determining means by which organisations may be able to sustain data quality improvements within diverse enterprise systems. The research is even more unique in that it has been undertaken within an organisation whose objective is to provide employment for disabled people. This research is also distinctive in that it uses an action research approach within this context, with the researcher taking an actual active participatory role in the process rather than acting merely as an observer or recorder of the events. However it must be stated that the researcher did not control the process, but acted as both guide and participant.

Review of the Research Question:

The development of the research questions and their evolution was discussed in detail in Section 1. As part of this process the research questions went through a number of iterations culminating in the final question:

“How can an organisation create an environment where data quality improvements can be sustained?”

The findings, conclusions and recommendations of this study have identified, means by which the quality of data within planning and information systems can be improved, together with the opportunities for such improvements to be *partially* sustained. At the moment any real sustainability exists mainly within a controlled environment requiring periodical interaction by the overall champion, sub-champions and elements of the leadership. Means to achieve *self-sustainability* need to be researched and identified and this will be discussed further.

Benefits and limitations

Rich access

The ability of the researcher to gain full access to such a wide and diverse contact base has added considerably to the overall richness of this research. This is reflected not only in the volume of the sites covered and people interviewed, but also the extent to which virtually everyone appeared eager to participate fully and attempt to make a contribution. Walsham (2006:322) emphasised the extreme importance of having appropriate access to an organisation relevant to the scope and direction of the study.

The application of action research within this study

Discussion within Section 9 identified that action research is not a unique approach within the overall arena of planning and information systems, however the majority of the literature followed the established trend and focussed upon ERP procurement and implementation Akkermans and van Helden (2002); Stefanou and Revanoglou (2006); Walsham (2006); Beyon-Davies, Baker and Williams (2008); Deep, Guttridge, Dani and Burns (2008); Bohorquez and Esteves (2009); system enhancement Klueber and Alt (2000); Adams, Baker, McFadzen, Miller and Smith (2004); and information systems (Baskerville and Wood-Harper 1998; Baskerville 1999; Stirling, Petty and Travis 2002; de Vries 2007). Whilst a number Lee (2004); Lee, Pipino, Strong and Wang (2004) did focus on data quality, they essentially viewed the topic from a generic perspective. This study therefore may be considered to be unique in the manner that it employs an action research approach to generate considerable rich material within the area of sustainable data quality improvement within enterprise systems.

Eden and Huxham (1996:84-85) argued that action research poses potential challenges, around levels of uncertainty, imprecision and instability, a lack of control and understanding of the concepts of consultancy and intervention, which may ultimately prove problematical when used by doctoral students (Eden and Huxham 1996:85). One appreciates these methodological reservations but believes that one's personal and professional experiences both academic and practical, gained over a considerable period of time in a number of organisations, together with an intimate knowledge of the environment being investigated, have acted as a form of 'apprenticeship' for this approach.

The research methods

The qualitative element of the research for this document took the format of a series of discussion-type focus group meetings around a basic flexible agenda, employing an action research approach. To further extend this research and build upon the progress made within the Data Quality Improvement Programme, a web-based survey was then carried out amongst fellow Remploy colleagues.

The research methods employed were dictated largely by their appropriateness to the real-life environment within which the research was conducted, in particular the format of the qualitative focus groups and the ability to make a real contribution to improving business performance. This followed the realisation that a re-launch of the data quality initiative was necessary and that this would be best achieved by working with those colleagues who interfaced directly with the data. As discussed, this process escalated quickly as the benefits were realised by all parties. It is appreciated that an alternative approach could have been taken with a quantitative survey carried out prior to the qualitative study, possibly followed by

a further survey to determine whether perceptions and attitudes had changed. However in hindsight one feels that the chosen process was most appropriate in that it enabled the concept of data quality to be promoted throughout the company by personal contact and that an initial survey may well have garnered little response given the focus at that time on other priorities.

It is appreciated that other research methods were available of both a structured and unstructured nature. In-depth, semi-structured or closed interviews could have been employed but their individual focus would have been far too narrow, lacking totally the essential interactivity between interested participants that proved so beneficial. Similarly, observational research, whether open or closed would not have yielded the same rich material. As a contrast to the use of focus groups, the Delphi technique offered a structured alternative but its closed and rather anonymous nature would not have provided the essential feedback, although its use should not be precluded should further research be undertaken. Whilst the quantitative study was mainly a pre-coded self-administered questionnaire, there was scope and opportunities for participants to express their opinions in number of instances and one believes both elements worked well.

Validation of the research contribution

In validating the contribution that this research has made, one should examine this process through alternative lenses. From a practical work-base perspective within Remploy the importance of the need for quality data is now accepted in greater areas of the organisation and positive feedback has indicated that peoples' perceptions as to the quality of the information they receive and the reliance and trust they place upon it has improved dramatically. This has assisted greatly with the introduction of more sophisticated business intelligence and budgeting tools, leading to the reduction in the regular monthly reporting schedule from ten working days to less than three within four years. The improvements in the levels of data quality as indicated by the Data Quality Accuracy KPI Index described in Section 13, provides further evidence of the practical implications. Also the development of a corporate data governance policy allied to the establishment of a data management presence within the IS Design Authority as described in Appendix 1 and page 118 can also be attributed solely to this project.

The initial research for this study recognised that a gap existed within the academic literature surrounding the process of improving and sustaining the quality of data within enterprise resource planning and information systems. Subsequent research identified those key findings as described in Tables 19 and 20 (pages 102-106) which are not exclusive in themselves but have the capacity, when aggregated together and allied to the principle findings, to bring about the dramatic changes evidenced by the practical improvements

described above. It is contended that this collective process is unique within the environs of planning and information systems and that this research has therefore unearthed new knowledge with the capacity to make a contribution to the body of literature. It is also argued that the employment of the specific action research approach within this context has also been responsible for developing theory and generating positive practical business outcomes. Therefore it may be seen that the version of action research methodology applied within this research has not only created an environment where lasting improvement process theory can emerge, but actually engenders a cultural atmosphere where such processes can propagate.

This relationship between theory and practice, research and action to attempt to enhance theoretical knowledge whilst providing practical solutions as expounded by Van de Ven and Johnson (2006a) and Van de Ven (2007) has been the overriding ambition of this study. It can therefore be argued that this research has not only made a contribution to *theory* as evidenced by the partial success in answering the final research question, but has also enhanced the reputation of action research as a form of *work-based research*, when applied to situations where the researcher has experience of and credibility within the research arena and all parties have participated actively within the entire process.

Design science

The research for this entire study has been based around the behavioural-science paradigm having its origins in natural science research. Within the arena of information systems research however a complementary approach has gained wider and wider relevance, that of design science. Design science has its roots in engineering and the sciences of the artificial, being essentially a problem-solving paradigm attempting to create innovations or artefacts to improve the analysis, design, implementation and use of information systems (Hevner, March, Park and Ram 2004: 76). Hevner, March, Park and Ram (2004: 98) also argued that behavioural-science and design science are inter-related, the former seeking to find 'what is true' and the latter 'what is effective'; truth and utility respectively, with truth informing design and utility informing theory Hevner, March, Park and Ram (2004: 80); to both improve performance in the development and use of information systems whilst making a contribution to research knowledge (March and Storey 2008: 726). Hevner (2007: 91) contended that design science is essentially a pragmatic science with the emphasis on making a contribution that is relevant and measurable, whilst at the same time having the rigor to learn from the existing knowledge base with the potential to contribute to knowledge (Hevner 2007: 90).

There has been discussion in the literature as to the relationship between design science and action research in that both attempt to change the world Iivari (2007: 53) and to learn from failures (Iivari and Venable (2009: 11). Jarvinen (2005: 12) argued that both could be

considered to be similar research approaches, both in their characteristics, action and pragmatism and their validation processes (Jarvinen 2005: 13). livari (2007: 53) argued from a paradigmatic perspective that they were clearly separate conceptually, and that their paradigmatic assumptions differed dramatically (livari and Venable 2009: 12). Whilst livari and Venable (2009: 10) accepted the view that action research and design science were in principle compatible, their research orientations were different and that any similarities were superficial and therefore both were decisively different (livari and Venable 2009: 12). Approaching the debate from a scientific perspective Ogland (2009: 171) contended that the paradigmatic differences could be overcome and the combination of action research and design science could be a critical success factory particularly within the area of software process improvement research.

Whilst it has been clearly evidenced how design science has influenced information systems research particularly over the last decade, its application within enterprise systems and data quality research appears to be non-existent. From a personal viewpoint design science appears to require far greater direct involvement by the researcher in carrying out the process than one would expect with a comparable action research project. This is certainly the case with this study where the researcher has made every effort not to influence the proceedings. Given the growing acceptance of design science within the information systems academic literature there may be opportunity for future research to examine both data quality and enterprise systems through the lens of a design science approach with or without an alignment with action research.

Potential limitations of a single case

The qualitative and quantitative research for this document was undertaken within a single organisation which may imply certain limitations; however the focus group/action research study and the internal web-based survey did in fact embrace forty eight factories and twelve business streams many of which are quite diverse. This approach takes the process out of a single case environment into a far wider and varied research arena. In addition the survey carried out within Document Four embraced data quality professional from across the world. Therefore it can be argued that the findings, conclusions and recommendations do have a fair degree of relevance to a far wider managerial and professional audience than just a single organisation.

Opportunities for Further Research

Whilst this study has enhanced both practice and theory in integrating both established and largely untested improvement processes and practices into a new environment, it has also identified a number of topics which will benefit from further research outside of this particular

study. It is entirely appropriate that additional lines of investigation worthy of exploration should emerge and this is seen as a further illustration of the benefits of this research. The outcomes may also have relevance externally to this particular sphere. The wider change management community and in particular the process improvement and quality management fraternities may find resonance with a number of the principal findings.

As stated previously the single most important finding to emerge from the quantitative survey was the huge disparity in perception of data quality in that 82% of respondents believe they have the ability to influence the quality of their data and provide quality data to others, whilst only a quarter believe that the data they receive is of equivalent quality. This entire subject is worthy of further investigation outside this study, especially around the theme of communication.

Whilst it is extremely encouraging to witness notions as to how improvement processes are able to generate degrees of sustainability, this must be tempered by the knowledge that only partial progress has been made. Further research is necessary to extend this knowledge to discover those methods by which organisations are able to move from an environment of *controlled* sustainability to one of *self-sustainability*. There is a strong evidence to suggest that the role of 'the champion' in various forms may shed important light within this arena.

Considerable research has taken place within the scientific discipline of neuropsychology, examining the human capacity to accept change, relating to the inner powers of the human mind, in the way that it may support or sabotage efforts to bring about change and achieve buy-in. This may well be a fruitful area for further investigation and the manner in which this branch of science can be applied to data and information quality.

The extreme bias within the literature towards initial-phase related ERP research has already been discussed in detail within the introduction to this study and possibly best illustrated by Pollock and Williams (2008:84) and Williams and Pollock 2009:3) who highlighted the fact that over ninety five per cent of the six hundred plus articles contained in *the ERP Research Group* online bibliography may broadly be described as ERP implementation studies. One believes that there is a strong requirement for far more detailed research allied to the longer term use and development of enterprise systems rather than concentrating upon the procurement, implementation and short-term optimisation arenas. It is hoped that this study has made a much needed contribution towards addressing this academic imbalance and hopefully will encourage and inspire other researchers to undertake similar projects within this area.

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Remploy is the largest provider of employment opportunities for disabled persons in the UK currently employing over three thousand disabled people in fifty four individual factories across the entire country, whilst placing over 10,000 others into external open employment. The Company, which has an annual trading turnover of £160m and is supported by the UK Government's Department for Work and Pensions, was founded over sixty years ago initially to provide employment for war victims. It has been emphasised throughout the first four documents that the fundamental aim of any DBA project is to add to and develop the pool of knowledge within management practice and in this context this thesis is no exception. There is also however the subordinate aim of applying the principles and practises learnt and developed to practical use within the disabled employment community, not only Remploy but also other similar organisations across the World. In addition both primary qualitative and quantitative research studies have been carried out within the organisation. Therefore it is important to place the document within the overall context of Remploy's environment. This section provides background information and indicates how the Company is positioned within the scope of the overall project and its connections with similar enterprises.

This subordinate aim has not changed, indeed its importance, within Remploy specifically, has increased considerably within the life time of this doctoral programme. The Company carried out a fundamental strategic review of its entire operations, in collaboration with its single shareholder, the Department for Work and Pensions (DWP) and other stakeholders including employees and unions during 2006 and 2007. The final outcome as endorsed by the DWP, under the title 'Modernisation Programme', resulted in considerable structural and strategic change taking place during 2008, including the withdrawal from unsustainable operations and vacating a third of the operating sites, to produce a new working model to enable those remaining businesses to grow. In addition the 'Employment Services' operation, its disabled person recruitment, rehabilitation, learning and external placement business, is planned to expand over the next five years by a factor of a least five or maybe even seven. These overall changes placed enormous strain on all areas of the Company requiring considerable change management/change leadership resources, skills and support. The implications for quality systems, quality data and quality information are enormous. This project has already assisted the Company during this period of fundamental change and is intended to continue to do so. A number of data quality initiatives have already been implemented during the duration of this DBA and are seen to be generating improvements and it is envisaged that they will continue make considerable contributions in managing and controlling the next phases of organisational change.

Remploy's Mission

"To transform the lives of disabled people and those experiencing complex barriers to work, by providing sustainable employment opportunities"

Remploy's Principles

The company's objective is to provide equal opportunity and to promote the independence of disabled people by creating the widest possible spectrum of employment opportunities, accompanied by appropriate training and development. It is committed to providing quality jobs and personal development for disabled people to enable them to fulfill their potential- 'Real jobs for Real People'. Its over-riding aim is to maximise the number of disabled people employed, both within the Company's own manufacturing and service sector businesses and by other external companies and organisations

Accessibility

'Accessibility' refers to the hardware and software technologies that have been developed in order to assist visually or physically disabled persons gain access to information technology either for personal use or within a work environment. Fundamental to this has been the development of the concept of 'Assistive Technology'. Within an IT sense this refers to specialised keyboards and mouse devices, voice recognition, screen magnifiers and Braille printouts etc. In a non-IT environment the term can encompass any aid to promote greater independence for disabled persons. The Company employs an IT specialist whose objective is to expand the use of assistive technology within all the Company's IT applications. A continuing element of this study will be to align this objective to assist in individuals' personal development as well as contributing to improving data quality.

Workability

Remploy is an influential member and co-founder of 'Workability International' the world's largest body representing providers of work and employment services to people with a disability. More than three million people with disabilities are engaged in work programmes delivered by the 133 Workability member organisations in some 42 different countries. The organisation is registered in the UK. Its Secretary General, based in France, is a former employee of Remploy and it is anticipated that the findings and benefits arising from this project will be shared with other members of Workability International where applicable. The author has also been in regular contact with the Secretary of Workability Europe.

ERP within Remploy

A Baan/Infor ERP system was implemented over ten years ago and whilst there have been many benefits overall; there is still considerable scope for further improvements, especially within the area of data quality and system complexity. Maintaining sustainable quality data within any ERP system can be problematical at best, but when one factors in an organisation with twelve individual business streams operating within such diverse areas as automotive,

electronics, packaging, PC recycling, healthcare, furniture, in addition to manufacturing protective clothing against nuclear, chemical and biological threats for the UK military and police, the overall picture can become very complex with a high potential for errors and problems. This position is complicated even further when it is then superimposed upon the current network of over fifty separate factories with over 800 active users, the majority of whom are disabled in one form or another, at the same time that the organisation is undergoing the greatest change and upheaval in its history.

Remploy's IT Strategy Review 2009

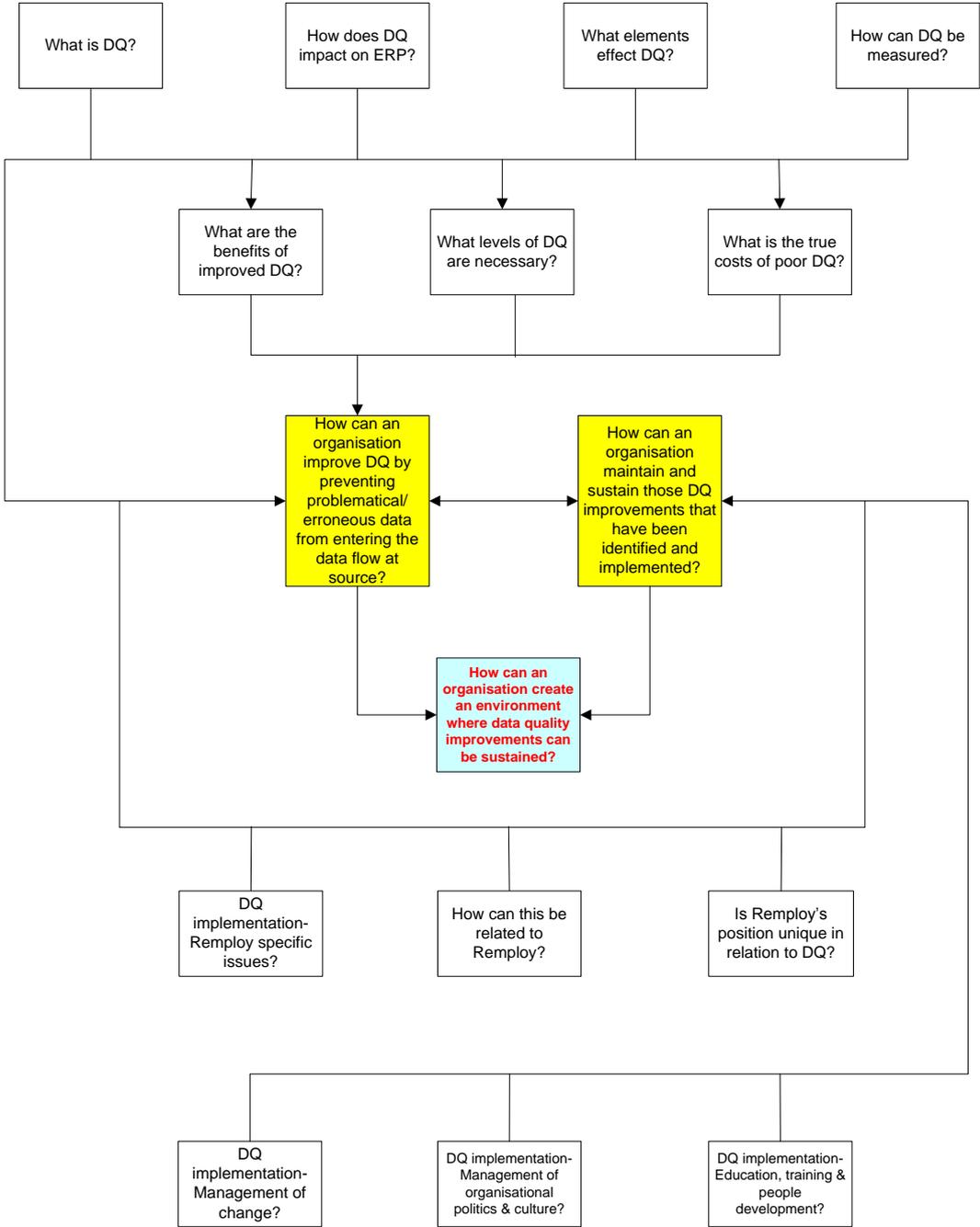
During the early part of 2009 Remploy carried out a review of its IS strategy and identified four key areas that must be addressed in order to fulfil the business plans. It was agreed that the Company must be able to manage its finances, develop and support its staff, deliver sustainable employment outcomes, all within an integrated platform that is flexible to scale up/down to meet the needs of all the elements of the various businesses. Providing such a set of IT applications and systems, represented a major change from the strategy introduced during the Baan implementation ten years previously when Remploy was a more traditional manufacturing organisation. In May 2009 the Board authorised the investment in an IS transformation programme termed 'Usability' within which four new project streams were set up within the programme, embracing Finance, HR/Payroll, Employment Services Support and IS Transformation, to provide a platform for growth to significantly improve the delivery and flexibility of the core systems. The effect of this was to be the introduction and implementation of new Finance, HR/Payroll and Case Management (to support the huge planned growth in Employment Services indicated above) systems across a new hardware platform to be externally hosted. It was also decided that the Baan ERP application would be retained to manage the operations of the factory-based businesses and be interfaced with the new finance application.

To support the Usability programme, an IS steering committee was formed reporting directly to the Executive, overseeing a number of subordinate projects covering each of the new applications. Potential problems and risks were identified around the introduction of three new independent systems being layered over existing applications operating on a new platform. To this end a Design Authority Project was set up to ensure that all the elements complied with the IS governance policy, with particular reference to ensuring that all the separate components fitted together, were consistent with the overall strategy, all the various technical and design interdependencies and tradeoffs were understood and addressed and that all the dimensions of the various solutions both hardware and software, were compatible in the overall model. The areas seen to be key to ensuring success were, the management of data (referred to within Section 3), system architecture and integration, compliance and security and accessibility. It was agreed that minimum governance standards would be established to align both Remploy's policies and regulatory requirements both internal and external, initially

in respect of the new applications but then to be extended to the existing legacy applications. Alongside this, guiding principles would be established to assist with implementation and provide leadership, direction and focus around the main objectives. The author was seconded onto both the Design and the Finance project teams with particular responsibility relating to the management of data.

Research Questions for Document 5

Appendix 2



**Generic KPI
Weighted
Index**

Appendix 3

Company/Site														
Credit notes	19	27	46	59	32	34	36	25	27	23	30	22	21	401
Proportion of total	0.05	0.07	0.11	0.15	0.08	0.08	0.09	0.06	0.07	0.06	0.07	0.05	0.05	
Rev. weighted total	0.62	0.81	1.26	1.47	0.72	0.68	0.63	0.37	0.34	0.23	0.22	0.11	0.05	7.51
Despatches not invoiced	1037	300	12	391	7	0	0	0	0	0	2	0	0	1749
Proportion of total	0.59	0.17	0.01	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Weighted total	0.59	0.34	0.02	0.89	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.88
O/S Production orders	412	50	3	2	0	0	0	0	0	0	0	0	0	467
Proportion of total	0.88	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Weighted total	0.88	0.21	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.13
O/S Purchase orders	474	51	10	2	2	0	4	0	0	2	0	0	0	545
Proportion of total	0.87	0.09	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
Weighted total	0.87	0.19	0.06	0.01	0.02	0.00	0.05	0.00	0.00	0.04	0.00	0.00	0.00	1.23
O/S Sales orders	467	28	1	0	0	0	0	0	0	0	0	0	0	496
Proportion of total	0.94	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Weighted total	0.94	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.06
Purchase invoices under query	124	41	20	9	7	7	9	1	5	0	3	1	3	230
Proportion of total	0.54	0.18	0.09	0.04	0.03	0.03	0.04	0.00	0.02	0.00	0.01	0.00	0.01	
Weighted total	0.54	0.36	0.26	0.16	0.15	0.18	0.27	0.03	0.20	0.00	0.14	0.05	0.17	2.52
Receipts not invoiced	1673	519	140	160	38	74	177	77	141	78	63	38	589	3767
Proportion of total	0.44	0.14	0.04	0.04	0.01	0.02	0.05	0.02	0.04	0.02	0.02	0.01	0.16	
Weighted total	0.44	0.28	0.11	0.17	0.05	0.12	0.33	0.16	0.34	0.21	0.18	0.12	2.03	4.54
Index for Company/Site														19.88

The questions of security around the various electronic formats pose far more complex problems. The entire DBA data is held on the author's own company laptop, essentially in word, visio, SPSS and excel files. This data is also stored upon a back-up media within the Remploy IS network as part of the company's back-up and disaster recover policy and procedure. Detailed person-sensitive data is also held externally. As already stated, the author has used NTU's web based survey tool Autoform to carry out two electronic questionnaires. It is important therefore to ensure that adequate security exists within both the internal and external data storage areas. Access to the author's company laptop is password controlled with industry-standard PGP encryption and on occasions when a memory stick has had to be used, then a type with a military-style encryption format has also been employed. One has also attempted to obtain satisfactory evidence that the data held within the Remploy network and NTU's Autoform environment meets acceptable storage and access requirements.

Security enquiry**NTU- Request by Author**

"As part of my submission I want to cover ethical elements of electronic surveys including important considerations relating to data storage and access etc. Can you please advise me as to how the data is stored, controlled and archived etc within the Autoform application in line with NTU's security policy. I am not questioning any potential security issues but attempting to show that I have looked at all elements of ethics, having given all respondents an assurance about anonymity"

NTU- Response

"Data and surveys are stored on two different parts of a server, and while the surveys themselves are accessible to browsers, the data is not. There is no link between the two, so any hacker would need to know the structure of the system to match a survey to its responses. The responses are stored simply as lists of numbers (except for text responses) and would be meaningless without access to the survey HTML at the same time.

Survey authors cannot access their data directly on the server. Instead of using a vulnerable author password system, Autoform approaches security by storing the email address of the author and will issue data only to that email address. This email address cannot be edited by the author once the survey is set up, so the data is as secure as the author's email system.

Data is not encrypted on the server, or when sent.

A very small number of people have access to the data folder on the survey: Kristan and myself, plus certain IT technicians at NTU. Data is backed up (daily I think) and stored securely in a different building.

No additional information on respondents (eg IP address) is stored with the survey data, so authors have no access to such details. IP addresses are collected and stored elsewhere should legal processes require post hoc tracing of a respondent. This has never happened. Certain precautions are in place to prevent hacking and misuse, some of which are embedded in the Autoform program, and some are security features of the server. I would be reluctant to give further details about these.”

Remploy Internal Audit Manager’s Comments

“Looks like they have got it pretty well tied up.

I would imagine that the data held as part of your survey is of little interest to hackers as, I seem to remember, little personal data other than name and job title (?) and as such would not come under the requirements of the data protection act anyway (there has to be two linked personal bits of “sensitive” information). All in all, very low risk I would suggest.”

Remploy IS Service Operation Manager’s View of Security

“My response to the below email from an IS Service Management and security point of view are:

- *Even though survey responses risk of personal data being compromised on the servers, there is still potential of data being hijacked in transit over the network. To reduce this risk for html traffic, it is worth encrypting the traffic using SSL certificates by an external company like VeriSign which will ensure traffic over the internet is sent via HTTPS and not HTTP.*
- *IT might be prudent to audit system administrators’ access and review system activity logs by a separate department such as audit team to ensure integrity of data is not compromised by system administrators who have access to the whole of the servers.*
- *System administrators password should also confirm to strict password policy which is more complex than standard users password policy*
- *Live data should be kept separate from test system data by having separate networks such as VLANS on the same network, so live data can not mixed with non live data.*
- *Data must be backed up on a daily basis as daily incremental (files that only get changed) and also weekly full backups. Backup tapes should have two copies, one onsite and other offsite so data can be restored quickly in live environment to resolve corruption of data rather than having the tapes to be sent from offsite site to live site.*
- *Data backup must be tested annually to ensure RTO (Recovery Time Objective) can be achieved within the set time, i.e. can recovery data from backup tapes within the agreed SLA. You also need to ensure RPO (Recovery Point Objective) can be achieved within the agreed time for data integrity, i.e. data is recovered up to when data was lost, so people do not have to re-key in full days worth of data.”*

It has been confirmed that these guidelines are followed by Remploy.

From the above responses, the author is totally satisfied that the procedures in place in both NTU and Remploy satisfy the security requirements of this DBA project. This of course is predicated upon these procedures being adhered to.

DATA QUALITY RESEARCH PROGRAMME

Appendix 5

Research survey to ascertain factors that impact upon sustaining data quality improvements-
positive/negative

Date: 11/03/09

Site: Site/Business Names

Present: Names of all attendees
Tony O'Brien

Details: **Note Site and Attendee details have excluded to preserve anonymity**

Question: 'Let me have your comments concerning the Data Accuracy Programme?'

Comments

1. Appreciation as to how the Data Accuracy KPIs fit within the overall Corporate Data & Information Quality initiative
2. Need to ensure that everyone is fully aware of the implications of their actions with all the process flow
3. Salvesen transport invoices and utility bills causing problems with incorrect direct charges. Takes time & effort to correct & receive appropriate credits. Team to come up with appropriate process improvement plan (potential for cascading across the Company)
4. KPIs not really understood and details & explanation never previously cascaded down
5. Appreciative of the requirement to ascertain the root cause by analysing all problems & identify why problems have occurred
6. Initial emphasis to continue to focus on those areas where the business/sites have 100% control- ie despatches not invoiced and overdue production, purchase and sales orders
7. Cyberquery access required for members of the team
8. Confirm Business/Site authority levels
9. Plan of action- short term
 - a) All outstanding orders & DNYI are clear by 18/03
 - b) Review purchase invoiced under query and clear all but current month by 31/03
 - c) Analyse KPI with particular regards to returns & possible contras
 - d) Provide list of problem areas by 31/03
 - e) Identify Baan training needs and produce plan by 31/03
 - f) Commence holding weekly KPI review meetings with the team & cascade KPI summary and related detailed reports- suggest Monday

Note Site and Attendee details have excluded to preserve anonymity

DATA QUALITY RESEARCH PROGRAMME

Appendix 6a

Research survey to ascertain factors that impact upon sustaining data quality improvements- positive/negative

Note the Site and Business names have been excluded

Analysis of factors

Current	
Actions/Policies	The way we are doing things currently
Issues/Problems	Issues/problems identified
Action Going Forward	What we are going to do in the short term
Culture-current	Current inherent thinking, attitudes & behaviour
Culture-future	Intended inherent thinking, attitudes & behaviour

									No
Appreciation as to how KPIs fit within the Corporate D & IQ initiative	Focus initially on the four key site specific elements (DNYI & orders)	Ascertain root cause of issues/problems	Need to ensure that everyone is fully aware of the implications of their actions	KPIs never understood & never previously cascaded down	Detailed short term action plan- with target dates	Issues with transport & utility bills	Weekly KPI review meetings	Cyberq access required	9
Appreciation as to how KPIs fit within the Corporate D & IQ initiative	Focus initially on the four key site specific elements (DNYI & orders)	Training issues identified	Need to ensure that everyone is fully aware of the implications of their actions		Detailed short term action plan- with target dates	Issues with DNYI?	Weekly KPI review meetings	Review credit notes	8
Specific policy re RNIs	Focus on outstanding orders	SSC Issues							3
Contact TOB re any underlying SSC issues	Focus initially on the four key site specific elements (DNYI & orders)	SSC Issues contact keeps changing	Better understanding of the underlying principle & requirements	Confirmation of PO authority levels required		Review RNI principally 'returns'	Weekly KPI review meetings		7
			Need to ensure that everyone is fully aware of the implications of	KPIs never understood & never previously cascaded	Detailed short term action plan- with target dates		Weekly KPI review meetings	Cyberq access required	5

			their actions	down					
Low level of business activity		Training issues identified	Need to ensure that everyone is fully aware of the implications of their actions						3
Appreciation as to how KPIs fit within the Corporate D & IQ initiative	No business specific ISBM contact	Dating of order-should be expected reipt/defivery date NOT default date 'today'	Need to ensure that everyone is fully aware of the implications of their actions	Key people left through VR without adequate replacement knowledge & training	Detailed short term action plan- with target dates	Requirement for visit by Tony Taylor	Weekly KPI review meetings	Super User' concept not followed up	9
No business specific ISBM contact	Baan outstanding PO report not complete-missing final steps	Training issues identified	Need to ensure that everyone is fully aware of the implications of their actions			DNYIs outstanding	Weekly KPI review meetings		6
Greater publicity of the existence of KPIs	Prioritising of the impact on the business	Need to explain importance of KPIs at both business & site level to help sites take ownership	Need to ensure that everyone is fully aware of the implications of their actions	Toolbox of how to drill down through the reports to understand what has happened & what can go wrong					5
Problem with identifying site specific data from Co 510	Receiving outstanding order lists weekly via email	Printing & reviewing sales orders weekly	Overall performance is good	LRM has back office experience as a former production controller	Pricing of manual POs where actual price not known- 50 @ £1	Requirement for visit by Tony Taylor			7
Good processes in place using Baan	Agreed that KPI data will be used in conjunction with Baan reports	RNIs reviewed weekly by LRM	Baan outstanding PO report not complete-missing final steps					Cyberq access required	5

Process to improve credit notes	Implement automated process to advance dates on 'out to fit' production orders	Enter anticipated receipt date on POs NOT default date (today)	BFP not known		KPIs reviewed weekly	5
Problems with carriage charges	Issues with SSC	Issues with raw material price changes-- ownership & responsibility	Problems with incorrect conversion factors	Purchase returns- no process for chasing for supplier credit notes	Weekly KPI review meetings	6
New LRM not fully aware of the KPIs	Focus initially on the four key site specific elements (DNYI & orders)	Enter anticipated receipt date on POs NOT default date (today)	Need to identify the personnel dealing with each type of order & agree who does what with responsibility for each process	Production orders for large volumes are set up as one qty- better if broken into smaller qty orders	Weekly KPI review meetings	6
Agree process for dating production & purchase orders	Issues regarding invoicing for tooling- may take over a year	Process for improving credit notes- print documents	Focussing on KPIs must not sub-optimize day to day operations		Weekly KPI review meetings	5
Contact TOB re any underlying SSC issues	Focus initially on the four key site specific elements (DNYI & orders)	Enter anticipated receipt date on orders NOT default date (today)	Need to ensure that everyone is fully aware of the implications of their actions		Weekly KPI review meetings	5
Site not aware previously of KPIs	Should order dates be changed if customers redates orders?	Baan outstanding PO report not complete- missing final steps	Need to ensure that everyone is fully aware of the implications of their actions	Focussing on KPIs must not sub-optimize day to day operations	Weekly KPI review meetings	6
SSC issues	Baan training requirements identified	LRM provides a weekly business KPI summary	LRM has produced business KPI guidelines	Pricing of manual POs where actual price not known- 50 @ £1	Weekly KPI review meetings	6

Some interesting comments (point 8)	Should order dates be changed if customers redates orders?			Purchase returns- no process for chasing for supplier credit notes			Weekly KPI review meetings	4
Everyone involved in the process	Culture of urgency where something needs to happen	Targets set & measured	KPI are beneficial & graphs useful	Assists in identifying & reducing poor practices	Indicative of the quality of the processes	Overall performance is good	Weekly KPI review meetings	8
Review all orders & pass details to relevant person at the start of each month	Call-off orders open for a long time	Set up production orders for smaller quantities covering shorter lead times	Need to ensure that everyone is fully aware of the implications of their actions- financial & transactional	Build DQ targets into people's objectives	Contact TOB re any underlying SSC issues	Requirement for visit by Tony Taylor	To review KPIs to measure progress	8
Ecycle orders not being picked up	Business to use KPIs on a weekly basis	Weekly planning meetings at each site, consolidated at the Center	Problems with carriage charges on suppliers' invoices	Baan outstanding PO report not complete- missing final steps	Purchase Invoicing problems	SSC issues lack of continuity	Granfos receipts & returns not being contra'd	8
SSC issues lack of continuity	Contact TOB re any underlying SSC issues	Incorporate KPIs within staff's objectives	Importance of the KPIs identified	Focus initially on the four key site specific elements (DNYI & orders)				5
Problems with aggregated sales invoice for Glasgow liaison with SSC	Implement automated process to advance dates on 'out to fit' production orders	Training issues identified	Strictly monitor overdue purchase orders					4

Purchase returns- no process for chasing for supplier credit notes	Users need more knowledge to tell them which reports to run to obtain information	Loss of skills following Modernisation. Training issues identified	Need to ensure that everyone is fully aware of the implications of their actions- financial & transactional	Automate essential reports & send via email		5
KPIs have not been cascaded down to Operations. Staff do not understand the process	Previously not seen as important by LRMs & production controllers- merely lip services	Graphs are good provides visibility	Fundamental to running the business	Cultural issues	Problem with identifying site specific data from Co 510	6
Problem with identifying site specific data from Co 510	Focus initially on the four key site specific elements (DNYI & orders)	Objective to achieve November index target of 21.22 by Christmas				3
Use super users to communicate and implement 'best practice'	Focus initially on the four key site specific elements (DNYI & orders)	Problems with accounting for consignment stock. Company policy required?	Common process for dealing with carriage charges on suppliers' invoices	Training requirements to be identified by each site		5
Highlight any SSC issues to TOB/Adam	Focus initially on the four key site specific elements (DNYI & orders)	Business/sites to provide feedback on DQ issues	Problems with carriage charges on suppliers' invoices	Maintain ongoing focus on weekly planning meetings	Weekly planning meetings at each site, consolidated at the Center	6
	Focus initially on the four key site specific elements (DNYI & orders)	Business/sites to provide feedback on DQ issues, problems & successes				2

	Focus initially on the four key site specific elements (DNYI & orders)	Training issues identified	Need to ensure that everyone is fully aware of the implications of their actions	Policy re the re-dating of orders	Detailed short term action plan- with target dates	Issues re DNYI, invoicing & receivables		Review credit notes	7
All sites indicate good practices in place- aiming to be 'the best'	Super User set up but no feedback	Provide all LRMs with access to the GL Transaction Report?	Training requirements identified	No business-specific ISBM	Detailed short term action plan- with target dates	Problems with Aged Inventory Report- not clearing old receipts	Weekly KPI review meetings		8
A lot of bad habits have been carried forward & a lack of understanding in the sites	LRM process focussed: Right first time mentality: Coaching admin support	An error can take 30 seconds but a correction can take hours'	Produce a document covering each KPI highlighting examples of problems/issues with resolutions	Re-age orders as appropriate	New process for reduction of credit notes in Packaging	Review sales orders at daily production meeting	Weekly KPI review meetings	Running new Cyberq RNI report	9
Jobs & roles carried out by people who left under VR need to be identified & picked up	Re-age orders as appropriate	Print KPIs weekly & distribute to the Team	Review Cyberq access						4
Major improvements at all 3 sites	Data accuracy targets built into peoples' objectives	Issue monthly credit note report to all LRMs	RNI returns a big issue	Regular monitoring of KPI index (daily)	Detailed short term action plan- with target dates		Weekly KPI review meetings		7
No follow up on the 'Surper User' concept	Multi-despatches on a single invoice with only one detach note number causes problems	Do we check suppliers statements to see if there are old invoices not received?	Access to Accounts Payable enquiry sessions may be useful	Review training requirements	May be useful to cascade GL Transaction Report to all LRMs	Runs aged debtors report weekly	Weekly KPI review meetings	Credit note reasons investigated	9

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DATA QUALITY RESEARCH PROGRAMME

Appendix 6b

Research survey to ascertain factors that impact upon sustaining data quality improvements-
positive/negative

Current Actions/Policies
Issues/Problems
Action Going Forward
Culture-current
Culture-future

Culture-current	No	+/-	Current Actions/Policies	No	+/-	Issues/Problems	No	Action Going Forward	No	Action Going Forward	No	Culture-future	Cat	No
KPIs never understood & never previously cascaded down	2	-	Specific policy re RNIs	1	+	Problems with carriage charges	4	Focus initially on the four key site specific elements (DNYI & orders)	11	Strictly monitor overdue purchase orders	1	Appreciation as to how KPIs fit within the Corporate D & IQ initiative		3
Overall performance is good	2	+	Focus on outstanding orders	1	+	Training requirements identified	6	Detailed short term action plan-with target dates	7	Purchase returns-no process for chasing for supplier credit notes	1	Ascertain root cause of issues/problems		1
LRM has back office experience as a former production controller	1	+	Low level of business activity	1	?	Issues with DNYI?	2	Weekly KPI review meetings	16	Users need more knowledge to tell them which reports to run to obtain information	1	Need to ensure that everyone is fully aware of the implications of their actions		12

New LRM not fully aware of the KPIs	1	-	Key people left through VR without adequate replacement knowledge & training	1	-	SSC Issues	6	Cyberq access required	5	Automate essential reports & send via email	1	Better understanding of the underlying principle & requirements	1
Site not aware previously of KPIs	1	-	Receiving outstanding order lists weekly via email	1	+	SSC Issues contact keeps changing	4	Contact TOB re any underlying SSC issues	6	Objective to achieve November index target of 21.22 by Christmas	1	Need to explain importance of KPIs at both business & site level to help sites take ownership	1
Some interesting comments (point 8)	1	+	Printing & reviewing sales orders weekly	1	+	No business specific ISBM contact	3	Confirmation of PO authority levels required	1	Use super users to communicate and implement 'best practice'	1	Prioritising of the impact on the business	1
Everyone involved in the process	1	+	Good processes in place using Baan	1	+	'Super User' concept not followed up	3	Review RNI principally 'returns'	1	Training requirements to be identified by each site	2	Need to identify the personnel dealing with each type of order & agree who does what with responsibility for each process	1
Culture of urgency where something needs to happen	1	+	RNIs reviewed weekly by LRM	1	+	Baan outstanding PO report not complete- missing final steps	4	Dating of order-should be expected reipt/defivery date NOT default date 'today'	4	Business/sites to provide feedback on DQ issues, problems & successes	2	Focussing on KPIs must not sub-optimize day to day operations	2

Targets set & measured	1	+	Weekly KPI review meetings	6	+	Problem with identifying site specific data from Co 510	3	Requirement for visit by Tony Taylor	3	Maintain ongoing focus on weekly planning meetings	1	Build DQ targets into people's objectives	2
KPI are beneficial & graphs useful	1	+	LRM provides a weekly business KPI summary	1	+	BFP not known	1	DNYIs outstanding	1	Provide all LRMs with access to the GL Transaction Report?	1	Graphs are good provides visibility	1
Assists in identifying & reducing poor practices	1	+	LRM has produced business KPI guidelines	1	+	Issues with raw material price changes-- ownership & responsibility	1	Greater publicity of the existence of KPIs	1			Jobs & roles carried out by people who left under VR need to be identified & picked up	1
Indicative of the quality of the processes	1	+	Review all orders & pass details to relevant person at the start of each month	1	+	Problems with incorrect conversion factors	1	Toolbox of how to drill down through the reports to understand what has happened & what can go wrong	1			Access to Accounts Payable enquiry sessions may be useful	1
Importance of the KPIs identified	1	+	Weekly planning meetings at each site, consolidated at the Center	2	+	Purchase returns- no process for chasing for supplier credit notes	2	Pricing of manual POs where actual price not known- 50 @ £1	1			May be useful to cascade GL Transaction Report to all LRMs	1
Loss of skills following Modernisation	1	-	Re-age orders as appropriate	2	+	Issues regarding invoicing for tooling- may take over a year	1	Agreed that KPI data will be used in conjunction with Baan reports	1				

KPIs have not been cascaded down to Operations. Staff do not understand the process	1	-	Using new Cyberq RNI report	1	+	Should order dates be changed if customers redate orders?	3	Process for improving credit notes- print documents	2
Previously not seen as important by LRMs & production controllers- merely lip services	1	-	Review sales orders at daily production meeting	1	+	Pricing of manual POs where actual price not known- 50 @ £1	1	Implement automated process to advance dates on 'out to fit' production orders	2
Fundamental to running the business	1	+	Runs aged debtors report weekly	1	+	Call-off orders open for a long time	1	Production orders for large volumes are set up as one qty- better if broken into smaller qty orders	2
Cultural issues	1	?	Credit note reasons investigated	1	+	Ecycle orders not being picked up	1	Set up production orders for smaller quantities covering shorter lead times	2
All sites indicate good practices in place- aiming to be 'the best'	1	+				Granfos receipts & returns not being contra'd	1	Problems with aggregated sales invoice for Glasgow liaise with SSC	1

An error can take 30 seconds but a correction can take hours'

1 +

A lot of bad habits have been carried forward & a lack of understanding in the sites

1 +

LRM process focussed: Right first time mentality: Coaching admin support

1 +

Major improvements at all 3 sites

1 +

Data accuracy targets built into peoples' objectives

1 +

Regular monitoring of KPI index (daily)

1 +

27

+ 19
- 7
? 1

Problems with Aged Inventory Report- not clearing old receipts

1

RNI returns a big issue

1

Multi-despatches on a single invoice with only one detach note number causes problems

1

Do we check suppliers statements to see if there are old invoices not received?

1

52

Produce a document covering each KPI highlighting examples of problems/issues with resolutions

1

New process for reduction of credit notes in Packaging

1

Issue monthly credit note report to all LRMs

1

71

11

28

WEB-BASED SURVEY REQUEST

Appendix 8

Dear Colleagues

As you are aware we have been carrying out meetings over recent months with representatives from almost all of the sites and businesses to ascertain how best we can improve the quality of our data. This has taken the form mainly, of site and business meetings to review the Data Accuracy KPIs, in particular the way in which they are able to assist in improving our processes and individuals' education, training and development.

This effort has proved very successful with real positive feedback and more open communications and as a result the overall index of the sites covered has improved by 24% with a 43% improvement in the 'net' index, ie those elements over which the sites have total control (despatches not yet invoiced, plus overdue production, purchase and sales orders)

The Businesses & Sites have expressed the opinion that they now have far greater visibility and control over their data. In addition, from a Finance perspective, the year end appears to have gone far more smoothly as a result of cleaner data, especially around quicker error resolution & reduced invoice queries.

To assist us in further advancing our initiative to embed a sustainable data quality culture within Remploy, we should like to invite you to participate in a short internal web-based questionnaire survey to collect your feedback and views on data quality both in general terms and also specific to our operations. In addition we are also reviewing how we are integrating 'Assistive Technology' (hardware and software techniques developed in order to assist visually or physically disabled persons gain access to information technology within the working environment) into our operations.

We are using Nottingham Trent University's survey tool 'Autoform' to collect the data. The survey has 19 questions and should take no longer than 15 minutes to complete. The content is confidential and will not be presented in any format that can be related to any specific individual.

May I also ask you to cascade this to all relevant members of your team as we are looking to obtain company-wide feedback

I appreciate the input of your thoughts and experiences and will be publishing a summary of the results in due course. If you have any queries please do not hesitate to contact me.

Please access the survey by clicking on the link below

Thank you in advance

Regards Tony

**REMPLOY INTERNAL DATA
QUALITY SURVEY**

MAY 2009

Appendix 9

		Type of Questions	Types of Variables
Please enter your name	<input type="text"/>	Demographic Data	Personal information
Email address	<input type="text"/>	Demographic Data	Personal information
Site/Department	<input type="text"/>	Demographic Data	Personal information
What is your main job role?	Business Manager Operations Manager LRM Supervisor Production Controller Stores Purchasing Sales/Marketing Finance HR Senior Executive/Director	Demographic Data	Nominal

Other (please specify)

--

Very High High Neutral Low Very Low

How highly will problems in the following areas impact the overall quality of data within your organisation's data systems? (including non-Baan systems)

Generic DQ

Ordinal

Master Data entry
(Items/Customers/Suppliers etc)

Operational Data processing
System Housekeeping
(processes that ensure that system orders and processes are kept clean and up to date)

Others

Please specify

How highly do you evaluate the impact of the following on the quality of the data within your organisation's data systems? (Including non-Baan systems)

Generic DQ

Ordinal

Data Suppliers (persons who provide data)

Data Processors (persons involved in processing data)

Data Customers (persons who use the data output)

Others

Please specify

How highly will problems in data processes and procedures effect the quality of the data? (including non-Baan systems)

Any comments, please specify

Generic DQ

Ordinal

Please rank the following as potential causes of data quality problems

Employees
 Customers
 Suppliers
 External data sources
 Processing errors
 External systems
 System errors
 Others
 Please specify

Generic DQ

Ordinal

Please rank the following as potential causes of data quality problems

Poor data entry
 Lack of DQ knowledge, training, education
 Poor processes
 Poor management
 Others
 Please specify

Generic DQ

Ordinal

Please rank the following in terms of their effectiveness in resolving data quality problems

- Build targets into peoples' objectives
- Root-cause analysis of problems
- Maintain up-front error prevention
- Identify and clean errors at source
- Identify and clean within the process (ie downstream)
- Identify and correct errors in reports
- Take no action
- Others
- Please specify

Generic DQ

Ordinal

How often do you print and review the Data Accuracy KPIs?

- Daily
- Twice Weekly
- Weekly
- Monthly
- Quarterly
- Others (please specify)

Remploy KPIs

Nominal

Please rank the following KPIs in terms of their impact in improving

Remploy KPIs

Ordinal

the quality of the data

- Credit Notes
- Despatches Not Yet Invoiced
- Outstanding Production Orders
- Outstanding Purchase Orders
- Outstanding Sales Orders
- Purchase Orders Under Query
- Receipts not yet Invoiced

Please rank the following KPIs as a source of data quality issues/problems

- Credit Notes
- Despatches Not Yet Invoiced
- Outstanding Production Orders
- Outstanding Purchase Orders
- Outstanding Sales Orders
- Purchase Orders Under Query
- Receipts not yet Invoiced

Remploy KPIs

Ordinal

What are the main areas where you have problems and issues with the quality of data and information?

--

DQ Issues

What are the main things you do to improve the quality of the data under your control?

--

DQ Improvements

Please rank the system training and developments requirements of your site/department

- Sales
- Purchasing
- Production
- Finance
- HR
- Others (please specify)

Training Requirements **Ordinal**

At what level should the responsibility for data quality sit within Rempoy

- Director
- Business Manager
- Operations Manager
- LRM
- Departmental Head
- IS Department
- Finance Department
- Everyone
- Others (please specify)

Rempoy Responsibility **Nominal**

How do you feel about the following statements?

"I am happy with the quality of the data I receive"
 "I believe I have the ability to influence the quality of the data under my control"
 "I believe that the quality of the data I provide to others meets their requirements"

Perceptions

Ordinal

Assistive Technology

(Hardware and software techniques developed in order to assist visually or physically disabled persons gain access to information technology within the working environment)

Assistive Technology

What % of your team's employees currently use some form of assistive technology?

0-10%
 11-25%
 26-50%
 51-100%

Assistive Technology

Ordinal

What do you feel are the main benefits of employees using assistive technology?

Beneficial to everyone
 Improve the quality of life for disabled users
 Improve Data Accuracy

Assistive Technology

Ordinal

Have you ever heard of Access to Work and the work they do funding Assistive Technology to disabled users?

Yes

No

Assistive
Technology

Semi-Dichotomous

Working definition of Data Quality

Comments/Input

To assist with ongoing research, we have attempted to define a working definition of 'Data Quality' which we feel encapsulates our ultimate vision of the subject

"Having the right and correct data in the right format, in the right place at the right time, from one single version of the truth across the Company"

We would welcome any comments you may have on this definition:

--

Any additional comments with regard to this survey will be most welcome:

Comments/Input

--

REMPLOY INTERNAL DATA QUALITY SURVEY SUMMER 2009

Appendix
11

Summary of Responses

Summary Table

	Invitations	Responses	Response	Invites
Analysis of Invitations/Responses	Nos	Nos	%	Split %
Executives/Business Managers	10	6	60	9
Operations	53	19	36	48
Commercial	15	7	47	14
Finance	26	9	35	23
IS	7	4	57	6
Total	111	45	41	100

Summary of Responses

Agree and Strongly Agree %

	Remploy Survey 2009 %	IAIDQ Survey 2008 %
--	--------------------------------	------------------------------

How highly will problems in the following areas impact the overall quality of data within your organisation's data systems?

Master Data entry	88	88
Operational Data processing	84	69
System Housekeeping	79	73
Other problems	40	83

How highly do you evaluate the impact of the following on the quality of the data within your organisation's data systems? (Including non-Baan systems)

Data Suppliers (persons who provide data)	79	77
Data Processors (persons involved in processing data)	83	76
Data Customers (persons who use the data output)	56	32
Others	47	33

How highly will problems in data processes and procedures affect the quality of the data? (including non-Baan systems)

Level of effect	93	96
-----------------	----	----

Please rank the following as potential causes of data quality problems

Employees	80	77
Customers	39	44

Suppliers	58	44
External data sources	46	46
Processing errors	80	54
External Systems	31	33
System errors	48	48
Others	20	75

Please rank the following as potential causes of data quality problems

Poor data entry	88	81
Lack of DQ knowledge, training, education	88	69
Poor processes	73	85
Poor management	70	65
Others	11	100

Please rank the following in terms of their effectiveness in resolving data quality problems

Build targets into peoples' objectives	64	
Root-cause analysis of problems	100	
Maintain up-front error prevention	91	88
Identify and clean errors at source	93	84
Identify and clean within the process (ie downstream)	59	44
Identify and correct errors in reports	60	24
Take no action	2	4
Others	13	40

How often do you print and review the Data Accuracy KPIs?

Daily/Weekly	73	41
--------------	----	----

Please rank the following KPIs in terms of their impact in improving the quality of the data

Credit Notes	59	
Despatches Not Yet Invoiced	73	
Outstanding Production Orders	70	
Outstanding Purchase Orders	86	
Outstanding Sales Orders	86	
Purchase Orders Under Query	91	
Receipts not yet Invoiced	86	

Please rank the following KPIs as a source of data quality issues/problems

Credit Notes	61	
Despatches Not Yet Invoiced	56	
Outstanding Production Orders	63	
Outstanding Purchase Orders	75	
Outstanding Sales Orders	68	
Purchase Orders Under Query	83	
Receipts not yet Invoiced	83	

Please rank the system training and developments requirements of your site/department

Sales	32
Purchasing	57
Production	51
Finance	56
Others	73

At what level should the responsibility for data quality sit within Remploy

Everyone	58
Management	42

How do you feel about the following statements?

I am happy with the quality of the data I receive	26
I believe I have the ability to influence the quality of the data under my control	83
I believe that the quality of the data I provide to others meets their requirements	81

Assistive Technology

What % of your team's employees currently use some form of assistive technology?

0-10%	87
11-25%	9
26-50%	2
51-100%	2

How do you find Assistive Technology?

Beneficial to everyone	80
Improve the quality of life for disabled users	98
Improve Data Accuracy	72

Have you ever heard of Access to Work and the work they do funding Assistive Technology to disabled users?

Yes	88
No	12

Working definition of Data Quality

To assist with ongoing research, we have attempted to define a working definition of 'Data Quality' which we feel encapsulates our ultimate vision of the subject

"Having the right and correct data in the right format, in the right place at the right time, from one single version of the truth across the Company"

Analysis of the Key Findings from the Research

Appendix 12

This appendix presents in detail, the key findings from this entire research; extracted from the research findings, short term guidelines, issues and ongoing suggestions from the qualitative study, the findings from the Data Accuracy KPI Index performance review; and the summary findings from the quantitative survey. To this has been added further perceived outcomes derived from an appraisal of the entire project over its lifetime, coupled with one's related personal and professional experiences.

These key research findings are then classified further within Appendix 14 into the main headings of the conceptual framework: Cultural/Organisational- Leadership (L) and Management (M); Processes (Pr) and People (Pe) as indicated below, together with the key recurring themes from the review of the quality literature shown in Table 2 on pages 49-51

A. Research Findings- Qualitative Study

Lessons Learnt

- Take things slowly to ensure everyone is onboard (Pe)
- Identify ownership and responsibilities (M)
- The Businesses 'own' the data NOT IT- a paradigm shift (M)
- Provide regular visible measures and report progress (M)
- Identify how the 'measures' will influence the quality of the data (M)
- Involve everyone, provide support (Pe)
- Explain the underlying reasons behind the improvement programme and how it will support the corporate objectives (L)
- Ensure everyone is fully aware of the implications of their actions (Pe)
- Build data quality targets into peoples' objective and reward success (Pe)
- Ascertain root causes of issues and problems and resolve at source (Pr)

Motivational Factors

- It is the 'right' thing to be doing, it supports one's principles (Pe)
- Belief that it will improve efficiency, help control and manage the factory and department (Pe)
- Competition between colleagues (Pe)
- Peer and Manager pressure (Pe)
- 'League Table' Syndrome (Pe)
- Requirement to achieve monthly/quarterly targets (Pe)
- A distinct movement away from 'I'm going to be in trouble' to 'My life is better for doing it this way' (Pe)

Environmental Factors

- Sell the concept up and down the organisation (L)
- Executive and senior and middle management sponsorship and involvement (L)
- Measurement of progress and the publication of results (M)
- Have an Internal Champion who has the respect of the audience (L)
- Tackle negative cultural issues (M)
- Cultivate an attitude and willingness to embrace new ideas (L)
- Build in system and structural changes to prevent a return to type (M)
- Improve communications to share ideas (M)
- A 'Bottom-Up approach with 'Top-Down' support (L)

General

- The concept of People, Processes and Data (Pr/Pe)
- A mixture of all of the above

B. Guidelines, Issues and Suggestions- Qualitative Study

Short Term Guidelines

- Involve everyone (Pe)
- Continually measure, report and provide feedback (M)
- Hold regular reviews with the 'Team' (Pe)
- Make the measurement and results visible (M)
- Focus on the 'key' elements setting objectives and targets (M)
- Ensure that potential problem areas are identified (M)
- Ensure that the appropriate processes and procedures are in place- 'one size does not fill all' (Pr)
- Communicate across the business on a regular basis (M)

Issues

- Training, education and development requirements not being met fully (Pe)
- A need for ongoing support in all areas with an internal 'expert' user community (M)
- Requirement for closer liaison between functions (M)
- Potential 'problem' areas identified (M)

Ongoing Suggestions (as above)

- Need to ensure everyone is fully aware of the implications of their actions (Pe)
- Better understanding of the underlying principles and requirements (M)
- Ascertain root causes of issues and problems (Pr)

- Appreciation as to how the KPIs fit within the corporate data and information quality initiative (M)
- Identify the personnel dealing with each type of order and agree who does what with responsibilities for each process (Pr)
- Build data quality targets into people's objectives (Pe)

C. Findings Data Accuracy KPI Index Performance

- There is potential for real cultural change to take place if improvement initiatives are managed correctly (M)
- "What is measured, communicated, discussed and agreed at all levels has a very good chance of becoming embedded"
 - Bottom-up supported by top-down
 - A potential key to sustaining any kind of change? (L)
- Any improvement initiative cannot be undertaken in isolation and that everyone needs to become involved. (Pe)
- The level of progress achieved appears to be commensurate with the level of activity of the internal champions or change leaders, leading to a climate of *controlled sustainability* rather than *self sustainability* (L)

D. Summary Findings from the Quantitative Survey

Generic Data Quality

- There is a high appreciation of the influence that People, Processes and Data have on the quality of data
- There is a realisation of the importance of having the data right first time (Pr)
- The level of positive responses compares very favourably with the previous survey held amongst the data quality community

Remploy Data Quality

- The overall attitude towards measurement, reporting and feedback was very positive (M)
- There was an appreciation of the importance of education and training (Pe)
- Almost 60% felt that 'everyone' has a responsibility to improve the quality of their own and the organisation's data (Pe)
- There was a huge disparity between the respondents' perception of the quality of the data they influence (82%) and that which they receive (26%) (Pe)
- 90% of respondents identified measurement and reporting, problem resolution and process improvement as key elements for improving data quality (M/Pr)

E. Additional Outcomes

Additional Outcomes

- The Data Accuracy KPIs and the Index is merely a barometer of the effectiveness or otherwise of the related processes- not an end in itself. Any improvement is predicated on the quality of this process and the degrees of adherence of the related persons' behaviour to follow these processes
- There are two types of processes
 - Operational processes- SOP/POP etc
 - Quality processes- what we need to be done to improve data quality ongoing
- Get the processes right and adhere to them, then the improvement in the KPIs will fall out
- Identify the *processes* (operational and quality) that are required and then change the behaviour (*people*) which needs to take place to ensure the agreed processes are followed continually
- Creating an environment where quality data can be sustained is dependant upon changing the way *people* behave to ensure they follow the most effective and appropriate *processes* and policies to a given situation- process change and people (behaviour) change
- Sustainability requires stability- NOT rigidity
- Identify changes required to embed a sustainable data quality culture
- From both the qualitative and quantitative studies
 - Emphasise the positive practices (Pros)
 - Review and take action on the issues and problems identified (Cons)
 - Focus on the important cultural environment and ensure that it is place

Analysis of Key Findings and Key Recurring Themes related to the Conceptual Framework Appendix 13

The key findings from the research detailed in Appendix 13 have been classified further into the main headings of the conceptual framework below, alongside the key recurring themes from the review of the quality literature shown in Table 2 on pages 49-51. This is an initial general classification with no intent to compare the findings and themes. This comparison takes place within Table 19 on pages 101-103, where similar related findings and themes have been categorised into thirteen broad generic common headings ((1)-(13)) as indicated below. There are a number of key findings without a comparable key theme and these are indicated as (A) and detailed as Additional Key Findings in Table 20 on pages 104-105.

Cultural/Organisational

Leadership:

Key Findings

Key Recurring Themes

<ul style="list-style-type: none"> • Explain the underlying reasons behind the improvement programme and how it will support the corporate objectives (2) • Sell the concept up and down the organisation (2) • Executive and senior and middle management sponsorship and involvement (1) • Have an Internal Champion who has the respect of the audience (A) • Cultivate an attitude and willingness to embrace new ideas (2) • A 'Bottom-Up' approach with 'Top-Down' support (A) • What is measured, communicated, discussed and agreed at all levels has a very good chance of becoming embedded (A) <ul style="list-style-type: none"> ○ Bottom-up supported by top-down ○ A potential key to sustaining any kind of change? • The level of progress achieved appears to be commensurate with the level of activity of the internal champions or change leaders, leading to a climate of <i>controlled sustainability</i> rather than <i>self sustainability</i> (A) 	<ul style="list-style-type: none"> • Executive and Management support and sponsorship (1) • Establish a clear vision with targets and milestones (2) • Importance of Leadership and Culture (2) • Align the Organisation (2) • Focus upon achievements (2) • Celebrate successes (2)
---	--

Management

Key Findings

- Identify ownership and responsibilities (5)
- The Businesses 'own' the data NOT IT- a paradigm shift (5)
- Provide regular visible measures and report progress (3)
- Identify how the 'measures' will influence the quality of the data (4)
- Measurement of progress and the publication of results (3)
- Tackle negative cultural issues (7)
- Build in system and structural changes to prevent a return to type (4)
- Improve communications to share ideas (6)
- Continually measure, report and provide feedback (3)
- Make the measurement and results visible (3)
- Focus on the 'key' elements setting objectives and targets (4)
- Ensure that potential problem areas are identified (8)
- Communicate across the business on a regular basis (6)
- A need for ongoing support in all areas with an internal 'expert' user community (A)
- Requirement for closer liaison between functions (A)
- Potential 'problem' areas identified (8)
- Better understanding of the underlying principles and requirements (2)
- Appreciation as to how the KPIs fit within the corporate data and information quality initiative (A)
- There is potential for real cultural change to take place if improvement initiatives are managed correctly. (4)
- The overall attitude towards measurement, reporting and feedback was very positive (3)
- 90% of respondents identified measurement and reporting, problem resolution and process improvement as key elements for improving

Key Recurring Themes

- Improvement requires change which has to be managed (4)
- A belief that change is worthwhile and necessary (4)
- Manage the change (4)
- Identify risks, benefits and overall objectives (4)
- Plan and identify required actions (4)
- Measure, monitor with reporting and feedback to support accountability (3)
- A continual on-going process (4)
- Accept that there will be set backs (7)
- Avoid undue pessimism, stay focussed and be positive (7)
- Identify potential pitfalls (7)
- Manage any potential short term and long term conflicts (4)
- Align the processes behind the people (13)
- Establish clear channels of communication (6)
- Manage the relationship between the way data interacts between the processes and the people (13)

data quality (A)	
------------------	--

Processes

Key Findings

- Ascertain root causes of issues and problems and resolve at source (8)
- Ensure that the appropriate processes and procedures are in place- 'one size does not fill all' (9)
- Ascertain root causes of issues and problems (8)
- Identify the personnel dealing with each type of order and agree who does what with responsibilities for each process (13)
- There is a realisation of the importance of having the data right first time (8)
- 90% of respondents identified measurement and reporting, problem resolution and process improvement as key elements for improving data quality (A)
- Concept of People, Processes and Data (13)

Key Recurring Themes

- Best practices within the right environment (9)
- Continual process reinforcement (9)
- Elements of quality management principles in all forms (4)
- Continual process improvements (9)
- Root cause analysis and error prevention (8)
- Concept of People, Processes and Data (13)
- Align the processes behind the people (13)
- Identify and document the process enablers (9)

People

Key Findings

- Take things slowly to ensure everyone is onboard (A)
- Involve everyone, provide support (12)
- Ensure everyone is fully aware of the implications of their actions (A)
- Build data quality targets into peoples' objective and reward success (11)
- Motivational Factors (A)
 - It is the 'right' thing to be doing, it supports one's principles
 - Belief that it will improve efficiency, help

Key Recurring Themes

- Obtain buy-in, ownership and belief (5)
- Involve everyone (12)
- Build targets into peoples' objectives with a reward mechanism (11)
- Importance of education, training and development (10)
- Importance of ownership and responsibility (5)
- Teamwork (12)
- Tendency for people to revert to type (4)
- Concept of People, Processes and Data (13)
- Align the processes behind the people (13)

<p>control and manage the factory and department</p> <ul style="list-style-type: none"> ○ Competition between colleagues ○ Peer and Manager pressure ○ 'League Table' Syndrome ○ Requirement to achieve monthly/quarterly targets ○ A distinct movement away from 'I'm going to be in trouble' to 'My life is better for doing it this way' <ul style="list-style-type: none"> ● Involve everyone (12) ● Hold regular reviews with the 'Team' (12) ● Concept of People, Processes and Data (13) ● Training, education and development requirements not being met fully (10) ● Need to ensure everyone is fully aware of the implications of their actions (A) ● Build data quality targets into people's objectives (11) ● Any improvement initiative cannot be undertaken in isolation and that everyone needs to become involved (12) ● There was an appreciation of the importance of education and training (10) ● Almost 60% felt that 'everyone' has a responsibility to improve the quality of their own and the organisation's data (A) ● There was a huge disparity between the respondents' perception of the quality of the data they influence (82%) and that which they receive (26%) (A) 	
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DOCTOR OF BUSINESS ADMINISTRATION

NOTTINGHAM TRENT UNIVERSITY

A Reflective Journal

Document Six

Tony O'Brien

Document Six is submitted in part fulfilment of the requirement of Nottingham Trent University for the degree of Doctor of Business Administration

February 2011

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Appendix

1. Initial Topic Discussion

List of Abbreviations

ALS	Action Learning Set
DBA	Doctor of Business Administration
DQ	Data Quality
ERP	Enterprise Resource Planning
GRC	Governance, Risk and Compliance
IAIDQ	International Association for Information and Data Quality
IDQ	Information and Data Quality
IQ	Information Quality
KPI	Key Performance Indicator
MBA	Master of Business Administration
MIT	Massachusetts Institute of Technology
NTU	Nottingham Trent University

1. INTRODUCTION

People travel to wonder at the height of mountains, at the huge waves of the sea, at the long courses of rivers, at the vast compass of the ocean, at the circular motion of the stars; and they pass by themselves without wondering - St. Augustine, (Philosopher) From the Professional Development Review page of the Vitae website
<http://www.vitae.ac.uk/researchers/1305/Professional%20Development%20Review.html>

“The finest end products come from quality beginnings”. The sign on the side of van I overtook near Junction 22 on the M1 motorway near Leicester, at approximately 7.45 hours on Tuesday 7th October 2008.

This succinctly captures the mood of my journey over the course of this DBA project in that it has a plurality of meaning. Its not just about the quality mantras of: “getting it right first time”, “up-front error prevention”, “up-stream solutions”, “data defect prevention”, “root cause analysis and prevention” which pervade the previous five documents, but the concept that real progress can be made if one starts with the right attitude and has a firm fixed idea as to where one wants to go. Stephen Covey talked about “beginning with the end in mind” Covey (1992), whilst Lou Tice, the founder of The Pacific Institute in one of his daily homilies, referred to a journey home from an unfamiliar area where all the major routes are blocked or closed: “You could be in an unfamiliar area or completely unaware of alternate routes, but that wouldn't stop you, would it? You would figure out the "how-to" as you went along, you would ask for help, borrow a map, and, one way or another, you would reach your goal- home” (Tice 2005).

This DBA started out in a similar fashion. The goal being?..... to complete it?, gain a treasured qualification?, perhaps, but more importantly to achieve something long lasting both personally and professionally. It has not been about the ‘three letters’, it is far more than that, it is about one’s self and one’s surroundings. I commenced the journey in September 2005 armed with the course booklet, supported by an excellent two-day initial workshop with an idea as to the focus of my forthcoming research *but* more importantly with the end in mind that, ‘I’m going to make this’. To mix my metaphors even further, ‘to reach that place which is situated over a hill, which is over the next hill, which is over the very next hill etc’. Although the final hill (Document Five) proved to be a mountain compared with its predecessors. This vision of the end product and the images described by Covey and Tice, has parallels in Senge (1990), in particular the disciplines of our own ‘mental model’ of how we understand the world and ourselves in it, together with our level of ‘personal mastery’ to define our own vision upon which to focus our energies Senge (1990: 7-8) to achieve our goals.

The journey that Tice envisages reflects the trials, tribulations, challenges and successes of the researcher as he or she exhibits widely swinging, conflicting emotions. One may try a road and find it to be blocked or to be a cul-de-sac and have to retrace one's steps (possibly a 'null' research result). Consult a local or national map (a literature review). Ask for directions by; face to face contact, the phone, the web or sat-nav (qualitative study or quantitative survey). Work out the way by deduction, process of elimination, or even instinct (action research) and then tie all the pieces together to finally arrive home, hopefully benefiting by the experience (action learning).

Also In writing this reflective journal I am attempting to evaluate my personal feelings as to the whole 'why', 'how', 'where' and 'what' of it all. 'Why did I start?', 'how did I start?', 'how have I travelled and where am I now?', 'what have I done?', 'where do I want to go?' and 'what do I want to do now?' I believe my reflective experience is best approached by examining and assessing the progress and development of my DBA journey, the overall programme itself, my learning experiences and my own personal and professional development both internal and external. I also believe it is important to place my experiences within an academic perspective after all it is within this context that I have lived these past five years.

An interesting study investigating the motivations and impacts of a professional doctorate upon students undertaking the Ed.D degree at the University of Sheffield asked the following four questions (Wellington and Sikes 2006:726)

- Why did you decide to do a doctorate?
- Why did you choose a professional doctorate?
- What impact (if any) has it had on your personal life?
- What impact (if any) has it had on your professional life?

I believe this to be a very useful framework to enable me to focus my thinking upon the motivations and outcomes associated with 'doing research'. In a way the two pieces of bread on the sandwich.

Personal Critical Reflection

I understand critical reflection to be the process whereby an individual reviews their own experiences to gain a better understanding of their inner self, whilst at the same time questioning their assumptions and values within the wider context. Sambrook and Stewart (2008) discussed the concept of critical reflection in relation to professional doctorates, including how this may be best incorporated within the context of a DBA. They raised a very interesting point which has a strong personal resonance, by contending that a professional doctoral student's critical reflection and learning can only be realised if they are able to apply or transfer their knowledge to/within their workplace (Sambrook and Stewart 2008: 363). This echoes strongly the principles of 'engaged scholarship', expounded by Van de Ven and

Johnson (2006) and Van de Ven (2007), which sought to enrich both academic theory and managerial and professional practice, by co-sharing that knowledge that is co-produced when the two streams of investigation combine. The resultant 'whole' is then capable of being far greater than the sum of its parts and therefore certainly not an academic 'black hole'.

This document will attempt to demonstrate how this process of knowledge acquisition and transference has taken place building upon the experiences described within the five previous documents comprising this entire study. It will also attempt to investigate avenues by which these processes that have emerged to inform and improve practice can then have the capacity to add to the body of academic knowledge, in the manner developed by Van de Ven and Johnson (2006) and Van de Ven (2007).

2. THE DBA JOURNEY

Why a doctorate?

The decision to undertake a DBA was the culmination of a series of events encountered over many years, although not necessarily all connected. The failure to pass my 11 Plus examination still rankles with me even after fifty years, with a real desire to 'prove them wrong', which has always been a spur. Whilst this is not the platform to debate the English education system circa 1957 to 1963 with regard to streaming at an early age, I still feel I should make my point and what better way to do so, than to successfully complete a doctorate! My MBA programme undertaken between 1990 and 1992 was inspirational, coming as it did seventeen years after qualifying as an accountant. It was also part practical-based, with various assignments geared towards generating improvements within my then employer. I now see this as an early indication of the benefits of combining theory and practice, as a precursor to my professional doctorate. After completing my MBA, the idea of further advanced study appealed to me, with a PhD as the preferred option at that time. However heavy work commitments over a number of years coupled with my wife's long term illness, prevented any real progress in this direction, although I looked at a number of university PhD offerings from time to time. Inter-twined with these life events, was the continual desire for self improvement, a quest for knowledge in areas of interest, enhanced personal satisfaction and a wish to promote greater confidence and self esteem, all of which were bubbling under the surface. In undertaking this reflection, I have returned to Maslow's Hierarchy of Needs Maslow (1943) in that I am able to identify a great deal of his discussion around esteem and self-actualisation as being relevant to the attainment of a doctorate. Self-respect, the respect of others and attempting to fulfil one's full potential. "A musician must make music, an artist must paint, a poet must write, if he is to be ultimately happy. What a man *can* be, he *must* be. This need we may call self-actualisation", (Maslow 1943: 383). From my perspective then, *this* accountant must..... The remaining part of this document will expand upon this.

The final catalyst was a series of events which took place between November 2004 and May 2005. Remploy introduced a personal development programme for employees under the auspices of The Pacific Institute, an organisation referred to above, part of which involved a leadership/impact assessment via a 360 degree personal appraisal, followed up by a series of three one-to-one meetings with an advisor. During the initial meeting in November 2004 the high level aspiration to undertake a PhD surfaced and at the second meeting at the end of March 2005 the advisor immediately asked "what have you done about the PhD?" This was sufficient to galvanise myself to enquire whether Remploy would be interested in me undertaking an internal research programme and within twenty four hours this was agreed, together with the offer of total sponsorship. Also around this time my job role (hands on general management and financial and management accounting) changed, in that I was

offered a position, reporting directly to the Finance Director, to 'improve things within Finance' which involved drawing up my own job specification and objectives, starting with a blank canvas. This focussed my attention immediately upon the specific area of finance systems and thence onto data quality. This has developed further as described within the five previous documents.

Why a Professional Doctorate?

The existence of the DBA as a research vehicle became apparent following the decision to commence a doctoral project. The availability of a structured programme with practical implications, based around workshop activities with interactions with fellow researchers was particularly appealing. In addition the modular approach with specific deadlines with an overall duration of three to five years felt far more manageable than an open ended and seemingly isolated PhD. In addition the potential to make a positive contribution to managerial and professional practice, however small and to be able to do this within an area of special interest made a very compelling case. Within the work environment this opportunity also appeared to be an ideal fit. The new job role allied to a new objective/project was a huge challenge, especially as one was starting from a position of very little detailed understanding of the inherent drivers. To satisfy a longstanding desire to expand my academic horizons, acquire new skills, knowledge, enhanced personal development and training, assist my own development within a new job role AND to provide an opportunity to bring about professional change by acquiring new knowledge, provided an ideal work-life balance.

The choice of university was particularly apposite in that Nottingham Trent appeared to have a large and experienced DBA programme. In addition Remploy had an association with the University in that one of its main board non-executive directors at that time was Peter Cooke, a professor within NTU's Automotive Management programme.

3. THE LEARNING EXPERIENCE

I have never been a strict diary keeper as such, more of a 'jotter' of notes and a 'maintainer' of lists, consequently I decided not to change my style completely but to utilise tried and trusted methods. I have always eschewed a diary, notepad, organiser, filofax etc, preferring to use the reverse side of redundant A4 paper held together by a bulldog clip, maybe the nonconformist inside me. Throughout all my reading, thinking and eventual writing, I continued to take notes on any points, questions, ideas, issues as they arose, together any feelings both highs and lows. At the end of each document I also added a Reflective Review distilled from the notes and my thoughts and feelings at that time.

During Document One I reflected that the initial five months had been the most dynamic period of academic learning, or should I say just 'learning', in my entire life. This should not have been a surprise given the stature of a professional doctorate compared with an MBA. I felt I needed a period of 'academic rehabilitation' prior to focussing on the intended topic, consequently I devoured a number of books and articles some provided by the University, plus others I thought would be worthwhile aids. One latter example Phillips and Pugh (2005) contained a very enlightening chapter covering 'How *not* to get a PhD'. Phillips and Pugh (2005: 38) also generated probably the first epiphany moment with the point that "research means finding good questions as well as good answers". I realised I needed to challenge my pre-conceived ideas and be prepared to 'unlearn' and re-think concepts. Academic writing also provided a challenge. After thirty five years cocooned within finance and IT, I was used to producing short punchy documents incorporating numbers, facts, figures, bullet-pointed or notated, delivering information in a speedy, efficient and focussed method. The move from a concise précis-type, singular approach to a more academic dialogue approach required almost a re-learning of academic essay writing.

Wellington and Sikes (2006: 725) also debated the position of students undertaking a professional doctorate and their place within the practical/theoretical discussion. Subtle distinctions were drawn between 'professional researchers' and 'research professionals' and the article then proceeded to enhance the discussion, by introducing the notions of 'professional scholars' and 'scholarly professionals'. From my perspective the latter alternative in each category has a far greater resonance and I believe firmly that the DBA has assisted me in becoming more of a 'scholarly professional', as a more rounded personal and professional individual both inside and outside the area of research. Once again this discussion brings my thoughts back to the concept of 'engaged scholarship'.

Learning Theory and Learning Styles

Kolb (1984: 38) defined learning or in this case 'experiential learning' as "the process whereby knowledge is created through the transformation of experience" This definition emphasised

the central role that experience plays in the learning process Kolb (1984: 20) and therefore has personal resonance in that action research and action learning is based fundamentally on learning from one's experiences. In discussing action research Van de Ven (2007: 28) confirmed that "The foundation of this learning process was client participation in problem solving using systematic methods of data collection, feedback, reflection and action" and described action research as a form of 'engaged scholarship' (Van de Ven 2007: 281)

Different people learn in different ways each having their own particular style. The concept of learning styles, commonly depicted in the form a cycle known as the 'Kolb Learning Cycle', was developed by Kolb from work carried out by Kurt Lewin (Kolb 1984). This model comprises four stages of learning; concrete experiences, observations and reflections, formation of concepts and generalisation and testing the implications of concepts in new situations. An example of this model is depicted in Figure 1 below appearing as a seemingly continuous process which is logical given that life is a process of continual learning whether one realises or not.

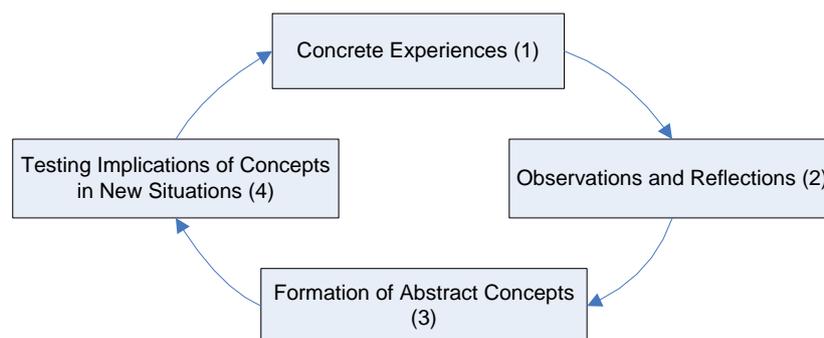


Figure 1 Kolb's Experiential Learning Cycle (Kolb 1984: 21; Gill and Johnson 2002: 30) Using this framework Kolb (1984: 21-22) describes the Lewinian Model of Action Research and Laboratory Training based upon the integrated process of 'here-and-now concrete experiences' to validate and test concepts and then using the resultant feedback as a basis for continuous goal-directed action and further evaluation.

(Gill and Johnson 2002: 34, 40) argued that a deductive research approach corresponds to the left hand side of the cycle whilst an induction approach relates to the right hand side. I can certainly appreciate this relationship and observe that this in many ways depicts the research processes I undertook during Document Five.

In tracing my journey within this context, I feel I began Document Five with my own preconceptions, developed from my personal and professional experiences, together with the learning acquired during the four previous documents, all of which confirmed my position at (1). The qualitative study comprising the factory meetings maybe seen as an element of (2) but I would argue though that this exercise was not merely observational or reflective, but the

'gaining' of information by the 'giving' of information, a two-way interactive process to determine what actually was happening and how this could be improved. Position (3) represents the appraisal of the outcomes of the study related to the relevant findings and ideas and guidelines that were co-developed, whilst position (4) represents the questionnaire survey findings, which together with the outcomes from (3) helped generate the overall conclusions. The very nature of using an action research approach meant that as the study evolved, the cycle began again as individual outcomes were revisited and reviewed as the entire process progressed as described in the model above.

Mutch (2008: 163) discussed elements of practical learning where such forms of learning are more informal and experiential than formal bodies of theory and that such learning may be as much around being a member of a community, as it is about learning to carry out one's tasks. That is, learning about the 'practice' can be related to becoming an accepted member of the group. This concept of 'Communities of Practice' was also discussed in Document Five page 23. The idea of 'community' or 'team' has a distinct relevance to the process of action research and action learning, in that the term 'team' or 'community' may refer not only those members who perform the normal on-going day-to-day operational tasks, but also to the group who undertake the action research and learning process including any 'external' member such as myself. I know this to be true because I still feel an affinity with every site I visited and every person I met, in that the entire process has become a part of *my* learning.

(Honey and Mumford 1982) built upon Lewin's and Kolb's works. They identified four styles of learning and developed a self-diagnostic questionnaire which attempted to identify individual's preferences as: Activists- (who are 'hands-on' learners and prefer to have a go and learn through trial and error); Reflectors- (who are 'tell me' learners and prefer to be thoroughly briefed before proceeding); Theorists- who are 'convince me' learners and want reassurance that a project makes sense; Pragmatists- (who are 'show me' learners and want a demonstration from an acknowledged expert)

I completed their 80-item questionnaire whilst writing this reflection and my preferences were identified as being a Strong Theorist, Moderate Reflector and Pragmatist and a Low Activist. This result does not surprise me, but it may have been interesting had I undertaken the questionnaire prior to the commencement of the DBA, to determine whether there had been any underlying change. My own feelings are that I am now a more rounded learner and the close proximity of the scores around Theorist, Reflector and Pragmatist reflects this thought. Honey and Mumford also provided descriptions of each style and my three prominent styles appear to fit within the role of an individual working within a financial and IT environment.

External Support Mechanisms

As part of my research I was able to identify many of the world's leading academics and practitioners and I contacted a number of these directly. I have had a fair degree of success with only a very few failing to provide at least some level of encouragement and support. A number have made important contributions at various times throughout my journey. At the beginning Richard Wang- Co-Director of the Total Data Quality Management (TDQM) Program at Massachusetts Institute of Technology and a pioneer and internationally known leader in the field of data quality, provided a link to the International Conference on Information Quality website with related links: www.iqconference.org together with details of the MIT data quality website (Wang 2006). Stuart E Madnick- John Norris Maguire Professor of Information Technology at MIT Sloan School of Management provided a link to the Social Science Research Network website <http://hq.ssrn.com> as well as directing me to a number of important articles of his own (Madnick 2006).

During Document Two, Diane Strong, Professor/Director of the MIS Programme at Worcester Polytechnic Institute, Massachusetts, also a co-contributor to a number of the leading articles emanating from MIT during the last ten to fifteen years, provided support during the early part of my research, guiding me in establishing working definitions around 'data' and 'information' (Strong 2006a and Strong 2006b). In a similar way Ralph Kimball, a leading author and practitioner in the fields of data warehousing and business intelligence, highlighted the relationship between processes and data within an information system and the necessity to improve processes to create higher quality data (Kimball 2006).

During Document three I corresponded with Jean McNiff, an extremely influential action researcher at both Bath and Limerick Universities. Within an email reply she advised, "As we know there are many different perceptions of action research and how it can be done. My way is to focus on the individual who asks, 'How do I improve what I am doing?' I don't know if you wish to take an 'I' perspective in your research, or adopt a more traditional interpretive view. If you did want to take an 'I' perspective, then I'd be asking questions of the kind, what do you want to investigate? What do you want to find out? How will you show the evolving situation as you take action to improve things? How are you going to generate evidence to show that your own learning and actions are having some influence in your own and other people's learning? How do you judge the quality of what you do?" (McNiff 2007a and McNiff 2007b). Reflecting again on Jean's words, I can appreciate how this has influenced my thinking and as a consequence how my research evolved particularly in Document Five. I believe it also identifies strongly, the inter-relationship between action research and action learning employing similar principles. In many ways they are two sides on the same coin in that action research can be related to making improvements within an 'external' environment such as the workplace, whilst action learning embodies the attempt to make 'internal' personal improvements within oneself. Adapting Jean's perspective I believe action research takes the

'We' a collective 'external' approach whilst action learning employs an 'I' personal 'internal' viewpoint.

In discussing action research and action learning one is also mindful of Schon's concept of 'reflecting-in-action' a form of 'learning by doing'.. "thinking about doing something whilst we are doing it" Schon (1983: 54) in that "The extent of our capacity for reciprocal reflection-in-action can be discovered only through an *action science* (my italics) which seeks to make what some of us do on rare occasions into a dominant pattern of practice" (Schon 1983: 353).

Within the field of professional practice I have been very fortunate in establishing a dialogue with a number of the World's leading practitioners. I have had conversations with Tom Redman (widely regarded as one of the founding fathers of data quality), both verbal and electronic, in particular a one hour one-to-one transatlantic call in June 2006 which enabled me to put a practical perspective on a great deal of the knowledge gained during my initial detailed review of the literature. A further source of guidance and indeed inspiration has been Larry English, an internationally recognised speaker, educator, author and consultant in knowledge management and information quality improvement. I have met Larry on a number of occasions both professionally and socially and have been able to discuss elements of my topic with him, in particular the application of quality management principles to data and information and my thoughts and philosophy underpinning my Conceptual Framework. Active membership of the International Association for Information and Data Quality (IAIDQ) has also enabled to come into contact with other leading data quality professionals and to be able to discuss and share ideas.

My attempts to engage others, fits the philosophy passed onto me at a very early age, that one can always learn from the 'best' and one should seek out and contact the 'best' to learn, so as to become 'better' oneself.

Internal Support Mechanisms

In addition to the external guidance and assistance, I have also been extremely fortunate in having strong ongoing support from of my fellow students, but more importantly from my two academic supervisors, because without their advice, support, encouragement and guidance I would not be writing this document. Separate Action Learning Sets (ALS) were organised during the initial workshop and the Set in which I was a member certainly worked very well during the first two years. We all appreciated that this was a not only a medium for sharing ideas and discussing each other's research, but first and foremost a 'self help' group, which was evident from the initial meeting. I use the plural 'sets' as the interaction with fellow students developed and became very fluid. One element that came out of my experience of participating within an active ALS was the complete lack of any perceived egos. I felt this was

extremely refreshing, all coming from different backgrounds, career and academic levels and dare I say it, age groups. The interactions were very positive with respect shown by everyone for each others' views. As people progressed at varying rates, the original ALS lost some of its immediacy. From this, an ad hoc ALS formed mainly with fellow students who now have become very firm friends. This group has largely remained intact and is likely continue in some form for years to come, post DBA.

The eight two-day workshops proved to be such an essential ingredient in the whole process that at the concluding session in September 2007, it was felt that additional NTU contact was essential to the success of the final two documents and to this end a number of us organised an unofficial one day workshop at Dublin Institute of Technology in January 2008 at which two members of staff attended. This proved very successful and a further session was held also in Dublin in February 2009 again with a representative attending from NTU. Given the fact that there is at least a year between the final workshop and the submission of Documents Five and Six, I believe the structure for future Cohorts should contain at least one further event, part-way through the third year either in the form of a ninth 'official workshop' or an unofficial session.

4. PERSONAL DEVELOPMENT

Throughout the programme I have continued to grow in confidence, moving from being an 'apprentice', to becoming someone who now feels capable of expressing my opinions to a far wider audience. This has happened slowly, but I now feel they are *my* opinions developed through my own research, experience and reflection not just regurgitations from articles or books. I feel I have developed a living bed-rock of understanding and knowledge which will continue to develop and I believe this to be a direct corollary of my progress within the doctoral programme.

A number of events have put the DBA in perspective, in particular, one's improved ability to communicate both verbally and via the written word. I feel far more confident in expressing my thoughts and feelings in sentences and paragraphs than ever before, in a coherent and succinct manner. This increased confidence has also manifested itself in improved verbal communications. All of this is the result of acquiring new skills and developing greater self-confidence, self-awareness and self efficacy- the extent to which I believe I can make things happen in my life and improved confident in my ability to cause/make things occur. I started this journey concerned about the 'daunting' prospect of producing Document One with a target word count of five thousand. Presenting a major piece of work has not been an easy process, but I feel that the learning curve has continued almost subliminally with step-change improvements at each level alongside the production of each document.

I have also attempted to identify 'epiphany' moments, as I see these as significant milestones on my learning journey. One particular article reviewed in Document One had an immediate impact in placing the entire concept of data quality in true perspective. Redman (1995: 102) reinforced my belief in the importance of data as a corporate asset and that I was not alone in feeling frustrated in discovering that data quality was largely ignored by the majority of organisations, my own included. However, more fundamental was Redman's analogy of a lake which is horribly polluted and that in order to clean this lake one must first ensure that the feeder streams were cleaned, the very sources of this pollution. He compared the lake to a database insisting that the streams (processes) must be treated as an asset, applying the necessary cleaning processes (data quality systems), if one is to have clean water (quality data) (Redman 1995: 106). A further example I gave in Document Two of an 'epiphany' moment arose after reading a chapter covering data integrity in Wallace and Kremzar (2001: 202) a practical book covering ERP implementations, which turned around my thought processes. In the section relating to inventory cycle counting it stated that the justification for inventory counting is to identify inventory errors and then take action to eliminate them, the actual correction of records being far less important. The priority being to discover and eliminate the errors NOT just 'correct the error to get the books right', but rather to prevent the symptoms arising in the first place. This reconciled immediately with the quality management principles that I have described extensively within Document Five and whilst it is not contra to my finance philosophy of employing financial controls and the mitigation of risk, it put matters

in a different perspective. Another 'epiphany' moment I have already described earlier regarding "research means finding good questions as well as good answers" (Phillips and Pugh 2005: 38).

As a corollary of this research my thought processes have developed and I am now able to see beyond which appears to be apparent, in that I now identify certain events immediately as 'a data quality problem' rather than 'a human error'. An excellent example may be drawn from an article appearing in the Management Today daily email business bulletin on 23rd November 2009 where the headline read: "Red-faced Tesco feels the pain of the business cycle". It appeared that the retailer had overpaid a supplier by a factor of a thousand for six bikes. The article began "Tesco managed to pay a supplier almost £1m for six bikes. Someone's getting a rocket in accounts..." and that "someone in its finance department managed to overpay by a factor of thousand". My immediate reaction was "NO!!" it is not a 'someone in accounts' problem but a management control and process issue", with the inherent source probably tucked away in the supply chain organisation and in poor management controls, rather than solely within finance.

<http://www.managementtoday.co.uk/newsalerts/dailynews/news/969625/Red-faced-Tesco-feels-pain-business-cycle/?DCMP=EMC-Daily%20News>

Double Loop Learning

Reflecting upon Redman (1995: 106)'s vision of the lake and the related requirement to clean all data sources and not just the database, together with Wallace and Kremzar (2001: 202)'s similar focus upon error prevention, leads me to believe these to be basic examples of the application of 'double loop learning' (Argyris 1977a). The 'single loop' learning approach would be to identify the issues and then to clean the database or correct the inventory record, ones' natural reaction to encountering a problem. The elegant and effective approach of course is to also apply the second loop, to question and then *learn* from the results to prevent future occurrences. Argyris (1997a: 113); Argyris (1977b:116) also applied effective visualisation in using the image of a thermostat and a manufactured product to illustrate the importance of questioning and confronting the basic fundamental principles and then modifying and correcting the underlying norms, policies and objectives. An example of 'double loop learning' which illustrates my individual progress, is that essential element from the findings of the qualitative study undertaken in Document 5 page 84, represented below:

This has implications for the wider context of this research as seen by the evolution of the measurement and reporting process which may best be summarised as:

- "What gets measured gets done"
 - A good start, but by whom?

To:

- What gets measured by the Exec gets done quicker”
 - “A further improvement, but too top-down

Leading finally to:

- “What is measured, communicated, discussed and agreed at all levels has a very good chance of becoming embedded”
 - Bottom-up supported by top-down
 - A potential key to sustaining any kind of change?

This is not an example of an epiphany moment, but the result a series of questioning, confronting and learning events, from which this description evolved. The initial statement is a commonly used phrase of questionable validity, whilst the second statement emerged part way through this study in response to the acknowledgement of the importance of executive support. The final all encompassing statement is the corollary of questioning the norms and making resultant modifications to bring about improvements, to both inform my own learning and hopefully to contribute to academic theory. As Argyris argues “The underlying aims....are to help people to produce valid information, make informed choices and develop an internal commitment to those choices” (Argyris 1977b:122).

One aspect of my writing and indeed general progress has been the concern that my natural instincts may lead me to write from a more practical perspective. I appreciate that if I am to convince the reader that I have added to the overall debate then a far more balanced approach is absolutely essential.

Sensemaking

I appreciate that learning is about making sense of experiences and by experiences I mean not just the events that happen in one’s life, but also the talk and dialogue and interactions with others and just as importantly, the literature one reads. This is what ‘action learning’ is all about for me, be it intentional or subliminal. Weick (2001: 460) discussed sensemaking in terms of acting upon what one has discovered and developing a situation in order to affect the future. I’m not talking about ‘grounded theory’ experiences but perhaps recognition of what finally works in a given situation. Weick (2001: 460) developed his point further, implying that the journey of discovery can become seductive whereby one can be tempted to resist the challenges to update and revise ones’ self defined views, by taking the early options. This is perhaps where the elements of ‘time’ and ‘maturity’ which feature so prominently in Document Five are so essential to the journey. I also discussed ‘data’, ‘information’ and ‘knowledge’ in detail within Document Five (pages 20-24) and to these three maybe I should add ‘sensemaking’ and then possibly ‘wisdom’. I would certainly position ‘wisdom’ at number five,

but whether 'sensemaking' bats at number three or four needs further consideration and possibly a full doctoral programme in itself.

Talking about definitions, Redman suggests a somewhat interesting, if flippant, range of definitions within a narrative article:

Question: "What the heck are 'data' and information' anyway?"

Answer: "Do we really know? There are a lot of opinions and it gets worse if we throw in 'knowledge' and 'wisdom'." For now: Data can be structured to fit a database, information is what you didn't know before, knowledge can get you out of trouble and wisdom can help you avoid trouble in the first place" (Redman 2005: 22). Now I can introduce 'sensemaking' into this equation.

Methodological Stance

I feel I write from a realist perspective in that I like to label things and have degrees of certainty. I appreciate that I am dealing in concepts or 'Universals' Fisher (2004: 217) in terms of data quality and that 'people' and 'processes' as well as 'data' are concepts which can be interpreted in a number of ways; in particular the inherent unpredictability of people each with their own individual priorities and agendas. My conclusions are based upon my own interpretation of my experiences and research findings upon which I have put my own unique (to me) spin. My proposals are founded upon the premise that if the events I recommend exist or are put in place, then evidence suggests that some form of successful outcome will ensue. I believe that this has informed my research in that I have applied implicitly my feelings and assumptions which I understand to be those of a realist. I have always operated this way, focussing upon what is important to me, looking to change the world as I see it. I acknowledge that in some quarters, focussing upon the principles of action research whilst claiming to be a realist may appear contradictory. Whilst I appreciate the nature of the debate, I would argue that the outcomes have not suddenly appeared from a 'grounded theory' source, but were known to be elements of managerial and professional best practice as identified within the detailed review of the literature particularly within the sphere of quality management. I believe that their aggregation provides a degree of uniqueness within the scope of my research which renders this form of methodological pluralism to be consistent.

5. PROFESSIONAL DEVELOPMENT

My professional development has really advanced on three fronts. My ability to develop and expand a totally new job function and consequentially make real, meaningful and hopefully lasting improvements within the workplace, has been described in Document Five and any success can be related to the structured learning process engendered by the DBA. I may well have made progress by reading industry white papers and by trial and error attempts to resolve problems, but none of this would have had the underlying hardcore principles on which to base my thought processes and guide me through the entire programme to make lasting changes.

I believe I have matured further as a professional manager. Research learning from the literature review process has improved my professional reading and appreciation skills. The inter-actions with my colleagues as part of the both the qualitative studies and quantitative surveys have honed my communication and inter-personal skills. The structured progress demanded by the DBA has guided me at every turn, although I have experienced quite a number of cul de sacs along the way. The added confidence gained from my progression has also manifested itself in the workplace and although I have not broadcasted widely the fact that I am studying for a professional doctorate, a number of colleague are aware and this and this I believe, has further enhanced by professional credibility.

A further major area of development in my professional advancement has been my progression towards becoming a data quality professional. I have already referred to the external influences, particularly my communications with professional practitioners and I have attempted to expand upon this by active participation in the world of data quality. I became a member of the International Association for Information and Data Quality (IAIDQ), the professional association for those interested in improving business effectiveness through quality data and information, in October 2006. I began to actively communicate with members across the world, making a short presentation at a data quality conference at Dublin City University in February 2007. This was an extremely useful event in that it enabled me to share my burgeoning research experiences with other practitioners and university students whilst advancing my presentational skills within a new field. In 2008 I widened my involvement with the IAIDQ becoming the Moderator for Association's monthly IDQ Webinar (formerly 'Ask the Expert' Forum), a moderated interactive webinar service designed to serve as discussion platform for the data and information quality community. Over the last three years I have helped expand this service attracting some of the world's foremost speakers including Larry English, Tom Redman, John Talburt, David Loshin, Gwen Thomas and Danette McGilvery. During May 2010 I was invited to join the IAIDQ's 'IDQ Expert Panel', alongside twenty six other members worldwide, to assist in developing examination questions for the forthcoming IDQ Professional Certification Program.

Conference Presentations

As my study has progressed I have become more and more confident in sharing my ideas within a widening fraternity. In November 2009 I made a presentation, in the form of a case study based upon my research, at the Data Management and Information Quality Conference in London- Europe's most authoritative. The event went very well and I received interesting and valuable feedback, which then led me to apply to present a similar paper at the 4th MIT Information Quality Industry Symposium, at the Massachusetts Institute of Technology, Cambridge, Massachusetts in July 2010. On 1st February 2010 I was informed that my application had been accepted. The real significance of this latter event did not really hit me until I had attended, presented and reflected on the entire occasion and is therefore worthy of further elaboration.

The 4th Massachusetts Institution of Technology Information Quality Industry Symposium- July 2010

This event has put the previous five years in full perspective. As already stated, at the beginning of this study, I contacted several members of the MIT Information Quality fraternity as well as reading a considerable portion of the literature and now I was able to converse with these people as a professional data quality researcher/practitioner. I feel I have evolved from a 'data quality virgin' to someone capable of making a valid contribution to the proceedings of one of the most influential data/information quality conferences in the world. It was also noticeable that my presentation differed from that of November particularly around the conclusion, reflecting the way in which my thought processes have matured over the last year in line with the development of Document Five under the help and guidance of my supervisors.

I also found that a number of the other presentations I attended had distinct areas of similarity and I was therefore able to contribute to the audience interaction. Of particular note was one of the key note speeches delivered by John Bottega Vice President and Chief Data Officer of the Federal Reserve Bank of New York, in which he referred to "The Manufacturing Process whereby data is collected and maintained" and described a 'Data Supply Chain' in terms of "Its about getting the right information, to the right people, at the right place, at the right time" Bottega (2010: 3), which is very much in line with my own definition of data quality "Having the right and correct data in the right format, in the right place at the right time, by having one single version of the truth across the enterprise". Also a number of the recommendations made to address data quality challenges had direct resonance with my work (Bottega 2010: 17-19).

I was also privileged to make a presentation as part of a “Data Asset Management Master Class” organised jointly by the Irish Computer Society and the IAIDQ which took place in Dublin on 13th September 2010, at which Tom Redman was the main speaker. This event was yet another milestone on my journey not only as a further means of communicating my feelings and ideas to a new audience and gaining feedback, but an opportunity to share an event with someone who has figured prominently throughout my entire journey.

I have also been asked to participate in an interview as part of a series conducted with data quality professionals across the world, published by the influential website Data Quality Pro run by Dylan Jones. I received the invitation in November 2009 together with a series of questions, but have decided to defer completion until my entire study is finally submitted as I feel this will enable me to reflect more closely on my contribution.

<http://www.dataqualitypro.com/>

I can state categorically that I would not have been able to make such progress in both my personal and professional development had it not been for the DBA.

6. REFLECTIONS UPON REFLECTING AND LEARNING

Reference has been made earlier in this document (page 9) to the notions of a 'professional researcher' and a 'research professional', a 'professional scholar' as against a 'scholarly professional' Wellington and Sikes (2006: 725) and in Document Five (page 63), a 'consultant as a researcher' verses a 'researcher as a consultant' Eden and Huxman (1996: 79) or my own alternative 'practitioner as a researcher' (page 64). I have highlighted in red the alternatives that appeal most. In attempting to combine the strands of theory and practice I now ask myself whether I am a 'practical-researcher' or a 'research-practitioner'? By having a greater affinity for the former statement I feel I am remaining within my traditional sphere of influence, although with a far greater leaning towards this new arena of academic interest. Maybe that is what the whole five years has been about for me personally, although I ask myself "am I poacher looking to become a gamekeeper, or visa versa; or rather am I now attempting to straddle both sides of the 'estate's' fence?"

A very useful aid in enabling me to take my first burgeoning steps, emerged from Watson (1994: S80) in the form of a 2X2 box which assisted me in shaping my initial topic ideas as to the 'what?', 'why?' and 'how?' questions and I attach these ramblings as Appendix 1. This was drawn up during December 2005 three months after commencing the study and whilst a considerable portion of these research process thoughts ultimately evolved into the actual process of doing research, the most significant aspect appears to be the total concentration upon the concept of 'creating a world class resource planning and information system within a multi-location disabled employment environment' with little or no direct reference at that time to the quality of the inherent data although one had been aware of its significance for some time!!! How situations can evolve and become focussed!!!

I appreciate that I have concentrated on the 'softer' less technical side of the data quality debate and whilst I did state in Document Five (page 52) that I am not eschewing the use of data quality software tools, I am reminded of the comment made by Tom Redman during the IAIDQ IDQ webinar I hosted on 23rd September 2009, to celebrate the Association's fifth birthday- "It's unfortunate that recently Data Governance has been high jacked by some of our colleagues who promote tools, to mean the stuff you need to do so my tools don't fail" (Redman 2009).

As I viewed the proceedings of the MIT conference and the coming together of academics and practitioners in the manner exhorted within the concept of 'engaged scholarship', I reflected upon Schon (1983: 308)'s comments "there is a disturbing tendency for research and practice to follow divergent steps" and "Practitioners and researchers tend increasingly to live in different worlds, pursuing different enterprises and have little to say to one another". I ask myself has there been a sea-change in general over the last thirty years, is it unique to the world of information and data quality or merely to this particular forum? From my

experiences of this and other conferences and vendor events there appears to be an acceptance of the importance of research. Indeed I would suggest that a number of the prominent commercial consultant/practitioners (not necessarily specific purveyors of software) such as Tom Redman, Larry English, David Loshin, Danette McGilvray, just to name a few, are themselves researchers, as well as other persons like myself. Although they are not based solely in academia, their work can be just as valuable in bringing about improvement and change as that which emanates from within the walls of university campuses.

From a 'practice' perspective the word can have several meanings; relating to a specialist professional role (a practice), the performance of that role (practice or practise) and also training or rehearsal for improving one's performance (practicing). Schon (1983: 61) depicted this inter-related process in terms of what one may term a 'verbal noun' as a practitioner being able to "practice his practice".

7. BUSINESS PERFORMANCE OUTCOMES OF MY RESEARCH FOR REMPLOY

I think it will be useful to reflect upon the outcomes of my work from a business performance perspective in addition to the research outcomes detailed in Document Five. As an accountant for over forty years I have always been reluctant to claim financial and operational improvements without clear categorical evidence, therefore I feel it more appropriate to discuss both the tacit and explicit financial and operational implications of my research as a reflection rather than in direct support of my overall findings. I group my thoughts below within appropriate headings.

Financial Performance

If one examines the financial performance of Remploy's Factory-based Businesses over the period of this study, the following facts emerge:

- During the four operating years from April 2006 to March 2010 (to coincide with the introduction and development of the KPI reporting process) the Company's Operating Result improved by 37%. This of course embraces the major restructuring that took place during 2008 which had a major positive effect upon performance.
- On a year on year basis during 2009/10 (April 2009 to March 2010) the Operating Result improved by 12% compared with the previous year. This period follows the series of business/site meetings which took place during December 2008 and April 2009.

Whilst I am not claiming specific financial consequences for my work there may well have been some related effect.

Operational Performance

The actual performance of the Data Accuracy KPIs and the related Index was reviewed and discussed in intensive detail within Document Five particularly around their relevance as an 'indicator' of improvements in the quality of data. It may be useful here to review the actual volumes of the underlying transactions themselves and perhaps deliberate as to the resultant effects upon basic business operations. If one analyses these numbers in a similar way to the financial performance review above the following picture emerges:

- Between March 2007 and March 2010 the number of outstanding order transaction lines reduced by 52% in total and by 26% allowing for the reduced number of sites following the Modernisation restructuring
- There was a corresponding reduction in the number of transaction lines during the twelve months to March 2010 of 12%

It is worthwhile recalling that the overall weighted index also showed 56% and 22% improvements respectively over these periods indicating an improvement in the aging of these transactions. It can therefore be argued that the actual reductions in volumes, together with the improved aging has assisted in reducing the number of queries, processing problems, providing greater visibility of the true operating issues, thereby increasing operational efficiencies both within the factories/businesses as well as the central Share Service Centre.

Reporting and Management Information

A report published in July 2010 titled 'Management Information for Remploy' contained a number of comments which can be related to this study:

- **Data Quality:** A great deal of work has already been undertaken to focus Baan users on the accuracy of their data, largely due to the enthusiasm and vision of Tony O'Brien. This has succeeded by observing the following principles:
 - Identify where the Ownership, Responsibility and Management of the data lies and ensure that this is communicated and accepted by all relevant people.
 - Establish KPIs and a monitoring process to measure the ongoing quality of the data

In the case of Baan, this has been achieved largely by factories taking responsibility for the accuracy of their own data, which is continually monitored, measured and reported (see Appendix 2 below).

In relation to certain other areas of the Company... "Adoption of the above principles could assist in improving their effectiveness"

Appendix 2 is reproduced below:

Appendix 2 – Case Study – Baan Data Accuracy Project

Between its inception in September 2006 and year end March 2010 the monitoring index for Baan Data Accuracy recorded an overall improvement of 56%

A major contributory factor was a series of thirty four site meetings, encompassing forty eight of the fifty four factories and seven business operation teams. These took place between December 2008 and April 2009, during which data quality issues and the data accuracy monitoring in particular was discussed in detail. From these discussions and the points raised a number of short term guidelines, issues and problems, together with ongoing suggestions for improvement were published in March 2009.

In June 2009 a web-based internal questionnaire was carried out with all 111 recipients of the monthly data accuracy reports to study reaction and perception to the notion of data quality, from which 45 responses were received (41%)

- The Finance Director commented “Financial reporting is generally ok”, whilst the Director of Finance for the Factory-based Businesses stated “Management Information is the most accurate it has ever been”

Corporate Governance

I reproduce a statement made on page 117 of Document Five:

As an example of the progress made and benefits derived within this field, the following statement appeared as part of the Annual Corporate Business Report submitted to the Executive of Remploy during April 2010:

“The introduction of a formal Data Governance strategy, allied to improved Data Quality, has strengthened overall Corporate Governance within the Company especially around the elements of Governance, Risk and Compliance (GRC). In addition there appears to be far greater confidence in the quality and value of the information shared and also greater visibility within the businesses, as to their day to day transaction processing”

8. RELATING THE INTER-RELATIONSHIP BETWEEN THEORY AND PRACTICE TO A WIDER AUDIENCE

My contribution to theory and practice has so far been restricted to the confines of Remploy, NTU and a narrow data quality academic and practitioner audience. I am now considering how best to reach out to the wider theoretical and practical communities as my study is nearing completion.

Theory

During my visit to MIT a number of opportunities developed. Richard Wang and Rolf Wigand (Professor of Information Science and Management at University of Arkansas at Little Rock) suggested that I consider submitting my completed thesis for the next Ballou and Pazer DQ/IQ dissertation Award, a leading competition for doctoral dissertations in the field of data and information quality. During the conference there was also a call for theoretical and practical-based articles to be submitted for possible inclusion in the new ACM Journal of Data and Information Quality (ACM JDIQ) co-edited by Yang Lee and Stuart Madnick, a journal I referenced in Document Five. During a conversation with Yang Lee (whose work figured prominently in my literature reviews), she expressed interest in the 'People' aspect of my study in particular the focus on disabled people. I feel this may be a suitable subject on which to base an article for submission in the future.

Within Document Five I have referred on numerous occasions to the works of Neil Pollock and Robin Williams from the University of Edinburgh Pollock and Williams (2008) and Williams and Pollock (2009) in relation to their studies of ERP systems, particularly SAP. Whilst certain aspects of their research have resonance for me in particular around the element of time allowing for ERPs to mature and also the lack of real research into longer term data quality improvement processes, I was interested as to how they saw their own contributions in terms of outcomes for actual ERP practice. I contacted them both in May and had a brief email exchange with Neil during which, we both agreed that it would be useful to get together after the completion of my studies and share ideas. I particularly expressed my own interest in the concept of 'engaged scholarship'. This may open up an interesting avenue.

Practice

In addition to my presentations at major conferences and meetings and the possibility of further conference seminar appearances and papers aimed at the data quality fraternity, my thoughts have also been geared towards promoting the concepts of data quality and my research within wider business and professional areas. The January 2011 edition of the

'Chartered Secretary', the magazine of my professional body the Institute of Chartered Secretaries and Administrators (the world's leading authority on governance and compliance), featured an article written by myself focussing on how poor quality data and a lack of data governance can have serious financial and legal implications for organisations. A similar article was also published in the January 2011 IAIDQ Newsletter. I also intend to approach other leading accountancy bodies with the offer of similar article(s) focussing upon data quality. In addition there is also the potential to target certain auditing and consulting organisations, where I have contacts. In addition I have recently gained professional membership of the British Computer Society and I have had a similar article published in the February edition of their online newsletter. I also intend to participate actively in promoting the concept of data quality within this body.

Reference has been made in Appendix 1 of Document Five to Remploy's involvement within Workability International, the world's largest body representing providers of work and employment services to people with disabilities. This arena may provide a number of potential opportunities for the transfer of knowledge within numerous practical working environments. I have had a number of conversations and an actual meeting with the General Secretary of Workability Europe therefore this may be an effective ingress to share ideas within this body.

9. FINAL REFLECTION ON THIS JOURNEY

My initial thought was to title this section 'Final Reflections', but that would of course be anti to this entire learning development, as I realise that personal reflection has to be an ongoing lifetime experience. Far better the title I have chosen, in that the 'journey' analogy permeates this entire study. In terms of placing this 'journey' within the context of my wider 'life expedition', one may ask; 'is this the beginning of the beginning? the end of the beginning? the beginning of the end or the end of the end? Reaching pensionable age in twelve months time, it is perhaps not the former, but equally it is certainly neither of the latter two. A more apposite description may be 'the beginning of something new'.

I have already discussed in some detail, the current impact both personally and professionally as well as the learning experience, of undertaking this programme. I also envisage the potential for future long term, maybe even life changing benefits, as I muse over the years to come. Whilst I have yet no real plans outside those specified in the previous section, post retirement from Remploy offers some intriguing possibilities to both continue learning and making a contribution to the work place and society in general, both paid and unpaid. I should like to explore the possibilities within academic life for teaching or doing further research, or some form of consulting or other part-time work within the spheres of finance and data quality or even in other disciplines. Whatever the future holds, the DBA has certainly equipped me for my life ahead.

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Creating a World Class Enterprise Resource Planning and Information System within a Multi-location Disabled Employment Environment

What?	Why?
<p>I want to understand why are we only utilising only 50%-60% of the potential of the existing Baan system- half of the 'iceberg' is still under the water?</p>	<p>It will be of interest because it may help organisations to optimise their performances regardless of whether they are employers of disabled persons or not</p>
<p>What can we do to make things better?</p>	<p>As a guide it may assist users/potential users/software & hardware suppliers to understand better the requirements of a disables user community</p>
<p>What does it take to achieve a far better performance from the software, processes, procedures & people and therby improve the Business?</p>	<p>A highly effective & efficient ERP and information system has the potential to enhance dramatically the performance of the Company- particularly in areas of Planning, Logistics, Finance, Management Information as well as overall Corporate performance</p>
<p>Key research questions- see Relevance Tree</p>	<p>As a contribution to knowledge it may provide a comparative analysis of areas not researched previously in any considerable degree</p>
How- conceptually?	How- practically?
<p>Models/concepts/theories a. Structured approach- preliminary theories, concepts and hypotheses that guide research and data collection b. Grounded approach- the project may require pure material & data collection without any relation to pre-concepts</p>	<p>Research methods a. Quantitative: KPIs- Internal- in use currently within remploy plus those to be developed as part of the optimisation programme. b. Quantitative: KPIs- External- to measure progress towards achieving comparative status with best of class & world class in ERP users & disabled employers c. Use of analysis techniques identified in academic journals on the subject d. Qualitative: Interviews, questionaires to various sources of information such as: Workability; ERP providers Baan, SAP, J D Edwards; Best of class organisations; plus colleagues and associates e. Potential use of Balanced Scorecard framework for assessing & comparing effectiveness f. Possible use of Action Research techniques using 'test company' facility within Baan to simulate/test theories, new processes & procedures prior to corporate 'roll-out' across the full system g. Review existing major case studies in the topic area, as well as the possibility of designing specific case studies around the Remploy model</p>
<p>Key research questions- see Relevance Tree</p>	