Inhibitors and Enablers of Supply Chain Management

a study of implementation

Laura McCartney

A thesis submitted in fulfilment
of the requirements of
The Nottingham Trent University
for the degree of Masters of Philosophy

31 May 2009

Abstract

Supply chain management was investigated using three objectives: identifying how the management of the supply chain had changed, how new ideas had been implemented and primarily the identification of the inhibitors and enablers of supply chain management. In the 1990s and 2000s research had focused on concepts and approaches. When considering supply chain management it cuts across the whole system including: suppliers, internal company functions, managers, employees, customers information and material flow and services. A large proportion of publications were on materials, matrices, techniques and cost benefits. The literature had little written about management support and employee involvement to engage buy in for supply chain management implementation. There was an overall lack of detail into what actually happened during implementation in the supply chain. Very little was published on the inhibitors of supply chain management.

The methodology attempted to consider all the limitations which could affect the outcome of the research objectives. The researcher believed by adopting the case study strategy a multi level design could be adopted by analysis at 2 manufacturing companies and 4 mini supplier case studies. Triangulation was used to ensure validity and reliability of the research findings.

The 2 manufacturing companies both made significant implementation changes in their supply chains. New ideas were implemented using published tools and techniques to improve their supply chain management. The research revealed 5 main inhibitors of supply chain management: lack of management commitment, lack of clear strategy and policy, lack of understanding, lack of clear communication and negative attitudes of senior managers and employees. The 5 main enablers of supply chain management were: lead by example, performance management, accountability and responsibility, incentive and an open honest culture. This research contributed to theory and practice by taking us beyond current published research in particular the significance of senior management commitment, the management of the supply chain changes, the implementation of ideas and primarily the inhibitors and enablers of supply chain management.

Acknowledgements

I would like to thank my husband Mark McCartney
for his ongoing love and support. My parents Patricia Buck and
Alan McCartney for their encouragement for me to finish this study.

I am sure there were times when my family and close friends
thought this thesis would never be accomplished, but here it is.

My sincere thanks and gratitude goes my supervisor Professor David Smith.
Without David's professional guidance, perseverance and commitment,
the achievement of this research would never have been possible.

Contents

Tables

Figures

1.0 Introduction

Manufacturing companies face continual pressure to be more efficient and effective. Their customers expect continual improvement in performance to enhance: service levels, product quality, cost reductions, rapid delivery and reliability. For some manufacturing companies to remain competitive they have relocated or outsourced core processes to India and the Far East, to take advantage of lower cost. For manufacturing companies that remain in the UK they continue to have the highest rate of redundancies (Heap 2004). More than ever before manufacturing companies have to target every ounce of inefficiency that exists and re-define their supply chain (Hines 1994).

Supply chain management is seen as the shared objective of every function in a company. It is a single process which depends on strategic decision making to impact overall costs and market share. It requires a completely different perspective to systems. (Houlihan 1988). This definition is used during the research for consistency and clarity. A glossary of terms is also provided in appendix 1.

To support competitive challenges, research has been published on supply chain management to guide and influence managers to improve. The well publicised cost benefits of supply chain development include improving quality of product, customer service, reducing transaction costs, removing waste, reducing non value added activities, reducing supply lead times and inventory, lowering material costs and technological improvement. (Hartley and Choi 1996; Watts and Hahn 1993; Baily et al 1994; Womack and Jones 1990; Hines 2000).

Despite published benefits there is still a slow uptake in the UK to successfully implement and sustain supply chain management improvements. (Drucker 1982; Galt and Dale 1991; Christopher 1992; Cox and Hines 1997).

This study investigates the supply chain management of two manufacturing companies. RHP-NSK a 3rd tier bearing manufacturer to the automotive industry. Alstom-Siemens a 1st tier low volume, high capital goods gas turbine producer for the oil and gas industry. RHP-NSK's strategic suppliers were also examined to provide four mini case studies on supply chain management.

To support the uptake of supply chain management the UK government heavily invests in supply chain development by national programmes funded from the Regional Development Agencies (RDA's) and Learning and Skills Councils (LSC's) which equip small and medium companies and individuals with the appropriate tools and techniques for business improvement.

Funded programme include:

- Vision 2010 for a better future in the manufacturing industry and purchasing
- CBI Partnership Sourcing regional and national supply chain networks
- The Society of Motor Manufacturing and Traders (SMMT) Industry Forum
- Supply Chain Relationships in Aerospace (SCRIA)
- Construction Industry 'Building down Barriers' programme
- The Birmingham Centre of British Manufacturing had European funding for supplier development programmes, known as 'Accelerate'
- Manufacturing Advisory Services (MAS) to improve productivity in UK manufacturing.
- National Academies supporting quality in food and drink, manufacturing and engineering.

The Lean Learning Academy (2006) is funded by the London Development Agency to improve supply chain competitiveness across industry sectors. The Lean Learning Academy believes after 5 years companies could achieve the following benefits:

Product defects reduced by 90%
Throughput time reduced by 90%
Inventories reduced by 75%
Space and costs reduced by 50%
Unit Costs reduced by 50%
Increased profits by up to 100%

Academic research centres also support supply chain development. Contributing centres include the Lean Enterprise Research Centre (LERC) located at the University of Wales. The LERC, who are part of Cardiff Business School specialise in supplier development and lean approaches. The Centre for Research in Strategic Purchasing and Supply (CRISPS) located at Bath University which specialises in purchasing and partnering. Both universities have Supply Chain Development Programmes (SCDP), drawing innovators from retailing, automotive, electronics, clothing, process and service industries. Supply chain management has become a popular subject throughout the UK.

To sustain supply chain management implementation the researcher explored the adoption of specialist techniques such as *Hoshin Kanri* and the Balanced Scorecard. This enables the examination of the impact company policies and practices can have on supply chain management implementation. It was apparent from researching different manufacturing companies, that the larger the supply chain, the number of departments and people involved, the greater the degree of complexity. The complexity is made up of interface problems in communication breakdowns, bottlenecks, poor service levels which all impact customer performance.

1.1 Supply chain development

From the literature key themes were important for supply chain management implementation. In 2006 The SMMT Industry Forum Director noted:

> 'Starting the process improvement path was not difficult, dramatic improvements were made in individual activities, within a matter of days. However, spreading process improvement across the plant and linking the island of improvement up and down the supply chain needed patience and perseverance.' Director of the SMMT (1996)
> (Cox and Hines 1997)

This was an important message which recognised that quick hits could be easy to implement but long term sustainable results from implementation and continuous improvement took considerable effort. Changing the hearts and minds of everyone in the supply chain takes time and sustainable implementation is not easy.

Hines et al (1995) identified supplier co-ordination and supplier development as two areas needed for supplier development. Supplier Co-ordination referred to the activities made by a customer to manage, coordinate and mould their suppliers into a common way of working. Supplier development includes adoption of tools and techniques undertaken with communication with a customer to improve competitive advantage.

The emphasis on co-ordination focuses on the internal systems of the company and the processes established to sustain developments. Supplier development on the other hand involves activities which are implemented at supplier companies.

In 1998 one of the key findings of the SMMT Accelerate Programme was that British manufacturing did not lack innovation, but companies experienced problems in managing and applying concepts. (Cox and Hines 1997).

Hines et al (1997) found most new management recipes ran their course without having a lasting impact on profitability. Employees waited for managers to lose interest and move to the next initiative. Hines et al (1997) emphasised the need for managers to think and act with the whole business in mind. To achieve such agility Hines et al (1997) argued a company must become lean. Senior managers' and employees' attitudes towards change and how to influence employees is a prerequisite for positive results from supply chain management.

In publications (Hines 1997, Gattorna 2005) there appeared to be a weak alignment between supply chain management implementation and the existing company culture. The company culture and people aspects are paramount for successfully implementing and sustaining supply chain management. Across different industry sectors people who are not process conscious could perceive that they were 'unique' or 'too complex' to adopt proven approaches across industry sectors. To gain buy in and commitment senior managers and employees 'reinvent the wheel' by developing their own company frameworks. This seems unnecessary when there are perfectly adequate tools and techniques that have been successfully applied by companies. Re-inventing the wheel increases investment cost and time of implementation to achieve business benefit.

The existing published case study research (Hines 2000) lacks evidence of inhibitors, inhibitors (seen as factors which prevented or stopped implementation) and enablers (factors which encouraged and supported implementation) of supply chain management. The published research references heavily focus around the tools and techniques. One of the biggest challenges for supply chain management appeared to be 'changing hearts and minds' and 'managing' and 'implementing' ideas over time for sustainability, which are given poor attention in the literature.

1.1 Origins of the Project

The researcher became interested in supply chain management on a two year project at RHP Bearings Ltd, in Newark in 1996. The researcher worked in a central purchasing department which had 20 people, responsible for a total purchasing spend of £19m, 60% of the total running costs. The researcher was a practitioner working in purchasing on a project focused on cost reduction and quality improvement throughout the supply chain, by eliminating waste and achieving total customer satisfaction. The supply chain investigation was for the UK group and included establishing, implementing and managing the programme.

The role provided exposure across all levels of a company, its politics, varying cultures and challenges. Existing academic research was the starting point to increase academic learning and review case studies, to appreciate the progress of supplier development. There were many research articles available in the literature on process tools and techniques. (Womack and Jones 1990; Hines 2000, Bicheno 2000, Bateman 2000). However, there was very little coverage of the human aspect and the implication of change on employees. There were also few in depth case studies which allowed a detailed analysis over time. Within the available literature it appeared that there were brief summaries and no deep coverage of how a company could approach these challenges and what barriers they would face and have to overcome to sustain changes.

During the establishment of the project plan for the supply chain role it was apparent that RHP had not allocated any time for the human side of the impact of these changes. The researcher spent a large proportion of time on cultural issues such as supporting managers to think more strategically and cross functionally about their company and working with employees encouraging them to take ownership of changes. This was essential for success and sustainability of supply chain management.

The research undertaken for this thesis investigated two main manufacturing case studies, their cultures, organisational hierarchies, functions and senior management attitudes. Both companies needed to become more integrated, with a cross functional focus on the whole system.

After working in procurement at RHP and Alstom-Siemans; the researcher became the process development manager in HR, responsible for culture change. The success of this role on cultural change grew the business improvement focus and the researcher became the business improvement manager responsible for supply chain development across all the transactional departments comprising 160 people and a £25m budget.

On leaving Alstom-Siemens the researcher became a business transformation consultant and quickly moved into managing the profit and loss account as the head of learning and skills for Production Engineering Research Association (PERA), responsible for an Innovation Programme in the East Midlands, Leadership Programme in London, a training provider for the Lean Learning Academy, Business Improvement Programme in the South West. In total these programmes covered 645 small and medium companies across industry sectors.

The researcher established her own consultancy and training company in 2006 supporting workplace development in supply chain management, for companies across the UK.

1.2 Research aims and objectives

The research aims to understand the principles of supply chain management and investigate the application of these principles in practice by examining a number of themes linked to the implementation of supply chain management.
The key factors were identified by researching the literature and identifying key areas heavily reported. These key factors then formed a conceptual framework which was explored in the supply chain management case studies. (Figure 1).
The factors include: policy deployment, management support, employee involvement, business improvement and suppliers.

The research objectives were to:

1. Investigate the ways in which the management of the supply chain has changed
2. Analyse how new ideas on supply chain management have been implemented
3. Identify factors that inhibit and enable supply chain management

The research focused on how the management of the supply chain has changed by exploring and explaining the implementation of identified themes in practice. To analyse how the new ideas on supply chain management have been implemented, this includes the application of business improvement tools and techniques. Finally the factors that inhibit and enable supply chain management were to be identified and evaluated.

1.3 Case studies and objectives

Two case studies are presented covering management, people and processes within 2 manufacturing company supply chains. Firstly a Japanese manufacturing company RHP-NSK producing high volume bearings, primarily for the automotive industry. Secondly Alstom, a French manufacturing company, which in 2003 was acquired by Siemens, a German manufacturing company, producing low volume industrial gas turbines, predominantly supplying the oil and gas Industry. The companies are located in the East Midlands. Four supplier action research case studies are made to suppliers of RHP to examine how new ideas were implemented at supplier locations.

1.4 Methodology

The methodology adopted was a case study research strategy. The fundamental reasons were to permit multiple data sources to exist which provide detailed analysis over time (Yin 1989). The case study strategy includes multiple data sources and vignettes of managers and employees experiences within the supply chain. Both companies had 60 year old histories and faced cultural change due to environmental pressures. The case study strategy is felt to be the most appropriate means to provide a detailed answer to the research questions.

1.5 Limitations of scope and key assumptions

The case studies focused on 2 UK based manufacturing companies to compare and contrast research. They were located in two different industry sectors automotive and the heavy equipment sector. One company was Japanese owned, whilst the other was French and then German owned.

A limitation of the scope was the ability to translate the research findings across other industry sectors. The 2 case studies had a heavy emphasis on low volume manufacturing. The application of this research to other types of industry such as the service sector, retail, leisure and tourism and high volume remained to be examined.

1.6 Outline of the thesis

The research was divided into the following chapters, literature review, methodology, case studies, analysis and conclusions.

Chapter 2 explores the available literature in the field of supply chain management. The research fields covered include quality, purchasing, logistics, operations and aspects of business management to thoroughly examine and explore the research questions. Firstly research was made into supply chain management definitions investigating the interpretation of existing researchers, which captured the scope and themes. The themes identified in the literature were used to investigate the implementation of supply chain management. Themes include customer expectations, policy deployment, managers support, employee involvement, supplier development and business improvement processes. The themes are investigated in the case studies.

Chapter 3 is the methodology. A review of research strategies is provided. In essence the methodology adopted was case study strategy which enabled a detailed examination of two manufacturing brown field sites' supply chains and the stories of employees and management within them. The case study research strategy includes the adoption of qualitative and quantitative data in the forms of unstructured interviews, team supply chain improvement activities and employees vignettes to enrich evidence. The tools and techniques used for the supplier development case studies were the housekeeping technique (5S's), set up reduction and process mapping.

Chapter 4 and 5 are the company case studies of supply chain management. These reveal that functional departments and tall hierarchies still exist. Senior managers' are found to be driven by vertical departmental measures, where measures and targets exist. There is very a poor flow of information and communication across the supply chain and employees felt many initiatives came and went before sustainable improvements could be realised. Over time there were good examples of ideas being successfully implemented in supply chain management.

Chapter 6 provides cross case analysis and evaluates findings under the research objectives. Research at both companies shows evidence of big changes in the management of the supply chain, resource allocation, structure, roles and prioritisation.

Chapter 7 provides the research conclusions. In the current supply chain management literature there is little written about the implementation side and the contextual factor of senior management, which is heavily under valued in particular the impact this factor alone can have on supply chain management. The other supply chain management inhibitors are lack of clear strategy and policy, lack of understanding, lack of clear communication and negative attitude.
The enablers of supply chain management were leading by example, performance management, accountability and responsibility, incentive and open and honest culture.

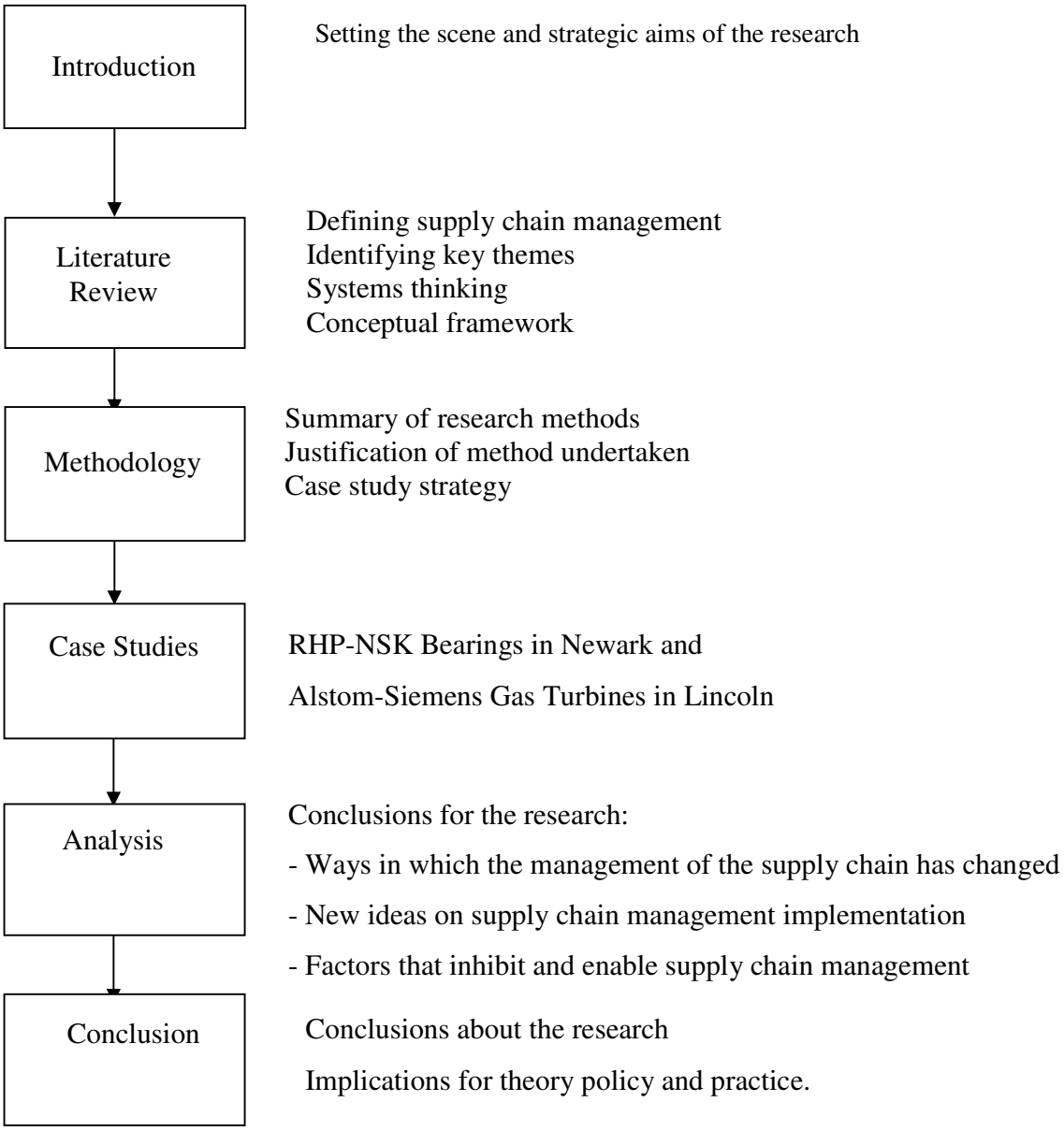
1.7 Contribution to knowledge

Through reviewing the available literature the researcher revealed there were a large number of matrices and techniques associated with supply chain management. There was too little written about senior managements' impact on supply chain management and implementation, strategic supply chain management and engaging employees. There was an overall lack of detail into what happens in terms of the implementation of supply chain management. Despite published research and techniques there was a relatively small amount of research that looked at supply chain management implementation. There was also little attention by past research to understand the factors that act as inhibitors and enablers of supply chain management.

1.8 Summary

The research can be summarised in figure 1 by a research process framework.

Figure 1: Research Process Framework



2.1 Introduction

The most fundamental area to consider, which could have formed an area of research in its own right, was the definition of supply chain management and clarification of its scope. To explore the research questions thoroughly, five fields of research will be undertaken: quality, purchasing, logistics, operations and business management. The purchasing field captures research into buyer and supplier relationships, partnerships, price, total cost and supplier development. The quality and operations field covers continuous improvement tools and techniques, team working, lean thinking and six sigma. Logistics provides information on materials, inventory and process flow analysis. Aspects of business management cover research on policy deployment, balanced scorecards, best practice and accounting for the financial benefit of business improvement in the supply chain. Systems theory is briefly researched to underpin the literature review. Supply chain management considers the whole system, which is also the emphasis of systems theory, so research into systems theory is complementary to supply chain management.

2.2 Supply chain management

To add to the complexity of understanding supply chain management, there is no universal definition for supply chain management (Croom et al. 2000). Different authors provide different definitions of supply chain management, which can be classified into three categories; a management philosophy, the implementation of a management philosophy and a set of management processes (Mentzer et al. 2001). It is useful to categorise supply chain management into factors to simplify the research.

Gattorna (2006) identifies four types of supply chain management: 1. Continuous replenishment – bringing customers and suppliers together for mutual benefit; 2. Lean – the most efficient, reliable and low cost; 3. Agile – the most responsive, competitive and quickest turnaround; and 4. Fully Flexible – new innovative supply chain solutions. However, in my view there is little value today in Gattorna's (2006) four types of supply chain. This is because, with global pressures in competitive markets, companies should be all of these things – lean, agile and fully flexible. My findings are supported by Naylor et al. (1999), which argues that the most efficient supply chains at any given time will be those that are capable of integrating the lean and agile logistics paradigms.

The breadth of the subject area and lack of precise definition makes it difficult to determine and understand the true boundaries of supply chain management. To add further complication, a variety of terms are used, including network sourcing, value chain management, agility, lean and six sigma. Mentzer et al. (2001) found the term 'supply chain management' causes confusion for those involved in researching the phenomenon and those attempting to establish a supply chain management approach. Table 1 provides different authors' published interpretations of supply chain management. The first three authors listed in the table highlight the interlocking nature of the supply chain.

Table 1: Interpretations of supply chain management

Authors	Definition
Forrester (1958)	Company success depends on the interactions between the flows of information, materials, money, manpower and capital equipment. The way these interlock to amplify one another and to cause change and fluctuation will form the basis for anticipating the effect of decisions, policies, organisation forms and investment choices.
Jones and Riley (1985)	Supply chain management deals with the total flow of materials from suppliers to end users.
Houlihan (1988)	The supply chain is viewed as a single process. Responsibility is not fragmented to a functional area such as: manufacturing, purchasing, distribution and sales. It depends on strategic decision making, it is a shared objective of every function in the chain, it impacts on costs and market share.
Ellram (1991)	A network of firms interacting to deliver products or services to the end customer, linking flows from raw material supply to final delivery.
Christopher (1992)	Network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.
La Londe and Masters (1994)	Supply chain strategy includes two or more firms in a supply chain entering into a long-term agreement, the development of trust and commitment to the relationships. The integration of logistics activities involving the sharing of demand and the sales data.
Cooper et al. (1997)	An integrative philosophy to manage the total flow of a distribution channel from supplier to the ultimate user.
Lee (1997)	A network of entities that starts with the suppliers' supplier and ends with the customers' custom. The production and delivery of goods and services.
Monczka (1998)	SCM requires traditionally separate material functions to report to an executive responsible for coordinating the entire materials process and also requires joint relationships with suppliers across multiple tiers.

Bicheno (2000)	Improving the supply chain means extending the principles of 'lean' and six sigma to all participants in the chain. There are massive opportunities from calling on the strengths of partners, sharing information about customers, and agility at the most appropriate parts of the chain.
Tan (2002)	Supply chain management encompasses materials supply management from the supply of basic raw materials to final product (and possible recycling and re-use). Supply chain management focuses on how firms utilise their suppliers' processes, technology and capability to enhance competitive advantage.
Mentzer et al. (2001)	A set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.
Siems (2005)	The purpose is to get the right resources and products to the right places, at the right times, while yielding the highest possible profits.
Gattorna (2006)	The supply chain is any combination of processes, functions, activities, relationships and pathways along which products, services, information and financial transactions move in and between enterprises. It involves movement from producer to end-user. Everyone in the enterprise is involved in making this happen.

Source: Author's research findings 2006

The definitions were invaluable as they identified the key factors that are most prevalent in the research. They also highlighted areas with a weaker record of publication and which were given little attention. There are more publications around the involvement of suppliers and customers (Jones & Riley 1985, Ellram 1991, Cooper 1997, Lee 1997, Stevens 1998, Brewer and Steph 2000, Tan 2002 and Gattorna 2006). Research on the material flow, planning and resources is also well publicised (Jones & Riley 1985, Ellram 1991, La Londe 1994, Lee 1997, Womack and Jones 1996, Stevens 1998, Brewer & Steph 2000 and Tan 2002). There is also considerable research around the business improvement tools and techniques and the use of lean, six sigma and process improvement to develop the supply chain (Christopher 1992, La Londe 1994, Hines 1995, Womack and Jones 1996, Hines 1997, Monczka 1998, Tan 1998, Bicheno 2000, Simchi-Levi 2003 and Gattorna 2006).

In the current literature, little consideration is given to management support (Forester 1958, Simchi-Levi 2003), strategic decision making (Forrester 1958, Houlihan 1988 and Hines et al. 1997) and supply chain management as an integrated philosophy (Cooper et al. 1997, Tan 2002). Despite the slow uptake in the UK, there is ample published work on the optimisation of efficiency, cost reduction, market share, customer retention and competitive advantage (Hines

1997, Houlihan 1998, Stevens 1998, Bicheno 2000, Tan 2002 and Siems 2005). Table 2 summarises the main key factors.

Table 2: Key factors of supply chain management

Key Theme
Material flow, planning and control
Process activities and alignment of the whole system
Suppliers to end-users/customers

Source: Author's research findings 2006

Not until the late 1990s and early 2000s did researchers start to consider information as part of the definition (Womack and Jones 1996, Gattorna 2006). It was disappointing that other researchers did not mention the strategic value of supply chain management for decision making. Many of the factors appeared operational in nature, such as the tools and techniques including processes and waste removal. It appears that there is weak definition and publicity of aligning management and company objectives to supply chain management. Forester (1958) aligned management only, as did Simchi-Levi in 2003. Hines et al. (1997) emphasised the need for managers to think with the whole business in mind. The key factors are presented in the conceptual framework I have constructed in section 2.9.

Siems (2005) took his research further by suggesting that supply chain management development benefits macroeconomics, lower inflation, more stable economic output, higher productivity growth and better standards of living. This research has shown that supply chain management has an impact on economic growth and community development.

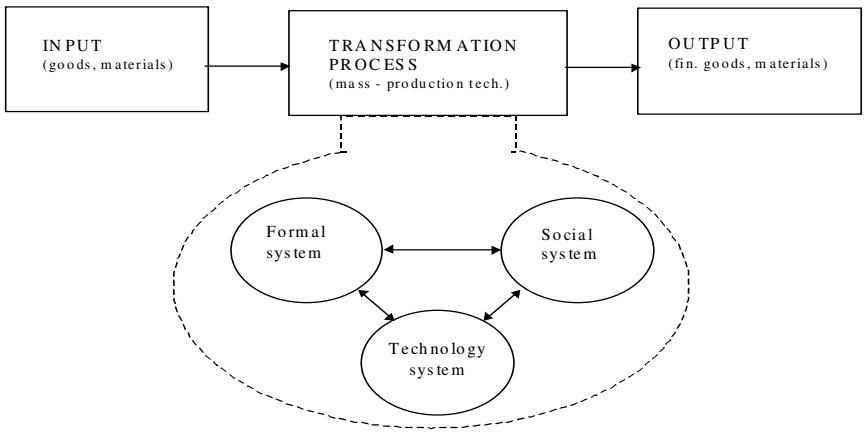
Houlihan (1988) provides the most in-depth definition of supply chain management. This definition identifies a number of key factors, including; it is a whole process, it uses strategic decision making, the shared objective of every function, it impacts costs and market share and appreciates the need for a different perspective on inventories, which then considers the way that people manage systems, information and integration. Houlihan's (1988) definition is adopted for this research as I believe all these aspects are still relevant in the twenty-first century. Two key factors are process and the whole system. Systems theory is explored to understand the interrelationship of operations across the whole process.

2.3 Systems theory

For 80 years systems theory has been the theoretical underpinning for studying organisations. Systems theory provides the theoretical foundation for conceptualising the organisation as a whole system with inputs, process, outputs and feedback (Katz and Kane 1966). This is visualised in Figure 1 using a system model (Robertson and Cooper 1987). A system can be defined as a collection of parts or elements that interact (Smuts 1926, Kauffman 1980). The component parts may be analysed separately, but finally it should be the whole system that is the focus of analysis (Checkland 1990).

Systems theory emphasises 'the whole system', the customers and their needs, the outputs of finished goods or a completed service and documentation. The transformation process is the activities undertaken to produce the finished goods or provide the service output. The inputs are the supply of products and documentation from suppliers and suppliers who provide the inputs. The whole system is considered as resource management, technology and the social system.

Figure 2: An open system view of an organisation.



Source: Robertson and Cooper 1983

The open system view shown in Figure 2 highlights the parallel with supply chain management which emphasises interconnectivity between inputs and outputs from suppliers, functions and customers and the entire system of a supply chain.

2.4 Strategic policy deployment

Policy deployment is a strategic way of communicating policy, goals and objectives throughout its hierarchy by focusing on the key activities needed for success. Policy deployment is linked to the achievement of top management goals with daily management at all operational levels (Witcher and Butterworth 2001). Two common approaches for strategic policy deployment are *hoshin kanri* and the balanced scorecard.

Policy Deployment – *Hoshin Kanri*

In Japan strategic policy deployment is known as *hoshin kanri* and is widely applied in Japanese international businesses. Lee and Dale (1998) summarise *hoshin kanri* as an approach that considers; the corporation, the division, the function, the team and the individual. Policy deployment is a way of aligning a company to perpetually improve its performance by adjusting quickly to change (Akao 1991). *Hoshin kanri* is a framework for policy-based objectives, often translated into Quality, Cost, and Delivery targets (QCD), which are used daily by management to drive development. *Hoshin kanri* is a participative approach to development and driving metrics through a review process. The focus and rigour of a top-down deployment aligning strategic objectives and uniting senior managers and employees internally to continually improve, means that businesses can respond more quickly. This appears to emphasise what the whole system and supply chain is focused upon.

Lee and Dale (1998) report that policy deployment was established in Japan in the 1960s and used a Total Quality Management (TQM) approach combining Deming's 'plan, do, check, act' cycle (PDCA) which was produced in the 1950s (Deming 1986).

At each phase consideration is given to the vision, mission, business goals, annual targets and critical success factors. After the corporate items are established, the resources, control items and priority action plans are produced. For every element there are feedback loops and reviews. However, outside Japan, the significance of policy deployment has gone largely unreported (Lee and Dale 1998, Witcher and Butterworth 2001). One of the reasons the take-up has been slow in the UK is the reliance on a formal review process. It is a long-term concept and needs continual development to sustain the methodology and to make it an everyday part of the working company culture.

Japanese companies focus on all their processes and alignment so that the whole supply chain works effectively. To begin the supply chain management implementation, senior management need to understand the organisation and its environment. *Hoshin kanri* provides companies with focus and alignment and enables policies and high level targets to be integrated into operations.

Balanced Scorecard

The balanced scorecard enables a business to evaluate a strategic balance of hard and soft measures. It was developed in the mid 1990s (Kaplan and Norton 1996). The scorecard drives the development and aligns individual performance. Balanced scorecard measures are often categorised into; financial, customers, internal business processes, learning and growth (Kaplan and Norton 1996). This approach encourages managers not to take a narrow focus and to look more broadly than traditional financial measures.

Brewer and Speh (2000) found that many managers saw supply chain management and the balanced scorecard as separate management tools. They suggest those who understand the interrelationship between the two concepts have a greater likelihood of leveraging their supply chain as a source of competitive advantage.

2.5 Senior management support

The role of senior management in supporting supply chain management is considered important, as their commitment is seen as paramount to ensure that the implementation of supply chain management is aligned to the business strategic objectives for sustainability and continual improvement. This is examined further by Pascale (1990) by considering the behaviour of managers through examining research over the last 100 years.

> For over one hundred years we grew accustomed to improving things without having to alter the mindset upon which the improvements were predicted… We keep trying to apply the tools of transformation without a corresponding shift in our managerial mindset. (Pascale 1990: 13).

This is important as it emphasises that companies are applying tools and techniques to improve, but are not considering how their managerial behaviour and style needs to change to adopt different ways of working. This also means that companies would attempt to implement new concepts without planning, preparing and organising a sustainable

management infrastructure in the supply chain to adopt new approaches. For some companies this could include trying to implement the latest concepts and thinking, but companies attempt new concepts on top of large hierarchies, traditional structures and ways of managing employees (Hines 1997). These considerations could be relevant in some companies in the twenty-first century.

Adair (1991) highlights that if subordinates are fully involved in decisions that affect their work they will be committed to carrying them out. Adair (1991) felt leadership had to win employees' commitment. This research is very clear and expresses that the involvement of employees in decision making is paramount. In my opinion, this is also an important factor in the twenty-first century.

Pascale (1990) compared scientific management and Japanese management:

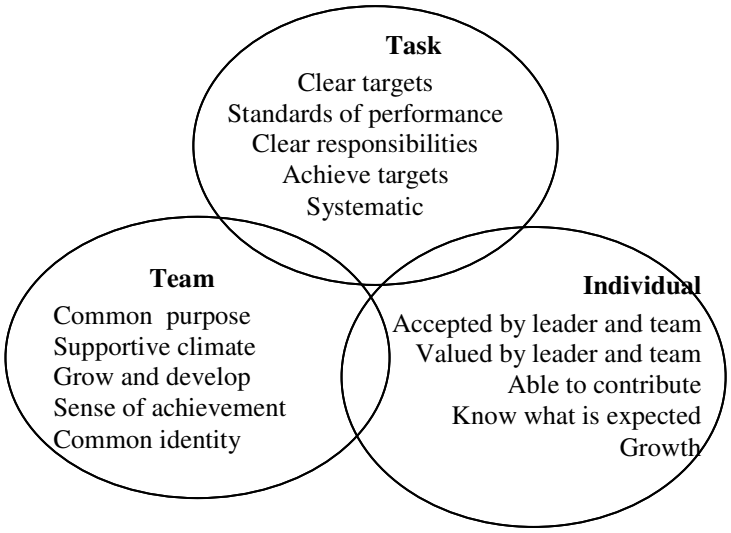
> Hardly can a competent workman be found who does not devote a considerable amount of time to studying just how slowly he can work and still convince his employer that he is going at a good pace. Under our system a worker is told just what he is to do and how he is to do it. Any improvement he makes upon the orders given to him is fatal to his success.
>
> (Taylor cited in Pascale 1990: 27).

Taylor's quote is still the experience in UK practice in companies where management controls too much of the business and operational staff and middle management do not have the responsibility to solve problems. In these cultures, management changes the processes, sets the improvement path and employees do as they are told. However, all the experience, knowledge, breadth of understanding of those processes, and ideas for improvement are with employees. Pascale (1990) emphasises this further by a quote from Konosuke Matsushita, the founder of Matsushita Electric Ltd (Kotter 1997):

> With your bosses doing the thinking while the workers wield the screwdrivers, you're convinced deep down that this is the right way to run a business.
>
> For you the essence of management is getting the ideas out of the heads of the bosses and into the hands of labour. We are beyond your mindset. Business, we know, is now so complex and difficult, the survival of firms so hazardous in an environment increasingly unpredictable, competitive and fraught with danger that their continued existence depends on the day to day mobilisation of every ounce of intelligence. (Pascale 1990: 27).

This quote provides a key factor for the importance of managerial support and employee involvement. Adair (Oakland 2000) concludes managers should think about the task, the team and the individual. Figure 3 illustrates the areas to consider.

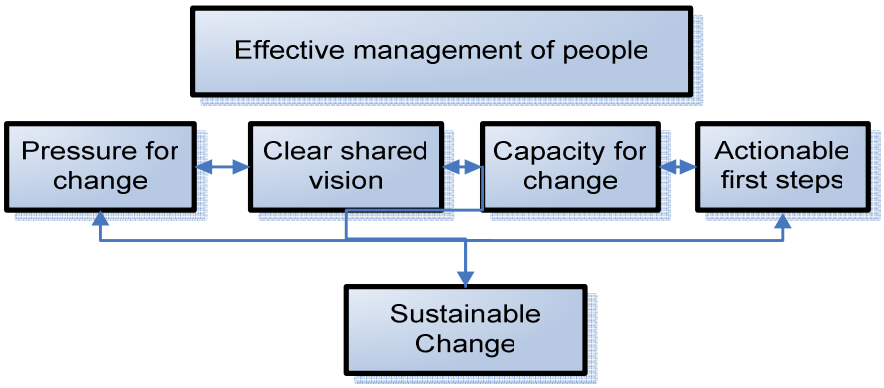
Figure 3: Task, Team and Individual



Source: Oakland 2000

This three-stage model provides a simple approach to ensuring coverage of various aspects of supply chain implementation. Gattorna (2006) has a framework for fast and effective management of change. This is illustrated in Figure 4.

Figure 4: The Effective Management of Change



Source: Gattorna, 2005:80

In Figure 4 the pressure for change is necessary to create a need to improve the supply chain; these are external pressures in the market place which could impact the company. Without

this pressure it is unlikely that continued development will take place. It is vital that senior managers communicate a clear vision; from this the capacity to change can be achieved through a systematic set of actions to implement changes in the supply chain. It is recommended that the implementation is not long drawn out as this could provide employees with the opportunity to resist and rebel, in part or in full. Evidence suggests that the faster the implementation the greater the chance of achieving the desired outcome in competitive advantage within the supply chain.

Examination of the existing literature reveals that, for some UK companies, there is still an opportunity for managers to support and regularly give feedback to employees to involve and engage employees in supply chain management implementation, which will enhance profitability and competitive advantage.

Parallels are drawn between strategic policy and key management research to compare and contrast these separate fields of research as part of the supply chain management analysis. This is because in the supply chain management literature there is only one article found aligning strategic policy deployment with supply chain management and only two authors who have discussed the need for management (Hines 1997, Simchi-Levi 2004 cited in Wang 2004). Nevertheless the researcher considers policy deployment and management support are crucial.

Purchasing management and the development of purchasing is investigated. The researcher felt it was important to look historically at how purchasing had changed as this could affect how new ideas are implemented in the supply chain. It may also contribute to the inhibitors and enablers of supply chain management by how customers work with their suppliers.

2.6 Purchasing management

Purchasing management is receiving recognition because the relevant duties have become less clerical and more strategic (Baily et al. 1996). However, during the 1980s many businesses were still struggling to develop purchasing from the traditional to a strategic way of working with suppliers. Syson (1992) argues that new skills must be learnt and there should be particular emphasis on supplier appraisals for selection and negotiations. Syson (1992) stressed that these approaches are not universally appropriate but used for the correct part of a purchasing portfolio they can provide immense power. Unfortunately he concludes his review by observing that many purchasing staff still remain adversarial.

Too many purchasing staff have inadequate knowledge of the end-user market, which means purchasing is unable to relate supply characteristics to the distinctive requirements of the end product. According to Syson (1992), the purchasing function appears to operate in a vacuum. This may be due to the operation being at the end of the supply chain which means they receive limited information and communication flow from other functions. There could also be a lack of alignment within the supply chain.

Hines (1994) found that training and development needed to accelerate change and put particular emphasis on purchasing tools and techniques for co-ordinators and projects teams. This would equip employees with the necessary skills and capability to implement changes in the supply chain.

Hines (1994) found the move to supplier development creates new roles for purchasing and summarises the new roles into five elements:

1. The co-ordination of all activities between buyer and seller, including activities undertaken by other functions such as production, quality, design and production engineering.

2. Purchasing role in seeking new areas and sources of competitive advantage from the supplier network and formulating strategies to maximise this advantage for the benefit of buyer and seller alike.

3. A role as consultant in co-ordinating the cascade of developmental assistance to suppliers from the different internal departments through the use of a supplier association.

4. A pivotal role in the two-way dissemination for strategic information between buyer and supplier. This dissemination would involve keeping the suppliers fully aware of developments in the marketplace so that they can respond to the needs of the end consumer as well as adopt the best technologies and operating methods. It would also involve the formulation of joint strategies with the supplier association (development) membership.

5. A role in targeting and measuring the improvement of suppliers as they seek either collectively or individually to develop continuously.

These new roles could have a great impact on purchasing departments, particularly when the traditional role of purchasing is to place orders with suppliers. These new roles (Hines 1994) demand different tasks, competencies and capabilities due to the shift from a traditional style to a more collaborative way of working. Hines and Taylor (2000) enhance the research by identifying buyer supplier characteristics. These are presented in four phases of development: no coherent strategy, piecemeal co-ordination, systematic co-ordination and networked co-ordination. Table 3 shows the characteristics for supplier co-ordination.

Table 3: Maturity grid for supplier co-ordination

Strategy/ Characteristics	No Coherent Strategy	Piecemeal Co-ordination	Systematic Co-ordination	Network Co-ordination
Buying criteria	Lowest price	Lowest cost	Maximum mutual benefit	Maximum network benefit
Purpose of supplier	To supply goods	To supply goods procedures	To supply goods in a cost-effective manner	To supply goods using customer procedures network
Relationship type	Adversarial	Localised co-operation	Close	Strategic
Relationship length	Variable	Variable	Long	Lifetime
Customer involvement with suppliers	Small	Some, Logistics	Frequent, mainly Logistic	Frequent, many functions
Quality requirement	Product specification	Quality control	Quality assurance/TQM	TQM spread to own suppliers
Delivery requirement	Standard lead times	Ad hoc projects	Joint ventures timed	True JIT deliveries
Cost requirement	Lowest market price	Lowest cost	Stable reducing interaction costs	Target costing share savings
Product design requirement			Some packaging and handling	Network packaging and handling
Technology sharing	None	Limited (mainly customer technology)	Customer sharing IT handling technology	Some reliance on predictive scores
Reliance on grading	None or external	Some reliance on reactive scores	Heavy reliance on reactive and predictive scores	Some reliance on predictive scores
Data interchange	Limited, operational only	Limited, mainly operational	Detailed and frequent	Detailed, some strategic, within network
Asset specificity	None/very low	Very low	Medium, e.g. designated trucks and handling equipment	Medium
Number of Suppliers	High and unstable	High, relatively very stable	Low and very stable	Very low stable
Frequency of interaction problem-solving	Frequent, expediting-based, planned, regular	Frequent, ad hoc, mainly reactive spreading	Very frequent at operational level, through meetings	Very frequent at operational level, network

Source: Hines and Taylor 2000:324

Table 3 is useful for gauging performance and identifying development areas. This snap shot assessment is easily achieved by identifying where performance currently is, where the company wants to be and the gaps in supply chain development.

However a weakness in these kinds of matrices is how the company or department decides to establish an implementation plan to move from one phase to the next and this could prevent a company from being able to move forward. A further weakness with Hines' matrices is the assumption of a high level of understanding to be able to implement the necessary changes. Sustainable implementation appears to be one of the inhibitors.

Hines (2000) divides the stages into four phases; price competition, quality competition, close cooperation and strategic partnerships. Table 4 shows the strategic competitive positioning model.

Table 4: Strategic competitive positioning model

Stage 1: Price competition	Low technology manufacturing and materials used. Competition on cheap prices only. No added value services.
Stage 2: Quality competition	Limited use of high technology manufacturing Techniques. Limited use of precision materials Competition by high quality PPM (parts per million) or (zero defects) products. Limited value adding processes available in the firm. Vertical integration.
Stage 3: Close co-operation co-ordination and development of suppliers,	Extensive use of high technology manufacturing techniques. Extensive use of precision materials. Competition by close co-operation with customers, management ability and JIT (Just in time) deliveries and production. Many value adding processes available in supply chain. Always seeking ways of continual improvement. Close proximity to suppliers and customers long term relations. Use of activity based costing. Zero industrial relations problems. Vertical disintegration.
Stage 4: Strategic partnerships development of subcontract network lean production	Member of customer subcontract team, probably organised into a *Kyoryoku Kai* association. Facilities available for product design for customers. Extensive use of own mutually dependent subcontract network. Creation of firm-specific advantages. Active technology transfer with customers and other members of the subcontract team. Increase in product diversity and customer service. Real JIT production. Maximisation of value-adding processes in network but minimisation by OEM or lower-tier customer. Close long-term relations with low cost sources of finance, probably in a *Keiretsu*-type arrangement. Extension of supplier co-ordination and development to lower tier firms.

Source: Hines et al. 2000: 324

The new demands placed on strategic purchasing needs greater emphasis to focus on supply chain management. As well as considering the modern characteristics outlined in Table 4, the roles of senior managers and employees need to change. These changes will take time, patience and perseverance to implement and imbed strategic methods. The next section considered total cost instead of price.

2.6.1 Shifting emphasis from price to total cost

Traditional purchasing is operated as a clerical function, placing purchase orders on a large supply base. The emphasis is on the 'cheapest price', which was often at the expense of product quality, delivery and service (Hines 1994). There is little or no appreciation given to the hidden costs of quality. Some hidden costs include; the cost of raising an order, transportation, storage, obsolescence, product handling, product scrap and rework. There is also the cost of vendor-rating systems, supplier visits and the cost of keeping supplier information up to date on internal systems and the life duration of the product at the end-use application.

Due to the shift of increased costs with suppliers, purchasing began to be recognised as a strategic function. Senior management realised purchasing could make large impacts on the bottom line. There was more demand to have a global supply base or to switch supply from UK suppliers to localised suppliers overseas, minimising labour costs. For example, Marks and Spencer were well known for partnering in the UK until the 1980s when they reduced local supply from 90% to less than 50% (Barker 1999). H&M and Next purchase all their merchandise from China. This shift has closed many UK manufacturing production lines, sites and companies, which have relocated overseas. An evident example of this in the published literature was the automotive and aerospace industries.

More sophisticated quality cost systems would build these costs into their quality reporting for all products and services. This would also enable the focus of improvement projects for current and potential problems, dependent on the priority and risk impact of the company. To identify the real cost of business improvements in the supply chain, the financial system of the business would need development. These strategic enhancements and emphasis on total cost will enable the purchasing department to be more equipped to undertake supply chain management.

2.6.2 Partnership development

In the UK many new terms have been introduced: 'Partnerships' (Macbeth 1994), 'Supplier Development' (Hines 1997), 'Strategic Alliances', 'Collaboration' and 'Supplier Networks' (Lamming and Harland 2004). These different terms have all been used to describe the activities of two or more parties working together for a common purpose.

The literature has clearly captured the characteristics of these types of relationship development which are summarised as being a move away from adversarial relationships to working more collaboratively (Lamming 1993, Macbeth and Ferguson 1993, Stuart 1993). Models were introduced which summarised the key differences (Hines 1994, Lamming 1994, Macbeth 1994).

Macbeth (1993) developed a five-phase approach for improving relationships: internal commitment and team building, partner selection, supplier communication and commitment, measurement and improvement planning, and action implementation and progress review. A weakness of this research was that it did not provide any further detail or explanation. The further information was necessary for successfully implementing the model. Macbeth (1994) presented an overview of the features of adversarial and collaborative relationships, as shown in Table 5.

Table 5: Adversarial and Collaborative Relationship Characteristics

Adversarial	Collaborative (Supplier Development)
Time-span of interaction	Transaction history
Discrete events	Supplier for life
Contracts for months	Switching is last option
Low switching costs	People development
Personal attitudes/behaviour	Devolve authority
Expertise closely held	Power two-way and hidden
Centralise authority	Supplier supports innovation
Power explicit and visible	Proactive suppliers
Buyer knows best	Multiple interactions
Reactive suppliers	Self imposed stress
Minimal interactions	Mutual respect
Customer imposed stress	Build for the future
Individual focus	Open sharing approach
Live for the moment	Group gains sought
Aggressive defence	Design involvement
Look good locally	Hands on
Organisational processes	Many touch points
Produce to drawing	Technology transfers
Hands off	Total acquisition cost
Limited gatekeepers	Relationship measurement
Static systems	Supply chain effectiveness
Measurements	Control inputs and processes
Unidirectional	Frequent feedback
Vendor Rating	Improvement
Unidirectional price	Success shared and rewarded
Internal cost reduction	
Inspect outcomes	
Limited feedback – blaming	
Learning limited	

Source: Macbeth 1994

Table 5 clearly summarises the key differences to enable the reader to appreciate the basic differences between the two styles. However, it provide no framework, examples or lessons learnt to enable these changes in relationship development to take place. Behavioural changes internally and externally need consideration if previous relationships were more traditional with a 'them and us' attitude, rather than mutual gain and collaboration (Hines 1994, Lascelles and Dale 1989, Macbeth 1994).

In the 1980s and early 1990s the literature on partnering tended to focus on the benefits and characteristics of a partnership. If an adversarial relationship exists with suppliers for many years and then a customer decides to start working collaboratively as outlined in Table 5, traits of the adversarial style could still exist (Macbeth 1994). Consideration should be given to the time necessary to move from an adversarial relationship to one of collaboration and this transition should not be underestimated. Some suppliers may need to re-build trust with customers, this can make the change a slow process.

Successful cases of companies working collaboratively on supplier relationships to improve product design, production processes and exploit innovation were primarily from the automotive, aerospace and computing sectors. Examples of such companies are Canon (Japan Management Association 1987), Toyota (Monden 1983, 1986), Mazda (Hayes, Wheelwright and Clark 1988), Nissan and Matsushita (Monden 1986). Companies that adopted techniques such as 'Just In Time', 'Quality Circles', 'Preventative Maintenance' and 'Vendor Programs' included Harley Davidson, General Motors (Sepheri 1987), Hewlett Packard (Suzaki 1987), Lockheed (Barret 1988), Ford (Brooks and Linklater 1986), General Electric, IBM and Westinghouse (Schonberger 1986).

The literature on partnership appeared to neglect the company strategy, culture and external environment, which had a direct influence on relationship behaviour that could result in development being short lived. To bring partnership and relationship development into context, supplier development and the benefits were investigated.

2.7 Supplier development

Hines (1994) carried out extensive research into creating world-class suppliers, concentrating his research efforts on Japan and in the early 1990s applying concepts through the Lean Enterprise Research Centre (LERC) and funding from the Welsh Development Agency. Hines' research findings emphasised the impact supplier development has on competitive advantage.

This had been clearly recognised and documented from the industrial history of Japan. The success and advancement of Japanese enterprises has been largely attributed to their focus on developing supplier networks (Hines 1994). Sadly in the West these concepts are still not often understood (Hines 1994).

Japanese developments have clearly been sustained over time and many case studies and continuous improvement tools used for operational and service improvement today originated from the Toyota Production System (TPS) (Bicheno 2000).

It appears that the majority of case analysis on partnerships and their benefits is from the automotive industry, where this is likely to continue. In the UK in 2005, nearly 250,000 people worked in the automotive manufacturing sector, which contributed around 1.1% of GDP, with around £9 billion of added value, representing 6.1% of UK manufacturing. Britain was the manufacturing base for seven of the world's leading volume car manufacturers, had nine commercial vehicle plants, was home to 17 of the world's top tier-one component suppliers and the base for 20 of the world's leading automotive design engineering firms (Automotive Academy 2005).

In 2005 the government committed up to £15m over five years to fund the development of the Automotive Academy, which will deliver programmes using existing providers in most regions across the UK, to enhance further use of lean and six sigma concepts. The benefits of supplier development across industry sectors are now examined.

2.7.1 Supplier development benefits

Academic literature and case studies on supplier development have emphasised the benefits and opportunities which could be achieved, such as improving quality, reducing transaction costs, removing waste, reducing non-value-added activities, reducing supply lead times, reducing inventory, lowering material costs and technological improvements, which all contributed to achieving competitive advantage (Drucker 1982; Galt and Dale 1991; Christopher 1992; Cox and Hines 1997).

Customers expect more and more from their suppliers for their products, end quality, performance and costs (Watts and Hahn 1993, Baily, Farmer, Jessop and Jones 1994, Hartley and Choi 1996). Nevertheless despite the publicised benefits of supplier development there was still slow uptake in the UK. In 1990 researchers found only one article which directly addressed the supplier development issue (Hahn et al. 1990). Before this time the focus was on partnerships and basic reviews.

Supplier development was slowly given attention through the tangible benefits seen through British and European government-funded programmes. Nevertheless, Cox (1996) found that the exposure given to supplier development within the academic and professional literature remained fundamentally and disappointingly unchanged.

Hines (1998) found the spread of knowledge and expertise in the West had until recently been very limited. Hines (1994) created models for implementing supplier development in the UK.

Hines (1994) developed a 10-step model for establishing supplier associations:

1. Benchmark present competitive position
2. Select appropriate co-ordination and development tools
3. Gain internal acceptance and create cross-functional team
4. Select appropriate suppliers
5. Benchmark supplier position
6. Jointly target improvements
7. Focus co-ordination and development efforts
8. Undertake group activities
9. Measure improvements
10. Refocus size of group and target areas

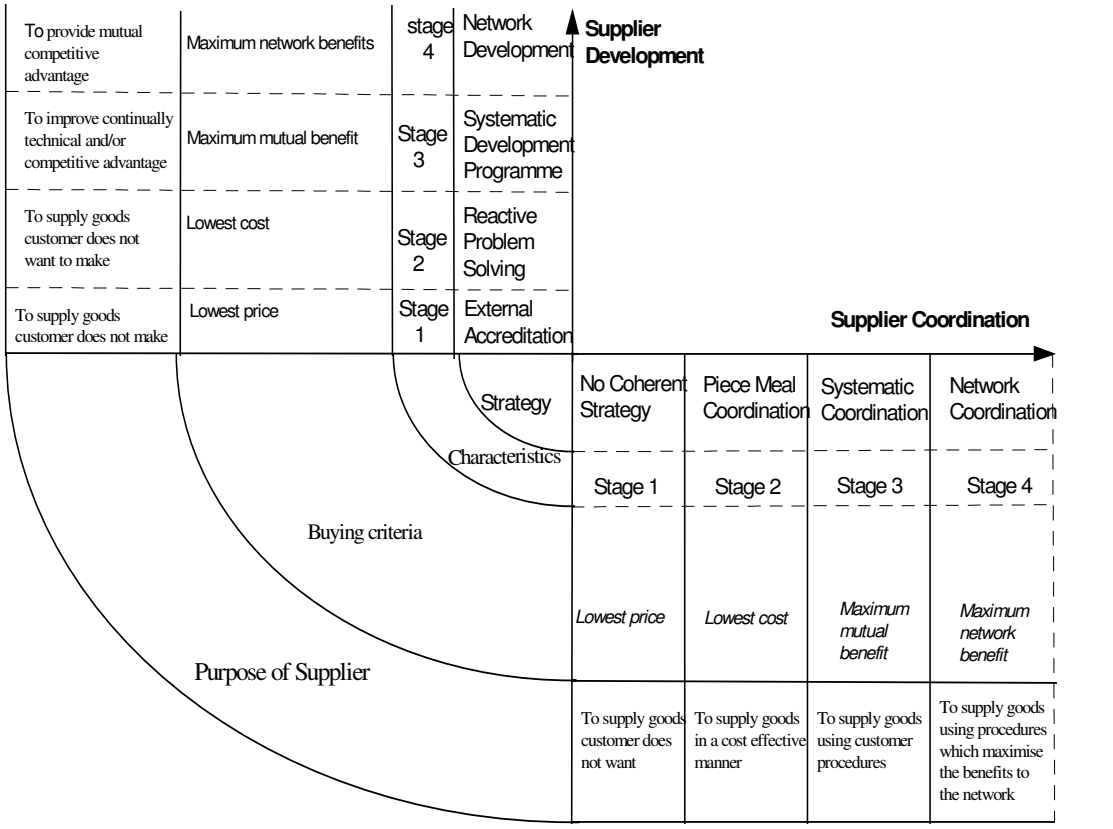
Hines' (1994) model appeared easy to follow and each area was expanded in the literature to provide further advice. The model was generated based on a 'plan, do, check and act' continual improvement loop, which was a Total Quality Management approach (Deming 1986). Developing a continuous improvement culture within a company may take a considerable amount of time and effort. To begin the process, benchmarking had to be undertaken and an assessment to ensure the right company measurement system was in place prior to benchmarking and deciding what to benchmark against. The appropriate development tools also had to be selected and a supplier selection process created or developed.

Hines et al. (1995) provided the most useful model for supplier development positioning, illustrated in Figure 4. Hines et al (1995) identified supplier co-ordination and supplier development as the two key areas needed for successful supplier development.

Supplier co-ordination referred to the activities undertaken by customers to mould their suppliers into a common way of working, developing the framework, company diagnostic, metrics and tools and techniques. Supplier development was the adoption of these approaches initially learnt with the customer to help improve competitive advantage. The two distinctions were extremely complementary, supplier co-ordination and supplier development emphasised a common consistent system of co-ordination and development implementation of processes for

sustainable development. The model illustrated in Figure 5 shows the purchasers buying behaviour in 4 stages.

Figure 5: Stages in Buying Behaviour by Purchasers.



Source: Hines 1994

Areas of development which the model excluded were the implementation activities needed to make progress to the next stage, for example, strategy, policy deployment, communication (people, processes and operations) and barriers to development which would prevent a company from moving to the next stage. It would also be very useful to provide practical examples of what was experienced at each stage (McCartney and Massey 1996).

A further consideration may be for companies' own internal systems to be made leaner and more proactive before embarking on development projects with suppliers. This was because the client company could have inherent noise in the existing processes, inconsistent communication and approaches which could cause conflicting messages and confusion to suppliers. If the client company was also very reactive and heavily fire fighting this could impact support, commitment and long-term success. Nevertheless, authors and practitioners often focused on supplier development due to the developments of both companies with the

efforts made to work together. Without the basic foundation and frameworks put in place internally, however, any quick reactive supplier development hits could be short lived.

McCartney and Massey (1998) found four generic characteristics of supplier development: Firstly, strategy, which was the company business plan and policy deployment including creating it, if it does not already exist. Secondly, communication, operations, people and processes. Thirdly, barriers to development which would prevent a company progressing. Fourthly, practical examples of supplier development activities.

To sustain a continuous improvement culture with strategic suppliers, the internal management structure and external activities must work in parallel to maintain the philosophy and standardise approaches through a system.

The paper by McCartney and Massey (1998) provided academics and practitioners with a matrix which could be used to analyse characteristics of supplier development. This matrix is summarised in Table 6.

Table 6: A Matrix for Supplier Development

Management Approach	Individual Stage 1	Fragmented Stage 2	Systematic Stage 3	Networked Stage 4
Strategy and policy deployment	Individual's perception of supplier development	Departmental strategy	Long-term vision and policy communicated by senior management	Standardised policy and optimised System. UK/Europe/ international supplier associations *Kyoryoko kai*
People, Processes and Operations Communication	Functionally based development. Interface with immediate internal/external customers. Basic process control	Process driven sourcing policy or preferred supplier list , Strategic resource departmental teamwork which supports the strategy. Technology advancements	Cross-functional teams established. Waste removal of non-value-added processes. Support participation of senior management. Training provided for new skills and buy in to policy. Strategic purchasing	Continued investment in people and resources. Target setting Leading edge concepts, i.e., product development.

	Stage 1	Stage 2	Stage 3	Stage 4
Barriers to development	No agreed future vision. Lack of management buy in. Lack of understanding of supply chain development and the benefits	Lack of supplier information. Fragmented approach. Lack of time & resource . Short-term focus Company structure and culture vision not shared with all	Investment in time and resource. Trust and mutual benefit	Ongoing continuou improvement - *Kaizen* - Trust
Policy Deployment	Suppliers who have IS09000 / BS5750, enter the market easily	Suppliers graded by quality assessments / vendor rating	Internal policy communicated to suppliers	Between suppliers to suppliers over tiers
Operations and people	Cheapest price. No training in total cost of ownership. One-off negotiations. Short-term tenders contracts	Firefighting – resolving immediate problems. Functional team projects which support strategy	Proactive Teamwork. Everyone believes in strategic vision. Open communication. Information and feedback target improvements	Aligned process and people strategies facilitating information flow and knowledge across companies
Practical examples of supply management	Lowest price. No or poor monitoring of quality, cost and delivery	Product and supplier rationalisation, waste removal, set up reduction, lead time reduction, technology development, consignment stocking, purchasing cards, EDI, performance concerns quality and delivery	Joint long-term plan focus over several years. Sisk and cost Sharing, technology transfer, direct line feed, CAD/CAM ISDN links, R&D investments and joint *Kaizen* Product Development	DTI automotive aerospace and construction programmes. Centre for Research in Purchasing and Supply (Crisps) Lean Enterprise Research Centre (LERC)

Source: McCartney and Massey 1998

Hines et al. (2000) produced a further matrix to focus on the effectiveness of supplier co-ordination of which the results are set out in Table 7.

Table 7: Effectively Focusing Supplier Co-ordination

Strategy/ Characteristics	External Accreditation	Reactive Problem Solving	Systematic Development Programme	Network Development
Buying criteria	Lowest price	Lowest cost	Maximum mutual benefit	Maximum network benefit
Purpose of supplier	To supply goods	To supply goods	To improve continually mutual Technical and/or competitive advantage	Customer does not make competitive advantage
Relationship type	Adversarial	Arms-length	Close	Strategic
Relationship length	Short/variable	Variable	Long	Lifetime
Customer involvement with supplier	Small	Some, purchasing and quality	Frequent, many functions	Continuous and multi-functional
Quality requirement	Product specification	Quality control	Quality assurance of TQM	TQM spread to own supplier
Delivery requirement	Standard lead times	Standard lead time	Customer involved in shop floor lead time reduction	True JIT
Cost requirement	Lowest market price	Lowest cost	Stable/reducing product cost	Target costing, share savings
Product design requirement	Customer specification or catalogue product	Some joint input	Significant joint input	Integrated design capability within network
Technology sharing	None	Limited (mainly customer technology)	Frequent with two-way flow	Frequent within network
Reliance on grading	None or external	Some reliance on reactive scores	Heavy reliance on reactive and predictive scores	Some reliance on predictive scores
Data interchange	Limited, operational only	Limited, mainly operational	Detailed, often operational and some strategic	Detailed at both operational and strategic level
Asset specificity	None/very low	Low–medium	High	High through network
Number of suppliers	High and unstable	High, relatively stable	Low and very stable	Very low
Frequency of interaction	Infrequent	Infrequent, scheduled and reactive	Frequent proactive and reactive	Continuous

Source: Hines et al, 2000: 325.

Hines' (2000) models and matrices provided the individual reader or a team reviewing approaches with a positioning framework for a given set of critical success factors. These models were powerful for teams to use to access performance.

2.7.2 Business improvement techniques

There are numerous publications on business improvement and continuous improvement approaches in the supply chain. When investigating supply chain management improvement, certains tools were identified as a key contributors, with emphasis on 'lean' (waste removal) and 'six sigma' (reducing process variation) (Hines et al. 1995, Womack and Jones 1999, Bicheno 2000). Bicheno (2000) saw that improving the supply chain meant extending the principles of lean and six sigma to all participants in the supply chain.

Business improvement approaches that have been published included Total Quality Management (TQM), which holistically looked at quality efforts, both quantitative and qualitative. It included quality circles, where focused improvement teams solve problems, the adoption of the quality certification system ISO9000:2000, which included performance reviews, Just in Time (JIT), Business Process Re-engineering (BPR) capturing activities in a flowchart and then improving them, and Total Preventative Maintenance (TPM) where holistically production operators are empowered to take ownership of the machines and areas in the plant for low and medium level maintenance.

Researchers who have studied business improvement in essence have found many tools and techniques originated from the quality literature published in the 1950s and 1960s by quality gurus from America and Japan. Juran and Deming took quality approaches from America to Japan after World War II. The Japanese gurus who responded and developed new concepts, which are still used today, were Ishikawa, Taguchi and Shingo. In the 1980s increased quality awareness came from two Americans, Crosby and Peters. Oakland (2000) produced a matrix (illustrated in Table 8) to compare and contrast the concepts of three 'gurus'.

Table 8: Three Quality Gurus Compared.

	Crosby	Deming	Juran
Definition of quality	Conformance to requirements	A predictable degree of uniformity and dependability at low cost and suited to the market	Fitness for use
Degree of senior management responsibility	Responsible for quality	Responsible for 94% of quality problems	Less than 20% of quality problems
Performance standard motivation	Zero defects	Quality has many scales. Use statistics to measure performance in all areas. Critical of zero defects	Avoid campaigns to do perfect work
General approach	Prevention, not inspection	Reduce variability by continuous improvement. Cease mass inspection	General management approach to quality especially 'human' elements
Structure	14 steps to quality improvement	14 points for management	10 steps to quality improvement
Statistical process control	Rejects statistically acceptable level of quality	Statistical methods of quality control must be used	Recommends but warns that it can lead to a too driven approach
Improvement Basis	A process not programme Improvement Goals	Continuous to reduce variation Eliminate goals without methods	Project by project team approach Set goals
Teamwork	Quality Improvement teams. Quality councils	Employee participation in decision-making Break down barriers between departments	Team and quality circle approach
Cost of quality	Cost of non-conformance Quality is free	No optimum continuous improvement	Quality is not free there is an optimum
Purchasing and goods received	State requirements Supplier is extension of the business. Most faults due to purchasers themselves	Inspection too late allows defects to enter system Statistical evidence and control charts required	Problems are complex Carry out formal surveys
Vendor rating	Yes, and buyers quality audits usele	No, critical of most systems	Yes, but help supplier improve
Single sources of supply	--	Yes	No, can neglect to sharpen competitive edge

Source: Oakland 2000

Table 8 highlights the relevance of different approaches to quality improvements. All of the gurus have one main thing in common – to listen to customer requirements – but their approach and style in carrying out improvements vary with opposing views of sourcing supply, continuous improvement or a project-by-project approach. The senior management approach of each guru provides a useful insight into the philosophy and implementation. Crosby saw senior managers as fully responsible for quality improvements, Deming 94% and Juran less than 20%. Juran argued for a company-wide approach enabling greater empowerment of responsibility for quality to employees. Table 8 is useful to see contrasting views of the theme of business improvement, which is to be examined further in the research.

To embrace business improvement fully it is necessary for senior managers to commit resources and remove high-level bottlenecks. However, for the full achievement of a continuous improvement culture I lean towards Juran's thinking, that it is necessary to involve employees to increase productivity and motivation. If a company applying business improvement makes senior managers 100% responsible there is only a small percentage of the business improving while all the remaining employees are uninvolved and they would not be empowered to take ownership.

On a project-by-project basis, different resources are involved in leading and contributing to teams which can create rapid results and start the continuous improvement journey. This is investigated further in the case studies and includes the impact of senior management.

In the late 1990s and 2000s, literature is published about lean and six sigma methodologies. Lean thinking is the elimination of waste and the adoption of five lean principles: (1) value from the point of view of the customer, (2) value stream, physical flow of information and product, (3) value flow, one stream flow and the removal of obstacles that prevent flow, (4) customer rate of demand extending to the full supply chain, and (5) continual improvement. (Womack and Jones 1996).

Six sigma is based around process and variation linked to the bottom line. The methodology covers; define, measure, analyse, improve and close. It focuses on process quality, service and product (Bicheno 2000).

Ultimately both are about winning and retaining customers. Lean and six sigma have a number of approaches in common and complement each other very well. Six sigma includes the reduction of process variation and improvement in quality performance by using a number of recognised quality tools and techniques. The six sigma methodology is built

around the Deming cycle; plan, do, check and act. Lean removes waste and increases flow by reducing throughput time. Lean uses many of the tools of the Toyota production system and process re-engineering which is more commonly known now as 'value stream mapping'. More progressive companies have incorporated 'Lean Six Sigma', combining the value of both approaches. Other companies have kept things simple by using the phrase 'Business Improvement' in order that employees should feel continuity with the actions being taken.

The lean philosophy was pioneered in Japan by Toyota (Hines and Rich 1998, Womack and Jones 1999). Many of the tools and techniques commonly used across industry sectors in the twenty first century were developed in the 1960s. When the activities company are examined, it is found that they can be broken down into value added, non-value added and waste. Value added is defined as something a customer is willing to pay for or the machining, forming, shaping and finishing of a product. Non-value added is necessary activities which need to take place, such as legislation compliance and documentation, and the other activities are known as waste. When examining a process or activity, a typical analysis is 5% of the value added, 35% non-value added and 60% waste. (Hines 1997). Examining the full process across the supply chain and not just focusing on the product means there is a greater opportunity to improve the process and simplify and streamline operations. Commonly adopted tools include the 5Cs or 5Ss for housekeeping, SMED or set-up reduction, process mapping and the seven wastes (Hines and Rich 1998, Womack and Jones 1999, Bicheno 2000).

Housekeeping, or the 5Ss, enables a company to be organised with 'a place for everything and everything in its place'. This is achieved through; *sorting out* an area and removing unused items, *straightening* the area out, *shining* and cleaning the area, *standardising* by introducing housekeeping audits, and *sustaining* through continuous improvement. This tool is often the starting part to introducing business improvement in the supply chain, by getting people to work in teams and develop a prestigious-looking area with a professional appearance, providing a clear and clean image to customers and saving time for employees who can find items easily. The first three stages are easy to achieve and very visible using before and after pictures. However, standardising and sustaining are much more challenging for companies to achieve. This means the company has to imbed the approach into the company culture so that it becomes a way of life.

Single Minute Exchange of Die (SMED) or set-up reduction, identified by Shigeo Shingo (Johansen and McGuire 1986), is focused on reducing downtime on a machine by analysing the activities that are taking place and adopting improvements and a new procedure to

minimise unproductive machinery. This is another powerful technique which simply analyses every activity and organises activities into internal and external categories. Internal activities are those which must be undertaken whilst the machine is switched off and external activities are those which could be organised and prepared whilst the machine was running.

Process mapping captures a visual picture of the activities under examination. The activity may be of a product or service, and captures the entire flow of steps, information and available performance measures. Different process-mapping techniques are available, simple activities maps of boxes and arrows known as process maps, matrices listing activities and identifying value added, non-value added and waste, or a value-stream map which is a very detailed visual picture of all activities, information, performance measures, value added, non-value added and waste. If the activities cut across departments, a cross-functional process map could be produced showing the movement in and out of departments. There are three types of process maps; the current state, picturing what currently happens, the future state picturing the new system, and a blue sky map starting the process again with a blank sheet of paper. The seven wastes identified by Shigeo Shingo are paramount in lean analysis and process mapping (Hines and Rich 1998). The seven wastes are explained with a description in Table 9.

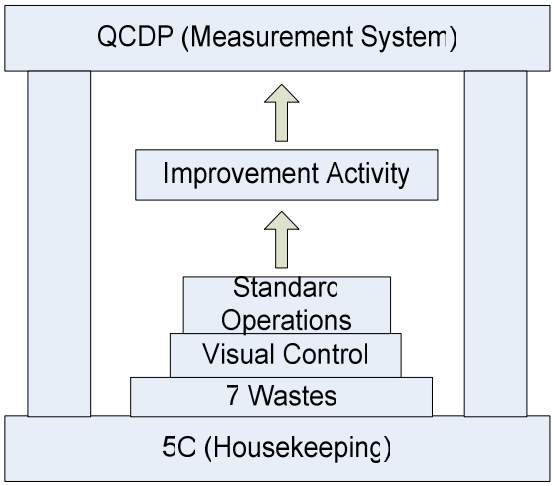
Table 9: The Seven Wastes

Waste	Description
1 Overproduction	Producing too much or too soon, resulting in poor flow of information or goods and excess inventory.
2 Defects	Frequent errors in paperwork, product quality, problems, or poor delivery performance.
3 Unnecessary inventory	Excessive storage and delay of information or products, resulting in excessive cost and poor customer service.
4 Inappropriate processing	Going about work processes using the wrong set of tools, procedures or systems, often when a simpler approach may be more effective.
5 Excessive transportation	Excessive movement of people, information or goods resulting in waste time, effort and cost.
6 Waiting	Long periods of inactivity for people, information or goods, resulting in poor flow and long lead times.
7 Unnecessary motion	Poor workplace organisation, resulting in poor ergonomics, e.g. excessive bending or stretching and frequently lost items.

Source: Hines and Taylor 2000: 8

These approaches have been visualised as the building blocks for continuous improvement (Bateman 2001) which were adopted by the LERC and SMMT Industry Forum. Figure 6 shows the building blocks for continuous improvement. The measurement system is introduced or data collected from an existing system to prioritise the improvement, the improvement activity takes place with the adoption of a business improvement tool, and a standard operating procedure or form of control is produced before completion.

Figure 6: Building blocks for continuous improvement



Source: Batesman 2000:10

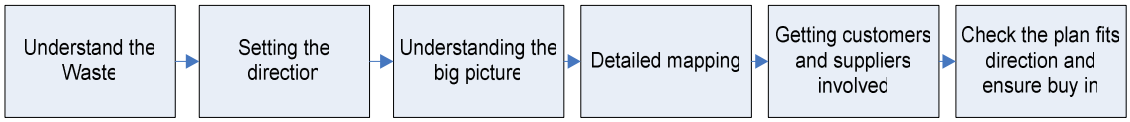
Womack and Jones (1996) described the lean supply chain by five lean principles:

1. Specify what does and does not create value from the customer's perspective.
2. Identify all the steps necessary to design, order and produce the product across the whole value system, to highlight non-value-adding waste.
3. Perform those actions that create flow without interruptions, detours, backflow, waiting or scrap.
4. Only make what is pulled by the customer.
5. Strive for perfection by continually removing successive layers of waste as they are uncovered.

These principles are paramount to prioritise and implement lean and to eliminate waste. When these five principles were formulated, they were heavily manufacturing focused. However, in item 2, 'product' could be replaced by 'service', which would make this philosophy equally applicable to service industries.

By aligning all the value-creating steps in a continuous flow, eliminating unnecessary steps and interruptions and recombining labour into cross-functional teams to run this flow, an individual firm can double its performance, flexibility and responsiveness (Jones 2004). 'Leaning' individual operations is not enough, the real gains only come when every step is reorganised (Hines 1994, Jones 2001). This emphasises the true value and competitive gain which could be achieved by improving the whole supply chain. Hines and Taylor's (2000) lean thinking process is illustrated in Figure 7.

Figure 7: Lean Thinking



Source: Hines and Taylor 2000

Figure 7 clearly shows the steps in lean thinking. However, it is concerning to see suppliers and customers becoming involved at phase 5, and gaining buy-in at phase 6. In my view, this process is deficient in not allowing for earlier employee or stakeholder buy in. Adair (1991) emphasised that if subordinates were fully involved in decisions that affect their work they will be committed to carrying them out. By having a key stakeholder involved at the end of the implementation could mean less chance of buy-in and of commitment and therefore successful sustainable improvements.

In my view, the process should begin with the customer and buy-in of key stakeholders, brought into the changes as early as possible, as well as involved at closure, to gain buy-in and make them feel involved in the changes for sustainability in the supply chain.

EEF commissioned a report in 2001 with 352 of it members to investigate productivity in the UK and US (Temple 2001). The report revealed that the productivity gap between UK and US manufacturing plants was as high as 30%. A lack of capital investment had hindered UK performance with lack of demand, concern over the future and the exchange rate. One reason for the better productivity performance in the US was the greater uptake and more intense use of lean principles.

Lean manufacturers do not pursue lean with the same intensity and depth. The US was getting more value from lean by applying it to every part of their business, but 40% of UK firms said they were not doing lean and did not plan to. For companies pursuing lean, the primary motivation of over 70% of firms was to boost overall company performance in terms of increased efficiency, productivity, profitability and lower costs; 25% stated they

implemented lean as a response to competitive pressures and 15% said it was a response to pressure from customers. The barriers to lean included attitudes to change (43%), lack of understanding (23%), cultural issues (13%) and management skills (12%) (Temple 2001).

From 1999 to 2001 research took place to investigate a three-day cycle time for car production. The consortium included; LERC, the School of Management at the University of Bath, the car distribution programme and 20 industrial sponsors (3day Car 2001). It investigated the supply chain complexity and what would need to change to make the vision achievable. The current supply chain cannot meet customer requirements without significant stock holding. The average lead time was 40 days, 34 of those were for customer order processing, which is the largest bottleneck in the supply chain. A wide range of aspects were investigated including customer attitudes, managing customer demand, expected technological changes, development of information systems, impact on environmental systems, changes in organisational culture and financial implications.

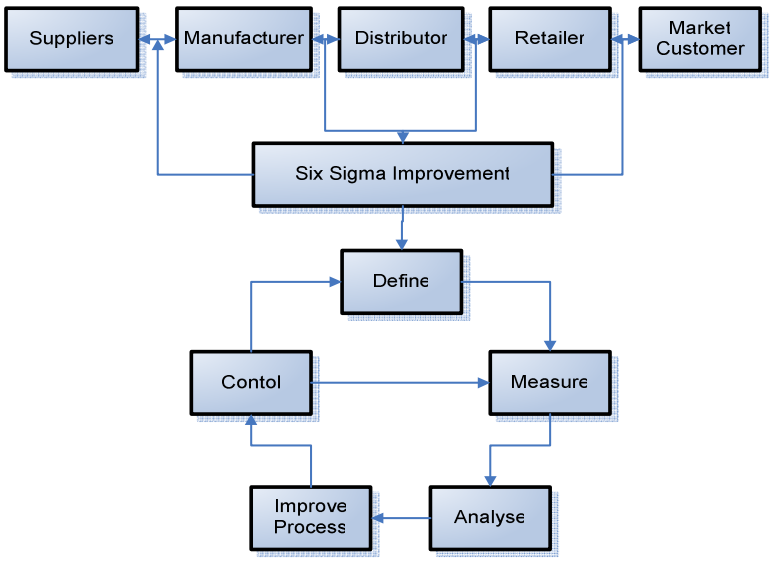
The three-day programme was an ultimate application of lean principles to the supply chain. Unfortunately this thorough research and analysis was not taken further as there needed to be a dramatic shift in the culture of the industry. It involved moving from a silo mentality, where each department focused on its own costs, and required all players to work together to optimise the whole chain.

The initial cost would be upstream but the benefits downstream, which means some players losing out for other areas of the company supply chain to gain. The focus on a holistic outlook would impact leadership, team working and performance metrics. The six-sigma model uses Deming's 'plan, do, check, act' methodology. It takes each of the areas and translates them into five phases; define, measure, measure, analyse, improve and control. It begins by defining a business problem with a business case, measuring and collecting data to determine the baseline of performance, analysis is carried out until the root cause of the problems are identified and control for the standardisation. Six sigma has had numerous publications (Harry and Schroeder 2000; Hahn et al 2000; Breyfogle 1999; Hoerl 1998) And six sigma projects have been adopted in operational areas outside manufacturing, HR (Wyper and Harrison 2000), purchasing, accounts, IT and supplier development (Avery 2001).

The six sigma methodology originated at Motorola in the 1980s in a high volume manufacturing environment, reporting savings in five years of $2.2 billion. Honeywell saved $2 billion in 3 years. Savings at Black and Decker rose to $75 million in 2000 (Breyfogle 1999). Nevertheless to achieve these cost benefits is not a quick fix. The company must be committed to investing in the resource, have charismatic leadership and coaching and a

holistic outlook focused on long-term continuous improvement. To take advantage of reducing variation and standardising processes and improving quality it complements lean extremely well. Both approaches together, as Lean Six Sigma, provide great opportunities for business improvement in the supply chain. A framework of the six sigma model in the supply chain network is illustrated in Figure 8.

Figure 8: Six sigma model in the supply chain network



Source: Wang et al. (2004)

Wang et al (2004) published a flowchart, illustrated in Figure 8, clearly showing the key areas of the supply chain and how six sigma improvement projects could be carried out in different areas of the supply chain. It is a useful high level framework, but it is not very practical for a practitioner or researcher to be able to apply it.

2.8 Literature review summary

The breadth of the subject area and lack of a precise definition of supply chain management can make it difficult to determine and understand the true boundaries of the subject. Houlihan's (1998) definition is adopted to ease understanding. In the existing literature, there are too many publications on techniques, matrices and multi-point plans to approach supply chain management (Hines 1994, Macbeth 1994, Hines 1998, Hines 2000). These matrices provide high level snapshots and lack real depth and explanation. More case studies in the research would provide a greater understanding of what is happening in company supply chains. I found few publications on changing the supply chain culture, such as the support by management and involvement of employees.
There is also a lack of detail as to the alignment of company objectives through policy deployment to align implementation of supply chain management with company objectives.

The research undertaken by Hines is very broad and has useful positioning matrices, but to apply these matrices practically in the supply chain, an assumption of high-level knowledge and understanding is made. Hines' (1994, 1998, 2000) research lacks detail behind the matrices, in particular, the development, the human aspects, and how to overcome inhibitors faced during the supply chain management implementation. There is still a basic focus on surface tools, concepts and matrices, but no deep appreciation given to the key factors such as strategy, policy deployment, supplier development process models, the human aspects and rigorous cost model frameworks, and the inhibitors that prevent companies moving forward with supply chain management implementation.

In the UK there remains a poor uptake of policy deployment and there is still little research published. However this could be an effective way to align supply chain implementation to a company's strategic goals and objectives. This will be examined further in the case analysis. Despite the strategic purchasing developments that have taken place over time, there remains little focus in the UK towards integrating employees into a whole system and the sustainability of supply chain management approaches.
This is a major drawback with many of the conceptual models. There is also a lack of alignment between strategy, leadership, infrastructure and implementation. Gattorna (2006) successfully aligns behaviour and culture with supply chain management.

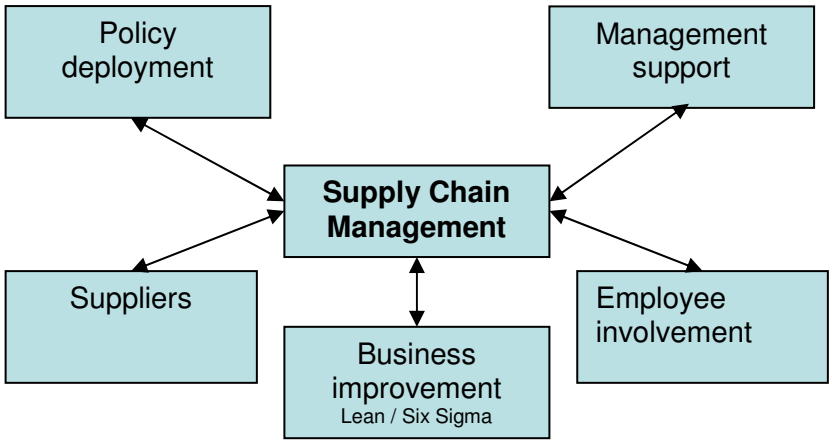
Despite the widely published benefits, there appears to still be a low uptake in supply chain management implementation across the UK. Temple (2001) found 40% of UK firms said

they were not doing lean and did not plan to, although the British government has heavily invested to support supply chain development.

2.9 Conceptual framework

To simplify the focus of supply chain management, five clear factors have emerged from the literature. These are illustrated in Figure 9. The factors are evident in the literature as those which are important for supply chain management. These factors include policy deployment, management support, employee involvement, business improvement and suppliers. These factors will be explored in the supply chain management case studies and will help to understand the research aims and primarily to identify the inhibitors and enablers of supply chain management.

Figure 9: Conceptual Framework for Research



Source: Own research on supply chain management

Prior to the case study analysis of two manufacturing companies and four suppliers using action research mini case studies, the methodology and research strategy has to be developed. This is set out in the next chapter.

3.1 Introduction

This chapter on methodology provides an overview of available research strategies and justifies the reason for selecting a case study strategy to fulfil the research objectives. The case study strategy employs interviews, reports and observation of implementation taking place. The stories and experiences of senior management and employees were also documented to elicit the impact on the company supply chain. Methods of data collection are outlined including the use of multiple sources to validate and triangulate the results. The potential limitations of the research are also explored.

3.2 Research questions

The supply chain management research has three research aims: to identify the ways in which the management of the supply chain had changed, to investigate how new ideas on supply chain management had been implemented and to analyse the inhibitors and enablers of supply chain management. The supply chain management research is operationalised by a conceptual framework which considers customers, policy deployment, senior management commitment, support by employees, operations, business improvement and suppliers. The conceptual framework (Figure 9) is explored through the case studies.

3.3 Philosophical stance

This section seeks to identify the philosophical stance that underpins the research strategy. A number of philosophies were reviewed including positivism and phenomenology. Positivism is concerned with 'things' and 'facts' obtained from numerical data about the world in order to achieve the research objectives. By its nature it is quantitative and normally utilises hypotheses which are tested through analysis of quantitative data. The very nature of the research objectives, particularly their exploratory nature, meant the methodology could not utilise positivist philosophy.

Phenomenology is concerned with 'meanings' and experiences' and how people make sense of their worlds. By its nature it is qualitative and data is collected. Since the research objectives lean more towards the phenomenological approach, this is the philosophy that underpins the research.

3.4 Research strategies

A prerequisite to undertake fieldwork and produce valid findings is to select an appropriate research strategy. Six possible research strategies were considered for this research. Table 10 identifies the research strategies and the context in which each is typically used.

Table 10: Research Strategies

Research Strategy	Context
Experiment	Certain variables are changed whilst keeping other variables constant to investigate the effect.
Survey	Typically a section of data and information is collected investigate a phenomenon, e.g.,a UK National management skills survey across industry sectors
Grounded Theory	A research study of a new topic or area that has previously been subjected to little research
Ethnography	Interprets behaviour and meaning over time by close observation of the social behaviour of the research subject
Action Research	Solves a problem with an organisation in collaboration with the people that work there
Case Study	A detailed study carried out over time

Source: Saunders 1987

The experimental strategy was discounted at an early stage because of the difficulty of controlling variables. The survey strategy was discounted because the research was carried out over an extensive period. In the case of survey strateg,y it was felt that it could not fully explain the research objectives, as a greater degree of depth was needed than could be obtained from a survey. A survey could not cover the required depth and the extended period over which I wanted to investigate the research objectives, providing scope for thorough explanations. Grounded theory was not appropriate because it was not a new subject or a topic which has had little research. Supply chain management is a comparatively well researched subject, as the literature review clearly indicates.

Ethnographic strategy was considered as it focuses on interrelationships (Gearing 1958, cited in Rosen 1991:1149). Rosen (1991) defines organisational ethnography as predominantly concerned with social relations around a subset of goal-orientated activities. In the process ethnographers consider epistemology, that is, the place of the meaning of data and enquiry, which they bring to the forefront of activity. As a strategy it is longitudinal in nature and is heavily socially focused. Consideration has to be given to the ethnographer's relationship to the group he or she is studying. The ethnographer's method of collecting data is to live among those who are being studied. He or she tries to learn the subject's rules for organisational life, to interface with them for a duration of time 'sufficient' to understand how and why they construct their social world. After gaining a full appreciation of

ethnography it was felt that the researcher was not going to get close enough to understand the subjects' social world or the life of the social group. In addition supply chain management research includes many contextual themes which are not social. At this point ethnography was also rejected.

Action research is a problem-solving approach to research, where a problem within an organisation is investigated in collaboration with the people that work there. Action research was used for four mini supplier case studies which were presented as part of the study of RHP.

Having discussed the research strategies outlined above, the case study strategy was adopted for the research. The fundamental reason for selecting a case study strategy was the scope it gave me for utilising a range of data sources, the depth of analysis that was possible and the length of time available to investigate the research questions. Multiple data sources would be beneficial for exploring and explaining the contextual factors. The data gathered was largely qualitative but with a small amount of quantitative data. Data sources to be adopted included; small-scale surveys, interviews, documentation, observation, and even the collection of physical artifacts. The full justification for this is detailed in section 3.5.

3.5 Justification of case study strategy

Yin (1984) defines case study research as:

> An empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.
> (Yin 1984: 23)

The focus of case study strategy is concerned principally with the interaction of factors and events (Bell 1987). Case studies are complex because they generally involve multiple sources of data and may include multiple cases within a study and produce large amounts of data for analysis. The various sources of data collection can add rigour to the research. Similarly the research is not static so it can provide a wide range of contextual factors. It is these contextual factors that are the distinguishing features of case studies. They provide a richness of detail that is vital in explaining the phenomena. The choice of a case study as a

research strategy had little to do with my background, my past research having largely been positivist and quantitative, since my first degree was a BSc in Management Science.

The case study strategy was felt to be appropriate for the research under investigation. There were many contextual factors that needed analysis over an extended period of time in order to explain fully and examine the research aims, and because the phenomenon under investigation was complex. Yin (1994) recommends the use of case studies in situations where the real world phenomena under investigation are complex. This was the case in this instance. Supply chains by their nature are complex. It was also a design in which the unit of analysis could be of more than one level.

There is no rule of thumb as to how many case studies are needed. This permits a degree of flexibility to alter the volume of case studies accordingly to the nature of the research and contextual themes. Where only a small number of cases are employed, this provides rich explanations which are typical of the research objectives under investigation.

A case study strategy could provide a more in-depth analysis into the problems that companies encounter in implementing supply chain management. To support this, six units of analysis were used (Table 11).

The case study framework involved four levels. Level 1: the company, history and multiple data collection methods. Level 2: the process or activity under investigation used observation or unstructured informal interviews with employees. Level 3: the key internal stakeholders' views were captured as vignettes. Level 4: the impact activities had on the company and employees to examine fully the impact of supply chain management.

A further advantage of the case study method was its applicability to real life human situations and its public accessibility through written reports.

The task was to describe, analyse and interpret material from those involved with supply chain management implementation. The use of case study research provides scope for in-depth investigations into the research questions. This strategy is selected to investigate 2 manufacturing companies in depth and breadth and 4 strategic suppliers.

3.6 Data collection methods

The research involved formal and informal data collection methods in 2 companies from 1996 to 2006, and 4 supplier companies. This research utilises a number of data collection methods to provide the breadth of analysis. Data gathering took place over 10 years, including six years of project work from 1996 to 2002 when supply chain management was researched with various departments. Data gathering aimed to capture work sessions, project team meetings, steering committees, training courses and problem-solving workshops. Participant observation was also undertaken for two years, working on projects within organisational development which were responsible for the culture change strategy. I worked across a range of industry sectors for two years whilst writing up research.

Data collection included informal one-to-one discussions with different employers and employees. The colleagues included: operators, buyers, secretaries, managers, team leaders, engineers, directors and managing directors within the two main case studies and four supplier companies. These discussions included listening to stories about the problems encountered during day to day work and discussions about team activities on specific problems or challenges. The use of company data included reports, memorandums and newsletters, providing existing documentation on structures, management systems and business processes. Quantitative analysis undertaken included an employee opinion survey, and data on suppliers' production volume, quality levels and downtime. Data was also collected on supplier spending and cost reduction activities.

A survey of 150 senior managers was undertaken to review the inhibitors of supply chain management. A network of 20 independent company managers was also used to provide formal closure. The principal unit of analysis comprises two case studies of large manufacturing companies. However, for one of these case studies four mini case studies of supplier companies were also employed. Table 11 summarises the units and data collection methods.

Table 11: Units of analysis

Unit	Data Collection Method	Number of people	Vignettes
Unit 1: RHP-NSK Bearings, Notts.	Company internal and external data sources	Purchasing 20 Quality 10 Manufacturing 10 Suppliers 3	Store Manager 1 Engineering Manager 2 Purchasing Manager 1
Unit 1a: Desford Tubes, Leics.	Participant observation	Engineer 1 Operators 3 Crane Driver 1 Quality Engineer 1 Manufacturing Engineer 1 Co-ordinator 1 Production Manager 1	Director 1
Unit 1b: JRD, Cambs.	Participant observation	Sponsor 1 Engineer 1 Production Manager 1 Quality Engineer 1 Manufacturing Engineer 1 Co-ordinator 1 Director 1	Managing Director 1 Supervisor 1
Unit 1c: Mansfield, Norfolk	Participant observation	Managing Director 1 Operator 1 Production Manager 1 Quality Engineer 1 Manufacturi Engineer 1 Supplier Development Co-ordinator 1	Director 1 Production Manager 1
Unit 1d: Synthotec, Worcs.	Participant observation	Managing Director 1 Production Manager 1 Warehouse Manager 1 Engineer 1 Operator 1 Foreman 1 Process Engineer 1 Quality Engineer 1 Supplier Development Co-ordinator 1	MD 1 Engineer 1 Foreman 1
Unit 2: Alstom-Siemens Gas Turbines, Lincs.	Company internal and external data	Management Board 14 Purchasing 60 Quality 20 Manufacturing 600 Suppliers 11 Supply chain survey 94	Managing Directors 3 Senior Manager 1 Head of Customer Support 1 Director 2 Operator 3 Senior Buyer 1 Engineer 1

To capture the implementation efforts of the two manufacturing companies, I used listening, reflecting and interpreting techniques through consultation with employees, as well as examining company information and reviewing relevant external and internal management literature.

Various forms of observation were carried out by listening to the people in a wide range of informal situations, watching discussions, formal meetings and sales visits. Data was also gathered through small-scale interviews, surveys, documentary sources including letters, memos, reports, notice boards, emails, project documents, brochures and company reports.

The action research at the four supplier locations was undertaken at four levels. Level 1 consisted of a brief company overview. Level 2 was the team collaborating in a workshop to solve a particular problem in which I participated to provide rich information about the systems and approaches undertaken. Level 3 was the vignettes of the team members involved. Level 4 was the outcome of the workshop for the supplier company for the future.

Active listening and note taking were my primary tasks. All data was captured, whether it seemed to have relevance or not to the research objectives. All field notes were taken down immediately and transcribed within 24 hours.

Reflective remarks were captured in the form of sentences, phrases, paragraphs and even a poem as part of the field sense-making process to interpret and support or disclaim the analysis. These remarks were captured as vignettes to enrich the research.

3.7 Data analysis

As there are multiple data sources, multiple data analysis was undertaken. Content analysis was used to compare and contrast the managing director's speeches to identify and match patterns. Pattern matching and content analysis was also used in the action research to explain the results and align them to how the management of the supply chain had changed and to identify inhibiting and enabling contextual themes. This was undertaken by reviewing the field notes that were written in the words of others, which were used to help frame ideas and capture new understanding as the research progressed. Coding was undertaken with the supply chain management survey results to cluster together all the exact findings of each participant and to identify all enabling and inhibiting factors by capturing all results in spreadsheets to create a coding reference to the main key themes. Cross-case analysis was also carried out between the two main manufacturing case studies and across the four supplier

action research reports to identify commonality. The analysis tools used included matrices, tables, process maps and graphs, where different forms displayed results visually and interpreted findings. Descriptive statistics were collected from employee questionnaires, a supply chain management questionnaire, the supplier value interviews and the business network. Table 12 illustrates the descriptive statistics for the questionnaires and interviews undertaken during the research.

Table 12: Questionnaires and Interviews Descriptive Statistics

	Number of People	Mean Age	Positions
Employee feed-back questionnaire	1000	48	40% response from employees across the company with 2500 people in total
Employee interviews	30 (5 females)	47	Employees were a sample randomly selected across functions; 5 Purchasing, 5 Sales, 5 Accounts, 10 Manufacturing, 2 Quality, 1 HR, 1 IT
Supplier values semi-structured interviews across 13 companies in South Yorkshire or East Midlands	13	55	Managing Director 1 Technical Manager 1 Quality Assurance Manager 1 Technical Sales Executive 1 Sales Director 3 Production Control Manager 1 Client Manager 1 Business Development Manager 2 Sales Managers 2
Supply chain management questionnaire	150 (140 males 5 females)	46	Managing Director 1 Directors 16 Manufacturing Managers 11 Engineering Managers 14 Purchasing Managers 11 Project Managers 15 Sales / Business Development Managers 20 Group Manufacturing Managers 12 Central Managers 20 Middle Managers 30
Business Network	20 (15 males 5 females)	44	20 senior managers across different Industry sectors.

Source: Research analysis

By using multiple data collection methods and analysis it was felt that the research explored provided authentic results. This was also enriched by the adoption of triangulation.

3.8 Triangulation

To ensure the research undertaken was authentic, multiple data collection methods were used as part of the case study strategy. By using different data collection methods, different perspectives were provided to cross check and confirm explanations and interpretations. This helped to provide a degree of robustness in the research findings. In essence the case studies permit comparison with previous cases to confirm or contradict findings (Gersick 1988). This helped to address the concern over reliability, an issue for which case studies have been criticised (Miles 1979).

3.9 Limitations

No matter how we might look at a particular set of data, another analyst, differently situated in time, education, gender, ethnicity, age and so on, might well highlight different patterns of meaning against the same background of raw data (Geertz 1973, cited in Rosen 1991). The researchers education, experiences, gender and age and having been raised in the East Midlands, could all contribute to preconceptions. Similarly the researcher was employed by the companies and directly participated in some of the findings could cause limitation. However, despite this, the findings were consistent with earlier studies and do provide plausible and logical explanations.

3.10 Summary

The methodology attempts to consider possible limitations which could affect the outcome of the research objectives. Adopting a case study strategy comprising 2 manufacturing companies will ensure the validity and reliability of the research findings. Overall this has brought together robust in-depth explanations to fulfil the understanding of the research objectives and contribute to the body of knowledge.

4.1 Introduction

The case study strategy was used at RHP to investigate the research questions. This strategy provided a thorough analysis which was used to identify changes that had taken place in RHP's supply chain management, how ideas had been implemented and the inhibiting and enabling factors of supply chain management were revealed.

The key factors identified for the implementation of supply chain management included: policy deployment, management commitment, employee involvement, business improvement and suppliers. The factors were investigated during the case study.

The case study provided RHP's background, procurement process and working practices in the purchasing department. 4 strategic supplier improvement workshops were also documented and an evaluation into how the purchasing department needed to change to support supplier development activities into the future.

The background of RHP was reviewed to set the scene by providing an overview of the Newark site and company history. The researcher felt it was important to capture the history as it could support the understanding of how new ideas have been implemented. This history may also impact the inhibitors and enablers in supply chain management. The history could also assist with the analysis. The history was documented by capturing available company literature. Information was collected from employees to provide meaningful analysis by capturing historical developments and management changes that had taken place over time.

The supply chain at RHP was investigated by examining and exploring the procurement process across each department in the supply chain, to see how the material was brought together to manufacture a bearing and to observe the inhibitors and enablers of supply chain management. The purchasing department was examined to assess the interfaces and interaction with managers and employees across the supply chain.

The supplier investigations were action researched into the implementation of new ideas. The study included the business improvement techniques used, the approach taken, short term and long term results of the improvement and a summary of the impact of the improvement to the supplier.

The purchasing department was re-examined after the supply chain development implementation to investigate further development opportunities. Purchasing needed to face changes in order to sustain supply chain development and to become more up to date with modern purchasing practices. (Hines et al 1997). The case study was summarised in four areas senior management attitudes, traditional purchasing and quality methods, internal communications and interface problems and absence of key performance indicators.

4.2 RHP Background

RHP manufactured roller bearings. The bearing had seven key components: balls, seals, inner rings, outer rings, clips, grease and packaging. All the commodities were seen as strategic except packaging as this was for shipping and storage only. The inner and outer rings were manufactured in house from bought in rolled steel. The remaining components were purchased from strategic suppliers.

In the late 1960s the Labour Government encouraged the merger of UK bearing manufacturers **R**ansome & Marles and **H**offman & **P**ollard. This was to fight off overseas competition in particular from Japan. Sir William Barlow, Chief Executive of **RHP,** established a new directors' team to investigate and make changes to the company.

In the mid 1970s the directors' team strategy was to diversify and move into the electronics market. Funding was taken from the bearing industry and reallocated to invest in the new electronics market. The decision was made to purchase MTE Limited to support this strategy. Despite efforts to form a strong united English front the traditional old management organisational hierarchy, with many hierarchical layers, remained almost the same. To make matters worse in 1977 the Government withdrew financial support.

In the late 1980s UK manufacturing faced heavy decline owing to the strong strength of the pound and overseas competition becoming fiercer. More pressure was put on RHP resulting in loss of market share. The survival of the group became questionable. Huge site rationalisation began, resulting in the shutdown of the Northampton and Durham sites. Reorganisation of the commercial and engineering functions also took place. The sales and drawing offices were rationalised and centralised to Newark.

In 1987 an entrepreneur called Alan Bowkett made a management buy in and renamed the company United Precision Industries (UPI). The new management re-focused the strategy on bearing manufacture and acquired two European companies, WIB in Switzerland and Neuweg in Germany.

In 1989 the turnover had dropped by two thirds of that in 1971. This was due to few management changes being made to compete in the market, continuing recession, poor investment into the company and continuing global competition.

In the mid 1990s SKF, the world's largest bearing manufacturer, made an offer for UPI, but the Government and the Mergers and Monopolies Commission blocked it as SKF would have had far too much of the world market. NSK, the second largest Japanese bearing manufacturer put in an offer, which was accepted.

In 1990 the Japanese bought RHP during this time there was much apprehension about the change of ownership and how it would affect senior managers and employees. Many expressed their fears and stereotyping 8 years later. Some of the employees thought they would come into work everyday and have to carry out physical exercises. Generally the employees were concerned about wearing the same uniforms, having their names on overalls. It was evident that little communication had taken place and there was poor understanding about the change of ownership and the impact on employees.

In the 1970s NSK had already made a presence in the UK with a plant based at Peterlee. In the 1990s UPI was purchased by NSK and renamed back to RHP. In total there were seven NSK-RHP manufacturing sites in Europe. Across the world NSK-RHP had over 18,000 employees operating in 25 manufacturing sites.

In the late 1990s and early 2000s competition remained fierce and costs high. As a result the Newark Precision site, Ferrybridge site and Ruddington Research and Development were closed down.

In 1998 the Newark site employed 2000 employees. By 2003 the employees had been reduced to 400. In 2006 RHP employed 350 employees. RHP used to be the largest employer in the Newark community. RHP brought wealth into the Newark market town and even had its own brass band within the community. In 2004 RHP made a profit and had completely changed over five years. More of its former employees moved into other jobs in the community of Newark, including a BT call centre and a large bakery.

By 2004 the new companies provided more jobs and wealth to Newark. Table 13 summarises the history.

Table 13: The history of RHP

1900	Hoffman manufacturing and Ransome & Marles start beginning bearing manufacture
1946	Pollard Ball & Roller Bearing Company created
1969	Creation of RHP - UK quoted Company
1970	Consolidation of three companies
1975	Start diversification - Buy MTE Limited
1980	Close Northampton Site, Annfield Plain and Durham Site
1981	Reorganisation of commercial and engineering functions UPI
1988	Purchase WIB and Neuweg sites
1989	Close Chelmsford
1990	Purchase of RHP by NSK
1997	Purchase of FLT Polish Bearing Plant
1999	Precision site closed and Operational Purchasing integrated into factory
2000	Ferrybridge site closed 2001 Ruddington relocated to Newark

Source: RHP 2001

4.2.1 Customer and Markets

In 1997 NSK world-wide sales were in the order of £3.2 billion. SKF was the world market leader holding 19%, NSK-RHP held 14%. The remaining competitors held a few percent each. The market sector was divided between 64% automotive, 17% electronic, 12% machinery and 7% other.

The customer range was very broad, due to the large range of products NSK-RHP offered. NSK-RHP resource for the customer base was allocated to three main areas, Automotive (including Rover, Nissan, Honda and Toyota), Aftermarket (including Caterpillar, RS Components, Uniparts) and Aerospace (including Pratt & Whitney, British Aerospace and Rolls Royce).

NSK-RHP decided to keep market brand identities separate. Despite the fact that most of the bearings range had only one line of manufacture, bearings were packaged separately for NSK and RHP. The branding was kept separate for four years as it was felt that customers had brand loyalty for English bearings and Japanese bearings. The separate branding caused problems for NSK-RHP, as the pricing was very different. For some bearings RHP was a few pounds more expensive. For example, the cost of a cylindrical roller bearing at the beginning of 1997 at RHP was 43% higher than that of the Japanese parent company NSK. In 1997 there were also employees at the same unit that worked for NSK and employees who worked for RHP. Even though these employees were working for the same company NSK employees were seen as more prestigious.

For NSK-RHP Europe the annual sales turnover was around £450m a year with approximately 3,900 employees, 2,500 of which were in manufacturing.

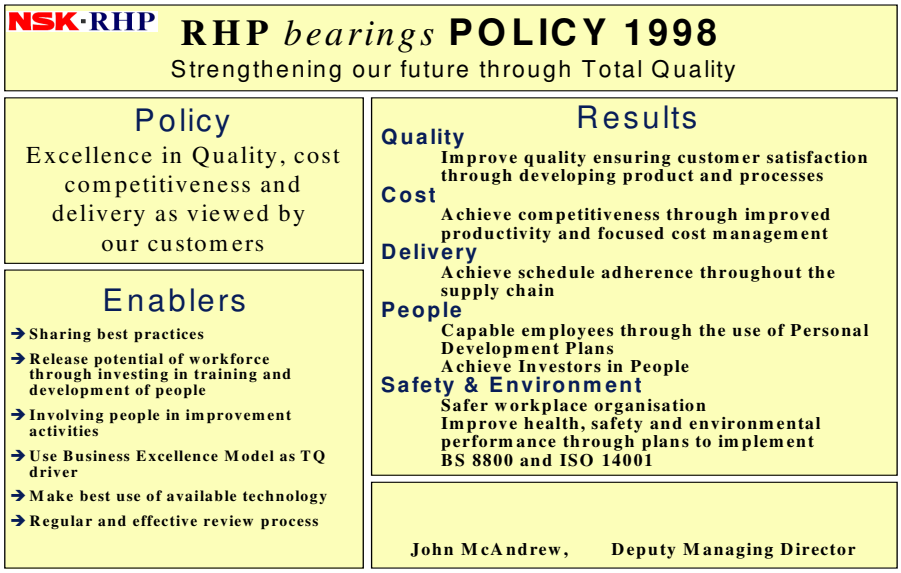
4.2.2 Policy Deployment

The majority of policies and practices were kept separate due to the nature of the different product volumes and supporting processes. However, benchmarking performance across sites and comparison with Japan was ongoing.

During 1998 the company targeted a 20% cost reduction across the RHP Group addressing the need to bring costs in line with overseas competition (as part of the company globalisation strategy). At RHP there was great emphasis on establishing an annual improvement policy. The policy was developed under four strategic headings; quality, cost, delivery and people (QCDP) and top level percentage improvement targets were developed for annual performance.

NSK-RHP Policy Deployment included the deployment and involvement of key personnel in the establishment and delivery of the strategy and targets for the company. The Managing Director began the process by creating the top-level strategy and targets for the company. Figure 10 shows the overall strategy for RHP in 1998.

Figure 10: NSK-RHP Bearings Policy 1998



Source: RHP Bearings Ltd

Managers at RHP briefed their employees on the above strategy.

At RHP Hoshin Kanri (Lee and Dale 1998) was carried out annually beginning by the Managing Director determining the top level strategy and measures which were then deployed to the next line management. Every employee was formally briefed annually on company performance from the previous year. This line of management would then determine their strategy and measures to reach the business goals, which would then again be deployed to the next line of management.

To release the potential of employees the deployment continued to be cascaded throughout the company. The cascade spread to individual engineers who had to agree their projects and targets for the year and also had to add further stretched targets to processes that had already been improved.

Policy deployment was carried out at all the manufacturing sites. The policies were then gathered together and deployed as a policy document. The policy document covered the top level strategy down to key projects, contact names and telephone numbers. This was known in NSK-RHP as the Total Management Concept (TMC). All TMC's were made visible on departmental notice boards with targets and progress. Each TMC was kept up to date monthly as a minimum requirement. However on the shop floor it was continually updated as the culture of improvement was becoming the daily way of working life. In other departments the TMC's were out of date and not regularly maintained.

Nevertheless, purchasing and other support groups such as site quality did not have any input into the policy deployment, even at senior management level. Instead the support departments were perceived as administration areas, with non-value added and wasteful activities 'paper chasers', and 'questioning decisions which held up production'. The emphasis was focused heavily on 'value added' within manufacturing.

4.2.3 Continuous improvement approaches

The main majority of factory changes and continuous improvement approaches were driven from each local site. There was little intervention and no initiatives enforced from the Japanese headquarters. The Japanese headquarters were interested in progress and performance and when visiting the unit spent most of their time in the manufacturing areas, except for presentations from the senior management team in the boardroom.

When NSK purchased RHP a new role for a Total Quality Manager (TQM) was created. This person reported to the Managing Director and was made responsible for deploying TQM principles across all the UK sites. RHP drove total preventative manufacture (TPM) as their approach. (Deming 1986).

To support the introduction of TQM manufacturing restructured and developed team leader positions and all similar existing roles were closed. Employees who held similar positions were asked to apply for the jobs they were interested in. Employees who did not accept the changes or were unsuccessful in their application for the new team leader positions left the company. Teamwork principles were introduced and regular team briefings were established at the beginning and end of shifts. Continuous improvement tools and techniques were introduced including 5S housekeeping, 7 wastes, set up reduction, 5 whys and the 8 steps for problem solving (Hines et al 1998; Womack & Jones 1999; Bicheno 2000; Bicheno 2002). There were regular audits of housekeeping and notice boards, changeover reduction and data analysis such as the measurement of downtime on the manufacturing machines. NSK-RHP used the European Foundation Quality Model (Bell et el 1994) to measure its business performance using the various categories and self assessments. EFQM was an effective tool for determining the priority of actions and focus to move the company forward. At NSK Peterlee the EFQM results were made visible to all employees by displaying the results visually on large notice boards along with the TMC strategy, projects and progress.

The TQM Manager had no direct reports but with the support of departmental managers identified twelve TQM facilitators' from different departments and sites across the UK. The facilitator's role was to coach, co-ordinate and help train employees on TQM development within their function. This part time role was additional to each employee's existing role. Unfortunately, the TQM facilitator's suffered as it was extremely difficult for those employees to carry out this role on top of their daily tasks. Also there was a mixed calibre of employees with differing levels of capability. No personal development plans were established to develop the facilitators' skills and competencies. Within a year these roles fizzled out of existence.

The TQM Manager and HR Manager provided training by introducing a mandatory four day training programme to engage every employee into teamwork, total quality principles and continuous improvement tools and techniques. The HR manager role was backfilled to free up resource for TQM training full time. At the end of the training each employee was given a pocket sized tool book for TQM tools and techniques which RHP had

developed. Within manufacturing the tools and techniques were used daily for implementation. Data was also collected to establish baselines of current performance levels in areas and to prioritise areas to focus improvements.

Different levels of culture existed in the departments across the supply chain. For example, manufacturing worked in improvement teams including managers, engineers and operators whilst in purchasing people worked individually on administrational transactions. Departments that spent little time working in teams or on projects and rarely used data to improve performance struggled to see the benefits and relevance to their areas.

After attending the training in teamwork and tools and techniques employees would go back to working the way they always had, without thought or consideration to the information they had gained on the course. RHP invested heavily in training and resources to establish a total quality culture. However managers had not thoroughly thought about the process and the impact the changes would have on employees. It would have been useful for the TQM team to regularly establish support and guidance reviews, coaching for individuals, teams or departments to manage the transition of change.

The training lasted four days; it was insufficient to change the behaviour and working culture of the employees. Departments had no support or discipline to make changes happen. However, manufacturing was able to integrate these approaches into their existing working practices as these employees were already targeted on improvements and were given ongoing focus and attention.

4.3 RHP procurement process

A review of RHP's supply chain management was made to gauge an understanding of the current state of the procurement process. The approach was to walk through the process from start to finish. At each stage the transactions were examined including paperwork, IT systems used and communications made between each operation.

The procurement process began within sales when a customer contacted RHP for some standard bearings. The procurement process went through logistics, manufacturing planning, purchasing, goods inwards, stores, assembly and accounts. Each department was investigated in turn across the supply chain and a review was also made with an

external strategic supplier. A bearing line was also included in the procurement walk to identify further opportunities for development.

A review of activities was undertaken in each functional area. This was achieved by communicating with relevant managers and process users to define the key procurement activities within each function. (Bicheno 2000).

To start the process an external customer contacted sales for bearings and specified the required delivery date. Sales checked if the product required by the customer was available from the European warehouse, if a part was available it was dispatched. If the part was not available the requirement was entered onto an electronic system (ASPAC) which passed the requirement to the logistics division.

The lead time quoted to the customer depended on the type of bearing. The lead time varied between two to nine months (dependant on stock levels). There were repeat customers from the automotive industry which had seven year agreements in place, or agreements to the life of the motor vehicle, as well as one off requirements for spares.

Many bearings were made to order. This increased lead times for customers compared to RHP's competitors. In 2001 a buyer for Hovard Boilers contacted RHP for some bearings and found they were under £4 each but they would have to wait eight weeks for delivery. An unnamed distribution company sold the same bearing for £40, but could deliver it within twenty-four hours. Hovard Boilers purchased from the distribution company. Customers were prepared to pay premium prices to get rapid response for their service requirements. A potential customer provided this example. RHP needed to ensure that their business responses were in line with customer requirements to be competitive in the market place.

All RHP manufacturing sites sold their products for a transfer price to the logistics department. The Newark delivery to logistics was scheduled to arrive anytime during the month. The logistics department then charged the external customer. This could make manufacturing units very detached from the external customer as the logistics department were manufacturing's end customer.

Once the planning manager logged onto the system the customer requirement automatically appeared on their 'things to do list'. A clerk checked the warehouse, if the bearing was in stock it was distributed to the external customer. If the bearing was out

of stock the requirement was downloaded from their system to the Newark industrial site material resource planning (MRP) IT system. The logistics department downloaded files to the manufacturing site for the customer requirements. The customer requirements list covered a 6 month forecast.

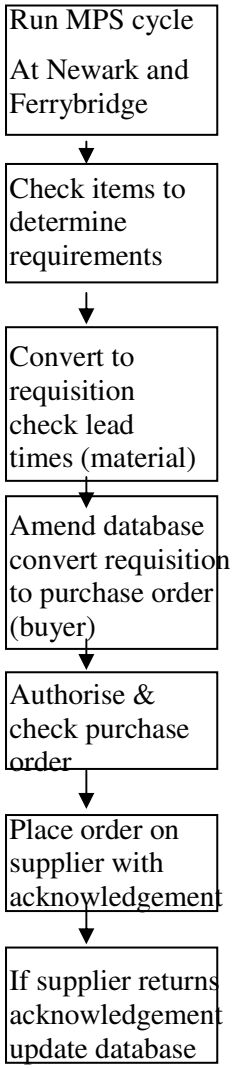
Manufacturing planning picked up the requirements from logistics. The manufacturing planning scope was 3 months. During the 3 months orders would become fixed. Manufacturing ran an initial print to identify all the component requirements and produce the bill of materials (BOM). Therefore 3 months of additional forecasting was on the logistics system that was not used by other operations in the supply chain. Packaging was the only bought out component that was excluded from the Bill Of Material (BOM), which was purchased through historical usage calculations. The BOM information was downloaded to a database and two schedulers completed the planning. A material planning schedule was produced every Tuesday afternoon that generated the entire computer planned orders, which were converted to works orders. The schedule ran again every other Friday afternoon.

Purchasing printed a schedule every Wednesday afternoon to generate order requirements. Therefore purchasing had used the forecasting that did not contain the revised dates by manufacturing planning which was produced 3 days later.

This could easily lead to different dates and quantities being collected by purchasing for bought out components and could have caused late or early supplier deliveries. The printed requirements were then compared to stock levels and the minimum order quantity.

To follow the process through to the supplier a completed order was followed (NP307065). The order was for a batch of 50,000 seals with a scheduled delivery date (required date) of 24 January 1997. JRD Mouldings had a minimum order quantity level set at 10,000 seals, with a 49 day fixed lead time. Once the order requirements were confirmed planning and expediting created the requisition which was passed to the buyer. The buyer checked the requirement and converted the requirement to a purchase order**.** Figure 11 shows the activities taken to raise a production purchase order.

Figure 11: Flowchart for raising a purchase order



Source: RHP Process

Key: MPS – Material Planning Schedule

When purchase orders were raised they were issued to suppliers monthly. No schedules or e-procurement methods were utilised. Purchase orders were batch printed every morning. Each buyer sent their orders to their portfolio of suppliers', enclosing an acknowledgement form.

When JRD Mouldings received purchase order NP307065 they returned the acknowledgement slip noting 'delivery to schedule'. Once the seals arrived at goods inwards from JRD Mouldings the inspectors contacted purchasing expediting to collect the delivery note. (This wasteful activity occurred for all bought out components). The expeditor walked at least ten minutes across the factory to collect the paperwork. Once the goods received note was collected by purchasing it was entered onto the IT system. The purchase order then became closed and a lot number was automatically created for

stores. At Newark industrial inspection took place at 3 levels. The sample and description of each level was highlighted in Table 14.

Table 14: Inspection sampling and description

Stage and Sample	**Description**
1) 20 batches out of every 200 deliveries.	This will always be for a new sample product, or a product which previous batch has been rejected and thus lost 5 demerit points.
2) 20 out of every 50 deliveries.	This will be a supplier which has not had any demerit points on the last batch inspected. If rejections were made on the previous batch the supplier would move back to level one.
3) Zero Inspections.	At present only bought out balls pass inspection. Every other bought out component for Newark industrial follows the inspection process of level 1 or 2 outlined above.

Source: Goods Inward RHP 1996

JRD's order was tracked and delivered in 2 batches without providing notice to RHP. Not only was the delivery overdue but it was also not to the required total quantity. When visiting JRD it was found that the fixed lead time of 49 days remained the same whether the quantity was for 10,000 seals or 50,000.

The supplier did not have the capacity or the resource to produce the larger quantity to the required delivery date. Nevertheless, the supplier noted 'acknowledgement to schedule' on the return slip, despite 2 split deliveries. This was left unnoticed by employees as there were some seals in stock. Manufacturing were fortunate that they did not have a material shortage. There were 52,000 seals in stock which could fulfil 2 months of order requirements.

When reviewing the long shop it was found that no inventory policy existed. There was also no management of product shelf life and traceability of parts was lost. Losing parts traceability was a major non conformance against the Lloyds quality standard ISO 9000.

The long shop was accessible to anyone. If there was a shortage of parts on the shop floor operators would help themselves to complete the assembly of bearings. To make

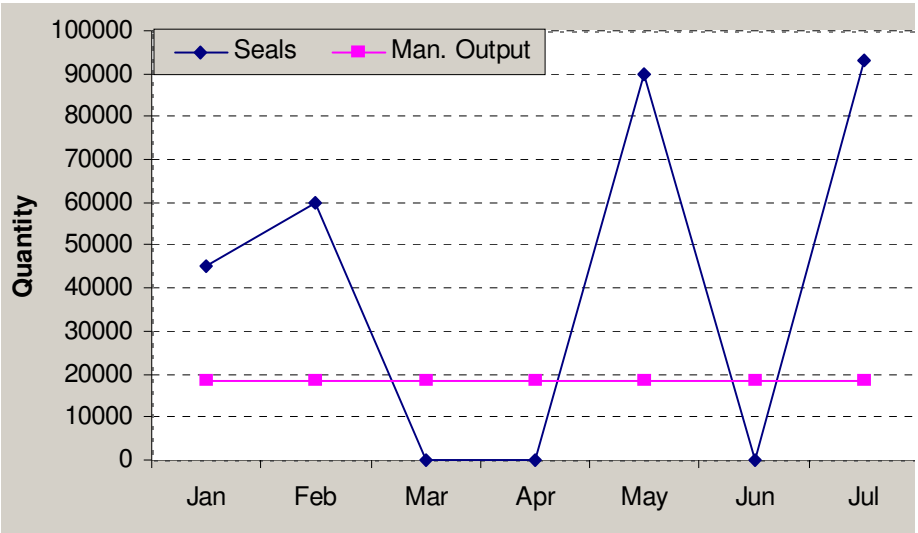
matters worse there was a £1m discrepancy between stock held on the shelves and stock recorded on the IT system.

Late payments caused cash flow problems for many suppliers. There was an outstanding dispute over six months with JRD on pricing; the site was using an old pricing list.

The DAC2004 line was studied as it was the largest runner producing a set output of 20,000 bearings a month. The quality problems on this line were relatively low. In 1997 the scrap costs for bearings and components were £3,072. However, despite having regular output of 20,000 bearings a month supplier delivery problems occurred, due to no forecasting and adhoc purchase orders being placed on suppliers.

The adhoc orders were examined by reviewing the monthly demand placed on JRD Mouldings over seven months. Figure 12 shows the quantity of seals ordered from the supplier against the manufacturing output for bearings. The graph clearly showed a smooth flat monthly demand at RHP that could be easily forecasted and delivered to the line frequently by the supplier. Instead RHP replenished stock from the supplier in high peaks and troughs.

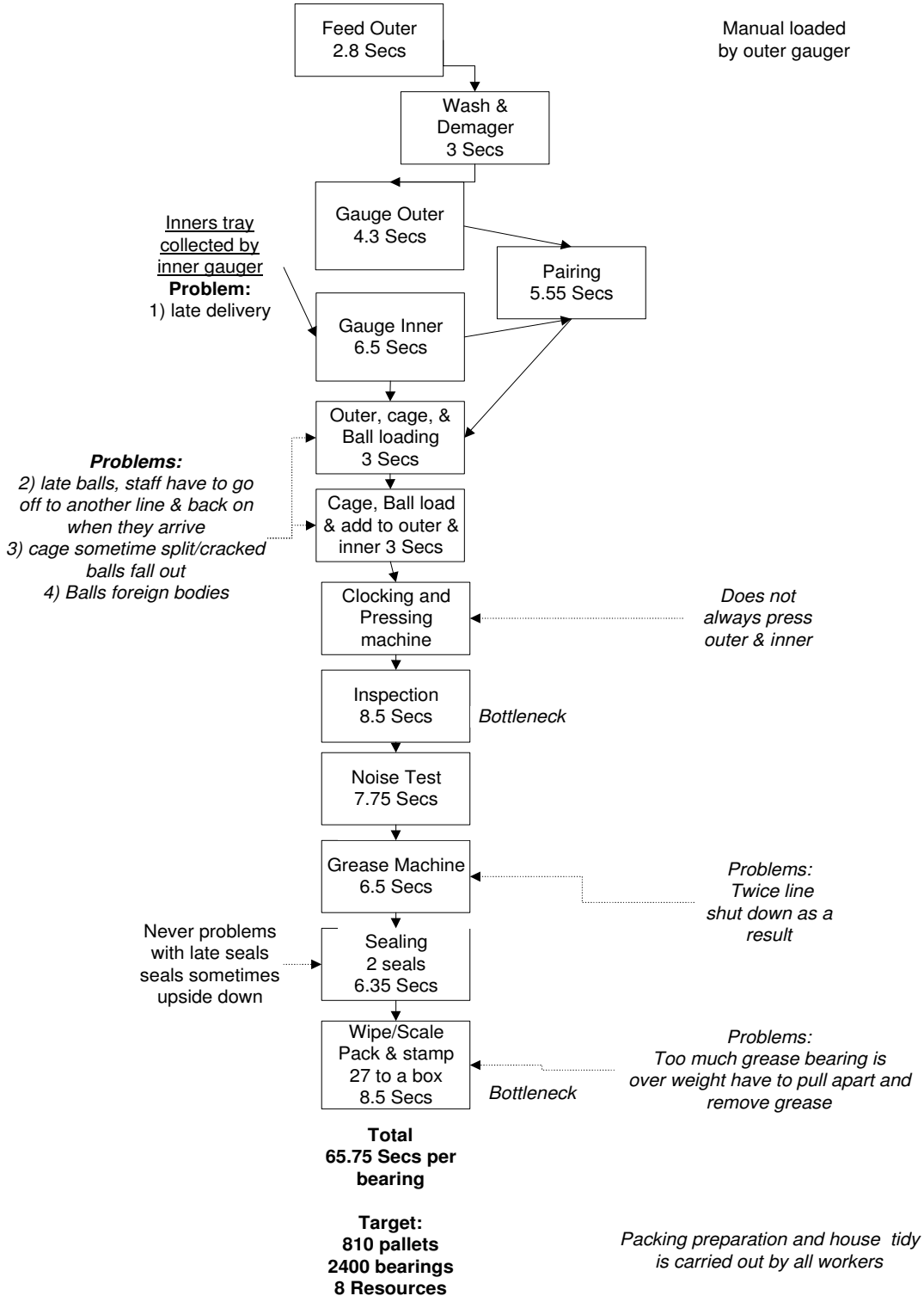
Figure 12: Manufacturing output against supplier output



Source: RHP Bearings

The assembly line which produced bearings for Ford (DAC2004) line was also flowcharted, highlighting opportunities in Figure 13.

Figure 13: Flowchart of the Ford Bearing Assembly Line



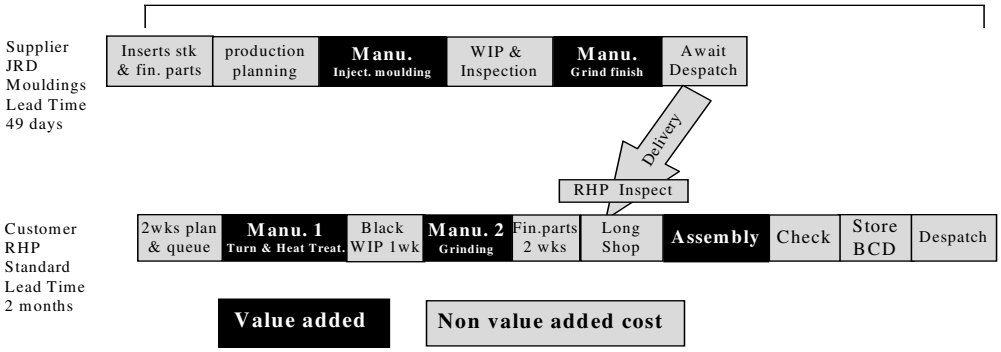
Source: Research findings

Bottleneck areas were identified within inspection and the weighing of the bearings. Both operations were time consuming and held up the flow on the line. Inspection was carried out off the line on a machine that was faulty.
The weighing was a time consuming process because if the bearing was overweight (due to too much grease) the operator would have to take the bearing apart, removing a seal and grease and then re-assembling and re-weighing.

There were many external part problems identified on the line but rigorous processes were not established to examine this. Therefore little acknowledgement was made to the hidden costs of quality. NSK-RHP had a standard cost culture. A lot of emphasis was made on measuring scrap on the shop floor. Supplier information was given to group quality that worked with those suppliers to get to the root cause but no costs were recovered from suppliers or any investigations made into the total cost of quality. Internal scrap was measured and the costs of those parts made visible, but little resource was used to carry out root cause analysis and therefore internally re-occurring defect problems continued.

At RHP there was heavy emphasis on removing costs from the product, production lines, scrap and set-up time. The focus on removing costs was predominantly made to value added activities. Non value added activities and waste within the supply chain was given little attention. Research from the Lean Enterprise Research Centre (LERC) found that when an entire process was examined only 5% was value added, 30% was non-value added and 65% waste. Figure 14 showed value added and non value added activities at JRD and RHP. The activities in black highlighted the value added activities.

Figure 14: Value added and non value added activities at RHP and JRD



Source: Research Findings.

Process mapping was broken down further to all operations which included distances and times. The application of this technique was shown in detail in the JRD Mouldings case study.

Summary

Reviewing the procurement process across the supply chain revealed that non-value added activities and waste was built into the existing system. There was excessive checking, duplication and poor transfer of information. For example, poor forecasting took place and updates to information in manufacturing were not shared with purchasing. Material controllers located in purchasing used a report to create a requisition to hand to the buyer for them to check the information and then convert the requisition to a purchase order. Traditional purchasing methods were used. This poor communication between departments caused poor flow of materials and requirement it could impact late deliveries and penalties from external customers.

There was opportunity to improve the flow of information and materials at RHP, to more efficiently and effectively optimise their supply chain.

4.3.1 RHP – the traditional purchasing era

In the late 1990s RHP purchasing was carried out in a traditional way. This section examined the purchasing department in more detail and provided an analysis of purchasing processes and the way employees interacted with each other.

The purchasing structure

The purchasing department had 23 people, with 1 purchasing manager and 2 senior buyers. The department spent £20m a year with suppliers, representing 50% of the total costs of the Newark site, which had a turnover of £40m. There was no defined procurement strategy for purchasing, despite RHP having a strong reputation for policy deployment (Hoshin Kanri).

The layout of the purchasing department

Purchasing was on the top floor 5 minutes walk away, from the assembly lines and main inventory store and 10 minutes away from the grinding areas. The buyers and senior buyers had individual desks six feet away from each other but put together in an open plan office. The 2 purchasing managers had separate offices overlooking the purchasing department.

Purchasing employees skills and expertise

The employees all had clerical backgrounds. Even the senior buyers had entered the purchasing department through local agencies on temporary assignments to carry out basic administration, filing and mailing of purchase orders. The majority of employees were not engaged in further learning and had little interest in keeping up to date with the latest purchasing developments. Except 3 employees, who studied for the Chartered Institute of Purchasing and Supply (CIPS) Qualification and 1 buyer undertook a BSc in Business and Finance. Nevertheless, the transfer and application of this knowledge into working practice was very poor. Buyers did not challenge inhibitors or think creatively to change or create new processes. Overall strategic purchasing was very weak.

Purchasing development was not encouraged when the only driver and measure on the department was price reduction. There were no individual targets and measures established for each buyer's development and their supplier portfolio. Too many of the purchasing roles were traditional operational administration roles. To make matters worse no formal skill matrices or competency frameworks existed for the roles. During the 2 years of research no formal purchasing training and development took place, not even for negotiation skills.

No one had received professional training for purchasing such as contract law, managing contracts, negotiating, outsourcing, financial analysis, material management or supplier appraisals. Everyone had undergone four days of total quality training, but did not apply this to their work.

Departmental communication

Purchasing department briefings were monthly. The purchasing manager presented price reductions achieved, the groups financial figures and general developments within the company. Each employee was allowed the opportunity to present back on work they had carried out. There was always a particular topic of focus where the leader of that project would present or discuss the progress.

The purchasing department briefings were held regularly and were a good form of communication. However the purchasing briefings were always insular in their issues, challenges and focus.

People from different departments strongly felt that purchasing worked to their own agenda. Regular comments were made in manufacturing including 'they sit up there in their ivory tower and never get involved in what's really happening'.

The Stores Manager highlighted this further:

> 'Purchasing buy material without asking anyone in the factory what they need. They buy great quantities that don't even fit in my stores. I then have to struggle to get my people to transport the items outside the stores. This can also be a health and safety hazard as we cannot use the crane or fort lift truck in some tight areas on the second floor.' Store Manager (1996).

The store manager's comments were evident by the packaging which lay everywhere. The packaging buyer obtained so much packaging to cover and ship bearings that the large quantities overflowed out of the designated store racks onto the floor. The excess packaging had to be safely hand carried up to the second floor to an unused room which had been converted for storing packaging inventory.

To make matters worse this room was not very accessible and meant that the stores employees had to struggle with large pallets of packaging.

There was no inventory holding costs calculated and no performance measures recorded in purchasing or communicated by stores. Overall there was very little interaction between purchasing and stores and no consideration by purchasing on the total cost impact of their decision. The communication was often only made at a conflict stage when the store manager became annoyed because everywhere would get overstocked. There was so much packaging in the stores which could cover a year of requirements. This evidence showed a functional silo mentality.

The procurement process

The process to obtain goods and services was monthly orders on suppliers. Few suppliers were supplied with open blanket orders, despite regular monthly order placements. Buyers would use traditional purchasing methods of obtaining three quotes and select the cheapest price and then place an order. This could sometimes mean that they would buy larger volumes of components to get cheaper prices. There were no long term agreements.

RHP performance indicators

No specific details of the relationship, goods or service requirements or performance indicators were collated. A few strategic suppliers had signed a partnership agreement but the content of the partnership agreement was an exact copy of the DTI partnership sourcing template in 1996. None of these agreements were adhered to and the infrastructure to support them was never established.

An engineering manager's frustration was expressed:

> 'Purchasing is so busy obtaining the cheapest price they order parts that cannot meet our required lead times. I was involved in a grinding improvement and the whole

> programme was held up by three months because we had to wait so long for the grinding wheels. There were also poor conditions negotiated with no consideration for maintenance, when I tried to enhance these I got into trouble with the purchasing manager.'
> Engineering Manager (1996).

The vignette from the engineering manager highlighted purchasing emphasis on price reduction. The manufacturing and strategic objectives were driven by quality, cost, delivery and service. Purchasing drove for the cheapest price at the expense of other operations with the supply chain. Purchasing totally overlooked what their internal manufacturing customer required.

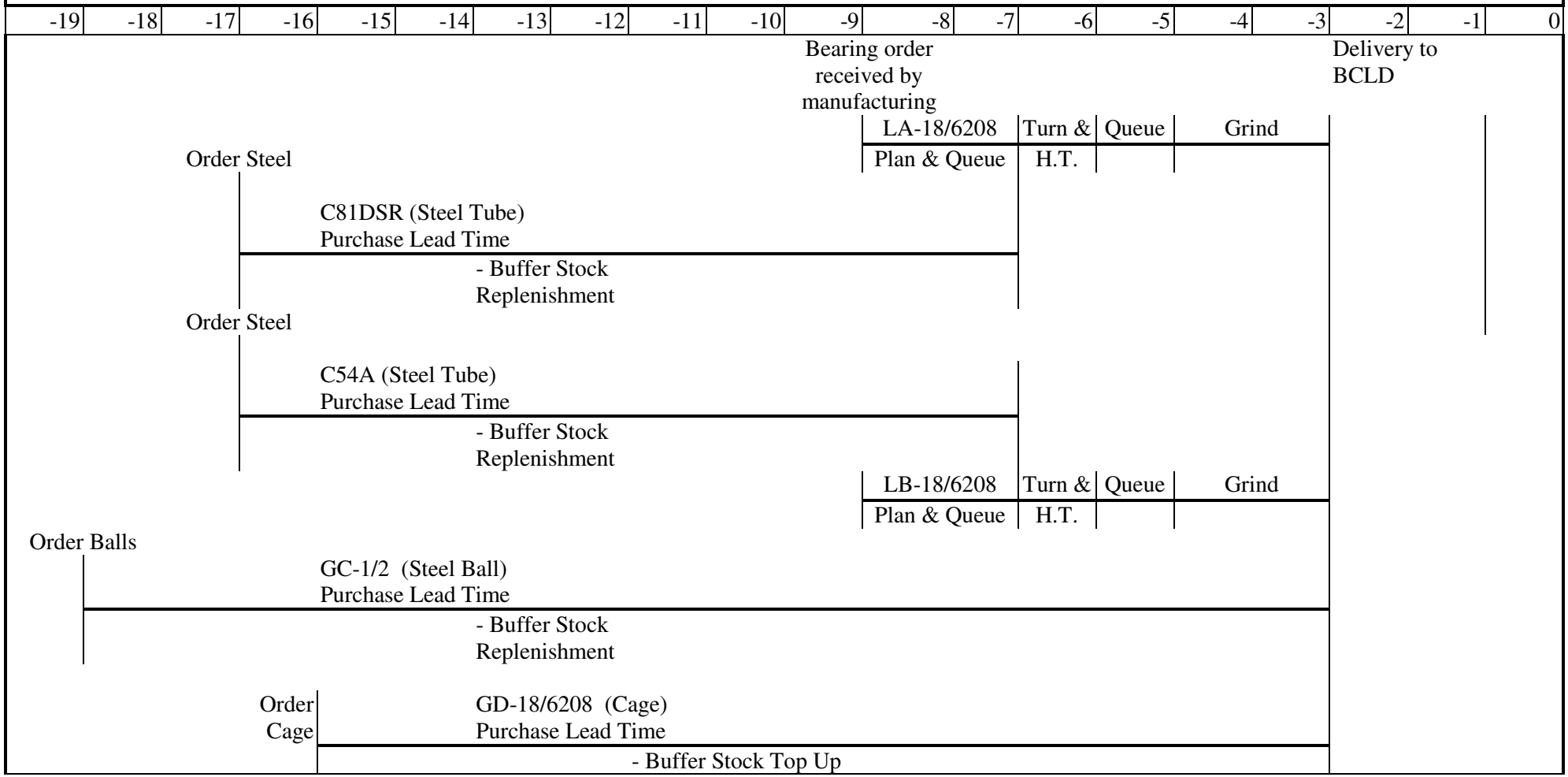
Supplier delivery was not measured so purchasing introduced a pilot measurement system, for the most frequent twenty suppliers. This would enable the department to apply for an independent Lloyd's certification for IS09000.

The purchasing department did not take service support into consideration, which was needed, for maintenance. This was a problem as it indicated that quality, total cost; delivery and service were not taken into account or benchmarked. As the total cost impact was overlooked the cheaper priced components could cost more in the long run, particularly if maintenance and warranty costs were not considered.

The internal manufacturing lead times were reduced from 12 to 8 weeks. However, the external supplier lead times all remained the same. Steel, balls and cages had to be ordered in advance of manufacturing production. To illustrate the amount of ordering in advance the bearing for Rover, part reference 6208=18, was examined.

Figure 15 showed the lead time model for Rover and included how many weeks material was ordered in advance of manufacturing the bearing to compensate for higher lead times. For example, the balls were ordered 19 weeks in advance and steel ordered 17 weeks in advance.

Figure 15: Lead Time Model for Rover. Week Number



Despite supplier lead-times being considerably higher than internal manufacturing lead times there was no drive to reduce supplier lead times by purchasing. Also purchasing did not receive the extra demand information from logistics, (as manufacturing only used a three month window) delivery problems were inevitable.

Departmental priorities

Manufacturing employees strongly felt that purchasing had an 'easy ride', they did not get involved in the cost reduction projects and their manager left them to carry out their job as they saw fit. The style of management within the factory was very different. The operations director was autocratic and drove decision making and improvement in the factory. He told the workforce to implement all the latest initiatives. The senior engineers would implement them even when they did not believe in the ideas. For example the engineering teams were measured on their Gemba (Imai), which was seen as the 'added value' time they spent on the shop floor. The directors were keen to get engineers working as closely to the cells as possible so they brought in hot desk offices in an open planned area on the shop floor. This annoyed and upset many engineers because of the volume of the radio playing through the tannoy on the shop floor. There was also great concern over the location as it was the dirty and dusty grinding areas of the factory.

However, many engineers did not comment and justify their concerns as they were fearful of career opportunities if they voiced their opinion. The change went ahead and when engineers needed more thinking time they actually moved further away from the factory areas to get some peace and quiet.

Purchasing department and group quality were seen as quite separate from the factory and worked to different agendas, carrying out activities which manufacturing felt did not support or align to factory priorities. Any activity with suppliers had to go through purchasing. Purchasing were the main source of contact with suppliers. Engineers who spoke to suppliers directly about technical issues without going through purchasing would get into trouble by the purchasing manager. The purchasing manager would often send complaints to the manufacturing manager about engineers. This caused great problems and conflict, particularly when no one within purchasing had technical understanding to fulfil customer requirements.

Internal support system

The only means of assessing supplier performance was by quality audits. Audits were carried out every 3 years and were initially completed for supplier selection by the quality department. Once the quality audit was completed the supplier received a quality rating from A to C. If an assessed supplier had IS09000 they automatically became a grade a supplier. Quality managed this whole activity and there was no involvement from engineering or purchasing. However, the top 200 suppliers were reviewed annually with purchasing. Engineering was excluded from reviewing suppliers despite being the customer who may have different needs to that of purchasing and quality. Also the audits did not take continuous improvement efforts into consideration and no review of real data or performance was used.

Very little historical information was available on suppliers. A new MRP system had been installed for 6 months, but no previous spend history was carried forward into the new system. Few performance measures were available except requisition turnaround and monthly price reductions. Supplier scrap was also recorded in the factory but no process had been established to recover poor quality costs from any suppliers who were identified as responsible.

In repeating cases if the quality defects caused too much pain to the factory the quality department would carry out root cause analysis with the supplier. The action plans would then be held centrally in quality, very little feedback was provided to purchasing or manufacturing. This situation was exacerbated as the quality department concerned with supplier audits and root cause analysis was located in Ruddington a village in Nottingham.

Supplier management

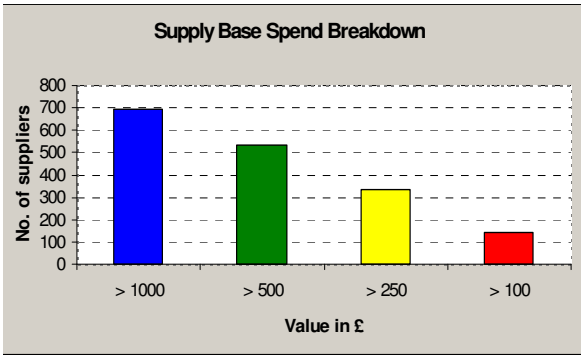
No process existed for capturing supplier improvement opportunities. Supplier development improvement opportunities relied on the external supplier providing informal feedback of innovative ideas. These ideas would be discussed with the buyer. If the buyer bought into the idea a team would be established for the project and it would be co-ordinated by Purchasing. Two purchasing employees regularly worked with the factory but other purchasing employees would continue transactional activities and not have any improvement teams in place.

The purchasing manager was responsible for procuring all raw materials that represented £9m of spend. This was almost half the total department spend. After five months the purchasing manager handed this over to a senior buyer to become more involved in people management and the strategy of the purchasing department.

RHP had a very large supply base in the UK. This was a major inhibiting factor as it was very difficult to manage. Managers were aware of the need to rationalise to a more manageable size. A purchasing team was established to review the 5,000 suppliers who provided parts for the 3 plants. The team consisted of purchasing personnel only. Monthly team meetings and discussion took place. The only historical data available on suppliers was the most recent spend. Available data was collected and plotted to show the number of suppliers. The suppliers were grouped into the following categories; RHP Group 1220, Aerospace 419, NSK 403 and European Headquarters 723 suppliers.

The RHP group included four sites Newark, Ferrybridge, Blackburn and Precision (another Newark site). An analysis of 1,020 suppliers was made to review the average spend levels. This was shown in Figure 16:

Figure 16: RHP



Source: RHP 1997

After 9 months the supplier rationalisation team was disbanded as the total number of suppliers remained unchanged. Data was not effectively gathered and analysed. Management were aware of the problem and established a team to implement changes. To fully implement changes would also require commitment from managers across the different UK plants.

Not making changes suggested that there were no internal pressures from within the business for 'the need to change' (Gattorna 2006). Also there was no methodology or framework developed to action the reduction in suppliers. For example, despite group purchasing emphasis on supplier rationalisation, there were still on average 2 new suppliers added each month by group quality, who were responsible for auditing and adding new suppliers.

Fundamentally the team leader and team did not know how to take their supply base data forward to carry out the improvement project.

With few performance measures and an increasingly large supply base many hidden costs to procurement were not captured and therefore not considered. The hidden costs included monitoring suppliers, auditing, assessing, processing and transport.

In 1997 RS Components used the Natwest cost of £40 to raise a purchase order. This meant if a buyer at RHP raised a purchase order for the price of £20 an additional £20 would be lost in the hidden transaction costs. RS Components were keen to encourage RHP to be more strategic. In 1996 RHP place 2,539 orders with RS the total good value was £248,568 the processing costs for these orders was £101, 560, the total acquisition cost was £350, 128. This meant there were hidden costs of 30% processing the cost of the order. This analysis only examined one account with RS Components. During 1997 RHP purchased goods by spot orders with 2,700 suppliers. There were many opportunities for RHP to reduce total acquisition costs.

4.4 External supplier development workshops

RHP recognised the need for a structured approach across the group for managing supplier development. This included establishing an internal system for co-ordinating supplier development across departments and carrying out the supplier development activities with suppliers.

RHP worked with the Society of Motor Manufacturers and Traders (SMMT) for 4 months to support the implementation a structured approach. The SMMT concept was developed in 1994 by the Government aimed at improving competitiveness. The SMMT were a non profit making improvement forum set up with experts on secondment from the automotive industry. When RHP worked with the SMMT they already had a successful track record of 40 improvement workshops.

The SMMT supported workshop activities on the shop floor at supplier locations. The 'focus group' approach was adopted at the supplier sites, bringing a representative from a number of suppliers into a study team, working with the industry forum.

RHP hoped that the SMMT would also assist with the internal co-ordination and establishment of an infrastructure to sustain supplier development. However, the SMMT expertise was focused entirely on data analysis (diagnostic) and workshop improvement activities.

This was evident in 1998 when the SMMT recorded company benefits of inline rejects reduced by 75%, scrap costs reduced by 59%, productivity increased by 124%, downtime reduced by 37% and changeovers reduced by 72%. After funding was agreed the next step was for RHP to initiate the pilot launch to senior management and internal functions.

It became evident that supply chain development focus enabled RHP senior managers to recognise the complexities of their company. The Engineering Manager expressed this:

> 'A concentrated approach in process improvement is definitely the way forward, RHP will need to push hard for the disciplines and support to be put in place.' Engineering Manager (1997:135).

It was good that early on the recognition was made for discipline and support to be established. RHP lacked a steering committee, a cross-functional team and a shared vision which would support the improvement drive at RHP, in order to sustain and embrace change.

The bearing had seven key components: balls, seals, inner rings, outer rings, clips, grease and packaging. The inner and outer rings were made in house. External strategic suppliers were selected for some of the component ranges, which made up the bearing. The suppliers who were involved in the pilot were illustrated in Table 15**.**

Table 15: Supplier Development Company Overview

	Desford	JRD	Mansfield	Synthotec
Turnover	£50m	£2.5m	£3.2m	£1.25m
Turnover RHP	£6m	£0.7m	£0.13m	£0.2m
No. of site employees	650	70	47	27
Products	Tube	Seals	Packaging	Plastic Cages
Ownership	Hayhall	Private	Remploy	Private

Source: Pilot supplier development programme

Firth Rixson was one of the selected suppliers but unfortunately they were not keen to participate in the workshops, as they did not see the value in carrying out a housekeeping activity (5S) at their forging site.

Firth Rixson saw it as a waste of time and money and could not see how their workforce would benefit. Despite managerial comments all employees worked in very dirty conditions and all the tools were scattered all over the floor. Senior management felt the cleanliness of the environment was acceptable because of the nature of their company.

The launch day successfully took place with five strategic suppliers. It consisted of the Managing Director and the purchasing manager delivering presentations, followed by the SMMT providing an overview of the tools and a timing plan of when the activities would take place.

There was initial resistance by suppliers due to a previous experience in which a supplier day was organised. resulting in many suppliers loosing business, as the agenda was to reduce price. The suppliers therefore expected a hidden agenda, but the drive was for RHP and the partnering suppliers to become more efficient and remove waste by working together.

After the launch day a meeting was made with senior management at the supplier location. Meetings were carried out in order to discuss the supplier's challenges and bottlenecks and to agree the most appropriate model area for an improvement. Before carrying out the supplier development workshop a reasonable understanding of the problem area had to be made. Data analysis took place to ensure the appropriate focus for the activity; this was known as the diagnostic. The resource for the activities included an SMMT engineer, supplier development co-ordinator, quality engineer and a manufacturing engineer from RHP. Data analysis meetings were held to review existing data collection and to determine what information was missed in the model area to gauge the current performance and determine the baseline position.

The first stage of the diagnostic involved an examination of the existing data. The data analysis would include productivity, downtime, rework and quality information. The data was analysed to assess the approach taken and to determine if there were any gaps in the existing data collection. Some of the suppliers had useful data, which was not utilised to its full potential by the company.

For example, some suppliers would measure downtime and not act upon the measures (Mansfield Amalgamated). No Pareto of the information took place and no root causes were identified. Other suppliers had data sheets introduced to the model area to enable the team to get a focus for the activity (Desford Tubes). Two suppliers had no measures at all (JRD Mouldings and Synthotec).

If there were gaps in the existing data collected by the supplier a data collection sheet was established with the operators and faxed back to RHP to support and review the analysis. Once information was available the data sheet was broken down into categories and a pareto analysis was carried out to establish the largest area of opportunity for the improvement workshop.

The SMMT encouraged the adoption of seven key measures commonly known as QCD. Quality, Cost and Delivery, expressed in Table 16.

Table 16: QCD Measures

	Quality	**Cost**	**Delivery**
None right first time	**O**	**O**	**O**
People productivity		**O**	
Stock turns	O	**O**	**O**
Overall equipment Effectiveness	O	**O**	O
Value added per person		**O**	
Floor space utilisation		**O**	
Delivery schedule achievement	O	O	O

Source: SMMT toolkit 1997

Key:

O primary

O secondary impact on the process

The SMMT were keen for RHP to adopt these measures with suppliers to ensure clarity, simplicity, feedback and benchmarking. However, all the emphasis of challenges led to three set up reduction workshops, a housekeeping workshop and process mapping.

The teams selected and included an enthusiastic operator for the activity. The operator had to be keen, as they would need to influence other operators when the activities were rolled across other areas on the shop floor. It was also essential that the supervisor or manager of the cell was committed and that they had top management support.

The appropriate tools and techniques were selected from SMED, 5S (housekeeping), 7 wastes, visual control and process mapping. The workshop timetable was then created to plan successful workshops. There was limited time to carry out analysis of the existing performance and make changes and pilot those changes, so planning and organising effective time management was critical. Table 17 illustrated the supplier development activity focus and improvement tools.

Table 17: Workshop focus and tools

Supplier & Product Type	Workshop Dates	Team Size	Workshop Focus	Tools and Techniques
Desford Tubes Hot & Cold rolled seamless tube	5-8 May	9	Mill stand changeover reduction	SMED 5S
JRD Mouldings Bearing seal moulded assemblies	29 Apr – 1 May	5	Process mapping Lead-time reduction	Process Mapping
Mansfield Amalgamated Packaging	2-5 June	5	Cutting / creasing machine changeover reduction	SMED 5S
Synthotec Ball cage moulding	9-12 June	6	Moulding machine changeover reduction and housekeeping	SMED 5S

Source: RHP 1997

RHP held the first supplier focus group on the DAC2004 assembly line. This assembly line was analysed and mapped earlier in the procurement process review. A line balancing activity took place over 5 days. The assembly line produced the rear wheel bearing for the Ford transit van (at RHP Newark). This was Newark's biggest runner for 1997, producing 220,000 bearings over the year.

During the week the team studied the 27 foot line working closely with the operators. Each operation was examined and activities and times undertaken. Each operation was reconfigured to align with the external customer demand. The team examined and aligned the flow of parts to meet the customer needs, so that the parts were pulled through the processes. The team made a full size model of the line in cardboard and laid

it next to the actual line on the shop floor. All the operators reviewed and moved the cardboard to gauge the best positioning for equipment and removal of waste. At the end of the improvement activity there were many lengths of conveyor belt disposed of.

As the line was for one customer with a constant monthly demand a takt time (drum beat) was calculated by dividing the demand over the total available hours. A steady output was then known for each day. By the end of the week the assembly line had been reconfigured to a U cell with the total length reduced from 76 feet to 54 four feet. Reducing the number of operations on the line meant that fewer operators were needed, 3 full time operators were re-deployed within the factory, to get involved in other value added activities. When speaking to the operators those that were re-deployed were all very positive and saw the changes necessary. Operators that had to move onto new machines were a little concerned about their new role but saw the change as an exciting opportunity. RHP strongly upheld a no redundancy policy as a result of continuous improvement.

By June 1998 the U cell production approach had been transferred to 3 additional lines which were moved from another area closer to the grinding process. By having the U cell layout additional floor space was also released. Performance measurement sheets were adopted on the line.
The data analysis was given to the team leader who had not had to analyse performance data before. A separate team was also established to carry out a full 5S housekeeping activity. RHP superseded the written operating procedures by having photographs explaining each activity visually instead. The operators found visual standards user friendly and they were regularly referred too.

Nine months later RHP utilised this approach on the remaining 12 assembly lines and relocated these lines to the grinding areas. The supplier development methodology had an astonishing impact at RHP and senior management were committed to improve processes further. The engineering manager and total quality manager gained board approval to reorganise the factory to release eight senior engineers full time onto an improvement activity team, to continue to effectively develop improvements in operational areas.

4.4.1 Action research case study - supplier Desford Tubes

Desford Tubes (DT) was RHP's main source for tubing. The tubing was used to make the rings for the bearings. Desford was part of the Hayhall Group. DT was first established during the Second World War and located in a small village called Desford in Leicestershire. DT has been supplying RHP since 1985. Desford's turnover was £50m, £6m was with RHP.

Supplier development approach

The 4 day activity concentrated on changeover time reduction. DT heavily focused on changeover reduction and had measurements in place to record downtime. The team consisted of 9 resources, an engineer, 3 operators, a crane driver from DT, a quality engineer, manufacturing engineer and supplier development co-ordinator from RHP and a production manager from Mansfield Amalgamated (RHP's packaging supplier).

Changeover reduction activity

The Director at DT was very positive and excited about further process improvements:

> 'We have already carried out a lot of process improvement but welcome the opportunity of further improvements and support from RHP.'
> Director (1997)

Despite DT already carrying out improvement activities the Director was keen to have the involvement of his customer in developing his company and welcomed new ideas.

DT was already collecting good data to understand the performance of their processes. A full time position was totally dedicated to the measurements of processes. The team used available data to graph planned and unplanned downtime and to understand what proportions of time were spent on each activity. Figure 17 showed the total planned and unplanned downtimes, Figure 18 planned and unplanned downtime, Figure 19 Unplanned downtime.

Figure 17

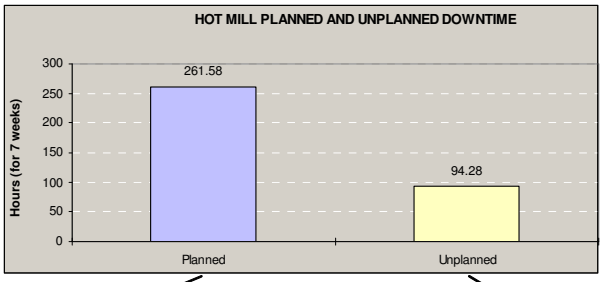


Figure 18

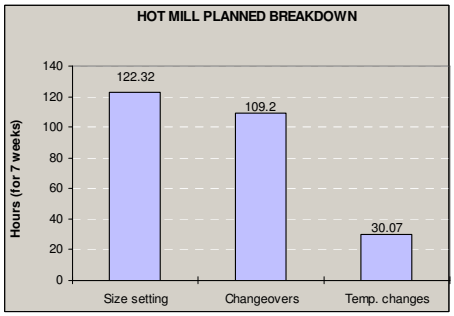


Figure 19

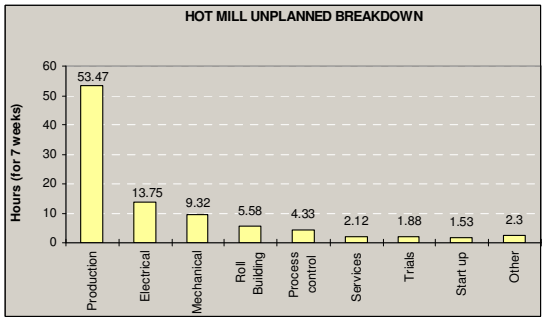
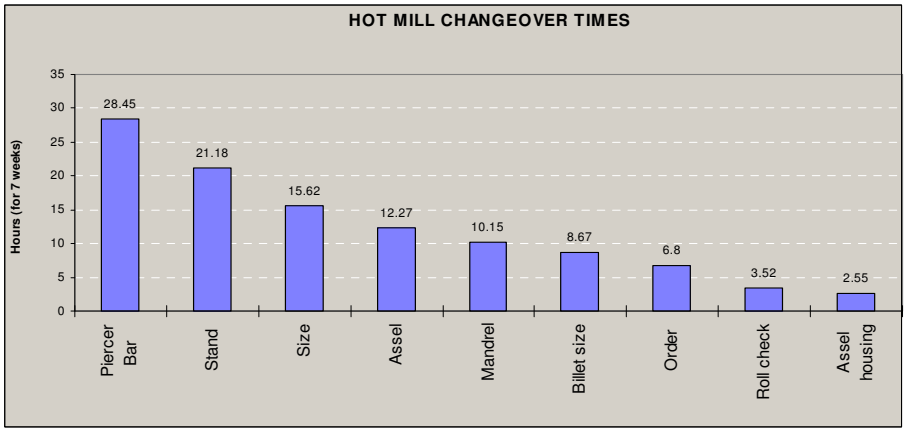


Figure 20: Changeover downtime



Source: Desford Tubes 1997

This was extremely useful to funnel down and focus on the improvement activity which will provide the best return for the company. There were already improvements underway to investigate the highest pareto on the piercer bar; the next largest opportunity was stand changeovers. Table 18 showed the average changeover and frequency time to help focus on the appropriate changeover.

Table 18: Average changeover and frequency

Average Minutes	6.13	10.00	2.49	61.3	5.15	47.3	1.46	3.91	51.00
Frequency	278	126	376	12	118	11	279	54	3

Using the standardised approach the changeover time, when first videoed, was only 10 minutes long. It was over so quick, there was a crane driver and 3 operators involved, as the stand was a very large heavy piece of equipment. The team examined all the process steps. In the old process an operator got involved half way through. By re-engineering each step the third operator's tasks were incorporated into the other two operators' activities. This safely removed the need for a third person. There was a lot of data recorded within the stand change that the team were able to reduce and simplify.

When the changes were put into practice and re-videoed on day 4, the team successfully reduced the changeover time by 50%, bringing the stand change time down to a sustainable 5 minutes by the new procedure.

Process and relationship inhibitors and enablers

The behaviour of the operators needed managing as there was no foreman on the team and the operators would drift in and out of activities. The improvement team had to get senior managers' to fully release the operators to concentrate on the improvement. Operators were concerned about production, having to do other work and no-one properly communicating with them after the confirmation from senior management they remained more focused. At the management presentation senior management were overjoyed with the results. DT had increased work coming through and did not have the capacity to support the demand within the plant. Senior management were going to extend the plant at a cost of £250,000, but from the changeover reduction this was no longer necessary. They would transfer the approach to other bottleneck areas and fully utilise the existing plant.

Short term and long term activity outcomes

From the set up reduction the operators learnt the new procedure instantly and 50% improvement was continually maintained. The data collection was simplified and the tools and techniques understood so that the engineer involved would roll out the approach across other areas of manufacturing.

Summary

Despite being an historical brown field site the senior management were open to change and new approaches. The senior management never extended the plant and took full advantage of implementing the tools and techniques across the existing plant, for further company benefit and sustainable continuous improvement.

4.4.2 Action research case study - supplier JRD

JRD, a private owned company, was established in the 1950s by the current Managing Director. This supplier had worked with RHP over 17 years and was the main source of supply for rubber seals. JRD's turnover was £2.5m, £700,000 of which was with RHP, 28% of JRD's turnover was with RHP, so they were a key customer.

Supplier development approach

The four day activity concentrated on process mapping. JRD were very constrained by available space and were investigating the opportunity of purchasing a new warehouse. The mapping would assist them in understanding the current flow and provide opportunity for improvement. A report was handed over on the last day as most of the management were out on business. The team consisted of JRD's engineer, quality engineer, manufacturing engineer, supplier development co-ordinator and a production manager, a representative from MA.

Process mapping activity

The Director's attitude was negative, when the team arrived, before the activity had begun:

> 'I can't see how this will help us; we know our business and we have just outgrown this facility.' Director from JRD (1997).

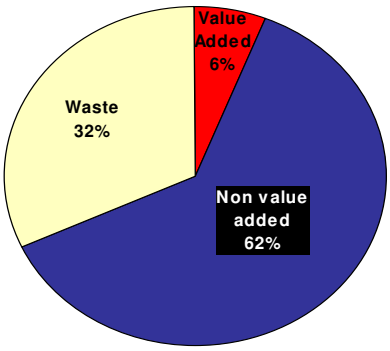
The director clearly expressed that he saw no value in what RHP was attempting to do. The director inhibited supply chain development with the negative attitude. They were evidently constrained with their existing facility but the director had an unwillingness to listen to new ideas and best practice from their key customer. This would give a poor message to employees and lack commitment to support process mapping.

The team had arrived to carry out the workshop which JRD had arranged with RHP three months earlier. Despite this poor welcome the team continued. To capture the detail of each process the team split up and walked each step, starting with the requirement coming through the post to parts being shipped.

The process study revealed that all correspondence went through the Managing Director who held the majority of the planning and pricing in his head. There was very poor visibility of processes and great reliance on his knowledge and input. More worryingly the Managing Director was retiring that year and his son, who was currently the director, was to take over. The director was supposed to be on the team but kept getting pulled away. He expressed his comments that he really did not see the value or want to get involved. There was so much work to do, yet the Director had one of the days off, despite 3 months notice.

Ninety five stages where identified to the process. The team captured distance travelled, whether it was an operation, transportation, inspection, store or delay. Each stage was also categorised into value added (machined) non-value add (may be necessary such as a regulation or test) or waste. The pie chart below summarises the percentages found for each category. A typical process was made up of 5% value add, 35% non value added and 60% waste (LERC 1998). In JRD's case there was a lot less waste but greater non value added activities, illustrated in Figure 21.

Figure 21: Percentage breakdown of process mapping findings



Source: JRD

The process steps were categorised into P types. This helped visualise further how the activities were split. The P time was the total lead time from procurement of material to delivery of the finished part at the customer, illustrated in Table 19.

Table 19: JRD process mapping results

P Type	Scope	Hours	Percentage
P1	Procurement time – the time taken to obtain raw material and sub components.	19730	41.17
P2	Non specific process time – the time from receipt of materials to when a part number is assigned.	310	0.65
P3	Specific process time – the time taken to complete the part.	25573.5	55.59
P4	Storage – the time the part is held in stock to the point of despatch.	1424.5	2.97
P5	Delivery the time from point of despatch to receipt at the customer.	880	1.84

Source: RHP 1997

Table 19 revealed that 42% of the time was taken up by the procurement activities to obtain raw materials and subcomponents. Also 56% of the time was used for manufacturing. Separate workshops could be organised to reduce the times taken up by these activities.

Process and relationship inhibitors and enablers

JRD was a traditional British engineering company, which had been in existence since the 1950s. Most of the management team had been there for many years and were approaching retirement age. The company faced some major decisions with regard to

expansion and the Managing Director retiring. The process mapping investigation provided some useful information that could assist in strategic decision making and improving the process. However, the behaviour of the director heavily influenced the lack of buy in to using the process mapping material.

The director clearly did not want to carry out the activity and saw little value for it. As there was no senior management commitment JRD employees could not understand the value of the process mapping workshop. All the hard work of the improvement team was never applied. The improvement activity made the RHP employees and business planning manager aware of the constraints of not having access to information for decision making purposes. The Managing Director held all the pricing, material information and procedures. The management were not interested in process improvement implementation.

Short term activity outcomes

The team applied process mapping to JRD and gained a good understanding of the company. The MA representative had applied this tool and could take this knowledge and application back to his company. The employees at JRD had an appreciation of the impact of over reliance on a person, rather than that information being readily available from the process. The employees needed to create pricing and material procedures. The management also had awareness that most of the value added work was outsourced. For example, the entire trimming process was undertaken outside the business. There was a great opportunity to manage this in house and remove some of the non value added and wasteful activities.

Summary

In the past JRD had been very involved and supportive with RHP. During the workshop senior management saw little benefit to the process mapping workshop. After the process mapping workshop JRD never prioritised or undertook the developments, despite RHP's encouragement. As few processes were mapped and the Managing Director was involved in a lot of decision making activities, the Managing Director had to stay past his retirement. His management team did not have the confidence that they could run the business without him. For JRD it was 'business as usual.' The senior management attitude at JRD was a major inhibitor for RHP's supply chain development.

4.4.3 Action research case study - supplier Mansfield Amalgamated

Mansfield Amalgamated Ltd (MA) was RHP's main source for packaging. MA was part of the Remploy Group, who was formed by the Government to provide disabled people with work. MA had a close working relationship with RHP, it had been supplying packaging for over 10 years and management were very pleased to be involved in this supplier development activity.

MA had 47 employees and a turnover of £3.2m, £130,000 of which was with RHP.

Supplier development approach

The 4 day activity was a changeover reduction (SMED) on the cutting machine which included a presentation to the management team on the last day. The 5 member team consisted of an operator, production manager, quality engineer, manufacturing engineer and supplier development co-ordinator.

Changeover activity

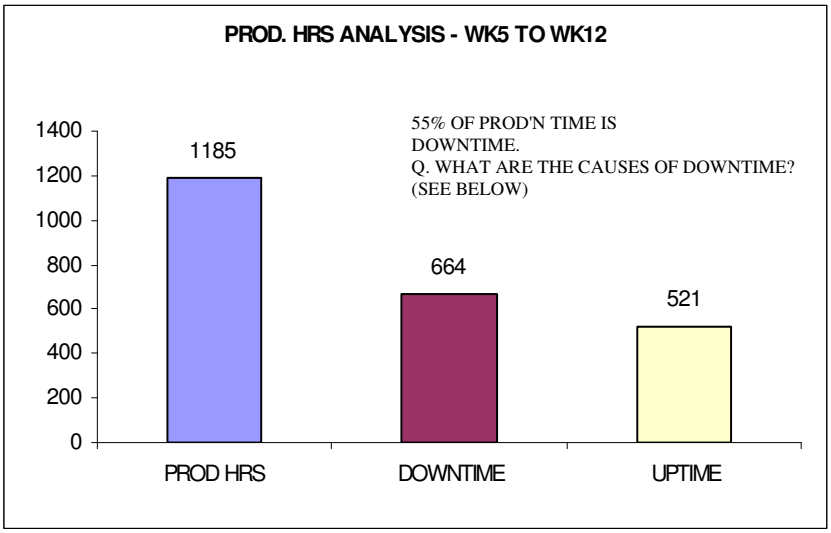
MA regularly collected data and produced graphs on the business, but no actions or workshops took place from the data. The Production Manager was relieved to see the data analysis being used:

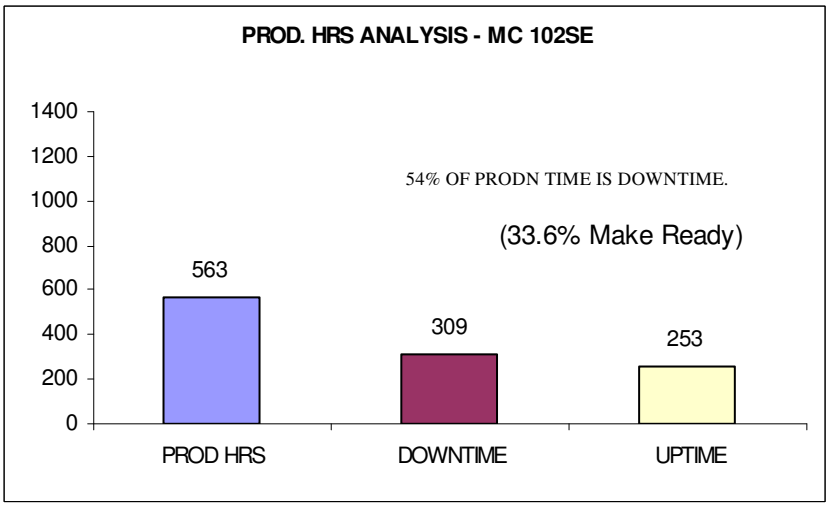
> 'We have been collecting this data for many years it is good to see it being put to practical use to get the benefit from it.' MA Production Manager (1997)

MA collected very good data on their machine utilisation, this made it easy for the team to produce graphs and quickly agree the focus. MA had not implemented changes before as they were inhibited by a lack of understanding for the tools and techniques. The Managing Director had an excellent rapport with employees on the shop floor as he would often take the time to got and talk to them and listen to what they were doing and their ideas, the shop floor found him very approachable.

Figure 22 showed the production analysis displayed as bar charts, 34% of the downtime was due to changeovers, MA calls this 'make ready'. The team quickly chose the machine and changeover which would be the focus of the improvement.

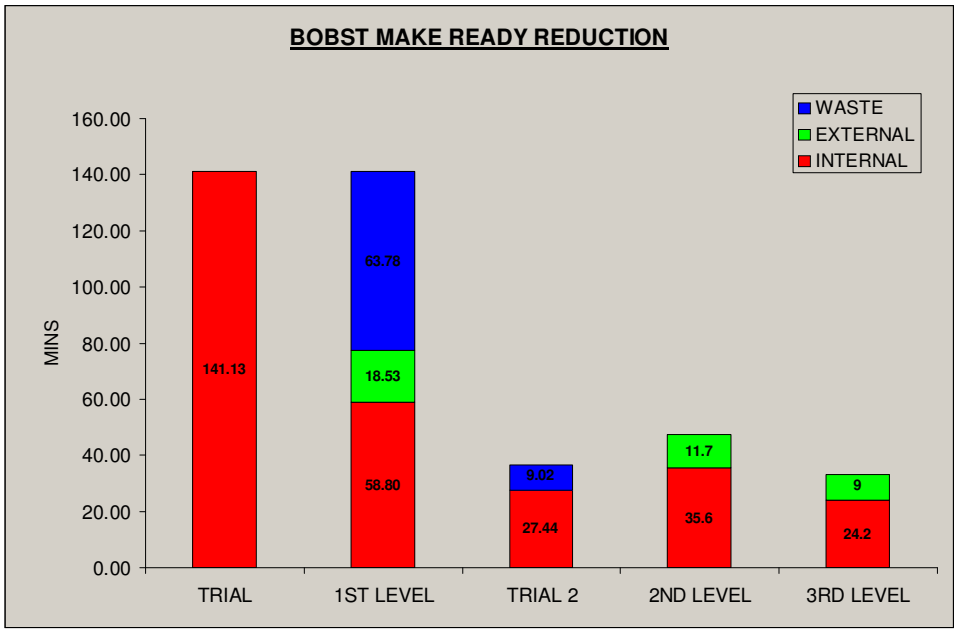
Figure 22: MA production hours analysis





Using the standardised approach the changeover time was reduced from 141 minutes to a final video result of 27 minutes. By MA implementing the longer term improvement ideas they could benefit with an overall 83% reduction. This improvement result would enable MA to effectively utilise their existing cutting machines, increasing the available production capacity. Figure 23: showed the results of the improvement at MA.

Figure 23: MA Changeover Reduction Improvement



Source: MA workshop 1997

Process and relationship inhibitors and enablers

Because MA's materials were used to package bearings the management felt they were not often invited to get involved in strategic opportunities with RHP. The focus was always on parts supplied to make up the bearing. MA management team had many cost reduction ideas they wanted to discuss with RHP and never felt they got the opportunities for this to happen.

The MA management team also expressed that too much of the packaging was over specified and for many customers the packaging was for transportation and would be discarded very quickly.

Despite the buyer and purchasing manager being aware of this they continued to purchase packaging material which was higher priced as the product was over specified.

The behaviour of the foreman on the set up reduction team made the activity very easy. He was very hands on and encouraged the operators and put them at ease when they had any concerns.

Short term activity outcomes

From the set up reduction the team produced a standard operating procedure. If the procedure was used MA would maintain a set up of 27 minutes. All employees grasped the objectives; in particular the production manager and Managing Director who were keen to drive this forward. Problem follow up sheets were also created with short term and long term ideas that needed further investigation.

Long term activity outcomes

If the set up operating procedure was maintained and the long term follow up was implemented, MA would be able to achieve the long term target of 83%. If the resource commitment and SMED technique were re-applied the approach could be taken to all appropriate areas on the shop floor.

Summary

The MA Management Team was very keen to develop these approaches. The team were encouraged by the presentation at the end of the week. Senior management were impressed with the outcomes and wanted to make these approaches part of their production culture.

MA wanted to have more activities like this with RHP. The Managing Director arranged to present this approach and results to the rest of the group in the UK, to influence senior management in other units to adopt these approaches.

4.4.4 Action research case study - supplier Synthotec

Synthotec (S) was RHP's main source of plastic cage supply. S was formed from a management buy out in the late 1980s. S had become a successful business, which had seen steady growth throughout the last ten years. S was privately owned with a turnover of £1.25m. Almost 40% of the turnover was from NSK-RHP. The researcher felt this amount of spend with one supplier was very high risk. There were 27 employees located at Malvern. S had invested heavily in automated injection moulding machines but was constrained by a lack of floor space.

Supplier development approach

The four day activity had two areas of improvement, a change over reduction and a housekeeping activity. The team was divided into 2 to carry out activities in parallel. Progress on each activity was reviewed together at the end of each day and a presentation to management on the last day. The team resource included an engineer, operator, foreman, process engineer, quality engineer and supplier development co-ordinator.

Despite only having 27 employees everybody worked individually and carried out their roles as they saw fit. This approach was encouraged by the Managing Director:

> 'I have highly qualified specialists running my business they are the experts in their field and are left to get on with what they know'. S MD (1997).

This comment from the Managing Director was concerning as there was no strategy, key performance indicators, standard processes or competencies identified. It was therefore difficult for the Managing Director to see how his business was performing except for his financial reports. The Managing Director had recently appointed a senior engineer from Canada.

The Senior Engineer expressed his concerns:

> 'It's like working in a mental hospital here, everybody has really strong overbearing personalities, nobody works together and nothing ever gets done'. Senior Engineer (1997)

It was a shame that after all the investment taken to recruit this senior engineer, he was de-motivated and frustrated as the small workforce did not work together as a team. The strong personalities and fixed individual opinions were highlighted further from the shop floor foreman:

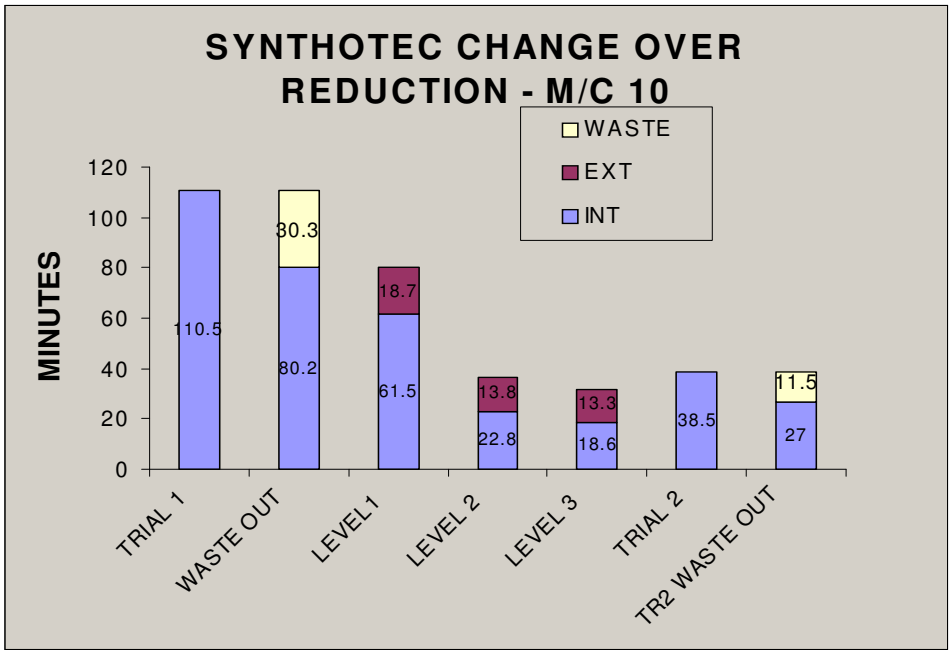
> 'This is all theory and fluffy sky thinking. We are working in the injection moulding business and none of this talk is relevant to us' The Foreman (1997)

The foreman chose not to listen or learn from RHP and the application of best practice tools and techniques to S. Instead the foremen chose to believe that these approaches were not relevant.

Using the standardised approach, the changeover time was reduced from over 80 minutes to a final video result of 20 minutes. The long term improvement would provide S with almost an 80% reduction in changeover times. This implementation would enable S to more effectively utilise their existing moulding machines and increase their available production capacity. This would also enable S to increase their flexibility allowing them to run with smaller batch sizes and in turn free up valuable floor space.

Figure 24 shows the reductions at S. Level 2 was achieved during the improvement activity.

Figure 24: S Improvement Results.



Source: Synthotec Workshop 1997

The housekeeping activity

The housekeeping team cleared the work area of unnecessary clutter, which provided much better visual control on the shop floor. Items that were not regularly required were stored away from the immediate area. This created much more space around the machines. All other equipment was identified, labelled and allocated to a place within the workspace. The team completely cleaned one machine and red tagged any technical

problems. When the cleaning was complete the cleanliness on the machine was even higher than that of a recently purchased new machine.

One exercise was housekeeping a large toolbox. A matrix was marked in tape on the floor to put tools in boxes marked 'daily', 'frequently', 'infrequently' and 'never used' boxes. The 'never used' tools were removed; duplicated tools of more than two were also removed.

The changeover tools were then located in their own new box, which could be taken to the required machine when a changeover was to take place. These simple activities enabled operators to have better and quicker access to the right tools when they were required.

The team marked out designated areas on the shop floor for each job so that there was 'a place for everything and everything in its place'. This was simply achieved through temporary markings using coloured sticky tape. A hand written template was also created for the shop floor to carry out housekeeping audits.

Process and relationship inhibitors and enablers

At S they did not work with Microsoft compatible I.T. systems, this caused difficulty with data and access to information. The company had to decide where to allocate the designated areas for work in progress (WIP) and for empty pallets and finished goods. Nobody appeared accountable to make decisions.

The behaviour of the foreman on the set up reduction team made the activity difficult. The foreman felt threatened by the programme and was very resistant to any changes or ideas. The foreman often took team ideas as personal criticism on his existing work practices and was against any new ways of working

From the management presentation at the end of the week it was disappointing that Senior Management were not impressed with the outcomes. Management missed the point of the activity. The team workshop was to learn and apply two successful tools to improve their business. These tools could then be applied across the whole shop floor. During the four day activity the team removed waste, improved efficiency and contributed to greater productivity gains through very little or no cost.

However, management at S were heavily influenced by the Foreman, they did not see the full potential of the application and particularly felt it was 'theoretical' and based on an 'ideal situation', even though the changeover was videoed, analysed and the improvements carried out and re-videoed before Friday's presentation.

Senior management appeared happy to continue investing capital for new machines, despite other machines not realising full capacity, which was evident through the data analysis presented. They over produced for customers months in advance and stored components on the shop floor, taking up a third of the area. Rather than moving towards JIT they were interested in looking at purchasing a warehouse which would incur further inventory costs and larger overheads.

The S Managing Director was happy to leave his managers and employees to continue making their own decisions about their parts of the business. The foreman was left to run the shop floor and the planning manager could plan the business as they liked. Delegation was effective for empowering employees. Nevertheless, their decisions were never challenged or questioned and no cost benefit or capital expenditure proposals were undertaken. The decisions could be made on managers gut feel.

Short term activity outcomes

The team produced a standard operating procedure from the set up reduction. If the procedure was used S would maintain a set up of 39 minutes, which was achieved in the trial. If they did not use the procedure the set up would stay at the original time of 111 minutes. Two of the employees grasped the objectives, the quality manager and the champion who was the new senior engineer. Problem follow up sheets were created for both activities. When the team departed S began to designate product areas for the housekeeping activity to progress.

Long term activity outcomes

If the set up operating procedures were maintained and the long term follow up implemented S would be able to achieve the long term target of an 80% reduction in set up times. If the resource commitment and technique was reapplied the approach could be taken to all machines across the shop floor.

If the workforce maintained the level of cleanliness on the shop floor, by housekeeping audits, a very high level of housekeeping standards would be achieved. This would be very impressive to the workforce, visitors and customers.

Summary

The tools and techniques provided small step change improvements to S. If the approach and initiatives were not maintained there would be no affect on their culture. The engineer assured RHP he would encourage the operators to adopt the discipline of using the procedure to maintain the short term benefit. S displayed negative feedback at the presentation which gave RHP great concern. Ultimately it was their decision as to whether they wanted to carry this kind of approach forward. S management were more interested in purchasing a warehouse and new machines, 2 at £500,000 each, when their old machines were are not fully utilised. Other companies were moving towards a leaner approach and moving away from having too much cost absorbed in material and storage. The S company was also in a high risk situation having 40% of its turnover with NSK-RHP.

4.4.5 Supplier development cross case analysis

This section compares and contrasts by cross case analysis each supplier development workshop, the key themes and the outcomes. Three of the supplier workshops used the same timing plan and tools and techniques however, very different results emerged. The difference in results was because of the attitude and commitment of senior management at each supplier location.

Results were also affected by the behaviour of different personalities within the team and the level cultural evolvement and environment of each business. Comparing and contrasting each supplier workshop explored these findings further.

Supplier case analysis

Desford and MA had positive senior managers' who embraced change and were very keen to adopt tools and techniques that were new to their business. Both companies already collected and reported data and had a team atmosphere. Desford already carried out regular improvement workshops on their shop floor. MA were keen to carry out actions from the data but were unclear on how best to approach it prior to the workshop. As a result, Desford saved money by not needing to invest in a further plant costing

£500k and also increased productivity by £250k annually. MA gained productivity improvement for the machine of £150k annually, which would be rolled out into other areas of the factory by the production manager. At MA the Managing Director took these approaches to the Group and established a network with other sites across the UK for productivity improvement.

S executive management left their senior management to run the business. The executive team and senior management were not prepared to learn about new approaches and did not listen to what their customer said or care to understand best practice. Senior management choose to see their company as 'unique' by thinking of the products and not process. The executive management took their senior management comments at face value, so when the foreman said this was 'blue sky and theoretical' executive management believed him. As a result S did not benefit by rolling this onto other machines, instead senior management chose to continue to reinvest in new machinery, when existing machines were sub optimised with downtime as poor as 60% and the rental of a warehouse to store finished parts. JRD was a family business heavily directed and controlled by the Managing Director. All knowledge and pricing information of the business was held in the Managing Director's head. Unfortunately, none of this information was captured in processes and was therefore a risk to the business. JRD did not continue to adopt new manufacturing approaches but fortunately maintained a steady production output. Because there was so much reliance on the Managing Director he was not able to retire, as planned.

Overall negative attitude and lack of commitment were two of the main inhibitors of supply chain management. A positive senior management outlook, leading by example and openness to embrace change was two of the main enablers of supply chain management.

4.5 Strategic purchasing development

The purchasing field in the UK had to face a transition of change across many industry sectors. Purchasing (also known as procurement and sourcing) had all undergone, or was going through change to support supply chain development. Outside RHP there was emphasis on supply chain management by process improvement using lean and six sigma methodologies.

More advanced purchasing departments' assigned full time resource to strategic purchasing, supplier development and supply chain management. These companies made strong links with universities or consultants for medium term support. As an example, RS Components had created a strategic purchasing support team who provided support to cross functional process teams established rather than functions.

The automotive industry had supplier development managers assigned to co-ordinate activities. Purchasing goods and services were also bought on behalf of sites. Purchasing stretched across the whole of Europe or for advanced companies global purchasing, where a central country managed procurement for companies across the globe. More companies were taking advantage of information technology, e-procurement utilising methods such as auctions, product development and bidding on the internet.

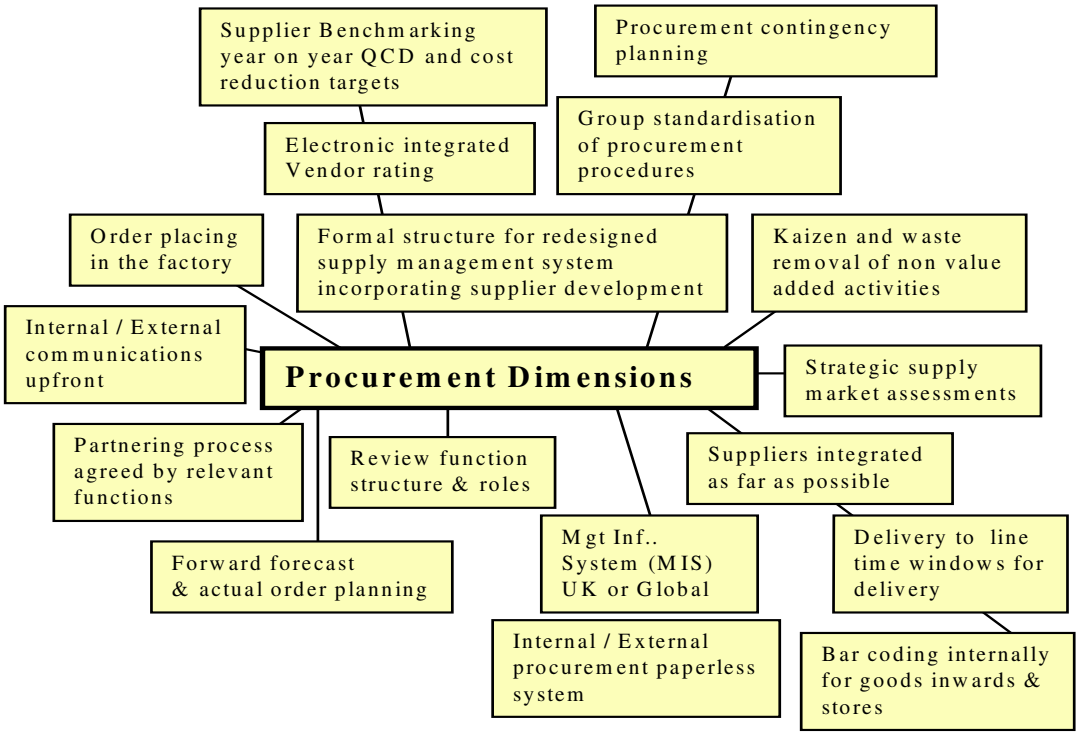
At RHP management and control of suppliers was made by purchasing for UK parts only. This included supplier selection and rationalisation without technical manufacturing involvement.

Each industry attempted to move away from sole management and control of suppliers by purchasing and got relevant employees across the company involved in supply chain management.

RHP did not organise the internal supplier co-ordination prior to the supplier development activities. The management team at RHP was very ambitious about their expectations. They attempted to deliver so many activities in one year which realistically could take up to 8 years to fully implement. Whilst the supplier development activities took place, awareness training and education had to be made with purchasing and quality. This was extremely important to educate and challenge the mindset and attitude of employees within these departments.

It was important for purchasing and quality to share a vision of what they expected the departments to be like in the future. This was brainstormed and is shown in Figure 25: RHP procurement dimensions.

Figure 25: RHP procurement dimensions

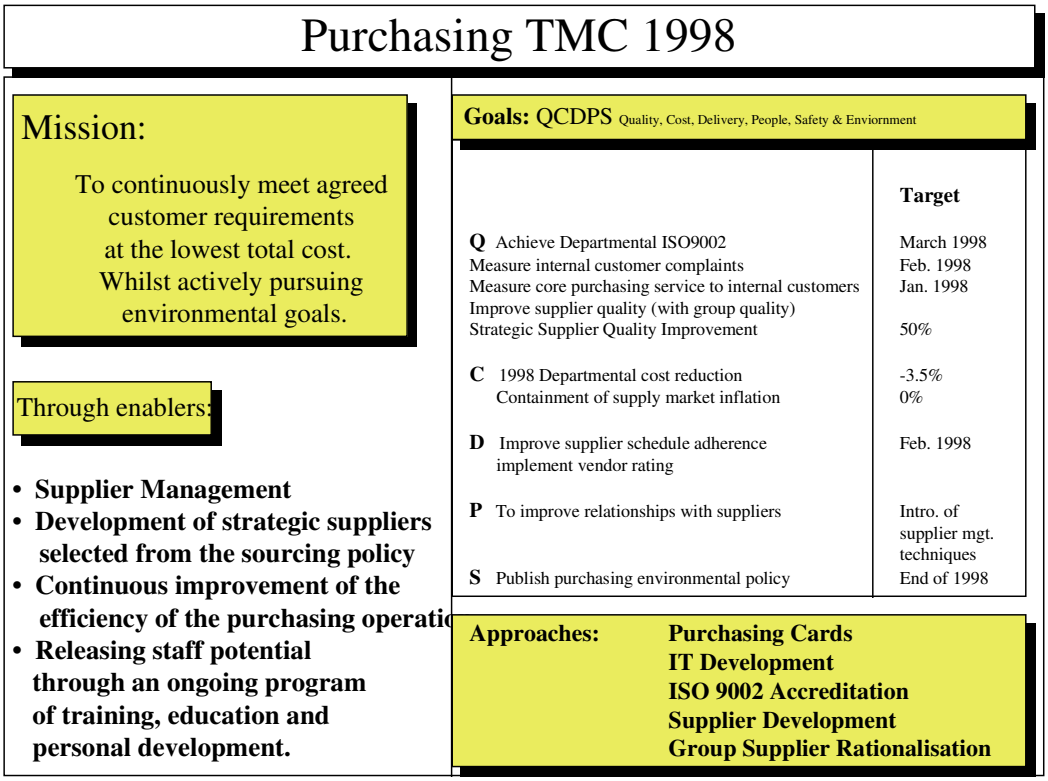


Source: RHP 1997

After the vision was developed it was categorised into short, medium and long term goals. The purchasing management set strategic objectives aligned with the company strategy, to deliver business results.

The policy was communicated across sites in the UK. This raised the level of the purchasing department and aligned them with other departments across the company. For the first time purchasing would become involved in the company total management concept (TMC). Quality had already been integrated. The top level TMC for sourcing is illustrated in Figure 26.

Figure 26: Purchasing TMC



Source: RHP 1998

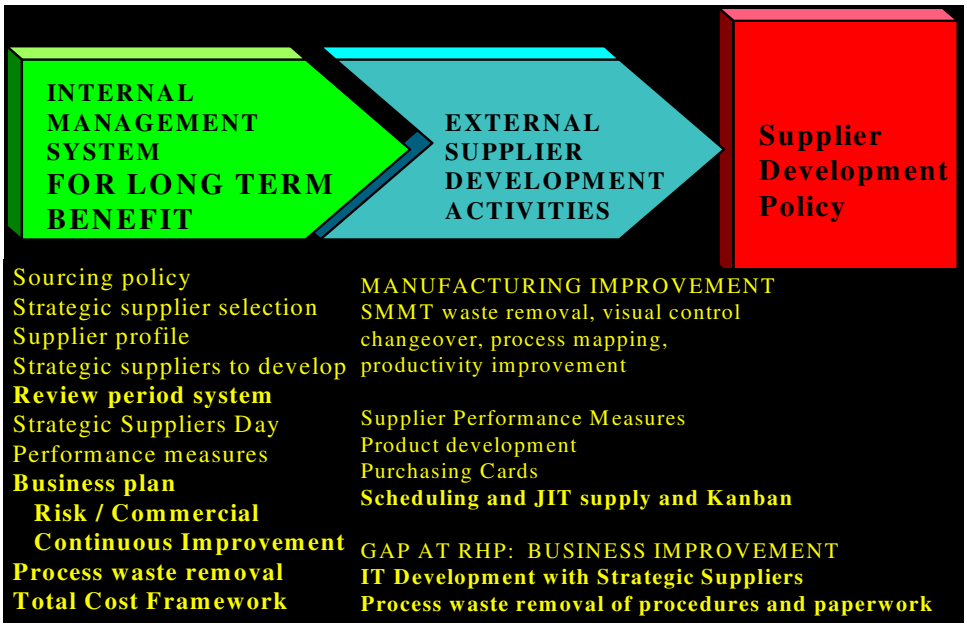
A sourcing policy was developed to identify strategic suppliers and RHP's goals and approaches. This was essential to focus developments on key suppliers. In total there were 20 strategic suppliers, which made supplier development more manageable.

A selection criteria was used to review and monitor other production suppliers. Joint agreement and deployment to senior management and internal departments were targeted for the end of 1998. Overall the policy allowed time and resource to be focused on strategic suppliers.

To drive delivery of the TMC the purchasing manager made the buyers become champions for supplier development activities. The champions were put in place, even if they were not involved in the supplier development projects, as the purchasing manager wanted buyers to feel involved in project co-ordination.

A working model was created which provided a visual diagram of the internal management system areas and external supplier development activities. This was produced to ensure an internal management system was in place to support the external supplier development activities. Figure 27 shows the supplier development model for internal and external activities.

Figure 27: Supplier development model

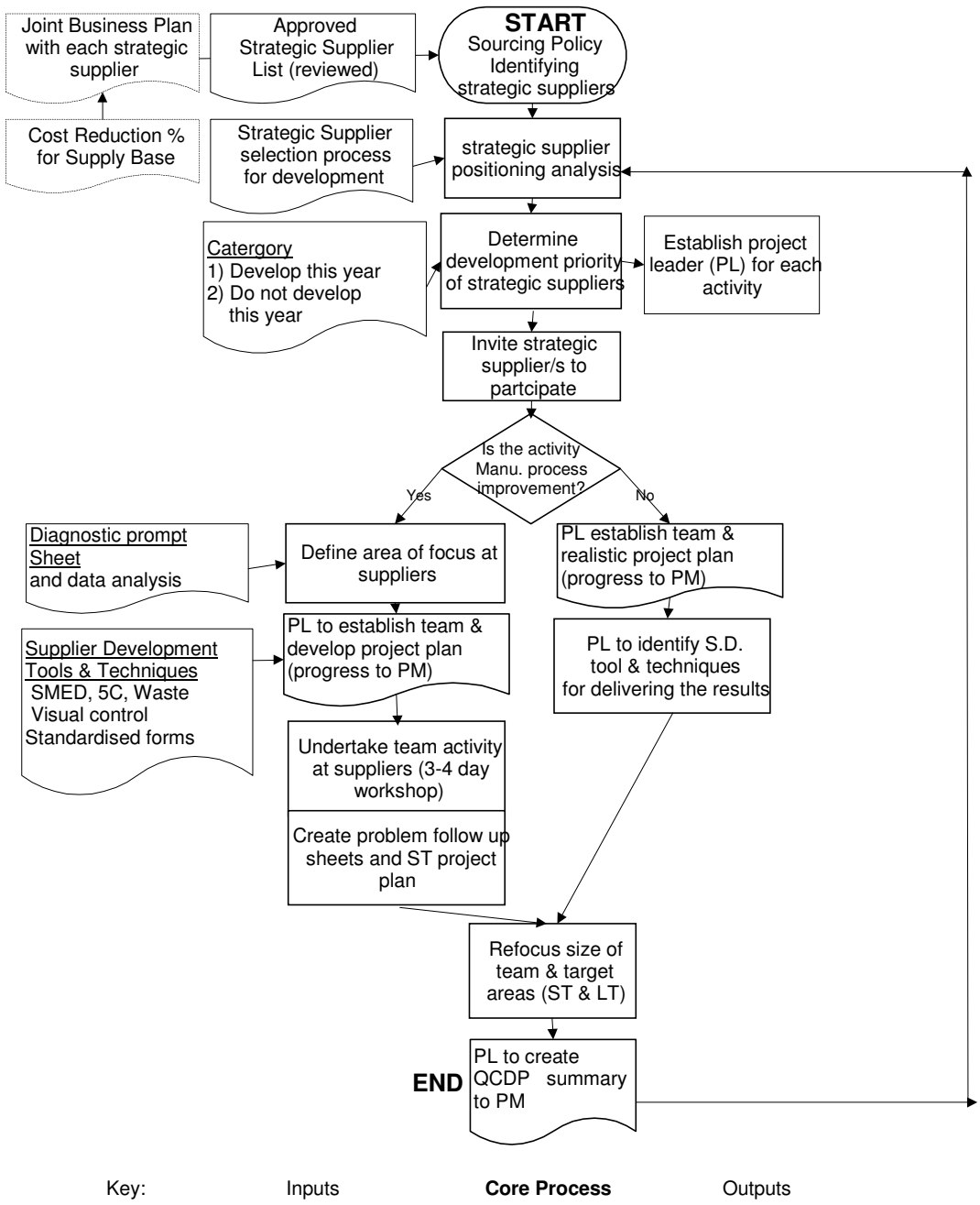


Source: Research findings.

A supplier profile was created to obtain more information on all suppliers and to build up a portfolio of their business. A supplier development policy statement was developed; the template is in Appendix 2. The next progression was a joint business plan between RHP and individual strategic suppliers to ensure commitment between both parties for commercial planning, risk sharing and continuous improvement activities.

Business process waste removal was an area which RHP did not focus on. RHP was out of touch with the latest thinking on scheduling, JIT and Kanban. The standard cost culture constrained a total cost of ownership approach. However a framework or checklist should have been developed to review the total cost of suppliers. To support deployment of the supplier development model a flowchart was created to bring the process together. This was shown in Figure 28.

Figure 28: Supplier development process framework



Source: RHP

PL - purchasing leader PM - purchasing manager
ST - short term LT - long term
QCDP - Quality, Cost, Delivery and People

Sustainability of the supplier development process at RHP was concerning. Production and non production purchasing resource had become heavily constrained by administration, order placing and chasing. The supplier development programme was progressing to a point where the purchasing department would have to manage supplier development. The purchasing manager did not want an individual to co-ordinate and drive the activity after the pilot. The purchasing manager restructured and reviewed roles and responsibilities to meet the changing needs for strategic purchasing. Purchasing was in a position to proactively work with other departments on supplier development and other strategic purchasing issues.

Previous to the supplier development pilot workshops with the SMMT, RHP was reactive with their suppliers and very few supplier development activities took place. Supplier management only existed by the quality assessments carried out every three years and supplier demerit ratings on quality performance measured continually from incoming deliveries.

Although these systems were still in place for all suppliers, a new tier level had been created for further focus to be made on strategic suppliers and the creation of a sourcing policy and selection checklist. The profile of purchasing was also raised and they had become an integral part of the RHP TMC culture.

It was clear that processes should be developed for the department to become more involved in strategic purchasing activities. There were varying levels of skills and capabilities with the buyers. Those that had potential to be more strategic were too heavily tied up with administration and order placing. If a separate group of strategic specialists supported buyers and drove changes through, more development work and changes could be implemented.

The purchasing manager closed the supplier development co-ordinator role to encourage buyers to co-ordinate supplier development approaches. Unfortunately, due to lack of time and resource and the ability to adopt and apply supplier development, all the processes were put on hold.

Nevertheless, the workshop activities on the Newark RHP shop floor continued. After the success of the supplier development projects the manufacturing director pulled eight of his best senior engineers into a full time improvement team.

The team was made responsible for carrying out improvement activities across the shop floor. The team maintained the philosophy across all of the manufacturing groups.

During the establishment of the supplier development programme and workshops, the purchasing department remained overstretched with order placing and high administration. It was clear that the supplier development programme was being introduced too early in the purchasing department. The supplier development programme was established as a result of a customer complaint. After five successful workshops the purchasing manager saw the need to integrate the supplier development co-ordination between the buyers existing activities. After 14 months of keeping supplier development on hold a re- organisation took place. The re-organisation decentralised operational purchasing back into the factory and a strategic purchasing unit was formed.

The changes were significant as operational purchasing had always been in a central department and now these employees would be part of the manufacturing company. There was a shift in direction of material planning and operational purchasing at Newark, these activities would report directly to manufacturing management. The changes already started at Ferrybridge and Blackburn would now include material planning.

The purchasing manager stepped outside the box of focusing only on purchasing and price and had clearly changed his emphasis to look at the company as a whole. This was also evident by his department adopting the same critical approach to customer measures of quality, cost and delivery.

The Purchasing Manager expressed the need for closer relationship with manufacturing:

> 'As a continuation of the drive to improve service levels, lead time to customers and manufacturing output it is vital that the Purchasing units reporting to manufacturing are given the full support of all concerned. They have an extremely important part to play in QCD improvements and this unit has a dual role of closer working relationships with manufacturing and involvement in supplier improvements driven by the strategic unit.' Purchasing Manager (1997).

The purchasing manager appreciated that purchasing and suppliers needed to work very closely with manufacturing and develop working relationships with technical people. The purchasing manager had made a big step change in his thinking, previously he worked in isolation with his team placing spot orders and measuring price.

This change was positive for the company and the employees working within the supply chain as it would bring operational purchasing and manufacturing together. The people would be aligned to deliver shared targets and performance improvement. On August 9 1999 a letter was cascaded throughout the business explaining the new strategic purchasing team. The Purchasing Manager expressed key points:

> 'Supplier costs represent 60% of our manufacturing product cost, and it is essential that our current initiatives on manufacturing cost reductions are supplemented by an intensive programme of supplier cost reductions. The team will be focused in driving continuous improvements and cost reduction projects with suppliers.
>
> The immediate task will be to plan and co-ordinate the transfer of the current operational purchasing activities to manufacturing and to establish rules of engagement i.e. roles and responsibilities and levels of authorisation in conjunction with all concerned at the 3 sites.' Purchasing Manager 1999.

This was a dramatic change for the company and as it took 4 years to be implemented. The de-centralisation of operational purchasing would enable the strategic procurement team to concentrate fully on strategic purchasing, without day to day operational and administrational distractions. The initial focus of strategic procurement could enhance supplier management and supplier development policies, system developments, group purchasing potentials and supplier rationalisation.

Operationally manufacturing would be responsible for day to day supplier issues and purchasing. This meant that suppliers and manufacturing would have a much closer relationship and become more closely aligned to understand each other's challenges and priorities.

The strategic purchasing team would continue to work closely with people operationally involved in the supply chain, understand the process problems and regularly receive feedback about supplier performance in order to optimise strategic decision making.

4.6 Case analysis of RHP

RHP supply chain management case study revealed there was a lack of integration and focus on the whole system. Functional departments existed, at each interface between these departments and communication, information and accountability were lost. The four main factors which impacted supply chain management were: senior management attitudes, traditional purchasing and quality methods, internal communication and interface problems and an absence of key performance measures.

4.6.1 Senior management attitudes

RHP had been purchased by NSK, a Japanese company and the employees expressed concern about the Japanese culture being imposed on them. Employees concerns were left unattended as communication between management and the workforce regarding all the changes remained poor.

There were different types of management style evident in the same company. There was the engineering director who was autocratic and dictatorial, his employees got told what to do and did it, even if they did not agree with the changes, as they were worried about their careers. This was highlighted further by the engineering offices being closed and their desks being put on the shop floor with noisy music being played through the tannoy. The purchasing manager treated everybody as equal and involved his department in all of the ideas and decision making and changes which needed to be made to the department. This style of leadership went too far as the employees felt they had no leadership or direction.

RHP managers lost focus on improving the business as a whole and concentrated their efforts on their own functions. This could often be at the expense of supply chain management particularly when purchasing was focused on price reduction and the company was driving quality, cost, delivery and people improvements.

The strategic supplier workshops achieved different results due to the senior managers' attitudes and commitment to change. The DT and MA senior managers' were very positive and welcomed changes to their companies and supported the teams to carry out improvements. Senior managers' at DT and MA were encouraged not only to implement the long term ideas and sustain the results from the workshop, but also to roll out the improvements to other areas.

At JRD and S senior managers' had negative attitudes towards change and chose not to listen to their customer, as they felt their businesses were 'unique' and their customer did not understand. Their senior managers' focused on their product and did not think in terms of processes and were not convinced of the benefits.

Senior management attitude was the largest inhibitor of supply chain management. The supplier case studies revealed if senior management led by example, set a vision and engaged employees' greater productivity was achieved. Senior management attitudes impacted other factors, traditional methods, communication, interface problems and lack of key performance measures.

4.6.2 Traditional purchasing and quality methods

Analysis of the procurement process showed that the supplier base was very large compared to industries focused on supplier management and development. This created major difficulties for effectively developing systems and managing suppliers. NSK-RHP had a total of 9,000 suppliers registered on the system for the UK, 5,000 of which were active. Current partnership agreements had not been maintained and supplier development was not effectively communicated.

There were no formal criteria for selecting strategic suppliers. For non production suppliers, there were no controls or monitoring processes and no preferred supplier list. For purchasing supplier visits, whether production or non production there was no standard template or systems for recording findings and storing information. The management of supplier development activities was at the time of research unplanned and reactive. No supplier development process existed until the pilot workshops took place and an applied process was created. Only one purchasing manager was found working proactively with the manufacturing engineers. However, project management was poor, milestones were continually missed and no designated time was regularly scheduled for the team to meet. The resources were constrained between the day to day manufacturing needs and the project.

Suppliers were managed separately purchasing for price and quality for the audits. These two departments kept manufacturing away from suppliers' and were keen to be the face of RHP on their specific issues. Despite manufacturing being the customer their voice was not often listened to. This practice was not in conformity with existing literature which commonly published that for strategic development and competitive

advantage it was essential that manufacturing be involved with suppliers for selection, development, resourcing, and most importantly for suppliers to understand the customers needs on technical issues (Hines 2004).

There was concern over the time and information transferred using a central person. RHP engineers were not permitted to speak directly to suppliers' engineers. More cross functional team activities were to be encouraged.

Purchasing and manufacturing employees generally felt there was insufficient data and visibility for forecasting. To compensate for the lack of forecasting, purchasing carried out spot ordering with suppliers. RHP was pressured from the logistics department and outside customer pressure to shorten lead times. Within a year manufacturing lead times were reduced from 6 to 2 months by process improvement.

However, raw material suppliers had much longer lead times and the forecasting data was available in the logistics department. There were 7 year business plans or life of the vehicle contracts with automotive customers. More strategic information was therefore available from sales, but that information was not passed down the supply chain.

To compensate for higher supplier lead times high buffer stocks were placed throughout the supply chain to ensure RHP did not run out of parts. Unfortunately for RHP this meant a £9.5m of stock for sales. The stock value was almost 1 year worth of RHP's profit.

The control of production suppliers was covered by a quality document (TI9). Group quality was responsible for management of the supplier review system. The supplier review system was managed by approving and grading suppliers from A-C. Once the supplier reached a grade A the system went no further. There was poor feedback of information to suppliers, particularly for positive results. No information was passed unless the supplier had been dropped by a grade. The current inspection system was so strict that it was virtually impossible for most suppliers to reach no inspection.

The supplier control system had no commercial or technical information included. For example, there were no processes for capturing joint improvement programmes, product development and process capability.

The supplier control system was heavily targeting 'rejection' and 'demerit' points that caused a negative drive. The only supplier measurement system undertaken was quality rejections monitoring. Group quality was responsible for collating this information from around the UK group. The supplier rejection process was manually paper based and therefore took additional time and resource.

4.6.3 Internal communications and interface problems

RHP had a 30% cost reduction drive across the company. The majority of cost reduction projects and teamwork was functionally structured. Internal communications between other functions often arose to overcome problems. Poor communications resulted in functional areas having negative attitudes towards each other. RHP functional areas had become heavily involved in 'fire fighting' and blaming each other.

Where functional interfaces existed, inherent inefficiencies would always be apparent. Responsibilities fell in the gap between purchasing and manufacturing departments for example high ownership over stock levels and high volume purchases of inventory. When problems arose blame was transferred and conflict took place between departments. Within the company employees often said: 'it's not my job'. Across functions little ownership was taken for key processes such as material management. For example, the ownership of inventory was unclear. It was not purchasing responsibility as the order was closed out when the GRN was created. It was not responsibility of the stores as they were responsible for issuing booking and putting goods away. Manufacturing were not involved until a requirement was needed for components and the store was contacted for picking and distribution.

When reviewing RHP supply chain management there was poor transfer of data, information and a lack of focus on the whole system. It was evident that three information technology systems were used. These systems had varying levels of capability. Having many I.T. systems caused data and information to be lost as it was transferred down the supply chain.

It was difficult to obtain information from other functions. For example, a meeting was arranged to discuss the automotive customers' supplier development programme with RHP Sales. Sales were involved with Nissan on their quality, cost, delivery, development and management programme (QCDDM). However, the sales manager would not allow any copies of information to be taken, despite Nissan's supplier

development programme being well documented in the public domain. The sales manager would not even provide the framework without RHP's results.

Purchasing never communicated with sales or logistics unless an external customer specifically requested to see purchasing. Purchasing was invited to a business review with Rover where the Rover purchasing manager expressed concern that RHP starved the company of information. He emphasised the supply chain and that when information was not transferred suppliers and customers suffered. If communication was proactively taken at RHP and included forecasting and long term agreements with suppliers greater strategic decision making could happen in the supply chain.

4.6.4 Absence of key performance measures

There was a lack of performance measurement systems in place. This made the total quality costs remain hidden and the standard cost culture continued to drive the company. Within sales and marketing there were numerous performance measures enforced by external customers. There were very few performance measures in place across the supply chain. In manufacturing there were measures placed on quality, scrap and delivery. There was ongoing benchmarking made with other manufacturing sites in Japan, with emphasis on process times, set ups, quality and delivery. For example, stock turnaround, delivery dates and delivery quantity were never regularly measured. Sometimes performance measures were made for one off projects. The lack of visible performance measures was concerning as decision making would be made by gut feel instead of using performance measures to benchmark, prioritise focus and manage development.

Without measuring it was also unclear whether an improvement had been made and it was then difficult to determine whether the company had benefited on the bottom line. There was one performance measure used within purchasing. The purchasing manager measured monthly price reductions, which were reported to the finance manager. The monthly price variation was displayed graphically on the notice board within the department. There was no appreciation of the delivery performance of suppliers. Inventory figures and quality grade measures were seen as the responsibility of other functional areas and total costs were overlooked. There were no supplier measures for delivery and suppliers had a 5 day window in which they could deliver goods.

RHP established a clear policy that was deployed and communicated across the UK with annually enhanced targets. Managers across the supply chain needed to establish key performance indicators and deliver activities that would bring company benefit. Without key performance indicators performance management was poor and it was difficult to establish the state of the company. (Batesman 2000). Most of the management and their departments continued to 'fire fight'.

4.7 Summary

RHP's supply chain management was complex, there was a general lack of understanding in the procurement process that affected communication internally and created functional boundaries and sub optimisation. (Hines 1994, Hines 1997). There were few cross functional team activities. Functions carried out development individually, which isolated activities and could cause duplication of effort. In purchasing there was clearly a competence and capability issue with 80% of the employees having clerical backgrounds. (Hines et al 1997). All procurement methods were traditional but the company attempted to develop a modern supplier development approach. (Hines and Rich 1998, Womack and Jones 1999, Bicheno 2000). Traditional purchasing methods and administration needed to be changed, so that employees could be educated and trained to focus on strategic purchasing and supply chain development. (Hines et all 2000). Overall senior management and employees attitudes were repeating factors throughout the case study. The evaluation also revealed traditional methods, communication, interface problems and outlook on utilising key performance measures. (Batesman 2000).

5.1 Introduction

The case study strategy was used at Alstom to investigate the research questions. This strategy provided a thorough analysis to identify changes that had taken place in supply chain management, how ideas had been implemented and to reveal the inhibiting and enabling factors of supply chain management.

The themes identified for the implementation of supply chain management included customer expectations, policy deployment, the whole system of processes, managers, employees, suppliers, business improvement and operations. The themes were investigated during the case study.

To understand the past, present and future changes of the gas turbine company located in Lincolnshire, this case study firstly provided an overview of the site company history. The researcher felt it was important to capture the history as it could support the understanding of the research questions. The history could also help with the analysis of the themes in particular operations, senior managers, employees, processes, suppliers and customers. This historical research covered the last sixty years and revealed technical information only.

To capture further changes in the supply chain historical research was captured by communicating with long service employees about company changes that had taken place over the last thirty years. The employees consisted of directors, managers, office staff and operators. Data was collected from various internal information and external information sources including internal and external company surveys, emails, articles, reports and interviews.

5.2 Lincoln site background

For more than 60 years gas turbines had been manufactured at Lincoln. The gas turbine engine was a complex product with over 8,500 components in a single engine. The Lincoln site designed, purchased, manufactured, assembled, tested, packaged and commissioned gas turbine engines providing a ‘total solution to customers’, including the option for maintenance service contracts.

In contrast with the automotive industry that produced high volumes annually, this Lincoln small gas turbine company was described as a low volume, high value capital goods manufacturer, producing a maximum of 120 engines per year and overhauling and maintaining a further 80 engines.

Once a gas turbine engine was installed at a customer site, with regular maintenance, it could reliably operate for over 30 years. There was 2 customer markets the oil and gas industry, who used gas turbines for providing power generation for light, heat and pumping oil or gas offshore and Combined Heat and Power (CHP). The CHP plants used gas turbines for back up power generation. The high temperature exhaust of the generator passed through a waste heat recovery unit or boiler and achieved a 95% overall thermal efficiency. The steam or hot water generated can be used in industrial processes or district heating schemes. The steam may also be used in small scale combined cycle applications in conjunction with a steam turbine. The exhaust heat may be utilised for drying industrial products. This makes the CHP an excellent application for hospitals, breweries, television studios and any large buildings that wanted to create their own power and heat.

5.2.1 Lincoln site technical history

The available Lincoln site technical history was reviewed to understand what changes had taken place in supply chain management over time.

Following pioneering work by Frank Whittle on jet engines, in 1946 Ruston & Hornsby Ltd set up a small team known as the combustion development group.
The team investigated the feasibility of designing long life industrial gas turbines. Detailed design work on the first Ruston industrial gas turbine began and by 1949 initial trials began with a prototype two shaft, open cycle engine.

In 1950 the engine was demonstrated to engineers of the leading British and overseas technical press which proved successful. By the 1950s full scale production took place for the twin-shaft engine, named the TA. The first order was received for an oil field application from the Kuwait Oil Company for gathering centre pumping. This engine was still operational in 1991 and had completed 170,000 operating hours, including a non-stop run of 10,800 hours. Following the initial success with the TA gas turbine Ruston's began to design and develop a gas turbine of 500bhp, the TE.

In 1956 Ruston's was awarded a design and development contract by the Admiralty for a more advanced version with a rating of 750 kW, which became known as the TF. The first TF was installed in the USA in 1957, and was used to drive a booster pump for the Williams Brothers' Pipeline of Tulsa. The unit was still operating satisfactorily until it was decommissioned in June 1980, having completed 100,000 operating hours.

In 1959 a Ruston TA gas turbine was put to work in the first Total energy installation in the USA, at the Park Plaza Shopping Centre in Little Rock, Arkansas. The TA gas engine provided the lighting, heating and refrigeration requirements of the centre.

In the 1960s the first TF gas turbines were installed in guided missile ships of the Royal Navy. The engines were firstly used as emergency and salvage generating sets and subsequently as base loading generating sets. The single-shaft TF gas turbine produced 1,300bhp at 60°F.

In 1963 a decision was taken to enter the larger engine range of gas turbines. These engines incorporated aerodynamic and thermal design for several frame sizes. In 1966 the TA 1500 was introduced, capable of producing 1,620bhp at 60°F. In 1967 a single-shaft turbine producing 4,000bhp was developed. This engine was known as TD4000, incorporating four combustion chambers mounted around the engine. Three years later the shop tests were completed on the first TD4000 unit.
In 1970 the TA1750, developing 1,833bhp and using new blade materials was introduced. Further developments were made upgrading the engine to 2,500bhp, by improving component efficiency and increasing the air mass flow. It became evident soon after the successful introduction of the TD4000 gas turbine that an engine of 3,000bhp would be attractive to the oil and gas industry, particularly for driving pumps and compressors.

To achieve compactness the concept of four combustion chambers angled back over the compressor was adopted. Also a two-shaft bearing system using an overhung turbine was incorporated. The design was also influenced by the trend towards packaged sets, which could be pre-tested to reduce on-site installation costs. This new engine was designated the TB. Other features incorporated to meet market requirements included standard or alternative arrangements for control of auxiliary equipment in modular form to simplify servicing. A further requirement was a flexible solid state control system to satisfy increasing demand for automatic and remote operation. Above all, the design had to achieve the high reliability associated with the earlier TA design that contributed significantly to the success of the Ruston gas turbine.

Following satisfactory experience with the TB engine rated at 3,300bhp, the power output of this engine was increased to 3,920bhp, then 4,900bhp. This later increase was achieved by changing to cast and by increasing the compressor speed by 4%. The power output was again increased to 5,200bhp ISO by incorporating proven technology used on other Ruston turbines, and to 5,400bhp on gas fuel only.

In 1981 an 8,500bhp gas turbine named the Tornado, was introduced. Available as a single or twin-shaft machine, it combined new technology, metallurgy and design factors with the traditional Ruston characteristics of reliability, endurance and minimal maintenance. It had an efficiency of 30% and a maximum cycle temperature of 1000°C, although the life of critical hot components was comparable with those of other Ruston engines. Cooled blades, using proven technology, were introduced to limit mean metal temperatures of the first stage compressor turbine rotor and stator blades to 780°C.

In 1984 Ruston began packaging large engines at Lincoln, initially with 15 and 25MW units using Rolls Royce gas generators, and later with the RLM range which use gas generators built by GE of America. Ruston and GE collaborate on a number of ventures involving industrial engines and component parts for Aero engines.

In 1987 Ruston announced development work on two new engines, the Hurricane rated at 1.5MW(e) and the Typhoon rated at 4MW(e). In 1989 the Typhoon, designed for electrical power generation, was formally launched into world markets.

To achieve 32% efficiency of the single-shaft Typhoon, Ruston engineers took advantage of substantial technological gains made during recent years in the analytical and experimental fields. The technological advances made to the Typhoon were to maximise performance and reduce capital and maintenance costs. The first orders for the Typhoon were received for three units for CHP installations in the UK and Spain.

An improved microprocessor based control system, available for all engines in the Ruston range, was introduced. The Rustronic MKII system offered improved features including increased performance, quicker response time, increased reliability and it was more compact.

In 1992 following successful operating experience in the field at its introductory rating, the Typhoon's power was increased to its design rating of 4.55MW(e). This was achieved by

increasing the speed from 16,570rpm to 17,384rpm and increasing the turbine inlet temperature from 1050°C to 1100°C.

The company developed a dry low emissions (dle) combustion system in 1993, which was available for use on the Typhoon. A twin-shaft version of the Typhoon was introduced in 1994 which was designed specifically for driving pumps and compressors for the oil and gas industry. Having an output of 6,500bhp and a thermal efficiency of 33%, the twin-shaft Typhoon incorporates a high level of gas turbine and package commonality with the single-shaft machine and uses a two stage free power turbine of high efficiency design.

Following improvements within the sealing system of the engine, the hot gas path and optimisation of compressor mass flow, the output of the single-shaft Typhoon was increased from 4.55MW(e) to 4,91MW(e) at ISO conditions on natural gas fuel. The Typhoon was also offered at the lower rating of 4.2MW(e) under the same conditions.

A more powerful version of the Tornado twin-shaft was introduced which delivered 8,900bhp from the output coupling. Total Tornado experiences exceed 250 units sold and 6.4 million operating hours.

The Tempest, a single-shaft gas turbine with a thermal efficiency of 33% and a output of 7.50MW(e) was launched in 1995. Based upon the proven technology of the Typhoon gas turbine, the Tempest is a scaled design which achieves higher output and complements European Gas Turbines (EGT) existing family of turbines. The HP turbine blades were investment cast and incorporate dual triple-pass cooling technology.

The first production Tempest was displayed at the NEC Birmingham in 1986. The first orders were received for eight units for cogeneration installations in Belgium, Turkey and Japan. EGT announced NOx emission figures of 25ppmV on natural gas for Typhoon, Tornado and Tempest fitted with a DLE combustion system.

An 18,000 hp gas turbine named the Cyclone was introduced in 1997. The Cyclone was a twin-shaft machine suitable for power generation and mechanical drive. The Cyclone utilised proven technology evolved through the Typhoon, Tornado and Tempest gas turbines and had simple cycle efficiency in excess of 35%. The Cyclone was an extension of the Tempest gas turbine, with the addition of a zero stage to the air compressor, a two-stage compressor turbine and a two-stage free power turbine.

The Cyclone entered into commercial operation. This milestone was achieved in less than three years from product launch to the gas turbine running providing power in parallel with the National Grid from the Company's facility. This DLE only unit builds on the 750,000 hour experience accrued on the same systems adopted by the Typhoon, Tornado and Tempest gas turbine.

A more comprehensive line-up of the Typhoon was offered with ratings of 4.35MW(e), 4.70MW(e), 5.05MW(e) and 5.25MW(e). The higher rating was achieved by a higher mass flow compressor, improved turbine materials and optimised cooling flows, with no increase in temperature.

The Tornado rating was increased to 6.75MW(e) for electrical generation that was achieved by a small increase in firing temperature, material improvements and component development. The twin-shaft machine received an increase to 10,300bhp using proven technology and materials from the Typhoon and Tempest. Table 20 summarises the product history.

Table 20: History of Alstom

Year	Activity
1946	Ruston and Hornsby Ltd worked on the first industrial Gas Turbine
1952	First TA Gas Turbine was produced for Kuwait Oil And was still operational in 1991
1950	TE, TD and TB engines produced. Initial engine 500 to 1970 bhp up to 5,400 bhp
1961	The first TF Gas Turbine was installed for the Royal Navy, producing 1300 bhp
2002	Typhoon, power generation (4,922 kW, 6,600bhp) Typhoon Mechanical drive (4.35, 4.70, 5.05 and 5.25 MW(e) Tempest, Tornado (7.75 MW) and Cyclone still in production

Source: Alstom 2002

Summary

After reviewing the available company history to understand what changes had taken place in supply chain management. It was highly evident that the company had captured only the high technological advancement of the product range. The technical history highlighted the huge investment the company made into technological innovation, research and development and the history emphasised the incredible amount of servicing hours which were achieved from an engine operational in the field.

The company historical information had not captured strategic changes such as aims and objectives, company ownership, company initiatives to examine the business improvement theme, processes, operational restructuring and redundancies. Each of these areas was examined to provide a full overview of the supply chain management. As the strategic objectives were difficult to identify, to appreciate the company direction the Managing Directors' speeches were reviewed over the last 15 years.

5.2.2 Managing Directors speeches

In 5 years there had been four Managing Directors' that had provided a different style of management for driving the company forward. An examination was made of three speeches to compare the executive management messages. 1989 was the first Managing Director speech:

> 'Ladies and gentlemen in two years time half of you will be redundant. Our products are 20% more expensive than Solar, our lead times are 50% larger than Solar, our new products take too long to bring to market, our quality is deteriorating, our costs are soaring. We are uncompetitive in many areas of manufacture. We are disorganised, we don't work as a team, we are losing good employees', we are failing to attract new ones. All of this adds up to decline. So what are we going to do? (Pause)
>
> What we are not going to do is carry on as we are. We are not going to keep our company performance a secret from our employees'. We are not going to have an atmosphere between January and March, where no trust exists. We are not going to have protectionism or compartmentalisation. We are not going to have our employees' saying no one ever asked me. What are we going to do? What we are going to do is change. Managing Director European Gas Turbines 1989.

This speech had an extremely shocking opening for employees' and a very concerning message on company performance. The first sentence, in two years time 50% of you will be made redundant would have stopped employees' listening much further, as they would have all thought about the impact of this harsh abrupt statement to themselves.

What the Managing Director had communicated was that he recognised there was a major problem with service levels, in particular long product development lead times, poor quality

and increasing costs and he saw the company really needed to change. The next speech was taken by the Vice President of the site 13 years later:

> 'To start with, both our on time delivery performance and our non-quality costs levels are unacceptable and through addressing them we have an opportunity to double our profits from today's level of activity. If we continue with our current delivery performance and product quality we will see a decline in our sales with obvious consequences – I am receiving regular customer feedback that their patience is running thin.' Vice President Small Gas Turbine Company November 2002.

This speech had the same message of quality, cost and delivery service to customers, but was communicated in a very different way to the other Managing Director in 1989. It focused on doubling profits, but then closed out with if our sales do decline 'obvious consequences' implying redundancies. A year later a further Vice President stated:

> 'The next order from SBM will not go to us, we have since found out the order has gone to Solar. The reasons for their decision (taken at the highest levels in SBM) were because of our product quality, our on time delivery record and our safety record. All of which have fallen below their expectation.' Vice President Demag. January 2003

Over 15 years the underlying message from three different Managing Directors' was; product quality, cost and delivery which were unacceptable to external customers. It was very difficult to visually identify the quality, cost and delivery company performance in the supply chain.

In two of the speeches, 1989 and 2002 if the company did not efficiently and effectively manage to address the problems it was clear redundancies would occur.

When the Managing Directors' were communicating performance they implied or stated jobs would be lost, it was unnecessary to say this as it is quite clear what will happen, if the company does not prosper. It was unfortunate that the head of the company who infrequently spoke to employees when they did mentioned potential redundancies; this could unnecessarily make employees feel disengaged, unvalued, affect their confidence and performance. In the last speech safety had became an additional problem.

5.2.3 Site ownership and company changes

Up until the late 1970s the company was known as Ruston Gas Turbines. At the turn of the century Ruston Gas Turbines (RGT) was still a reputable name across the world. However in the 1970s the site became European Gas Turbines (EGT) up until the late 1980s when it became Alsthom, part of Alcatel.

In 1998 the site became Alstom, a French company. A year later Alstom became ABB Alstom Power a joint venture with ABB. Nine months later Alstom bought the ABB part of the joint venture and the company became Alstom Power. In 2003 Siemens purchased the Alstom site and the site became part of the German company.

The site was then given the name Demag Delaval Industrial Turbomachinery Limited (DDIT Ltd). From the 1st October 2004 the site was renamed Siemens Turbomachinery Technology.

Over 6 years the name changes were very sudden and confusing for employees', who felt all the name changes, except Siemens, had been poorly communicated. Each time the Lincoln site changed ownership the name changes were in the public domain before they had been officially announced to the workforce. When ABB Alstom, a joint venture, took place an operator found the public notice on the internet and communicated it prior to management announcements, which took place over a week later.

The company vision for Alstom was very difficult to find, as most senior managers did not know what it was. The Alstom Vision was:

> 'Through the innovation and inspiration of our employees', customers and suppliers we will create the passion in our company to deliver world leading technology and company performance.' Vision 1997

The vision was very compelling and picked all the key areas of the supply chain including innovation and inspiration of employees, customers and suppliers to create 'passion'. There was little successful evidence of this happening in the company except for some operational improvements in manufacturing with operational employees only. The strategic objectives were also reviewed.

Alstom strategic objectives 1997 were:

- To capture 25% market share within the next 5 years of the 3-15MW market in oil and gas and CHP
- To develop and successfully launch at least one new market product within the next 5 years
- To develop our position as the preferred service provider by securing critical aftermarket company for the installed fleet
- To achieve industrial gas turbine technology leadership within 5 years
- To be the industry leader in profitability and cash generation

There were no annual targets set and the strategic objectives for 1997 were product development and marketing specific. It would be difficult for other senior management and their departments to align to the company needs. This strategy was presented annually to a selection of senior managers by the executive management team.

There was no facility on site large enough to cater with communication. To cascade information and communication across the supply chain directors cascaded to senior managers, senior managers to their line managers and line managers to their teams and so on. There were hundreds of managers on site and many lines of hierarchy; employees further down the company knew little of what was happening. Managers would often provide information on a 'need to know' basis. As such, the plan for information cascade on the company strategy never materialised.

Company initiatives were investigated to examine the business improvement efforts of the company. The improvement efforts were made under different initiative banners. There were 2000 employees on site and many employees had experienced most of the history. The average age of the workforce was 48 and employees had at least 15 years of history with the company. They had seen many supply chain management initiatives start and stop, with very little return. Most employees felt that the company initiatives had failed or had not got off the ground before being changed.

Ideas on supply chain management approaches included 'Double the Business', 'Liberating the Workforce', Total Productive Manufacture (TPM)', Kanban and Continuous Improvement Through Teamwork (CITT), Stretch 30 (cost reduction), Lean, Six Sigma and Value Generation Programme (VGP, cost reduction).

These changes left a lot of cynicism among the employees across all operational structures of the company. The cynicism was stronger when employees did not feel part of the change or understand why they had to change and they got overwhelmed with coloured slides and company abbreviations. The cynicism began by employees telling stories about a lock out in the 1970s. In the 1970s senior managers' and employees could not agree on a pay negotiation which had ended in a lock out for employees for seven weeks. Some employees who were not at the company during this time had heard this story and explained the story to others. The company had come a long way since the lock out in the 1970s the work between managers and the union became more closely involved.

In the early 1990s managers used the phrase "Liberate the Workforce" this meant that operations and processes could be improved by employees that were empowered to change anything they wanted. The initiative enabled employees to make changes that were totally outside existing policies or processes to complete company activities. However as there was no guidance from senior management or policy determined on how to implement new ideas, so nothing happened. Employees felt that many of the barriers to change were outside of their control so the company remained unchanged.

Employees who went on continuous improvement training listed all the challenges that they were facing. After this they had identified improvement opportunities that were within and beyond their control. This exercise revealed that employees felt only 20% of their challenges were within their control and the other 80% were managements responsibility. This was very alarming as employees felt they were not in a position to change anything. Efforts were made to get employees to break these challenges down further as a means to demonstrate that some of these challenges could actually be within their control. This was very difficult due to their mindset, which unfortunately had developed over several years of their experience within the company. The negative attitude of employees was a large inhibitor to supply chain management.

In the late 1990s the managers introduced 'Breakthrough Thinking' this meant stepping into the future and looking back at what activities were taken to achieve the end result. This was a creative way of thinking but it was too radical to put this approach on top of nothing. For

example if the company had spent time on continuous improvement or total quality management, a foundation would have been in place for breakthrough thinking to be effective and evolve. Instead the breakthrough concept was far too off the wall as it was difficult to look into the future and let go of day to day problems.

In the late 1990s Boston Consulting Group (BCG) supported the company to develop a cost reduction process. The cost reduction process was established for the purchasing and design departments rather than operationally across the whole supply chain. In 1999 standard costs were used as the baseline. All the purchasing buyers and the re-design to cost team were measured against reducing the standard cost of components, by 10% annually over three years. This metric was incorporated into the financial process and was reviewed by developing an IT system.

This approach got the purchasing department only to think about cost reduction using price. Employees who were involved did not consider the total cost impact of their decision. For example, if a buyer saved a reduction of £20 for a blade but it took longer to deliver and it perished more quickly in the field, it could actually cost the company more in total life cycle costs.

Also the 10% drive for every commodity to be reduced in the same way meant no consideration was given if the commodity could achieve more or less savings. Overall the 'Stretch 30' concept caused managers outside of purchasing and design to complain about the lack of total cost focus across the supply chain, particularly for the project management department. The full time design team struggled to gain an input from the departmental managers as their efforts were on operations. 'Stretch 30' continued for three years. After two years the redesign team was shutdown and the project leader remained to drive the operational management heads.

In 2000 an Automotive Director came to manage manufacturing and introduced Lean thinking. The Operations Director aspired to make Lean a way of working life across manufacturing. As a result 'Kaizen Blitz' activities took place in every cell over a year and every manufacturing employee went through a one day company simulation for them to quickly experience the benefits of Lean improvements. The cost benefits of lead time reduction, process flow enhancement, reduced inventory and transactional activities.

In 2001 Alstom Head office, in France, instructed that all units globally must pursue the Six Sigma methodology. This caused confusion within manufacturing as employees did not know what would happen to Lean.

It was important that senior managers kept a consistent and clear message to show how both approaches complimented each other. Instead the operations company continued to use the lean approach and any six sigma projects were known as projects only. The rest of the company carried out six sigma projects only.

By the end of 2002 the Alstom Lincoln unit invested in the training of four black belts and sixty greenbelts, from which only two black belt projects were closed out, which delivered £115,000 annually. No green belt projects were completed. This was primarily due to a lack of departmental head support and commitment for green belts to spend time and resource on the projects. The history of Alstom Six Sigma deployment globally was summarised in Table 21.

Table 21: Alstom Six Sigma deployment

Year	Activity
2000	July six Sigma was introduced in six power sector units
2001	October Power sector launch six sigma for all segments
2001	Executive workshops attended by management, six segments twenty nine companies and sixty unit teams
2002	Six sigma deployment commenced with segment executive workshops
2002	Six sigma deployment continues with unit executive workshops
2002	Six Sigma projects identified (Y=f(X)'s)
2002	January Black Belts and Green Belts selected and trained
2002	October awareness sessions started for everyone
2002	Power sector management team confirmed that Six Sigma was the change programme for the sector and wished to continue the deployment of the system at maximum speed

Source: Alstom 2002

Once Siemens purchased Alstom further investment was made into Six Sigma, by having a site master black belt (seconded from America), a programme manager and an additional 9 black belts and 36 greenbelts. Siemens also provided a one day awareness course, company excellence staff training and a two day leadership course. However the completion of projects was very slow, typically taking one year.

Primarily this was due to a lack of process owner accountability, senior management leadership, support and discipline. Far too much bottom up driving was evident through the black belt project leaders. Nevertheless the cost benefit increased to £1m in a year.

Lincoln internal processes

In the mid 1980s Lincoln had over 700 processes documented and the company converted all the written procedures to process maps. These processes were produced functionally by each department. Each department set their own inputs and outputs to the processes. No cross functional teams were used and the customer and supplier of each process was not consulted. Processes were silo based and sub optimised as most processes went across functions, but they were produced in isolation to the rest of the company and internal customers. This created the whole supply chain process to become more complex and contributed to problems upstream and downstream.

Despite process mapping starting in the late 1980s there was insufficient re-engineering taking place with the information. Managers created many of the process maps and those created by process users had little process review, except if Lloyds were coming to do an audit. At present all the performance measures for the company were not aligned to processes. There was also poor visibility of measures across the company. The cost of poor quality was heavily measured but little deployment was made across the company.

The quality department and the finance department produced the monthly quality costs report. The report was circulated to head office and the executive board. It was difficult for the company improvement teams to gain access to the information which was critical for project selection and prioritisation.

In 2001 the cost of poor quality was recorded at 4% of turnover. High poor quality costs meant the site worked for six months to make a profit and then threw the rest away in hidden quality costs. In 2003 the cost of poor quality increased to 12%. The cost of poor quality had increased as nobody acted upon the data and implemented new ideas into the supply chain.

A Senior Manager summarised the poor process:

> ‘Smash the plate, sometimes it is better to start again with a new plate than to put the pieces of the old plate together. Too many of our systems and processes are pieced together. Current systems lead to rubbish in and rubbish out.’ Senior Manager 2003

All the processes were developed using the existing systems with a couple of changes. Managers which had no targets were left to run their areas of responsibility as they saw fit. This finding was validated by the Head of Customer Support:

> 'No one can ever tell whether you're doing a good job or not as they only ever look at your budget costs.' Head of Customer Support (2003).

Senior managers were left to carry out their role as they saw fit and provided their budget was in control or even slightly over they were left alone to manage their own operation, no further performance measures existed. Despite having a strategy in place it was impossible to tell whether the activities managers carried out were aligned to deliver the company strategy.

The quality department was seen as remote from the actual running of the company. Quality employees worked heavily as audit police and were seen to stay in their offices in isolation. Some operational quality staff were located in manufacturing, but with no central co-ordination or guidance and heavily focused on concessions and raising inspection reports.

No root cause analysis was carried out. The quality department produced cost reports, internal audits and carried out quality checks. In 2004 the traditional quality department still remained.

5.2.4 Management at Lincoln

In 2002 feedback from a senior quality management course was that managers had lost their charisma and focus on their own budgetary objectives and the running of their own departments or teams. Most managers wanted to stay in their own comfort zone and continued to do so. Overall across the company there was too much resistance to change by managers and little acknowledgement for the need to change. This departmental operational focus sub optimised supply chain management despite business approaches to support the entire supply chain.

When ABB purchased Alstom as part of a joint venture in 1999 a new infrastructure and reporting processes was communicated to the company. The main competitor was Solar who had 80% of the market place. A director wrote a poem about the competition. This was shown in Figure 29.

Figure 29: Directors notes - paddle your own canoe

> Once upon a time, ABB Alstom UK Ltd and Solar decided to have a competition boat race on the Brayford. Both teams practiced long and hard to reach their peak performance. On the big day they were as ready as they could be. Solar won by a mile.
>
> Afterwards the ABB Alstom UK Ltd team became very discouraged by the loss and morale sagged.
>
> Senior management decided that the reason for the crushing defeat had to be found, and a project team was set up to investigate the problems and recommend appropriate action. Their conclusion: the problem was that Solar had eight employees' rowing and one person steering. ABB Alstom UK Ltd had one person rowing and eight employees' steering.
>
> Senior management immediately hired a consultancy company to do a study on team structure. Several months later and after spending billions of pounds, the consultancy company concluded that too many employees' were steering and not enough rowing.
>
> To prevent loss to Solar again next year, the team structure was changed to Four Steering Managers, Three Senior Steering Managers, and One Executive Steering Manager. A new performance system was set up for the person rowing the boat to give more incentive to work harder and become a key performer; 'We must give him employment enrichment. That ought to do it.'
>
> The next year Solar won by two miles. The ABB Alstom UK Ltd team laid off the rower for poor performance, sold off all the paddles, cancelled all capital investments for new equipment, halted development of a new canoe, awarded high performance bonuses to the consultants, and distributed all the money saved to the senior executives.

Source: Alstom 1999

This was a very controversial poem. It was surprising to find that a director had written it to highlight his frustration with the way in which the company was being managed. The poem was very close to the truth and the changes that the company had undertook.

When the internal project team was set up to find out why they lost the race they reached the conclusion that they had 'one person rowing and eight employees steering.' They then hired consultants to look at the structure. This implied that they did not have the understanding to implement these changes internally.

However they did not involve the rower to ask his ideas. 'Several months later after the company had spent billions on consultancy fees they agreed with the conclusion.' In reality

the site spent a significant amount of money with large consultants to undertake tasks cross functionally. The consultants would drive successful implementation by instructing senior managers' what to do; this often de-motivated employees' as they were not involved or able to take any responsibility. During the time of the poem BCG had restructured purchasing with senior managers and established a cost model for 'Stretch 30' and KPMG introduced the VGP cost system with the executive team.

The poem said: 'We must give him employment enrichment. That ought to do it'. During that time senior management were saying 'Liberate the Workforce' but there were no tools and techniques or training and support behind the statement, so it was just words to employees.

The poem expressed the disappointment of the only rower being laid off whilst the consultants and senior executives received a bonus. In 5 years there had been four periods of redundancies. Some directors felt there was too little investment in the business for product development and long term growth and the senior executive team had too many bonuses. On the site there were 160 senior managers who reported to the senior executive team, so the poem implied there were too many managers and no clear direction.

Overall the poem implied poor management. The senior executives, senior management and employees did not effectively communicate. There was no plan or clear targets and direction to win the race. There were too many senior managers steering and not enough rowers to win the race.

Redundancies

From 1990 to 1996 there had been 5 periods of redundancies. In 1999 500 employees within the workforce were made redundant due to high overhead and labour costs, this caused high inertia and low moral amongst the workforce. Workers had known about the redundancies for over 3 months, prior to the formal management briefings. The day of the management briefing the workers went out for lunch and found the redundancies headlined on the front page of the local newspaper, The Echo.

The direct reports (operators) were assessed by a last in first out policy and the indirect reports (staff) had a scoring performance matrix that was completed by managers. This matrix included sickness, performance and years of service. If the employee had worked for the company for over 10 years they automatically got 10 marks allocated to their score, which

gave them a higher score which meant a higher chance of continuing to be employed. These separate redundancy systems caused resentment between the shop floor and office. Some employees were concerned as they did not regularly meet or know their managers. Most employees had no targets and measures and never regularly had meetings with their managers. In one case a clerk had not met with her manager for almost a year.

The senior executive team made an announcement a year after these redundancies in June 2000, "Save us £6m by August or 350 of your jobs will go." It was not from a member of the board but the whole senior management team. During this time no leadership or action plan was used and no training or education was provided to enable employees to work with data to analyse and recover costs. Also there was no explanation given for where the cost reduction opportunities could come from as no further information was provided. This announcement made employees complacent as they felt redundancies would take place. This threatening adversarial management approach highlighted poor support and leadership to assist employees in improving the supply chain.

Sadly in August 2000 the process began to make employees redundant and Alstom hit the front page of the local newspaper The Echo:

> 'Workers sombre as job cuts start. Morale was very low as the first employees' to be hit by a double wave of redundancies left. A senior shop steward reported it's not the shop floor which has caused the problem, it's the management and getting rid of workers isn't going to solve the problem.'
> The Echo April 2000.

During this process every department had to make 10% of their workforce redundant. For the customer service managers the whole department was shut down, as it was felt that this department did little to deliver to the bottom line. This was extremely difficult to measure as the teams were ensuring customer satisfaction. An experienced Blade Operator shared his thoughts:

> 'Its all doom and gloom in ere, it's the worst I 'ave ever seen it. We've ad nothin but bad management for a long time and when they need to blame someone it always comes back to us workers. I have mates who ave gone to work in the offices and some who ave been sent home. But some of us ave no work and are just standin ere, coz our supplier is off so we aven't got any work comin in and then wot appens to the next customer along?'
> Blade Operator 2000.

It was interesting that the operator was clear about his customer and supplier interfaces and thought about the supply chain. This operator had been in the company for over 30 years. The morale in his whole area was very low. Operators would come to work and just sit at machines as they had no work to produce. This continued for over two months. Sadly this operator took voluntary redundancy and left the company very disappointed after all his service. It was upsetting to see operators were not put on improvement projects within production. Finally some of these operators were sent into the offices chasing unpaid invoices and carrying out administrative tasks.

Less than 6 months later the order book was very productive and Alstom recruited again, some staff which had been made redundant were recalled. Some of the experienced operators said this would happen, they had bet a couple of beers on the fact that production was there and management were cutting overheads before the year end, but would recruit again in 6 months time. This operator knowledge would have come from their previous history on the gas turbine site.

5.2.5 Annualised hours 2000

In 2000 the operations senior management team introduced annualised hours, the objective was to save money. This was achieved by removing shift allowances, overtime and introducing flexibility which meant employees would be sent home when no production work was available. For the workforce this meant smaller salaries, no overtime and poor visibility of working hours. Many operators had a reduction in their salary. The feelings of two Operators were captured:

> 'None of us are signing that contract. They'll ave to sack us. Most of us just don't care anymore it's the same old thing. Why don't they get us some sales and look at other parts of the company.
> If they get rid of us why don't they ever get rid of any of the office staff, there's just too many of em'.
> Shop Floor Operator 2000.

The operators often got frustrated as they felt they were treated differently to the office staff. In particular because the annualised hours did not impact on the office staff and there were typically five office employees to every direct employee.

> 'We all got issued contracts for annualised hours. I think it will benefit us in Spares and would have signed it but they said in the last sentence if we don't sign and return

> the new contract by Wednesday 2nd August 2000 then our jobs will be terminated! Most of us are not signing to see what happens.'
> Precision Grinder 2000.

The operators felt mistreated by the threat in the letter and how it was communicated because most of the operators had been in the company for so long.
They were shocked by the cut off date and threat of terminating their contracts. This made them resist the change to 'see what would happen'.

A third ballot was carried out on 17th June 2000 which found the majority of employees were against annualised hours. 70% opposed annualised hours. Workers felt that redundancies were on the horizon and once they had been squeezed to agree poorer contracts, redundancies would embark once more. An extension was made on the contract termination date to 2nd September 2000. Three days before this date the secretaries were assigned to call every shop floor worker within the company. The operators were told if they did not return their contracts by Monday morning they would be sacked. After 200 jobs were made redundant the workers signed the new contract.

At the end of 2003 when the company became Siemens 99 redundancies were made. During this redundancy many voluntary offers and early retirements were made, leaving only 8 compulsory redundancies.

There was a huge drive on cost reduction during 2003. However management had changed the focus to strip overhead costs, excluding labour costs, due to the effect the redundancies had on staff morale.

Employee feedback

Every year the company sent an employee survey to all employees with a covering letter from the Managing Director. The same employee survey was used for the last five years to gauge an understanding of how employees felt about nine key areas. The feedback note for 2001 was illustrated in Figure 30. The researcher felt it was important to consider the content of the employee survey to consider the affect on supply chain management.

Figure 30: Employee feedback note

Dear Employee,

The objectives were clear finding ways to achieve them took a little longer. What emerged six months later was a set of interlocking plans, the building blocks for a world class future.

The beginning of the new millennium has proved to be as challenging to our company as the end of the last one.

Some very difficult decisions have had to be taken to ensure that we have a successful company for the future, and as a result I recognise that morale is low in our company.

It is my job, along with the rest of the management team, to do what is necessary to improve this as it is an essential factor in achieving our long-term growth.

Your input from the employee survey is a valuable source of information that not only guides us in making development decisions but also for the training and development of our managers in the future.

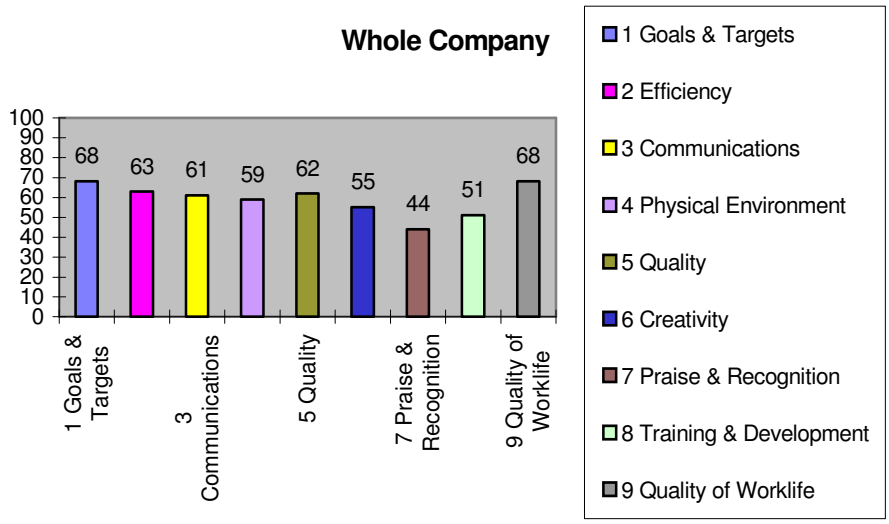
Managing Director

Source: Alstom 2001

The note started the objectives were clear, they may have been clear to the executive team but they were evidently unclear to senior managers and therefore their employees (5.2.3:125). The remaining of this note was well written recognising low morale and emphasising the survey will be a valuable source of information to achieve growth.

Alstom received a 60% response rate from 2,500 employees, which was very good. It was important the Managing Director and team captured the challenges and developed plans to improve performance. Figure 31 illustrates the employee survey results for the Lincoln site.

Figure 31: Employee survey results for Alstom Lincoln



There were no high performing areas 68% was the highest for quality of worklife and goals and target setting, praise and recognition was very poor at 44%. The results were also displayed by department and by team using department budget codes. Over the past five years the bar chart had followed the exact same shaped pattern. Praise and recognition, training, development and creativity were the lowest areas of performance every single year.

After 6 years the employee survey was removed by the HR Director as no actions were ever taken. The Managing Director and his team continued not to deliver the commitment to employees, by using the feedback to improve. The senior management attitude and lack of commitment not valuing employees' feedback and using it to improve supply chain management were once again an inhibitor.

In 2002 the training and development department interviewed a cross section of 30 managers to understand how they felt about the company adopting 9 values. Table 22 shows the results.

Table 22: Alstom employee interviews

	Rated %
1. Provide training and development opportunities for all	62.5
2. Create a supportive environment	59
3. Operate an equal opportunities policy	68
4. Communicate openly and honestly at all times	42
5. Ensure contributions from in a team environment	53
6. Provide the opportunity for personal growth and career progression	60
7. Review performance and recognises achievement	50
8. Involve all in company development	40.5
9. Create an environment where innovation and creativity are encouraged	51.5

Source: Alstom 2002

Despite 30 interviews, representing a small number for 2500 employees the value statements compared to the employee survey had similar results. For example encouraging creativity was 55% in the survey and 51.5% in the manager interview 2 years later. More concerning was that only 40.5% of managers felt they were involved in company development. As managers in a company each and every one of them should feel involved in some level of company development. 42% felt communications were open and honest at all times. 50% felt performance was reviewed and achievement recognised.

5.2.6 Supplier feedback on Alstom values

Strategic suppliers' were asked about 9 value statements that covered the relationship between the company and themselves. Each of the 13 strategic suppliers was given opportunities to create further statements. The value statements were discussed in an interview with the employee development manager. Each strategic supplier read each statement and scored accordingly. Table 23 shows the value statements.

Table 23: Value statements

		Agree strongly	Agree slightly	Disagree slightly	Disagree strongly
1	Alstom was open and honest in our dealings with suppliers	6	6		1
2	Alstom always invest time to understand its suppliers capabilities	1	6	6	
3	Alstom was always clear and consistent in their communication with suppliers	3	6	3	1
4	Dealing with Alstom was a satisfying experience	7	5	1	
5	Good supplier performance Received appropriate recognition	5	3	5	
6	Alstom were committed to mutual profitability and growth	5	5	3	
7	Alstom were committed to Continuously develop their suppliers	5	**7**	1	
8	Alstom honoured their commitments as established within the contracts	7	3	3	
9	Alstom valued long term company relationships	11	1		1

Source Alstom 2003

Eleven companies strongly agreed that Alstom valued long term company relationships. All contributors apart from one agreed that the company was open and honest. Statement 2 above "Alstom always invests time to understand their suppliers' capabilities" provoked the most discussion. The consensus of opinion was that Alstom did not invest sufficient time to understand suppliers' capabilities. The majority of the strategic suppliers said that there was a lack of 'technical' involvement.

The next statement "Alstom was always clear and consistent in their communication with suppliers" produced the greatest spread of responses. Some suppliers commented by discussing their most recent experiences whilst other suppliers based their feedback over the

duration of their supply. The experience of the 'Double the Business' initiative produced most of the consistent comments.

Suppliers felt there were high levels of communication to increase productivity and the opposite when orders were drastically reduced. Generally the initiative known as double the company was a bad experience for suppliers. Many suppliers had over produced to meet the needs of their key customer asking for more stock. For these suppliers it meant they had inventory on their shelves which took a long time to sell. Sadly for other suppliers it meant they went out of business.

The fourth statement "dealing with Alstom was a satisfying experience" was similar for all suppliers taking part in the survey, except one. Most suppliers felt they had developed good working relationships with their contacts at Alstom. The main concern of one supplier was about the frequency of personnel changes and dealing with inexperienced workers.

Two thirds of the respondents were satisfied with the recognition received for good performance. In some instances strategic suppliers were still waiting to receive quality certification to display in their reception areas.

Suppliers felt that without Alstom having a strong commitment to invest time to understand their suppliers' capabilities (statement 2) and commitment to continuously develop suppliers (statement 7) there would be little strength in this statement. Most suppliers opted for the slightly agree to continuously improving and developing suppliers statement with, some referred back to the 'Double the Business' experience. This statement prompted several requests for a supplier conference.

The statement Alstom honoured their commitments as established within the contracts received a positive response in most cases. The negative responses came from suppliers who had experienced rapidly changing situations. Some suppliers had one contract quickly replaced by a second and even a third.

The statement "Alstom value long term company relationships" generated the highest response of all of the statements. One exception was a supplier who believed relationships with his company were at their worst for 10 years and expressed concern about the relationship with key personnel in the sourcing area.

Suppliers were also given the opportunity to add any statements that they believed should feature in company values. Different suppliers suggested the following statements in Table 24.

Table 24: Supplier statements

No.		Agree strongly	Agree Slightly	Disagree slightly	Disagree Strongly
10	Alstom operate a team working approach in the interface between us and our suppliers			1	
11	Alstom always involve suppliers in the development of products within their areas of expertise				1
12	Alstom always give feedback on supplier performance				1

Source: Alstom 2003

Alstom never leveraged the power of the company as a whole, instead each unit carried out its own purchasing transactions individually.

When Siemens purchased Alstom in 2003 the competency frameworks, processes and policies were very evolved and aspired to create a standard global approach. Siemens used a process house framework which went down several process levels for every site globally. The make buy process became a global framework and purchasing buyer decisions for strategic commodities were leveraged by volume. Strategic commodities were negotiated through the head office, in Germany, to create power over suppliers. This was achieved by consolidating the cost base of multiple site usage together and thus getting stronger terms and conditions. Siemens worked towards key commodity management globally harnessing power and leverage of many units and their commodities combined.

5.3 Manufacturing

Up until the late 1980s the company carried out piecework and time and motion studies on the shop floor. Operators worked hard to hit output to get more money. Operators abused the system by booking time to scrap and rework when their output was low as they still got paid anyway for whatever they booked. This meant the scrap and rework data was inaccurate and as a result management removed the measurement system. In 2003 only scrap times were measured.

In the late 1980s the company launched a 'Double the Business' initiative but it was unclear whether management wanted to double the production or double the profit. This lack of clarity remained throughout the initiative as managers provided different messages. This also caused lots of problems and caused high inventory levels for Alstom and its suppliers. This confusion could have been prevented by an agreed consistent and common message by the executive management team.

Over the years a strong working relationship had been formed between management and the Union. The relationship had evolved strongly since the relationships in the 1970s. In the late 1990s the Union brought total productive manufacture (TPM) to the company. The deputy works convenor, who was previously an operator, became the continuous improvement co-ordinator for the site. He arranged for part-time TPM facilitators to be in place within each manufacturing group. The TPM facilitators were all young graduate engineers who volunteered. Each TPM facilitator faced opposition from group managers and operators. The two day continuous improvement training course was also voluntary to operational staff.

Many operators were not keen that the deputy works convenor was the improvement co-ordinator. One Operator expressed his opinion by saying:

> 'The convenor is running with the foxes
> and hunting with the hounds'. Operator 1997.

The operators felt little loyalty for themselves, they also thought TPM approaches were time and motion studies they had had before. There was not enough education or training made for employees to understand the concept.

5.3.1 Operational supply chain focus

The employees' did not think in terms of a process, where the output of the process would be measured, instead they strongly felt that they were personally being examined. This attitude was not helped by managers disciplining or sacking operators for scrapping parts. This was evident when a high performing young apprentice received a final written warning for scrapping a part, and an operator due for retirement was dismissed for scrapping a part. Instead of investigating the process and identifying the root cause to take the appropriate action the manufacturing managers blamed the operators. The autocratic management style would have to change to bring about an improvement culture.

In the late 1990s the Union introduce business improvement into the company and attempted to drive it, there was no commitment from senior management or the executive team. The recoveries went against the kanban principle as recoveries encouraged over production. To make matters worse the bonus system for all operations was on the recovery measure. In 2003 the recovery measure was still in place but the bonus system was changed and linked to company profit.

5.3.2 External operations director recruited

In 2002 a new operations director was appointed from the automotive industry. Three months before 'Six Sigma' was introduced to the company he brought in the Lean manufacturing philosophy. The operations director had a completely different approach to leading. He communicated his expectations and behavioural traits to the workforce, in particular an approach for 'openness, honesty, commitment and a can do attitude.' The operations director worked hard to improve communication; to achieve this he flattened his hierarchical structure, which had an unbelievable 40 layers and reduced work teams to a maximum of 20 in a department.

There was little understanding of processes and supply chain management, except from the operations director who found that a set of typhoon blades travelled 8,500 miles in the supply chain to get completed. The blades flew to America twice and actually only had a 20 minute value added operation in the factory on a viper grinding machine.

The operations director took his group managers offsite to create a shared vision prior to the lean rollout. To support the rollout of the lean philosophy a team of 8 employees were pulled together to carry out a 9 month programme across all cells in manufacturing. The operations management team raised 3 issues during the day influencing and gaining buy in from employees, the supporting infrastructure and the financial cost benefit model to support and recognise lean cost savings.

5.3.3 Influencing and gaining buy in from employees

Many initiatives were introduced into Alstom that overloaded the employees. Management needed to drive out fear and complacency to change and needed to convince operations employees that it was worthwhile. Every operations senior management attendee thought

the average employee felt no threat whatsoever from current company performance. Gattorna (2006) expressed a company should have identify what the need is to change. If the employees did not feel the need to change it would be more difficult to introduce and implement new concepts in the supply chain.

Infrastructure

The operations management needed to agree clarity over drivers. Some felt it was "cash" whilst others felt it was "lead time". There was also a need to examine incentive and reward and develop a recognition process.

A lean support team would be there to support the change working for the group manager, cell manager and lean implementer responsible for a designated area. The lean implementer role was created for them to work closely with the group manager and cell managers to further deploy the lean philosophy. A cell manager role was created for each cell to have a manager working closely with employees from the cell. Once the team of 8 moved into another area the cell manager drove changes whilst the lean implementer coached the cell on business improvement tools and techniques. (Hines and Taylor 2000).

Financials and cost benefit model

The management team needed to agree and develop a policy for redeployment. There were inconsistent measurements and cost models (ie. recoveries were in conflict). The management of direct and indirect costs needed to be examined, 40% of the costs were variable and this needed to increase. The management team were concerned about whether they should action future state or blue sky value stream maps. Management also expressed concern over the importance of realistic cost savings, when the current standard cost model poorly captured total savings.

Senior management felt they had attended many away days to look at the future of the company the same concerns and barriers remained. Senior management attempted to introduce new approaches or initiatives but did not overcome the barriers to change or embrace employees in why these changes had to happen.

The operations management team brainstormed the inhibitors and enablers to make lean happen. There were more enablers in operations to support and drive changes forward. Table 25 shows the inhibitors and enablers to making lean happen.

Table 25: Making lean happen – inhibitors and enablers

Inhibitors to Change	Enablers to Change
Lots of change	Remove roadblocks
Employees' don't care	Co-ordinated approach
No faith in the ability to change	Clear, concise strategy
Apathy and complacency	Lead by example
Lip service	Common language
No co-ordinated plan	No jargon
Not delivering	Benchmarking
Distraction by other company issues	Buy-in "benefit to employees
Poor leadership	Visible actions
Lack of resources	Recognition
Not tackling the big thorny issues	The need – consequence of not
Reluctance to change	doing anything
Unstable drivers	facts or reality of Solar
Lack of follow up	Accept there will be pain in changes
No task culture, not results driven	Achievable goals
Tied in bureaucracy	Robust models (finance, make/buy)
	Passion manage group as your
	small company
	Replace what we're doing today with lean
	as a way of life "empowered".
	Enthusiasm
	Training / knowledge
	Communication ongoing
	Resources
	Commitment
	Release resource and time
	No blame culture
	Delegate responsibility and authority
	Clear plan, objectives and vision
	Definitive milestones delivered
	Recognition of success
	Focus – part of the company
	Fix roadblocks quickly
	Work as a team
	Constancy of purpose

Source: Siemens 2005

It was comforting to see from Table 25 that there were many enablers for lean to succeed in the supply chain. The focus was on quick results achieved by developing pilot areas, consolidated plans and actioning future state maps, change management and team building were considered. For rollout it was intended that the group managers and lean implementers delivered lean awareness training. This was to instil commitment and support from the cells.

In practice the lean implementers worked very closely with the cell managers and operators. Facilitators did less coaching and mentoring and more driving and co-ordinating. Cell managers did not air their concerns in public. Instead they communicated amongst

themselves and the more confident ones raised their concerns in one to one meetings with their manager. The cell managers wanted more support and felt that their group managers were too detached from their operational cells and were always in meetings.

The group managers kept to their old behaviours and actions and continued to be away from the shop floor in meetings. They would collect their cell action plans for monthly reporting to the operations director.

Feedback was given to the operations director that more work needed to be done with his group management team to get them aligned to share the same vision. The operations director was extremely sensitive to this feedback and annoyed it was felt that his team were not aligned.

> 'Lean is not an option they have to be aligned, as I've told them.' Operations Director 2005

It was clear that his operational management team needed further support and understanding in order to delegate to their team. There was a fundamental difference in being told to do something and being convinced that it was the right thing to do. It was concerning that the operations management team did not talk the talk and lead by example which made the lean change process slow down. To support the lean change programme, lean managers from the automotive industry were recruited to take over managing and improving two of the perceived difficult operational groups. In three years the deployment of lean principles reduced inventory by £11m.

5.4 Purchasing

In 1998 there were 3 purchasing departments' core engine, packaging and turbochargers. Turbocharges was run as a separate company located on the same site. Packaging and core engines were accountable for £160m of external spend with suppliers against a £300m turnover. The purchasing departments were each supported by a purchasing manager and a purchasing director across the departments.

Alstom had over 10000 suppliers 8 years ago. This was reduced to 1700 (including service and production suppliers) through a major rationalisation programme. During this time each department remained totally separate. There was some duplication with supplier accounts, uncoordinated improvement projects, with different processes being used for the same

purpose. The only formal communications which took place were purchasing managers and the purchasing director who met weekly.

At the end of 1999 Boston Consulting Group came into Alstom to review the purchasing approach. BCG interviewed the purchasing managers' and revealed that not enough focus was spent with strategic suppliers, the spread of supplier portfolios was not evenly distributed across the buyers and finally each purchasing department were doing little to achieve effective cost reductions.

BCG worked with purchasing for 6 months to position commodities, review the make and buy policy, establish a cost reduction system and support in the reorganisation of the department. This was a very difficult time for purchasing employees; over the previous 2 years there had been 2 sets of redundancies and now the purchasing staff where faced with total uncertainty about their future.

The feelings of a Senior Buyer were revealed:

> 'You feel like a pawn in a chess game. Everything is changing around us and nobody even cares to ask about your opinion. My team are asking me what's happening and I have no idea.' Senior Buyer 1999

Nobody knew what was going to happen to his or her position and how their job would change. However, nobody talked to the managers about how they felt and the opportunities, instead individuals gossiped amongst themselves. In manufacturing there were rumours of purchasing moving into the same area. After 4 months of purchasing employees not knowing what was happening, an announcement was made to present the new department structures and teams' structures. Purchasing was renamed sourcing, to fit in with the corporate terminology. All jobs had a new portfolio with a set of new internal customers and new external suppliers.

All suppliers were clustered into 6 commodity team head by a sourcing manager. Six sourcing teams were established; packaging, combustion, control systems, production, facilities and rotor. For example the rotor team had all components that fitted to form the rotor, discs, bearings, blades etc. A sourcing support team were created to provide coaching and guidance to 6 sourcing personnel on purchasing processes, training and development, quality costs and global sourcing.

Unfortunately sourcing did not re-locate with operations; instead everybody was moved to sit with their team. Buyers who previously had experience with certain commodities were all moved to handle entirely different commodities. There was little time for handover as employees were in their new roles within 2 weeks. This big bang approach impacted the professionalism portrayed by sourcing internally and externally. The buyers in new positions hardly knew anything about their commodities.

In 2003 when Siemens purchased the Alstom Lincoln site sourcing was restructured. Many of the strategic commodities were taken from Lincoln and procured from Germany. Commodity account manager positions were appointed to negotiate global contracts, 12 positions were created. Operational purchasing remained but only 2 purchasing manager positions remained, 1 for packaging and 1 for core engine. All the buyers' commodities were re-arranged and each buyer ended up with a different portfolio again.

5.4.1 Order fulfilment

A group of engineers were involved in supporting the operations company groups with lean manufacturing. This involved them going into a group for a maximum of 8 weeks to improve the processes and material flow. This often meant they would have 1 or 2 weeks to improve a cell.

If the lean support team needed any purchasing requirements they would have to write a requisition to get it approved and take it to purchasing to convert into a purchase order. On this particular occasion the requisition stayed in the buyer's in tray.

The feelings of the Continuous Improvement Engineer were expressed:

> 'I was involved in a 5 day improvement blitz within a cell we wanted some standard storage racking. We could have got this off the high street but it took 2 months to come in through sourcing. They are working to a different priority list to Operations'.
> Continuous Improvement Engineer 2004.

Often the support team would move on to another group whilst the group they left waited for external materials to arrive. After many complaints from manufacturing to purchasing about the service being too slow the team escalated due dates to the operations director. The team finally got sourcing to agree to provide the lean team with a purchasing card.

There were only 15 purchasing cards allocated to employees' within the company with a set budget and suppliers to purchase non production items only. This had been frustrating for engineers. In 2003 electronic vendor schedules were introduced to 300 suppliers. In 2002 a weekly print out used to be sent to suppliers in the second post, which meant each supplier had to manually check what requirements had changed.

5.4.2 Purchasing skills and competencies

The competence and skills needed to carry out the strategic purchasing role were similar to the skills needed for a consultant. Further investment was needed in training and education to support the new and developing role. Sourcing employees would be equipped with the right level of understanding in tools and techniques to deliver results and to become more facilitative. There was often a generalisation that everyone could fulfil these new roles and skills. Nevertheless when the skills and competencies required were reviewed it raised questions as to whether the capability of some employees would be adequate.

A sourcing job family tree was available which provided the grading structure and job description for the sourcing department. Table 26 shows the 4 sourcing grades.

Table 26: Summary of purchasing staff grades

Role	Grade
Clerk	13
Trainee Buyer	14
Buyer	15
Senior Buyer	16
sourcing Manager	17

Source: Alstom 2001

When assessing grades within sourcing there was a high amount of employees' with a grade 13 at a clerk level and a few experienced operational buyers at a grade 15. It was clear that despite a grading structure being established management rarely used the range of payments available within the job family tree to award employees efforts in cost reduction and delivery of strategic objectives. This was highlighted in minutes from the sourcing managers meeting.

Minutes from the management meeting

There is increasing evidence that we are falling behind the market rate for sourcing staff. Specifically, we are finding it difficult /impossible to recruit at the levels we pay to our current staff. We are losing key staff for financial reasons, employees' of comparable ability transferring into sourcing from other functions within the company are paid more than our existing / experienced staff and sourcing has one of the lowest average salaries in the company.

Source: Alstom 2001

The sourcing department was driven by price instead of total cost. Everyone needed to take further responsibility to consider the hidden cost of quality such as transportation, storage and life of produce, processes as a whole system and the supply chain to proactively drive improvements.

5.4.3 Purchasing development – comparing Alstom units

A quick purchasing comparison was made between Lincoln and 3 other Alstom units. This was to compare purchase development and identify approaches. A summary was made for each unit's current purchasing processes Table 27 summarises findings.

Table 27: Alstom supplier site supplier development comparison

	Pre-Qualification	Supplier Classification Levels	Process Audit	Technical Assessment	Tools & Techniques	Supplier Rating	Number of Production Suppliers	Supplier Spend	Non. Conformance System
La Courneuve	QCD	6	Q	Y	No	QC DS	150	238m Euro	Y
Finspong	No	4	QC ET	In Audi	Y	D(QC) ***	1700 ****	300m Euro	Y
Bruno	No	7 total 5 used	Q	No	No	QCD	200	15m Euro	Y
Lincoln**	QCD TE	9	QET	In Audi	Y	QC DT	800	450m Euro	Y

Source : Alstom 2001

Key: Q - Quality, C - Cost, D - Delivery, S - Service,
T - Technical, E - Environment.

Common areas were non conformance systems for suppliers and performance rating systems for suppliers. Each site was at different levels of advancement in the purchasing and supplier development processes. Bruno's process had been in operation for 4 years and was regularly updated based on development of commodities. Two sites had QCD. Lincoln carried out supplier self assessments for audits and performance measures on suppliers. Finspong did not measure suppliers but planned to introduce cost and quality measures using existing tools and databases. The number of suppliers for Finspong was significantly larger as they had all their suppliers grouped together.

This illustrated that some good purchasing processes existed for supplier classification and audits. There were varying levels of coverage and supplier performance ratings. Each unit except Finspong covered delivery. Quality, cost and delivery were the only categories for Bruno. Lincoln included a technical assessment and La Courneuve a service assessment.

Only Finspong and Lincoln used tools and techniques to improve, the other 2 units did not use anything. Due to resource and time constraints some of the processes were applied in a fragmented way and were not reviewed regularly. The processes were predominantly created manually and there was a fundamental need for a more automated database. The database would then provide data and information to compare units' performance and carry out benchmarking.

5.5 Senior management view of their supply chain

In 2001 a strategic review day was held with 150 senior managers. All attendees completed a questionnaire which asked from their experience what they felt were the inhibitors and enablers of effective performance in supply chain management (appendix 3 shows the supply chain management survey).

For the purpose of this research all the comments were added into a database to carry out conceptual analysis. There were 795 inhibiting comments made by the senior managers' whilst for enabling comments there were 519. These results were not weighted which revealed that there were many more inhibitors preventing effective performance in the supply chain. Once all the inhibitors and enablers and their associated comments were entered into the database every comment was captured and all comments were clustered into themes. The findings were presented as inhibitors and enablers.

The key inhibiting themes identified were: negative attitude, fear, lack of priority, lack of commitment, lack of understanding and lack of openness and honesty. The key enabling

themes identified were: open performance, accountability, incentives and lead by example. The comments given under each theme were those expressed by the senior managers using their exact comments.

Inhibitors for supply chain development

The six inhibiting themes: negative attitude, fear, lack of priority, lack of commitment, lack of understanding and lack of openness and honesty were explained with the actual senior management feedback which was provided from the survey.

Negative attitude

An ingrained attitude existed that was negative, this meant asking managers and employees to do something they did not believe in was impossible from the outset. The preconceived views and the company history did not help the situation. A "so what" attitude existed, "why should I do it when they're not" or "even if I do it, others will let me down, so what's the point", "well last time….", "I've been here 25 years and its never…..". As a result past experiences and failures created a "how it's always been" mentality.

Fear

Fear fell into three categories; fear generally, fear of failure and fear of change. The continued change from department restructuring and new company names had caused employees to become reluctant to accept change. Many of the senior management and their employees had also become afraid of failure.

The site history and memories of past experiences and the baggage caused from previous failed initiatives such as "Double the Business" prevented them from moving forward. Employees' feared company failure from product quality, faults and delivery performance.

Lack of priority

There were too many requests and their work was becoming overloaded and overstretched. Employees were afraid of saying 'no', some had good intentions but continued to take on too much work and would not prioritise accordingly. There was no ranking process for commitments and a lack of acceptance of targets and objectives. There were also diversionary activities. Overall this created a domino affect of broken commitments.

Lack of commitment

It was too easy to give a commitment and then not deliver, as too often management and employees' were presented with unachievable targets. There were conflicting demands, interests and requirements, some employees' believed that others were not committed and so did not see the point to be committed themselves. Managers also gave commitment of their employees to do other managers activities without prior knowledge to the employee.

Lack of understanding

Lack of knowledge and understanding existed for management and employees. There was a lack of understanding and knowledge of individuals, customers and personal values and poor appreciation that everyone had an input. Lack of respect for each other was often due to a lack of understanding. They did not understand the size of commitment and what was involved. Many felt that the objectives and goals were unclear. There were unrealistic objectives and expectations; there was project overload and promise of many major new projects to come.

Lack of openness and honesty

Managers and employees' contrived answers by telling others what they wanted to hear. There was a culture of "it's ok not to be honest". This included communication internally and externally with customers and suppliers. Employees' avoided conflict, embarrassment, confrontation and bad news. They provided limited information and told others what they wanted to hear, as they did not want to 'rock the boat'. There was also an inability to value criticism as it was seen as 'exposing weaknesses'. Alstom needed to stop the blame culture, backbiting and hidden rules.

There were insincere and dishonest employees' who cheated for personal gain. There were unpalatable truths, especially from sales and customer perspectives. Many did not know what honesty meant to the company. There was too much use of statements like 'with all due respect' and 'I hear what you say, but', which showed a disregard by some managers for some employees. It was more a case of "do as I say and not as I do".

Enablers for supply chain development

The enabling themes were: open performance, accountability, incentives and lead by example and were explained by senior management comments.

Open

An open approach encouraged more debates and enhanced transparent requests. Managers' and employees' needed positive and negative feedback. This was achieved by open communication, forums, reporting and an open book policy. There was a need for ongoing relationship building to encourage an open society where everyone's ideas were respected and listened to. Managers' needed openness to accept different views and explanations, without ridicule. Employees' would then be treated fairly, know where they stood and would become more informed.

Performance

The company needed to become customer orientated and build customer confidence, both externally and internally. Decisions and performance development should be based on fact and the use of strategic measures.

Employees' performance would include realistic strategic objectives and the ability to meet targets. Performance improvement would impact greater efficiency, productivity, output, reduced cost of poor quality and delivery on time. Only then could the company meet customer, supplier and employee expectations. Employees' would continue to carry out step changes to continuously improve performance.

Greater focus and prioritisation of objectives and publishing completed and finished actions were required. Senior management and employees' needed to be more disciplined and deliver commitments.

Accountability

Managers' and employees' needed to be empowered to have a greater sense of ownership and accountability. Individuals needed to take the authority and ownership to make decisions. Employees' accountability meant they would need to determine acceptable levels of work and drop activities, which took their workload over the top. Big tasks needed to be

broken down into individual manageable bite size pieces, with understanding of limits, realistic targets and priority settings.

Incentives

To make change happen the company needed to motivate employees' through rewards and recognition. For example recognition for milestone achievement and visible rewards clearly linked to success. Employees' should be praised and recognised for having a 'can do attitude'.

Trust

Trust needed to be two way between employer and employee and vice versa. The company and the employees' needed to give and receive a greater degree of trust. Creating a trustworthy culture meant there would be no hidden agendas. Senior management and employees needed to build complete trust in the supply chain.

Understanding

Managers' and employees' needed to understand positions and pressures of others and demonstrate respect. Managers needed to be able to show empathy and appreciate diversity. This would include fair consideration of different views, cultures, beliefs, age and gender.

Understanding skills, roles and responsibilities would assist understanding. Employees would need to take interest, nurture understanding and give constructive feedback, be it in agreement with their views or not. This would provide the company with professional status and image.

Lead by example

The Managing Director needed to set example by ensuring a "top down" approach. Respect should be demonstrated by how managers' and employees' behaved. Employees needed to get on with their job and follow through on actions, not just listen and forget. Managers' would then be able to get the company back on track, lead by example and develop robust relationships with stakeholders.

Actions taken to develop the company

After the strategy day questionnaires were collated. A large lever arch file containing all the results was handed over to the executive board and no actions were taken. This was very disappointing as the survey contained valuable findings. After the results were used to produce a summary report these findings were presented to the Managing Director to agree a way forward.

Although most of the management feedback was inhibiting factors the Managing Director was pleased that senior managers had honestly written how they felt. It was interesting to reveal that the majority of the results were behavioural and impacted how senior management wanted their managers and employees to operate at work such as trust, openness, honesty and understanding.

The new approach could be to create an environment in which managers could operate differently. Senior management would need to lead by example for their employees to feel they could operate openly and honesty with clear targets, leadership and support.

Unfortunately because there were so many behavioural inhibitors the Managing Director felt that these inhibitors were not something that he could change. The Managing Director strongly felt the inhibitors came from his managers' personal values. By linking all these inhibitors to personal values he felt the inhibitors were innately part of what somebody lived for, which rarely changed. The researcher appreciated this view but felt managers could take some responsibility to challenge and break the mindset of complacency in the company. There was the environment in which employees operated, how employees were managed, how targets and priorities were set. Unfortunately no action was taken.

5.6 Siemens impact on the unit

In 2003 when Siemens purchased Alstom, the communication was different. Three formal briefing presentations took place for everybody prior to the company becoming Siemens. The football pitch was hired for everybody to receive communication together for the first time in company history.

In 2003 when the site became Siemens the cascade of information was more difficult, as all information was marked 'strictly confidential'. Even the quality cost information, which was

public knowledge to the entire company before, was now communicated to senior managers who were accountable for reducing the costs. This was dangerous as it isolated senior managers, project managers and teams from the real company issues and performance this also increased complacency. Employees' may think there was no longer need to change, which could not be further from the truth.

In 2003 the community of Lincoln still referred to the Siemens unit as Rustons. Siemens remained the largest employer for Lincoln with a workforce of 2500. It also provided the highest salary levels in the community, compared to agricultural companies and telephone call centres. In 2003 the average salary was £18,500 compared to the UK average of £21,000. Companies in Lincolnshire were able to take advantage of the lower cost of living.

When company name changes had taken place, the operational activities and organisational structures and roles were never impacted. However, Siemens globally were very process orientated and drove standard harmonised systems. Siemens were very keen on the application of high level standard processes and an integration plan was established for the company to implement the Siemens processes.

The Siemens processes begun with the introduction of a company Balanced Scorecard to assist in delivering the strategy and in the near future the site would adopt the Siemens process house. This defined high level processes for supply chain management, relationship management and supporting processes such as HR, Finance and I.T.

Value generation programme

In August 2004 the Lincoln management team introduced value generation programme (VGP). VGP was a tool created by KPMG consultants; it was developed to close a company cost gap between themselves and their main competitor. The tool baselined all the company costing data for the first year and projected the costs four years ahead, assuming an estimated cost calculation for economic costs, overhead costs and cost of sales. The tool then assumed that if all costs remained the same over the four years the company had a cost gap between them and their competitor. The huge cost focus drove everything in the company. As a result in one year over 30% cost reduction was achieved.

Siemens found standardised reporting and controlling of financial and quality information important. Many changes were made internally to fulfil corporate reporting requirements.

5.7 Summary case analysis of a Gas Turbine Company

The Lincoln gas turbine site had undergone considerable change including 5 company name changes in 6 years and 4 new Managing Directors over 5 years. This had made a significant impact on senior managers and employees, which had enhanced business improvement to the internal infrastructure of the supply chain.

There was a significant drive to reduce costs. Initially all cost reduction was focused on the labour costs and heavy savings were made through redundancies and annualised hours. However, regular end of year redundancies over a 5 year period placed considerable strain on employees' morale and motivation. The executive management team finally changed the approach to focus on all other overheads.

The continual pressure and drive to reduce costs meant that the strategic objectives were delivered extremely quickly. The speed of implementation to reduce cost meant that the resource was heavily constrained. There was no time for accepting and embracing change. This was experienced when Siemens drove a 30% cost reduction in 1 year for hard tangible cost savings. The strategic objectives were realised, nevertheless high pressured, stressful, confused and disengaged employees' remained. Too many short term approaches like could have a catastrophic affect on supply chain management.

The supply chain management at the gas turbine company was heavily focused on internal improvements and external cost reduction with suppliers. Improvements were heavily functional. The feedback of 150 senior managers' experiences of the enablers of supply chain management revealed a soft emphasis was needed. The soft emphasis was because openness, honesty, leading by example and a positive outlook, were factors which would enable impact to optimise supply chain management.

The main areas affecting the gas turbine company which heavily affected supply chain performance included; little service drive, management commitment, lack of ownership and accountability and no total process drive or focus on the supply chain. The five main areas which affected supply chain performance were examined further.

Little service drive at Lincoln

There was heavy conflict between a service focused company, concentrating on rapid response to customer needs and a make to order manufacturing unit concentrating on production and not the end customer. Despite Lincoln providing service support to oil and gas customers there was very little customer focus and understanding. In particular if a customer needed an urgent replacement part the following day, there would be no value in sending it months later.

It was evident from the company history research that the manufacturing plant was heavily technologically and manufacturing focused. This was emphasised by the history captured by the company which was technically biased.

The Lincoln site supply chain never felt a burning need to change. The company had existed for over 60 years and the majority of employees', who had a long service history; felt that it would continue to be there. A culture of historical complacency and negativity had evolved. Employees' had experienced a lot of initiatives and suffered fatigue. Management did not receive regular information or communication for the customer base and external environment. The information and communication of the key customer base was held within sales and marketing or the strategic development department. Little communication and information was transferred within the supply chain.

Management commitment

Management commitment was by far the greatest area of opportunity and this alone could drive the enablers of supply chain management. Management commitment was made through leadership, clear performance targets, accountability and disciplining employees that did not perform, when clear of their expectation. Every area in the supply chain could perform more effectively and the departments would become more closely aligned.

Unfortunately the company ownership, internal re-organisation, redundancies, cost reduction pressures and initiatives meant senior management would race ahead without taking time to communicate changes and get employees to embrace change. Many of the employees' continued to operate in chaos and heavy firefighting. Employees were not clear of what was expected or truly needed by their managers or customers.

Lack of ownership and accountability

There was great concern over the lack of ownership and accountability. Processes were mapped but ownership of processes and the effectiveness on processes were poorly measured. The company significantly struggled with delivery problems however the delivery measure was never fully examined or understood across departments and bottlenecks never appreciated. Employees provided examples of poor delivery and costs spiralling out of control where managers did not take ownership.

No total process drive or focus on the supply chain

The process maps reflected functionality and there was little ownership and accountability. The processes were slow to respond and had little flexibility. For example all purchase orders for Aberdeen were posted to Lincoln to be authorised, adding unnecessary time to the process as authorisation could have been made by a manager at the Aberdeen unit. Another example was buyers focused on cost reduction. They may select a cheaper supplier, but the supplier may have a longer delivery time, causing the total costs to be higher. At the beginning of the research each operation transacted their work for their part of the process with no consideration to the whole process or the supply chain.

Summary

There were considerable changes being made to the company to take it forward. There was significant investment in lean, six sigma and cost reduction systems to develop excellence in supply chain management. (Bicheno 2000).

However, there were a lot of negativity and fear of managers and employees who needed to overcome barriers which had remained untreated in the company. These were heavily highlighted in the employee opinion survey as were poor training and development, creativity, praise and recognition. (Hines and Taylor 2000, Gattorna 2005).

The company had introduced the Balanced Scorecard however further soft measures could be used as a driver for employees to value and respect each other and their management. (Kaplan and Norton 1996). The soft measures could include values for leadership, managing change, praise and recognition and effective communication.

The next chapter compared and contrasted the bearing company and the gas turbine company identifying parallel themes to answer the research questions.

6.1 Introduction

The chapter on cross case analysis looked for commonality in the case studies to answer the research objectives. The research objectives were: to identify the ways in which the management of the supply chain had changed, to investigate how new ideas on supply chain management were implemented, and to identify the inhibiters and enablers of supply chain management.

The supply chain management research was conducted using a conceptual framework (Figure 9) which drew its key factors from the relevant literature. These factors included; policy deployment, managerial support, employee involvement, business improvement and suppliers. These factors informed the analysis. The contextual factors were summarised within the cross case analysis under the research objectives.

RHP-NSK and Alstom-Siemens were compared as were 4 supplier companies. Both of the main case study companies had a 60-year history and were located in historical market towns. RHP-NSK (case study 4.0) was located in Newark and Alstom-Siemens (case study 5.0) in Lincoln. Both companies provided the main employment for their communities 20 years ago. However in the twenty-first century they have both faced shrinking workforces, due to global competition, the strength of the pound sterling and pressure to make higher margins. Added to these pressures, clients required higher quality, reduced costs and tighter delivery adherence. At RHP-NSK the sales and marketing team were targeted monthly by automotive customers' differing QCD systems (4.6.4). Alstom-Siemens placed emphasis on customers' QCDS expectations (5.2.2).

Mentzer et al. (2001) classified supply chain management into three phases; a management philosophy, implementation and a set of processes. The research revealed that both companies were heavily focused on the implementation phase. In both case studies there was very little evidence of supply chain management as a philosophy and thus less strategic emphasis; both companies had made considerable effort in implementation and had gained an increasing awareness of the need to focus on business improve supply chain implementation.

6.2 Cross case analysis

Cross case analysis was undertaken to answer the research objectives. This provided understanding and evidence from the literature and case studies to complete the study.

6.2.1 The ways in which the management of the supply chain had changed

In the twenty-first century, a change for both companies was that senior management had to think and act more strategically about supply chain management. This meant they needed to consider global supply chain management, planning and policy review and external factors which impacted their company, including product and market positioning.

Alstom-Siemens' management had the scope to pull supply chain management principles through its suppliers due to its global positioning, market share and spend. This began with the creation of the commodity manager role. RHP-NSK was constrained by smaller volumes. Nevertheless, for many of their strategic suppliers, RHP-NSK was their key customer. It was felt that RHP-NSK had greater potential to leverage suppliers through consolidating volumes across sites, but the strategic focus was frequently reactive.

The 2 manufacturing companies showed very little evidence of strategic supply chain management taking place, despite having a global presence. Both companies were taken over by foreign competitors and little change was imposed through the new head offices. RHP-NSK's Japanese head office management team simply came and reviewed the site's progress. They did not recommend any tools or techniques to be implemented, despite the widely publicised Japanese quality management approaches. Alstom head office was the only one which introduced six sigma training through its head office across all the sites worldwide.

Throughout the five company name changes at the gas turbine company, each head office left the local senior management to develop their company supply chain as they saw appropriate. Overall the takeovers were weak at introducing new ideas and concepts to under developed sites. The exception was Siemens who purchased Alstom in 2003. For a period of 18 months there was a great emphasis on the balanced scorecard, process alignment, standardising systems, stretching targets for cost reduction drive and financial/quality reporting. Siemens emphasised more regular communication and reporting, and re-introduced an employee survey.

The research showed that many managers operated functionally at the expense of the total process or 'whole system' and lacked consideration of supply chain management. This was evident from the vignettes and case study research, such as the purchasing department making price reduction decisions which affected the shelf life of components of the gas turbines in the field, which would cause additional labour, transportation and parts replacement. Overall there was a lack of communication and sharing of information across all functions in both companies. This was particularly found between the sales, manufacturing and purchasing divisions. At its worst, RHP sales had seven-year agreements with customers and six-month forecasts of demand, yet only passed a 12-week forecast to the manufacturing division. A longer-term forecast of information shared with purchasing would have been very advantageous for material flow and control and to provide suppliers with more visibility rather than the monthly spot ordering process. In 2006 a significant change to RHP-NSK was that all low-cost commodity bearings were manufactured in China, where they were cheaper to make and buy. The entire strategic focus was shifted to 'precision bearings', which were high technology and priced to compete.

To review the transition of how things had changed in supply chain management, both companies were reviewed from the beginning of the research to the current day, capturing 10 years of supply chain management developments. To compare a high-level strategic overview of the companies, a matrix was produced summarising high-level supply chain development. Table 28 identifies these key changes in supply chain management.

Table 28: High-level company cross case analysis

Key factors	RHP-NSK 1996	RHP-NSK 2006	Alstom-Siemens 1996	Alstom-Siemens 2006
Ownership	Japanese	Japanese	French	German
Supplier tier to customers	3rd tier	3rd tier	1st tier	1st tier
Strategic Approach	*Hoshin kanri* and Visual Mgt	*Hoshin kanri* and Visual Mgt	No high level strategic approach visible	Balanced Scorecard
External Customer Pressure	Quality Cost Delivery	Quality Cost Delivery	Quality Cost Delivery Reliability	Quality Cost Delivery Reliability
Drive	Cost	Cost	Quality	Cost and Quality
Costing System	Standard Cost	Standard Cost	Standard Cost in Finance, Quality Costs in Quality	Standard cost and quality cost system in Finance
Policy Deployme	QCDS	QCDS	30% over 3 years Cost Reduction 10% a year	20% Cost Reduction Annually

Source: Case study findings

Table 28 shows that, at a high strategic level, RHP-NSK remained fundamentally unchanged. The case study research revealed a heavy focus on the implementation phase (6.2.2). RHP-NSK had a consistent focus on annual targets and visual management using QCD measures (Figure 10). This provided benchmarking, targeted focus and performance review. It also maintained a common language of development across sites. For example, one Japanese unit had used the same QCD measurement system for over 30 years and continued benchmarking using the same high-level measures.

Table 28 shows that the external customer pressures continued to focus performance in the same areas. However, the internal focus changed at Alstom-Siemens due to the change in ownership and senior management priorities. Both companies had little deployment of customer systems within their supply chains, except for differing QCD systems which were measured and reported at the sales function at RHP.

At Alstom-Siemens the policy system went through dramatic changes. At the beginning of the research, the vision, strategic aims and objectives were unclear to managers. The executive management team kept the strategic aims strictly private and confidential. Only a small proportion understood what the company was trying to achieve. At the beginning of the research, Alstom-Siemens had the basic measure for a manager to keep control by 'staying within budget'. This was emphasised by a quote from the Head of Customer Support:

> No one can ever tell whether you're doing a good job or not as they only ever look at your budget costs.
> Head of Customer Support (2003).

Managers who did not have a budget had no means of being measured by the company and no expectations were placed on them. This culture existed for four years. At the end of each year senior management issued redundancy notices to achieve their plan. This short-term focus meant employees had a much greater degree of uncertainty, which heavily affected morale and motivation. This short-term emphasis was damaging to supply chain management, as employees who were made redundant would often be recalled to the company when orders increased, creating a high degree of uncertainty. Alstom was taken over by Siemens in 2003, and immediately Siemens made 99 employees redundant. Once the head office in Germany saw the impact this had on morale and motivation, all further redundancies were stopped and the focus was shifted to reducing all other overhead costs.

Siemens made strategic management changes which included the introduction of a Balanced Scorecard which considered financials, processes, employees and customers. The site MD

was measured on his profit and earning before interest and tax (EBIT) and reported quarterly on the Balanced Scorecard progress of the site to the German head office. The Balanced Scorecard company targets were agreed annually and cascaded down to every function. Each department in turn then produced their Balanced Scorecard to run their department. The policy deployment system was introduced over 18 months across the entire supply chain. RHP-NSK and Siemens both used a performance measurement system across their entire global business to compare units' performance. This was extremely powerful for strategic decision making and to compare different units' supply chain management development.

Lee and Dale (2000) reported that policy deployment cascaded from corporation to division, from division to function, function to team and finally the individual. In RHP-NSK the manufacturing, quality, sales and marketing operations carried out a full cascade. In purchasing they were initially excluded entirely and were measured on price reduction only. For Siemens the cascade was introduced top down across the whole supply chain and it became the way departmental managers were measured.

A common factor was that both companies adopted performance measures across departments which were visible and deployed down to departments and teams. In four departments – manufacturing, engineering, purchasing and sales – these targets were deployed to individuals. An immediate change at RHP-NSK was that purchasing became integrated into the policy deployment process (Figure 26). At Siemens policy deployment went down to individual buyer and commodity.

Lee and Dale (2000) reported that to achieve the full value of policy deployment effectively it should include everyone for optimisation of the supply chain. Brewer and Speh (2000) found that many managers saw supply chain management and the Balanced Scorecard as separate tools. Those who understood the integration had a greater likelihood of leveraging the supply chain as a source of competitive advantage.

Lee and Dale (2001) found that policy deployment was largely unreported. RHP-NSK and Alstom-Siemens appeared to show evidence that they were quite advanced with policy deployment compared with other manufacturing companies in the UK. In the research the 2 main manufacturing companies and 4 supplier companies lacked business planning and reacted on a day to day basis. Pascale (1990) found that short termism was common in western management. However through the influence of Japanese and German management approaches both companies had become more organised and had a longer term focus. RHP-

NSK and Siemens had included all functions, teams and many individuals which helped realise the value of policy deployment to leverage supply chain management.

Table 28 showed that when Siemens took over Alstom-Siemens the annual cost reduction targets and pressure to improve doubled. Siemens put greater focus on quality, as the cost of poor quality was reported but no action had been taken by Alstom-Siemens. Siemens integrated the quality reporting system into the financial system. This gave the quality costs a high degree of robustness and imbedded them into the company financial system.

Over the past 60 years Alstom-Siemens has been heavily focused on engineering and the technological development of a complex engine and has aimed for product leadership. This means Alstom-Siemens appeared to aspire to be the best in the market at the technology of the product and invested huge amounts of funding in technological development. It was the first company to use tree pulp to power turbines overseas. It was my perception that this continual focus on product leadership alone had put Alstom-Siemens out of touch with its customers needs. The customer needs had changed to a 'total service solution' and therefore great emphasis was on supply chain management. Alstom-Siemens faced an era of change where it was attempting to move away from product leadership to operational excellence, which increased when Siemens took over. To understand how the management of the supply chain had changed the research focused on how people were allocated to priorities in the supply chain. This is summarised in Table 29.

Table 29: High level resource changes

Unit	RHP-NSK 1996	RHP-NSK 2006	Alstom-Siemens 1996	Alstom-Siemens 2006
Site Turnover	£40m	£52m	£300m	£350m
Supplier Spend	£19m	£22m	£180m	£220m
Number of Buyers	18	1	40	40
No. of Senior Buyers	2	3	10	10
Purchasing Managers	2	0	7 1 Director	3 PM's 12 Commodity Managers 2 Directors
Number of Suppliers	5000	3000	1700	300
Designated Spend levels	Manager £150k Senior Buyer £25k Buyer £10k	No spend level. Spend allocation set in annual budget	Manager uncapped, Senior Buyer £75,000, Buyer £50,00	Manager capped Designated spend policy. Second signature from Germany. Director £75,000 MD £120,000

Source: Case study findings

Table 29 shows that Siemens managers' designated spend levels were strict and managers had to justify why they wanted investment. Therefore the German head office held greater control and reporting. Under the category of purchasing manager, many further management roles had been created to focus improvements on supply chain management. These new roles in particular were commodity managers who reported to the site and the head office. The commodity managers had to target global procurement, consolidating a particular commodity by liaising with other sites and negotiating high volume contracts. The commodity managers had a huge impact on reducing the supply base by 82%. These roles were clearly targeted and measured monthly to deliver supply chain improvements.

Siemens had always had many employees in management positions; this was evidenced in the case of the boat-race poem (Figure 29). A director expressed that the race was lost because there were 'too many managers steering and not enough rowing'. The new senior roles of commodity manager were different because they were measured and reviewed for deliverables. This was a significant change to previous management roles where they were not measured or driven to improve the supply chain.

At RHP-NSK using existing employees for strategic procurement took four years to establish. It was a dramatic change for purchasing to become fully integrated by handing over all purchasing operational responsibility to manufacturing and breaking up the purchasing department. In 1996 a vignette from the Engineering Manager expressed his earlier frustration with interfacing and communication problems:

> Purchasing is so busy obtaining the cheapest price they order parts that cannot meet our required lead times. I was involved in a grinding improvement and the whole programme was held up by three months because we had to wait so long for the grinding wheels. There were also poor conditions negotiated with no consideration for maintenance, when I tried to enhance these I got into trouble with the purchasing manager.
> Engineering Manager (1996).

Regular comments were made in manufacturing including 'they sit up there in their ivory tower and never get involved in what's really happening' (4.3.1). Purchasing staff were seen as being focused on their own price agenda with no consideration to the other functions in the company.

The lack of focus on material flow and planning was emphasised by the store manager:

> Purchasing buy material without asking anyone in the factory what they need. They buy great quantities that don't even fit in my stores. I then have to struggle to get my people to transport the items outside the stores.
>
> This can also be a health and safety hazard as we cannot use the crane or fork lift truck in some tight areas on the second floor.
> Store Manager (1996).

Within a year the purchasing manager did not just consider price but thought more about the supply chain and as a starting point expressed the need for closer relationships with manufacturing:

> As a continuation of the drive to improve service levels, lead time to customers and manufacturing output it is vital that the purchasing units reporting to manufacturing are given the full support of all concerned.
>
> They have an extremely important part to play in QCD improvements and this unit has a dual role of closer working relationships with manufacturing and involvement in supplier improvements driven by the strategic unit.
> Purchasing Manager (1997).

These vignettes captured the changes over time. In 1996 RHP-NSK had 22 employees in purchasing with a total spend of £19m, producing paper orders for all products, which were printed and posted. In 2006 one buyer procured the total spend of £22m and was part of the operations team reporting to the operations director. A significant change was that at the beginning of the research all ordering was one-off and paper based, 10 years later all purchasing was carried out electronically by one buyer and included vendor schedules. Table 30 summarises supply chain development over 10 years.

Table 30: 10 years of supply chain development

Key Factor	Areas	RHP-NSK – NSK	Alstom-Siemens – Siemens
Strategic approach	Aims and Objectives	*Hoshin kanri*	Introduced Balanced Scorecard
System	Technology	Oracle to MRP	MRP moved to SAP-ERP
Operations	Structure, Activities	Deep hierarchy TPM Operational Purchasing Manu.	Hierarchies reduced in operations. Deep hierarchies

		Led to Purchasing being integrated into Manufacturing.	elsewhere
Process	Improvements	TPM (included Lean)	TPM to Lean Manu. and Six Sigma
People	Senior management Employees	Policy deployment Targets	Balanced Scorecard Measures
Customers	Expectations and Communication	Performance systems with sales and marketing	Communicated with board, quality, sales and strategic development.
Suppliers	Targets	Measures Sup. Dev.	Measures and cost down

Source: Case study findings

Researching the history of RHP-NSK and Alstom-Siemens it was evident that 10 years ago both had a high number of employees who were functionally structured. At the beginning of the research, emphasis was on production and technological developments at both companies. The companies gave little consideration to the supply chain management and the need of every department to be integrated, to increase the flow of products and services to customers. The research findings appear to show there is still a weak customer service drive in both companies as there is little appreciation of customer expectations and priorities.

Functional structures remained and any functions away from the sales and marketing team were removed from customer involvement and feedback. The emphasis in both companies was heavily functional with no real need to change. This was highlighted heavily by RHP-NSK's sales manager's attitude to sharing information. The sales manager would not allow any copies of information to be taken, despite Nissan's supplier development programme being well documented in the public domain. The sales manager would not even allow RHP-NSK performance figures to be captured or taken away internally to develop the supplier base. This appeared to illustrate a traditional attitude and unwillingness to share information for supply chain development. The primary customer-facing function would get customer feedback and deal with customers accordingly. At Alstom-Siemens only when a customer complaint became extremely high risk would the executive management team cascade feedback to their supply chain via the Managing Director. During the research this revealed that more often the communication would be on negative customer feedback only.

During 10 years of research, change had taken place in both companies. The change in senior management thinking had created some consideration for the needs of the whole system and the supply chain. There had been big changes in the management of the supply chain resource allocation, structure, roles and prioritisation but there were much greater opportunities to be achieved by both companies working with the 'whole system' in mind.

RHP-NSK had made a lot of progress in terms of structure by fully integrating purchasing and manufacturing. This took four years to happen and further changes could have been missed such as reducing the suppliers. In 2006 RHP-NSK still had 2000 production suppliers on their system. Siemens had made the most strategic cost savings through its commodity focus and supplier rationalisation.

Summary

The evidence revealed over the period of the research that there was significant managerial effort aimed at change which contributed to the development of the supply chain. This was manifest in the number of initiatives and the range of tools and techniques being adopted. However the research has revealed that whilst there have been some significant changes in the management of the supply chain, the changes were less than hoped for in view of the literature available (Hines 2000). Both companies were not as strategic with supply chain management as they might have been and implemented it partially, as it affected some areas of the supply chain more than others.

One problem was that the initiatives were placed on top of existing structures, functional operations and a traditional managerial mindset. The company also had long lead times and long product development cycle times which enabled the pace of change to be slow; it was felt that this could encourage 'sleepy' companies with a slow drive to change. These factors contributed to making the changes insufficiently strategic and less focused on the supply chain as a whole.

6.2.2 Analysis of how new ideas have been implemented

The hardest challenge for both manufacturing companies was the implementation of new ideas. Firstly understanding the tools and techniques and how to apply them and secondly sustainability through continual focus on improving the objectives. The teams had very broad objectives such as 'RHP-NSK reducing the supply base' and for Siemens 'reducing margin erosion on the plant in three months'. Their senior management and employees struggled to understand how to break these objectives down so that they could become achievable. Projects needed more focus and this could simply be through SMART objectives; specific, measurable, achievable, realistic and time bound (Count 2000). Both

companies also implemented new ideas that were adopted in the supply chain at the beginning of the research without appreciating their customers' expectations and priorities.

In 2006 both companies used TPM. The tools and techniques used included: the fishbone diagram (cause and effect), five whys, eight steps to problem solving, 5Ss housekeeping, set-up reduction and seven wastes (Womack & Jones 1999, Bicheno 2002). At Siemens TPM was introduced by the trades union and had little senior management commitment, understanding or buy in. When the new operations director was appointed in 2002 he introduced the business to Lean and he had a completely different approach to leading (5.3.2). His approach included sharing his vision and aligning it with his group managers, sharing his values and behavioural traits, communicating regularly with his entire workforce of 800 and getting his group managers to create their own improvement plans which were used daily and reported monthly. A significant change in the tools and techniques was the more frequent adoption of value stream mapping (Hines et al. 2000).

In 2002 six sigma was also enforced by the French head office and began with executive workshops (Table 21). Due to projects being too large and unmanageable it took a year to secure £1m through 35 projects, in the same year lean secured £4m. The difference in bottom line financial savings could possibly be due to head office imposing a six sigma culture. This meant there could be less management commitment to it as it is not something the local management has instigated. The operations director introduced lean and aligned his senior management team to commit and support it. Supply chain management had become a daily part of the manufacturing team's culture.

The RHP-NSK quality manager reported to the MD and introduced TPM. However the emphasis was focused on manufacturing and a few days a year for other operations. In 2006 NSK still used TPM as the banner for supply chain development. Siemens used six sigma globally and manufacturing at Lincoln still used Lean.

In both case studies, employees were confused by the language used, which involved terms such as 'Process Re-engineering', 'Continuous Improvement Teams', 'Total Preventative Maintenance', 'Total Productive Manufacture', the most current label 'Lean' (waste removal) and 'six sigma' (reducing process variation). In essence these were all business improvement approaches, which was a key factor identified in the literature of supply chain management. However, when investigating how ideas had been implemented, the senior management commitment, management of change and acceptance of employees was given very little

attention. In practice the research revealed that these factors heavily affected the overall results.

Gattorna (2006) found pressure to change, a clear shared vision, capacity for change and actionable steps fundamental to achieving sustainable supply chain management. This was an extremely useful visual model but there were a lot of factors to consider.

In practice there was pressure to change from the external environment, these pressures being, social, technological, environmental, economic, political, legislation and ethics. Both companies had limited information and communications taking place. Customer needs were poorly transferred, unless customers were extremely unhappy with the service.

In RHP-NSK, when TPM was introduced the team leader positions were lost and employees had to re-apply so that management select the right skill set and competencies for the role. In Alstom-Siemens, cell manager and facilitator roles were created. Both companies used a full-time team to obtain implementation benefits quicker. Both companies experienced team leaders and management lacking the knowledge of the softer skills needed for effective implementation. These skills included motivation, influencing, coaching, delegation, communication and managing change as well as the understanding of the tools and techniques. The customer focus, management outlook and culture were also found to heavily impact the effect of supply chain development implementation at the supplier locations. Table 31 shows the high-level supplier findings.

Table 31: High-level supplier action research findings

Company	Senior management outlook	QCD Culture	Action Outcome
Desford	Positive	Existed	£250k throughput annual saving. £500k prevention, no need for new plant. Rolled out across the whole site.
Mansfield	Positive	Existed but not used	Set-up times reduced, £160k saving. Rollout taken to UK group.
JRD	Negative	Was introduced	Full process map of bottlenecks. No action taken.
Synthotec	Negative	Was introduced	Set-up times reduced by 70% in the activity observed. Engineers implemented procedure on machine. No further action.

Source: Case study findings

Table 31 shows the research undertaken at the companies, where those that already had a culture of working in teams and collecting data, supported by a positive committed senior manager got sustainable results and further site or group benefits. This was evident in Desford and Mansfield. Those that had a senior management team with a negative outlook and did not have a culture where they saw the value of using data for decision making, did not continue implementing improvements from the five-day implementation activity. JRD and Synthotec had a culture of 'we are unique' and were not willing to hear new ideas or appreciate and understand the benefits of supply chain development, they maintained 'business as usual'.

The Mansfield Production Manager was relieved to see the data analysis being used:

> We have been collecting this data for many years. It is good to see it being put to practical use to get the benefit from it. MA Production Manager (1997)

When the supplier development took place four months into the programme the suppliers said that they were very apprehensive as they thought there was a hidden agenda by RHP-NSK. This was largely due to strategic suppliers being previously managed in a traditional purchasing way and then RHP-NSK changing its focus without thinking about how to manage change with suppliers (Macbeth 1994, Gattorna 2006). Hines (2000: Table 7) found four phases to supplier coordination; external accreditation, reactive problem solving, systematic development and network development. RHP-NSK had moved their approach with suppliers from phase one (obtaining goods and supply) to phase three and four (mutual gain and competitive advantage for suppliers) without considering the shift in relationship development. This way of working with suppliers was a significant change, which left suppliers feeling apprehensive.

An opportunity which remained in both companies was the lack of supplier involvement in development and improvement. In RHP-NSK the four action research case studies were a pilot. For all other suppliers it was price reduction. I found Hines matrices a useful way of visualising the findings to summarise case study results. Hines' (2000) supplier development maturity matrix was used to summarise findings to reveal the level of supply chain development in both companies. This was achieved by the case study results. Table 32 shows Hines' (2000) maturity grid for supplier development with the results of both companies.

Table 32 shows that buying criteria and supplier purpose were basic price for RHP-NSK and lowest cost for Siemens, both were to supply goods. Despite suppliers working with both companies for over 10 years the relationship was still at arms length as they were not engaged regularly into the processes by being asked their opinions and ideas. Both companies managed suppliers through a quality control system and basic supplier rating systems which looked back at past performance.

Table 32: Maturity grid for supplier development

Stage:	1	2	3	4
Strategy/ Characteristics	External Accreditation	Reactive Problem Solving	Systematic Development Programme	Network Development
Buying criteria	Lowest price	Lowest cost	Maximum mutual benefit	Maximum network benefit
Purpose of Supplier	To supply goods	To supply goods	To improve continually mutual technical and/or competitive advantage	Customer does no make competitive advantage
Relationship	Adversarial	Arms-length	Close	Strategic
Relationship	Short/variable	Variable	Long	Lifetime
Customer involvement with supplier	Small	Some, purchasing and quality	Frequent, many functions	Continuous and multi-functional
Quality requirement	Product specification	Quality control	Quality assurance of TQM	TQM spread to own supplier
Delivery requirement	Standard lead times	Standard lead time	Customer involved in shopfloor lead time reduction	True JIT
Cost requirement	Lowest market price RHP-NSK	Lowest cost SIEM	Stable/reducing product cost	Target costing, share savings
Product design requirement	Customer specification or catalogue product	Some joint input	Significant joint input	Integrated design capability within network
Technology sharing	None	Limited (mainly customer technology)	Frequent with two-way flow	Frequent within network
Reliance on grading	None or external	Some reliance on reactive scores	Heavy reliance on reactive and predictive scores	Some reliance on predictive scores
Data interchange	Limited, operational only	Limited, mainly operational	Detailed, often operational and some strategic	Detailed at both operational and strategic level
Number of suppliers	High and unstable	High, relatively stable RHP-NSK	Low and SIEMENS stable	Very low
Frequency of interaction	Infrequent	Infrequent, scheduled and reactive	Frequent proactive and reactive	Continuous

Source: Hines et al. 2000, 325

Hines' (2000) matrix shows overall that both companies had reactive problem solving and were overall in stage two. There was a huge opportunity to develop the supply chain to move to stages three and four. Siemens supplier development was more advanced with a lower number of suppliers, a greater focus on cost and joint technology undertaken for new product development. However, its full-time supplier development team was focused on problems and therefore reacted to supplier delivery and quality issues. There was a need to take more time to understand suppliers' capabilities in both companies. In interviews with 13 suppliers, 47% disagreed slightly that Alstom-Siemens always invest time to understand its suppliers' capabilities (Table 23).

Comparing the literature research with the implementation of supply chain management, it was found that both companies still struggled with the basic implementation to realise business benefit and optimise supply chain management. The companies also struggled to look holistically (Gattorna 2006) and were still operationally structured in a function with deep hierarchies (Hines 1994) which continued a silo mentality and caused interface problems, rather than an alignment of the 'whole system' (Christopher 1992, Tan 1998, Simchi-Levi 2000).

A key factor was the attitude and commitment of senior management and the effect this had on employees and business results in the supply chain. A further factor was the level of evolution of the company culture and the environment of each company.

In both case studies, despite new concepts for consignment stocking, scheduling and long-term planning with suppliers, there was poor planning and control of materials, which was reactive. This was highly evident in the brief analysis of the Ford bearing line which produced a steady production demand of 20,000 a month; however, the seal supplier's product demand was in high peaks and troughs ranging from 0 to 95,000 instead of a regular 40,000 seals a month.

The functions which gained the most impact from implementing new ideas into the business were the manufacturing operations of both companies. The fundamental reason for their common development was that the operations senior management team implemented new ideas as part of their daily responsibilities having a business improvement culture.

In 1998 the RHP-NSK business improvement in the supply working with suppliers in RHP manufacturing a team took a 76 foot assembly like an altered it into a U-cell for increased flexibility, which also halved the floor space used. This production approach was later on transferred to three additional lines which were moved from another area closer to the

grinding process. By adopting the U- cell layout, additional floor space was also released. Performance measurement sheets were adopted on the line. The data analysis was given to the team leader who had not had to analyse performance data before. A separate team was also established to carry out a full 5Ss housekeeping activity. RHP-NSK also replaced the written operating procedures with photographs explaining each activity visually instead. The operators found visual standards useful and they were referred to regularly.

RHP-NSK utilised this approach over the remaining twelve assembly lines and re-located these lines to the grinding areas. This was completed in nine months. The supplier development methodology had an astonishing impact in RHP-NSK manufacturing and the management commitment was focused on improving processes further. The Engineering Manager and Total Quality Manager gained board approval to reorganise the factory to release eight senior engineers full time onto an improvement activity team to continue to develop improvements in operational areas effectively (4.4).

In Alstom-Siemens the operations director led by example, flattened his significantly deep hierarchy of 40 layers, set the need to change, made his vision known, shared his personal values and established an action plan framework for every cell across the factory. He also created a cell manager role and a facilitator role as well as establishing a full-time team of business excellence resource. He realised £11m for the company and continued to focus on cost reduction. He made sure he regularly communicated and got his senior management team to do the same. The Balanced Scorecard went down to every notice board in every cell and all the operators understood their components costs and how they contributed to the end product and knew who their customers and suppliers were.

Through the evidence and case analysis of the two companies and four suppliers, it is apparent that new ideas on supply chain management had been implemented. All the companies used the tools and techniques publicised in the literature (Bicheno 2002) for supply chain development. However the case study analysis revealed that senior management commitment and attitude significantly contributed to employee engagement and the outcome of the implementation.

To attempt to keep up with the competition, both companies continued to go through periods of rapid change, where new initiatives were introduced by senior management. The case studies revealed that ideas for implementation were poorly communicated, employees struggled with implementation and there was never sufficient time to gain the full benefit of the implementation. Therefore supply chain management was sub-optimal at both companies.

This is common in other manufacturing companies which frequently do not leave change in place long enough to achieve the full benefits and many companies continue to work with suppliers in a traditional way. This is often due to the short-term outlook of senior management. To highlight this, in seven years Siemens changed ownership six times and different business improvement approaches for supply chain development were repackaged and refocused. Uncertainty and confusion were created across the supply chain. Due to the repackaging and different terms used by senior management, employees became confused. They felt senior managers kept changing their focus and lacked commitment and support for existing initiatives.

Senior managers did not appreciate and understand enough about the concepts to be able to communicate with employees clearly and enable them to understand the value and benefits. Hines et al. (1997) found most of the new management recipes over the last 10 years had run their course without having a lasting impact on the bottom line. Employees waited for managers to lose interest and move to the next initiative. Hines' (1997) research was produced nine years before my research, yet in manufacturing this was still experienced in practice.

At RHP-NSK improvements in supply chain management were fragmented. There was continuity focused on TPM in RHP-NSK manufacturing, in particular, value added was always the focus of the visits by representatives of the Japanese head office (4.2.3). The rest of the supply chain appeared to operate more traditionally and functionally. Manufacturing worked on improvement activities in teams whilst other operational departments, such as purchasing, carried out individual roles and traditional transactions, including spot order placing on suppliers, who had provided products for over 15 years (4.2.3). That was until the purchasing operations became fully integrated into manufacturing.

Senior management and employees still struggled to understand and implement tools and techniques, as was evident through large-scale projects which were poorly scoped and long delivery times for project closure.

This has been observed in other companies. For instance, the trainees on a lean six sigma programme in a power plant selected large projects which were approved by senior management, yet there was only three months to complete them. Every project needed significantly broken down to become achievable. For example, a project manager wanted a three-month project to 're-design the site product development process' for a site that had 10,000 employees and a budget of £130m for this process. In addition to the size of the

project, when the trainees learnt about different tools and techniques they became so absorbed with the tools and techniques (what they meant, the history, the analysis) that each and every one totally lost sight of why they were using the tool in the first place, to resolve a specific business problem.

The management change process, engaging employees and being fully committed to supporting implementation, were key factors which management needed to understand more fully. (Hine 97, Gattorna 2007). This was a prerequisite to achieve successful and sustainable implementation of ideas for supply chain management.

Summary

Through the analysis into how ideas had been implemented for supply chain management, it was evident that both companies had made considerable implementation efforts and had gained cost benefit during the 10 years of study.

At the beginning of the research there was a high degree of fire fighting, chaos and reaction to day to day problems. Senior management tried many new ideas for implementation but often did not embed the approach long enough to reap the benefits. The hardest challenge for both companies was the implementation of new ideas; firstly understanding the tools and techniques and how to apply them and secondly keeping focused on the objective. At Alstom-Siemens the regular change in ownership heavily affected the implementation focus with different initiatives being introduced to improve supply chain management.

Hines (2000) model illustrated that both companies were overall reactive and problem solving. This was evident through RHP-NSK loading suppliers for material in high peaks and troughs when the end use was for a flat constant demand every month to the end customer. This was also evident when an RHP-NSK automotive customer emphasised that people were starving other departments of information which affected the overall supply chain management performance particularly for their customers and suppliers.

This fire-fighting, reactive day to day chaos was typically found in other manufacturing companies evident from the Manufacturing Advisory Service programme and the Lean Learning Academy where companies struggled to create business plans and market products and services, let alone devise a vision, establish a strategy and carry out policy deployment.

Both supplier bases were keen to become more involved with their customers on technological development and process innovation. Both companies had further opportunities to become 'systematic' and 'networked' (Hines 2000). However, through successful implementation there had been a significant reduction in suppliers, which were continuously being reduced. Both companies had also reaped cost benefit gains through business improvement, by the implementation of projects. Towards the end of the research there was an increasing drive for both companies to improve continuously. Manufacturing in both companies had made the most significant implementation gains as supply chain development had naturally become part of their day to day culture.

The senior management and employees had made step changes in improving the management of the supply chain, by simplifying and controlling processes and establishing aligned objectives and measures as part of the unit's policy deployment. It was found in both companies that the senior management commitment and company culture were two key factors which heavily affected the successful implementation of ideas. This was effectively demonstrated in the action research case studies on suppliers.

6.2.3 Identify factors that inhibit and enable supply chain management

The primary area of interest was identifying and understanding the factors that inhibit and enable supply chain management. The factors could be identified through my case study research. This meant identifying specific facts that helped and hindered the implementation. This would help industry to implement new themes in supply chain management, understand the pitfalls and barriers, by reducing risks to implementation. Companies could also better appreciate the important infrastructure to support, encourage and drive the enablers of supply chain management which will release longer-term cost benefits.

If this could be understood more clearly in practice and theory there would be a greater chance of taking full advantage of the benefits of supply chain management and implement ideas accordingly. A weakness in the research reported in the current literature was the lack of appreciation of key factors and of the impact senior managers had on supply chain management business results. Senior management could also have an impact on optimisation by the change in emphasis and focus of supply chain management.

The findings of the two case studies for inhibitors and enablers followed the findings of the survey which was undertaken with 150 managers, asking about their experiences. Also a validation was made with 20 managers from different industry sectors to compare results with

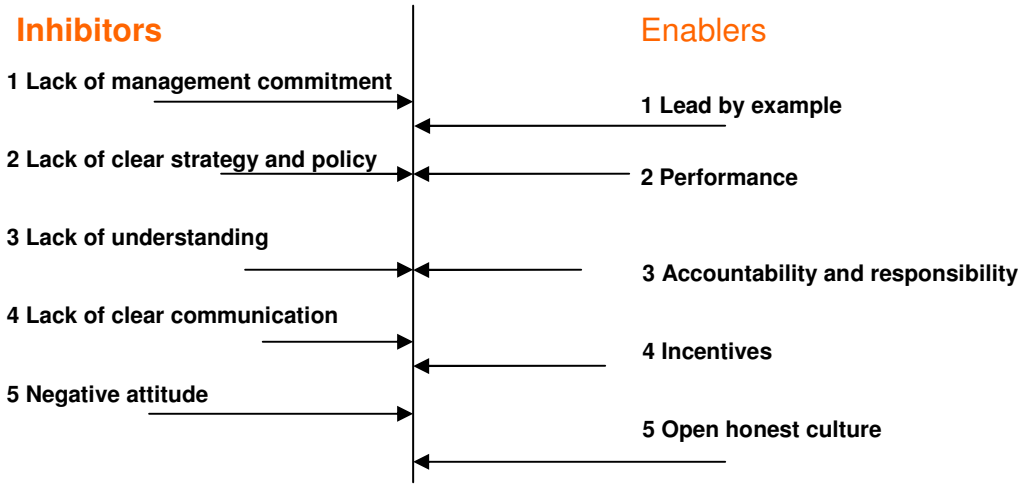
their company experiences. This was a two-hour business network focus group which revealed that the results were common.

The most significant inhibitors and enablers of supply chain management were revealed through the case study research. This were summarised into the five key inhibitors and five key enablers to enable focused implementation on the key contributors for supply chain management. Inhibitors which were revealed but were not included in the main five were traditional purchasing and quality methods and fear of failure, and an enabler which was not used was trust.

The results for each inhibitor and enabler were drawn from the thoughts and opinions of managers, customers, suppliers and employees. These were captured from the case study findings, the supply chain survey feedback, vignettes and business network feedback. The five inhibitors and five enablers identified for supply chain management were the main contextual factors from the research case studies. Each of the inhibitors and enablers will be analysed in sections 6.2.4 and 6.2.5.

Figure 32 visualises the inhibitors and enablers revealed from the supply chain management case studies.

Figure 32: Inhibitors and Enablers of supply chain management



Source: Researcher's own findings

Figure 32 shows the five main inhibitors and enablers in order of importance, as selected from research repeatability in findings and supply chain management impact. The five main inhibitors of supply chain management were; negative attitude, lack of management commitment, lack of clear strategy and policy, lack of understanding and lack of clear communication. The enablers of supply chain management in order of importance were; lead by example, open honest culture, performance management, incentives and accountability/ responsibility. Each contextual factor will be explained.

6.2.4 Inhibitors of supply chain management

Lack of management commitment

There was poor commitment from the top management and a lack of change management leadership. After senior management agreed to sponsor projects, when their priorities changed they would move on to other things and leave resource on issues they were no longer committed to. This was often the case with project work and larger longer-term projects. For example, a lack of management commitment to six-sigma projects at Alstom-Siemens and lack of supplier development support by purchasing management at RHP-NSK.

At a basic level managers found it difficult to allow employees time off from their day to day duties to spend time in workshops and be involved in business improvement. This was evident with part-time project work and team activities in all functions, including the part-time facilitator roles at RHP-NSK, which had to be cancelled due to lack of department managers' commitment. This was except for both companies' manufacturing functions. A fundamental difference between manufacturing and other functions was that in both companies the manufacturing operations saw business improvement as part of their role and culture.

Some managers wanted to keep control themselves and not empower employees to carry out improvements. At JRD, one of RHP's suppliers, many pricing and material decisions were just kept in the Managing Director's head. The management of this company was not keen to put this information into a process and wanted to keep control, despite the risks, even when the MD was due to retire.

The worst example of lack of senior management commitment was that of the Alstom-Siemens senior executive team who stated, in June 2000: "Save us £6m pounds by August or 350 of your jobs will go". This letter was briefed to senior managers to communicate with

their teams. It was not from a member of the board but the whole senior management team. No leadership, action plan or cost data was used, no training or education was provided to enable employees to work with data to analyse and recover costs. There were significant doubts about where the £6m of cost reduction could come from, as no explanation was given for where the cost reduction opportunities could come from in two months, as no further information was provided. This announcement made employees very complacent as they knew redundancies were inevitable, and from being poorly treated and disrespected, they took no pride in performing well for the company. The employees were made redundant and this threatening territorial management approach highlighted poor leadership, no commitment and a total lack of thought into the impact of this communication and no consideration to the 'total system' and improvement of supply chain management.

Lack of clear strategy and policy

A lack of clear strategy and policy affected supply chain management. The companies became more reactive and day-to-day driven as it was difficult to see the company strategy and policy. Both RHP-NSK and Siemens were more involved with using policy deployment; however, it was fragmented and not consistent across the whole system.

It was difficult in some functions to see how one's function, team or individual role contributed to the good of the company. This was the case for purchasing, measuring price at the expense of other performance measures and internal customer requirements. In 1997 at Alstom-Siemens, unless the function was product development or sales and marketing, it was unclear how the function, team or individual contributed to the company strategy, which was product and marketing based (5.2.3). Many employees felt that the objectives and goals were unclear. There were unrealistic objectives and expectations, and lack of clarity meant that employees worked on too many activities.

Lack of understanding

There was a lack of understanding by senior managers and employees particularly for change to happen and appreciation of how to implement fully ideas on supply chain management. Process mapping and pareto were poorly understood techniques, along with change management skills for both companies.

There was a long-held belief at director level that processes equated to functions. At Alstom-Siemens there were over 700 processes. These processes were produced functionally by each department, with each department setting its own inputs and outputs to the process and not consulting their customers or suppliers or working cross functionally (5.2.3). A senior manager summarised the process.

> Smash the plate, sometimes it is better to start again with a new plate than to put the pieces of the old plate together. Too many of our systems and processes are pieced together. Current systems lead to rubbish in and rubbish out. Senior Manager (2003:188)

All the processes were developed using the existing systems and making a couple of changes. There was poor capability to link day-to-day activities to customer deliverables.

This emphasised that the research on systems theory is still highly applicable in the twenty-first century. Senge (1990) found the focus was on parts of a system in isolation and as a consequence the root cause of a problem may not be achieved. Sixteen years since this research was published, both companies still focused on parts of a system in isolation. This was experienced with process development and creation in both companies, where functional departments had not considered communicating with their customers or working cross functionally to develop a system. In both companies, further effort was being made to work aligned and not isolated.

When RHP-NSK was keen to help JRD Mouldings carry out process mapping to improve the layout of the facility, the Director did not choose to listen in order to try to understand:

> I can't see how this will help us; we know our business and we have just outgrown this facility.
> Director from JRD (1997: 136).

It was dangerous not to listen to the customer and try out new ideas. RHP-NSK managers also lost focus and understanding to improve the business as a whole and concentrated their efforts on their own functions.

The functional outlook could often be at the expense of developing the whole company. Functional managers were not accountable for the supply chain and would concentrate on their specific areas often at the expense of another part of the supply chain. This was the case when purchasing was focused on price reduction and the business was driving quality, cost,

delivery and people improvements (4.6.1). The staff in the purchasing department at RHP-NSK were also very traditional and protective of their suppliers and lacked strategic purchasing understanding and did not consider the value of engaging technical experts to communicate together directly from both companies product development and competitive advantage.

There was a lack of understanding in both companies regarding supplier capability and the additional expertise and support suppliers could provide to their customers. This was evident through the analysis, in particular the comment from Mansfield, who were not seen as strategic within RHP-NSK but were its second largest spend, and were currently over specifying packaging to despatch bearings, when a lower graded plastic would provide the same function a half the price. The supplier regularly informed RHP-NSK of this but they continued to carry on in the old manner. Mansfield's management team had many cost reduction ideas they wanted to discuss with RHP-NSK and never felt they had the opportunities for this to happen. The supplier development positioning matrix (Table 32) showed that both companies reacted to problem solving with suppliers and also through the supplier value statements and interviews at Alstom-Siemens (Table 23).

There was a lack of understanding and knowledge of individuals, customers, personal values, poor appreciation that everyone had an input and lack of understanding for the soft skills of effective leadership, communication, coaching and influencing.

At Alstom-Siemens there was a history of management theories; 'Double the Business', 'Liberating the Workforce', Total Productive Manufacture (TPM), 'Kanban' and 'Continuous Improvement Through Teamwork' (CITT), 'Stretch 30' (cost reduction), 'Lean', 'Six Sigma' and 'Value Generation Programme' (VGP cost reduction). The cynicism was stronger when employees did not feel part of the change or understand why they had to change, and they were overwhelmed with jargon and acronyms within the company. This lack of understanding left a lot of cynicism amongst employees across all functions of Alstom-Siemens.

Lack of clear communication

In RHP-NSK the communication was often last minute, too late and the purpose was often to communicate bad news. Where managers had their own plans they were not often communicated. During all the changes at Alstom-Siemens it was only Siemens management

that successfully communicated. For the other things, employees found things out primarily through the company grapevine and externally to the company through the internet and newspapers. Communication between management and employees regarding changes was poor (4.6.1).

Negative attitude

The negative attitude of senior management was the greatest inhibiting factor to developing the supply chain. Senior management attitudes heavily impacted traditional methods, communication, interface problems and outlook on utilising key performance indicators (4.6). If a senior manager had a negative attitude, it allowed the employees to do the same.

The strategic supplier workshops achieved different results due to the senior managers' attitudes. At two supplier companies to RHP-NSK, JRD and Synthotec, the senior managers were negative towards the changes and chose not to listen to their customer. They both felt their businesses were 'unique' and customers did not understand. The strong personalities and fixed individual opinions were highlighted further from the shop floor foreman:

> This is all theory and fluffy sky thinking. We are working in the injection moulding business and none of this talk is relevant to us. The S Foreman (1997)

The foremen chose not to listen or learn from RHP-NSK and the application of best practice tools and techniques to Synthotec. Instead the foremen chose to believe that these approaches were not relevant to them. The MD expressed his opinion:

> I have highly qualified specialists running my business they are the experts in their field and are left to get on with what they know.
> S MD (1997).

At RHP-NSK, and at the beginning of the research at Alstom-Siemens, senior managers focused on their product and did not think in terms of processes, they were not convinced of the benefits. Therefore the attitudes of senior management affected any progress of development.

There was a negative attitude and resistance to change and an overall fear of trying out new ideas. A tradition existed where 'it has always been this way' and a culture existed that 'if it isn't broken, don't fix it'. A high inhibitor was the attitude, behaviour and emotions of senior

management, which affected the behaviour of employees, which heavily affected supply chain management.

Inhibitors of supply chain management – summary

To summarise from the case study research, five main inhibitors of supply chain management were found. Supply chain development and implementation was affected by a lack of senior management commitment and support. A lack of clear strategy and policy established by the senior management team and deployed for teams and individuals made it difficult to focus implementation. Implementation was affected by a lack of understanding of the tools and techniques and priorities of the company. Senior management and employees' negative outlook and lack of communication also affected supply chain management.

6.2.5 Enablers of supply chain management

The supply chain management enablers were; leading by example, performance management, accountability and responsibility, incentives and open honest culture. Each of these overall enablers was explained through links to case study findings and literature research.

Leading by example

To develop a continuous improvement culture, senior management would need to lead by example. If the executive management team and senior management led by example, their behaviour would breed like behaviour and would create a better working environment for employees. If senior management engaged their people and made them feel involved in business changes, greater productivity would result.

If management took the time to inform employees and communicate, employees would start to feel valued and would begin to feel understood and respected. If managers led by example by setting a standard of what they expected in terms of openness, honesty and trust, the culture could slowly be reformed. Senior management needed to define high-level processes and demonstrate cross-functional links. Directors should lead business planning as a basis for locally developed plans supporting the high level planning.

Good leadership needed to prevail to prevent initiative overload and improve communications upwards and downwards. The champion had to have a vision and

communicate messages of the vision. The best practice evidence of this was from the operations director at Alstom-Siemens who demonstrated conviction in his approach with his leadership, vision, measures, communication and review. The commodity manager also had the ability to develop rapport with employees to gain support and management buy-in for their purchasing decision.

At the two supplier companies to RHP-NSK, Desford Tubes and Mansfield Amalgamated, senior management led by example. Both senior managers were very positive and welcomed changes to their businesses and supported the teams in carrying out the improvements. Senior managers at Desford Tubes and Mansfield Amalgamated encouraged not only the implementation of long term ideas and to sustain results from the workshop, but they also rolled out improvements to other areas of the business. The MD of Mansfield Amalgamated also passionately took this approach to his UK group (4.4.5, 4.6.1).

Performance management

The key to performance management was to have clearly defined measures and objectives. This included employee involvement and giving people responsibility for their own work. Employees should be provided with the opportunity to take charge of their own development. People needed to know what they were expected to do or achieve and understand. They would also need established feedback and review.

When Siemens took over, managers were set annual objectives and monthly targets and measures to improve the company, which were frequently reviewed with the relevant line manager. This was also the case for RHP-NSK and Siemens when policy deployment became more fully integrated. The company needed to become customer-orientated and build customer confidence, both externally and internally. Decisions and performance management should be based on fact and the use of strategic measures.

Employees' performance would include realistic strategic objectives and the ability to meet targets. Performance improvement would impact greater efficiency, productivity, output, reduced cost of poor quality and delivery on time. Only then could the company meet customer, supplier and employee expectations. Employees would continue to carry out step changes to improve performance continuously.

Greater focus and prioritisation of objectives and publishing completed and finished actions was required. Senior management and employees needed to be more disciplined so that they

could deliver commitments. There would be much greater opportunities in supply chain management if employees were empowered and performance was managed by clearly defined measures, which are mutually agreed and regularly reviewed. This could also enable senior management to be less traditional and listen to their employees' ideas and not always use their own ideas, and to hold less control and decision making power (Pascale 1990, Oakland 2000). Instead they should delegate, using the commitment and competence of employees.

Accountability and responsibility

Senior management needed to encourage accountability and responsibility for action and completion. Adair's (1991) research also supports this. He found that if subordinates were fully involved in decisions that affect their work they would be committed to carrying them out. Adair also emphasised that senior managers cannot lead without winning employee commitment. Managers need to empower employees to have a greater sense of ownership and accountability. Individuals could then take the authority and ownership to make decisions.

Employees' accountability meant they would need to determine acceptable levels of work and drop activities which make their workload excessive. Big tasks needed to be broken down into individual manageable bite-sized pieces, with understanding of limits, realistic targets and priority setting. For example, at RHP-NSK and Alstom-Siemens, targets went down to individual level and this included monthly targets on individual buyers in purchasing which contributed to the team and department strategic objectives. The same applied to engineering and sales, where targets went down to engineers and account managers.

Incentives

To make change happen a company needs to motivate employees through praise and recognition. For example, recognition could be for milestone achievement and visible rewards clearly linked to success. Employees should also be praised and recognised for having a 'can do attitude' until it becomes a natural part of the culture. In the employee survey of Alstom-Siemens, lack of praise and recognition had came up consecutively over five years. If this could be turned into an enabler it would offer a great opportunity. At Siemens the financial bonuses for commodity managers, senior managers and the executive management team were linked to their balanced scorecard targets, likewise for RHP-NSK with their policy deployment for senior management and the executive management team.

Open and honest culture

In an honest and open culture, senior managers and employees will feel comfortable to communicate clearly and not feel fear. This culture will respect people's values and beliefs and operate ethically. In this culture nobody will feel that they can improve themselves out of a job. RHP-NSK had a no-redundancy policy for continuous improvement on the shop floor. When the line was re-balanced it removed the need for four operational roles, the operators were excited about moving into new areas as it meant they had new opportunities.

Enablers of supply chain management – summary

The supply chain management enablers were leading by example, where managers make their vision and values clear by operating in a professional leadership manner which embraces employees. Performance management was the establishment of targets and measures with regular reviews, then making employees accountable and responsible, incentivising and working in an open and honest culture. Good examples of this were two directors at the supplier companies, who were committed and had a positive outlook and embraced change, and the operations director at Alstom-Siemens who made his vision and values deliverable and clear.

The researcher felt there was significant value in the identification of inhibitors and enablers as it provided the key factors that would help and hinder supply chain management. This provides considerable explanations for understanding the implementation of supply chain management through six case studies, a survey asking 150 managers and a network of 20 different industry sector managers. By pre-empting what could happen and building this into the appropriate stages of implementation meant that risk could be minimised and there would be a greater degree of successful implementation and sustainable supply chain management.

7.0 Conclusion

7.1 Conclusions about the research

Supply chain management was viewed as a single process which depended on strategic decision making. It is a shared objective of practically every function in the chain and impacts overall costs and market share. It calls for a different perspective on inventories and a new approach to systems (Houlihan 1998).

The investigation into supply chain management implementation in the manufacturing sector showed 2 companies increasing challenging pressures to compete. In the UK many companies have closed down due to lack of competitiveness and other companies are outsourcing processes or establishing full manufacturing operations overseas for lower labour and material cost advantages. This shift in focus has closed many UK manufacturing production lines and sites and companies have fully relocated overseas. UK manufacturing faces a continual need to improve business performance and be more innovative. To reap competitive advantage, manufacturing companies needed to be more strategically aware of their supply chain management philosophy, implementation and processes (Mentzer 2001).

To explore and explain this further, three objectives were studied: the ways in which the management of the supply chain had changed, how new ideas on supply chain management had been implemented, and the contextual factors that inhibit and enable supply chain management. Inhibitors are factors that prevent, hinder or stop implementation of supply chain management. Enablers are factors that would encourage, support and drive efficient and effective implementation of supply chain management.

The critical review of the literature revealed that there was no common agreement on what supply chain management was and what it covered. Added to this confusion was an attempt by practitioners and researchers offering different interpretations to clarify the factors and scope. Through careful analysis of the literature a conceptual framework was produced which captured the main themes in the publications. The review revealed a large number of matrices and techniques (Hines 2000). Bicheno (2000) saw that improving the supply chain meant extending the principles of Lean and Six Sigma to all participants in the supply chain. Only two authors discussed the need for management in supply chain development (Hines 1997, Simchi-Levi 2004). There was far too little published research in supply chain management about management and engaging employees, there was an overall lack of detail about what happened, in particular, effective implementation outside high- volume

companies. The case study research particularly focused on automotive, aerospace, computing and retail sectors. The existing case studies also had very little on the inhibitors of supply chain management.

A weakness in the current literature is the lack of appreciation of the impact senior managers has on supply chain management business results, and thus the impact that senior management can have on optimisation of supply chain management for competitive advantage. There is also a lack of alignment between strategy, leadership, infrastructure and implementation. Also, despite the widely published benefits, there still appears be a slow uptake in the UK.

From the literature, supply chain management research factors were built into a conceptual model to be used when studying the companies. The common factors identified in the literature included; policy deployment, management support, employee involvement, business improvement and suppliers. Further themes identified in the literature which were not utilised in the case studies, were having an integrated philosophy, enterprise, strategic decision making, information technology and innovation (Table 2. In the published research and investigation of the 2 case study companies these themes appeared to have minimal coverage. In both companies' studies, there was very little focus on these themes. This may be due to the 2 case study companies' stages of transition and their supply chain management emphasis was reactive.

For example, in interviews at Alstom with 30 key senior managers, 48.5% felt creativity and innovation was not encouraged (Table 22). With suppliers there were frequent examples of poor communication and lack of utilisation of supplier capabilities. There was a need to take more time to understand suppliers' capabilities in both companies. At RHP-NSK there was very little proactive project work. At Alstom-Siemens, in interviews with 13 suppliers, 47% disagreed slightly that the company always invests time to understand its suppliers' capabilities. This meant both companies had a long way to go to be innovative within their supply chains. This should make it clear that the researcher appreciated the value of the additional themes found in the literature, but found they did not significantly contribute to the presented case studies.

The research revealed that there was significant managerial effort aimed at supply chain management. There was also evidence of significant implementation changes which had taken place. This was manifest by the business improvement factor in the number of implementation approaches and initiatives and the range of tools and techniques implemented

for supply chain management. The applied business improvement tools included housekeeping (5Ss), set-up reduction, process mapping and the seven wastes (Hines et al. 1998, Womack & Jones 1999, Bicheno 2000).

Whilst there have been some significant changes in the management of the supply chain in the 2 companies researched, the changes were less than hoped for, as they were not as strategic as expected during the time period. The implementation was also partial as it affected some areas of the supply chain more than others. The implementation was less strategic in both companies, where senior managers gave poor consideration to strategy, systematic development and networking, with weak emphasis on the efficiency and effectiveness of the 'whole system' to remain competitive. (Hines et al 1997) Instead, in both companies, management development was too functionally focused on their own areas of responsibility rather than for optimisation of supply chain management. Part of the problem of lacking focus on the whole system was that managers were only responsible for certain parts of the company, and would therefore focus on their area of responsibility and have little concern for or even disregard other areas of the business. This was also the case with executive board members who were functional specialists such as product development, strategy, HR, law and finance.

There was very little emphasis on strategic supply chain management, despite both company having a global presence. In both companies, when they were taken over by foreign competitors there was little change made through the head offices. For RHP-NSK, the Japanese head office management team simply came and reviewed progress. They did not recommend tools or techniques to be implemented, despite the widely publicised Japanese quality approaches. (Oakland 2000, Bicheno 2000). Alstom introduced six-sigma training (Bicheno 2000) through its head office. In the five company name changes at the gas turbine company, all the head offices left the local management to do as they saw fit. Overall the takeovers were weak at introducing new ideas and concepts to under-developed units. The only adoption from the head offices was policy deployment to collect high-level measures on performance from NSK and Siemens.

The exception for influencing change was Siemens, which brought Alstom. During 18 months there was a great focus on the balanced scorecard (Kaplan and Norton 1996), process alignment, standardising systems and stretching targets for cost reduction with financial/quality reporting. Siemens emphasised more regular communication and re-introduced an employee survey. Siemens made phenomenal strategic development during the first 18 months, however, the speed of achieving objectives was so fast that it meant issues of

morale, motivation and pressure on managers and employees became greater than ever. It is important to achieve the appropriate balance of supply chain development to prevent fatigue and stress from too much implementation activity at once, which heavily constrains resource, behaviour and time management.

Initially both companies took a short-term view, evidenced by the exclusive emphasis on price reduction by purchasing, transactional functional processes, traditional methods, fire fighting and poor communication. An example of this was the purchasing division heavily over-ordering packaging materials to gain a price reduction on volume, which was so much it did not even fit into the stores and created one year's worth of stock.

There were some good examples of implementation and considerable effort was made, but in particular functions or pockets of the company. Five excellent examples of supply chain development were:

1. RHP-NSK turning all its assembly lines into U cells within one year as a consequence of the supply chain development programme which was coordinated as a pilot in the purchasing division. The tools adopted were line balancing, housekeeping, visual management and standardisation. Once one assembly line was implemented in manufacturing, with the supplier development team and suppliers, manufacturing took ownership and drove the implementation across the remaining lines.

2. Two action research projects at two strategic suppliers were highly successful. The set-up reduction implementations enabled Mansfield to save £150k annually and Desford £250k annually and an additional £500k saving by not purchasing a new plant.

3. RHP-NSK's purchasing division became a strategic team and operations being responsible for all operational procurement transactions which were fully applied using e-business and supplier forecasting, by one buyer with a spend of £22m. At the beginning of the research there was a team of 20 buyers spot ordering with a £19m spend.

4. Alstom-Siemens established 12 commodity manager roles, who reported to the site and the head office in Germany. The commodity managers had to target global procurement, consolidating a particular commodity by liaising with other sites and negotiating high volume contracts. The commodity managers had a huge impact on reducing the supply base by 82%. These roles were clearly targeted and measured monthly to deliver supply chain improvements.

5. Alstom-Siemens operations business rolled out lean (Hines 94, Bicheno 2000), beginning with the operations director significantly reducing his 40-tier hierarchy to communicate effectively, setting a vision with his group managers, sharing his values, and reviewing blockers and enablers to rolling lean out into the supply chain. The management team established new positions to embed the continuous improvement culture. They created cell manager roles, lean facilitators for every area, and a full-time improvement team. In one year £4m was secured in supply chain development improvements.

Gattorna (2006) advised that implementation of supply chain management should not be drawn out as this could provide employees with the opportunity to resist and rebel, in part or in full. This was often the case in both companies. The implementation at Alstom-Siemens was more drawn out, which meant employees were found to be negative and to resist or rebel. Gattorna (2006) suggested that the faster the implementation, the greater the chance of achieving the desired outcome. In both companies, implementation was not fully planned to be completed fully to reap the cost benefits. This meant many projects were not properly closed out and continued, with very little return.

This was evident in the investment of 35 green belts (project leaders in six sigma) at Alstom-Siemens, which had little support and follow up and the projects were ongoing. This meant that 35 teams would become disengaged as something was not finished. Primarily this came down to lack of management commitment to continue the projects and equally lack of understanding by the project leader to be able to take the project forward for successful close out. The greenbelt staff attended a five-day course and after running for up to one year would forget what they have been taught as it had not been applied through implementation much sooner following training.

This lack of project closure contributed to the negative resistance that was particularly evident in Alstom-Siemens with constant changes in initiatives and company ownership. Employees felt strongly that things never got finished. This was also evident in RHP's supplier rationalisation, where the team was disbanded after a year as nothing happened.

The five-day *kaizen* (Bicheno 2000) implementations in manufacturing and suppliers did have better outcomes. Gattorna (2006) recommended fast implementation to prevent employee rebellion. However 50% of the supplier outcomes were not sustained due to lack of management commitment, attitudes of management and employees and lack of understanding which prevented full scale implementation at Synthotec and JRD.

Through the analysis into how ideas for supply chain management have been implemented, both of the 2 case studied companies had made considerable implementation efforts during the 10 years of study. At the beginning of the research there was a high degree of fire fighting, chaos and reaction to day-to-day problems.

Senior management tried many new ideas for implementation but often did not embed the approach long enough to reap the benefits. The hardest challenge for both manufacturing companies was the implementation of new ideas; firstly understanding the tools and techniques and how to apply them and secondly keeping focused on the objective. At Alstom-Siemens the regular changes in ownership heavily affected the implementation focus due to senior management changing the business improvement approach to improve supply chain management.

Hines' (2000) model was extremely useful to bring together the case study findings by illustrating both companies' supply chain development. This quickly showed that both companies were overall reactive and problem solving. This was evident through RHP-NSK loading suppliers for material in high peaks and troughs when the end use was for a flat constant demand every month to the end customer. The sales division also had an additional three months of data which they did not share with anyone, although the manufacturing and purchasing divisions could have found this information very useful for planning. This was also evident when an RHP-NSK automotive customer emphasised that people were starving other departments of information which affected the overall supply chain management performance particularly for their customers and suppliers.

Senior management and employees made step changes in improving the management of the supply chain. Both companies struggled strategically with supply chain management but had attempted to make considerable changes through the implementation.

From the case study analysis it was found that the change management process and the engagement of employees and team members were key factors which management needed to understand more fully. This was a prerequisite to achieving successful and sustainable implementation of ideas for supply chain management.

It was revealed in the analysis of suppliers that the outcome of the improvement activities was affected by the management, the culture of the company and how engaged the employees were.

This fire-fighting, reactive, day-to-day chaos was typically found in other manufacturing companies, as was evident from the Manufacturing Advisory Service programme and the Lean Learning Academy.

Despite the focus in the literature on improvement emphasising the voice of the customer there was little drive for customer service evident in the main case studies. Although the 2 main companies used policy deployment there was a lack of alignment focused on the 'whole system' and policy measures and targets used to manage performance. There was a lack of ownership and accountability which meant that the implementation of new ideas was often very slow.

The results for each inhibitor and enabler were drawn from the thoughts and opinions of managers, customers, suppliers and employees. These were captured from the case study findings, the supply chain survey feedback from 150 managers, vignettes and business network feedback of 20 business managers across industry sectors.

This framework would assist industry to implement new themes in supply chain management, by understanding the pitfalls and barriers in order to reduce the risks associated with implementation and reap cost benefits through the enablers. If the inhibitors and enablers were more clearly understood in practice and theory, companies could have a greater chance of taking full advantage of the benefits of supply chain management and implement ideas accordingly.

To make the findings and understanding focused and manageable, five main factors were identified for each. Further factors which were revealed from the research were; traditional purchasing and quality methods, interface problems, an absence of key performance measures and fear of failure by managers and employees.

The most significant inhibitor to supply chain management was senior management having a negative attitude. Managers' positive or negative outlook meant the difference between successful implementation and failed implementation. Lack of management commitment closely followed as an inhibitor. The worst thing uncommitted managers did was to leave their resources involved in projects to which they were no longer committed, as they now had different priorities. This meant the resources became unnecessarily drained and the culture became poor at closing-out supply chain implementation. This was highlighted in the six

sigma projects, where implementation had begun but they were not regularly reviewed by the agreed sponsors or executives.

Lack of clear strategy and policy by the company was the next main inhibitor and included defining the company vision, plan, strategic outlook, targets and policy deployment. Alstom was very poor in letting managers and employees know what they were trying to achieve. It was then difficult to know on which business improvement implementation to concentrate.

Lack of understanding by senior managers and employees of the concept and effectiveness of implementation was the third inhibitor. There was an overall lack of understanding of how to apply the concepts and focus on supply chain development, despite the well publicised research into the tools and techniques. More detailed case studies such as this research could support a deeper understanding of implementation.

Lack of clear communication by senior managers and employees continues to be poor. This was highlighted by executive communication often communicating negative news to employees, such as poor performance and redundancies, and not communicating positive news of success such as completed projects, new business, and praise from customers.

Negative attitude and outlook by senior management and employees was extremely damaging. It caused two failed supplier development activities and created poorly performing cultures and ingrained attitudes. This inhibitor was heavily present in Alstom-Siemens, where the employees had been in their jobs for many years and knew the history of bad experiences. A deep understanding of the inhibitors and lessons learnt by the 2 manufacturing companies would support managers during implementation, by understanding potential inhibitors to ensure that successful implementation prevails in the supply chain.

If the negative barriers were overcome, the enablers would provide a more positive enthusiastic environment which was open to embrace change. The main enabler found was to lead by example, with management displaying the qualities they want the employees to display in their work, clearly communicating the company vision, strategy and targets and engaging their employees. This was evident in Alstom-Siemens operations director and the two suppliers, Mansfield and Desford.

Performance management was having clearly defined measures and objectives for employee involvement and giving them responsibility for their own work. This meant managers letting go of some control and making employees accountable and responsible for their actions, with

incentives and an open and honest culture. This was evident from the commodity managers positions created at Alstom-Siemens.

Both companies had embarked on supply chain management and had reaped cost benefits through the successful implementation. However, there were many supply chain management implementations which had failed and were very slow to implement changes. Managers needed to work more holistically, with the whole system in mind, to gain significant supply chain development opportunities. Both companies would benefit from more executives and senior managers leading by example, incentivising employees through performance management and making them accountable for supply chain development, to continue to grow and develop an open and honest culture.

7.2 Implications for Theory and Practice

Implications for Theory

Supply chain management theory was widespread in the literature and is taught as a subject at many universities. There has been a great deal of research into the definitions, matrices and benefits. The most common publications were on quality management tools and the techniques of business improvement and approaches which had originated with the Toyota production system. In the 2000s the business improvement concepts were primarily known as Lean and Six Sigma (Hines et al 1998, Womack and Jones 1999, Bicheno 2000). Despite the published matrices (Hines 1994, 1998, and 2000) and multi-point plans (Macbeth 1993, 1994), which appear simplistic, the theory was weak in case study research, which had primarily focused on high-volume industries including automotive, aerospace and retail (Womack and Jones 1990, 1996, Gattorna 2006).

There was little literature on policy deployment. However, the 2 main case studies adopted policy deployment and it was investigated as part of the implementation research. Outside Japan, the significance of policy deployment has gone largely unreported (Lee and Dale 1999, Witcher and Butterworth 2001). In the mid 1990s, Cox (1996) found that the exposure given to supplier development within the academic and professional literature remained fundamentally and disappointingly unchanged. Hines (1998) found the spread of knowledge and expertise in the west had until recently been very limited. Temple (2001) found 40% of UK firms said they were not doing lean and did not plan to, despite the British government's heavy investment to support supply chain development. From all the published material, I

found only one recent publication, by Gattorna (2006), had successfully aligned behaviour and culture with supply chain management.

From this study, researchers should now be able to extend their range of supply chain management models beyond those which currently exist. This is because the case studies provided research into four small and medium-sized supplier companies, a third-tier bearings company and a first-tier, very low-volume, high-value capital goods manufacturer of gas turbines.

In the current supply chain management literature there appears to be little published on the implementation, and the contextual factors – primarily the impact of senior management – have been greatly undervalued. Only two authors have discussed the role of management (Hines 1997, Simchi-Levi 2004). Management commitment and attitude can have a significant impact on supply chain management. Another supply chain management inhibitor is lack of clear strategy and policy, which is imperative to ensure that the implementation is aligned to the company's needs and through successful implementation will deliver the best value for the company. Other inhibitors are a lack of understanding by senior managers and employees, particularly of the business improvement tools and techniques – despite a large number of publications on the subject –, lack of clear communication and the impact this has on the supply chain, and the negative attitude of senior management and the impact this has on the attitude of employees.

The literature also largely overlooks the enablers of supply chain management: leading by example by senior management in the way they conduct themselves and work in the company; performance management through clearly defined targets, measures and reviews; accountability and responsibility, so that employees understand what is expected of them and what ownership they do have for deliverables; incentive by praise, recognition and financial rewards; and an open, honest culture.

Overall there has been little published on implementation studies which provide valuable insights particularly into the inhibitors and enablers which might pre-empt factors which potentially affect implementation. This could enable potential problems to be avoided by appreciating the lessons learnt through the inhibitors of supply chain management and to minimise risk and implementation time. By understanding the enablers the right environment and company culture can be encouraged. This will support employees to embrace the changes and senior management to drive supply chain management with the 'whole system' in mind.

These case study findings provided deeper understanding of supply chain management implementation and would assist a researcher in developing further understanding and theories. Researchers could replicate the methodology in other companies for further analysis of strategy by case study. Overall researchers can more fruitfully pursue unanswered questions and explore new questions from this additional theoretical knowledge.

Implications for practice

A significant practical benefit would be for senior management to recognise their impact on supply chain management. With the wrong attitude, unclear vision, poorly defined objectives and few targets, sub-optimisation of the supply chain is inevitable. In contrast, with a positive outlook focused on 'the whole system', identifying the need to change, establishing and developing a 'shared vision', identifying the appropriate policy deployment and empowering employees to carry out actionable results, a culture of supply chain management can flourish.

In practice, learning from the case studies, practitioners could prevent the pitfalls and strategically plan and make decisions to improve their supply chain management. They could recognise particular inhibitors without waiting to experience them in their own supply chain. By utilising the case study findings, when practitioners implement supply chain management, they have applied examples which show how to establish a policy deployment system, proactively establish their own supplier development programme and partnership agreements and carry out their own supply chain development implementation. Senior management will also have a greater understanding of their effect to supply chain management implementation and the impact their behaviour has to sustainable results and employees' motivation.

Overall a practitioner can significantly reduce their learning curve and implementation time by understanding the inhibitors that could face them and focusing positively on the enablers to optimise supply chain management.

7.3 Limitations of the research

Limitations of this research were presented in section 3.9 in the chapter on methodology. There were only two main cases, both situated in a similar regional area of the East Midlands. They were both engineering companies which had been taken over by foreign companies and

had been established over a long period of time. There were four mini cases which were RHP-NSK's suppliers. These were useful to answer how ideas were being implemented.

To study the implementation of supply chain management, focus was placed on the identification of themes from the literature research. A common theme in both companies was business improvement, which was evident through the companies' different initiatives and tools and techniques. I found this was a key theme necessary for the implementation of supply chain management. Both companies may have been more focused on business improvement and not supply chain management in the broader 'whole system' sense.

A further limitation was the time taken to complete the research and the locations, in two market town communities. There was focus on two main organisations and four supplier companies, all in the manufacturing sector. All the companies were well established, the two main organisations were 60 years old, two of the supplier companies were established in the 1950s and the other two supplier companies were established in the 1970s.

The length of time taken to complete the case study research supported fulfilment of the authenticity of the research objectives. However, added to the length of time was the effect of companies' changing dialogue with the external environmental and impact this had on how the companies operated. All these factors could have an impact on the outcome of the research. However they were considered minor and were identified prior to the research which meant authenticity was built into the research methodology to prevent limitations from occurring.

7.4 Implications for further research

Due to the breadth and scope of supply chain management, there are many angles to be taken for further research. Further research could be made into each of the conceptual themes highlighted from the literature research. Further research could be made into each of the contextual factors identified from the research aims. Research could be undertaken in the service industry, a different industry sector, or generically across all industry sectors.

7.5 Conclusion – Summary

This research has provided useful evidence of significant implementation changes in two manufacturing companies in the management of their supply chain and four mini case studies of supply chain development. It has also revealed a greater consideration and appreciation of

the impact senior management commitment and attitudes can have on supply chain management implementation. During the time period of the research, the implemented changes in the case studies were less than I had hoped, as implementation was not as strategic as it might have been, and it was partial as it affected just some areas of the supply chain. This may be due to the longer product life cycle and as a consequence slower need to change. Senior management gave poor consideration to the strategy, systematic development and networking of supply chain management. Senior management were also very weak on the competitive impact of an efficient and effective 'whole system' for supply chain management.

Nevertheless through the existing research conceptual themes were identified to examine in the case studies. An historical analysis of both case studies provided a greater understanding into how the companies' supply chain management had changed. The cases revealed an excellent range of examples for how supply chain management ideas had been implemented. The inhibitors and enablers of supply chain management were found and analysed to produce the five main contributing factors, which would provide focus for supply chain management implementation.

Through this in-depth case study analysis into low-volume manufacturing this research has provided clarity as to some of the key contextual factors of supply chain management. Further work is needed in this field for researchers and practitioners to simplify the complexity of supply chain management.

Bibliography

Adair, J., (1991). *Not bosses but leaders*. Kogan Page Ltd. p1-171.

Adair, J., (2003). *Action Centred Leadership*. Chartered Management Institute. Revised March 2003.

Akao, Y., (1991). *Hoshin Kanri: Policy Deployment for Successful TQM*, Cambridge, MA: Productivity Press.

Automotive Academy: http://www.industryforum.co.uk/education/automotive.shtml

Avery, S., (2001). Linking supply chains saves Raytheon $400 million, Purchasing, August, p27-34.

Bacharach, S., (1989). Organizational Theories: Some Criteria for Evaluation, *Academy of Management Review*, Vol. 14, No. 4 p495-p515.

Baily, P., Farmer D., Jessop D., and Jones D., (1994). *Purchasing principles and management*. Pitman Publishing, Seventh Edition, p5-41, p265-335.

Banuelas, R., and Anthony, J., (2001). Critical Success Factors for the Successful implementation of Six Sigma Projects in Organisations. *The TQM Magazine*, Vol. 14, No. 2, p92-99.

Barclay, I., (2005). Supply Chain Management in SMEs – benchmarking best practice core competencies. *Journal of General Management*, Vol. 30, No. 3 Spring 2005. p36-p50.

Barry, M., and Fourie, C., (2002). Analysing cadastral systems in uncertain situations: a conceptual framework based on soft systems theory. *The International Journal of Geographical Information Science*, 2002, Vol. 16, no. 1, p23-40.

Barry, M., and Fourie, C., (2002). Analyzing cadastral systems in uncertain situations, a conceptual framework based on soft systems theory. *International Journal of Geographical Information Science*, Vol. 16, No. 1, p23-p40.

Baterman, N., (2001). *Sustainability a guide to process improvement*. Published by Lean Enterprise Research Centre.

Bell, D., McBride, and P., Wilson, G., (1994). *Managing Quality*, Butterworth-Heinemann Ltd, P4-7, p213-28.

Bessant, J., Caffyn, S., and Gilbert, J., (1996). Learning to Manage Innovation, *Technology Analysis & Strategic Management*, Vol. 8, No. 1, p59-70.

Bicheno J., (2000). *Cause and Effect Lean, Lean Operations, Six Sigma and Supply Chain Essentials*. Picsie Books, Buckingham England, p8-13.

Bicheno, J., (2002). *The Quality 75, Towards Six Sigma Performance in Service and Manufacturing*, Picsie, Buckingham.

Bose, I., and Pal, R., (2005). Managing Anything Anywhere Anytime in the Supply Chain, *Communications of the ACM*, August, Vol. 48, No. 8. p100-106.

Bourgeois, L.J., (1988). Strategic Decision Processes in Silicon Valley: Four Cases in the Microcomputer Industry, *Management Science*, Volume 34, Number 7, p816-835.

Bowen, H., et al., (1994). Regaining the lead in manufacturing. *Harvard Business Review*, September/October, p108-144.

Brett, C., Queen, P., (2005). Streamlining Enterprise Records Management with Lean Six Sigma, *The Information Management Journal*, November/December, p58-p62.

Brewer, P. C., and Speh, T. W., (2000). Using the balanced scorecard to measure supply chain performance. *Journal of Business Logistics*, Vol. 21, No. 1.

Breyfogle, F. W., (1999). *Implementing Six Sigma Smarter Solution Using Statistical Methods*, New York: Wiley.

Bridges, W., (1995). *Managing Transition of Change*, Nicholas Brealey Publishing Limited, p108-125.

Bonoma, T., V., Case Research in Marketing: Opportunities, Problems, and a Process. *Journal of Marketing Research*, Vol. XXII, May, p199-208.

Brooks, G., and Linklater, J., (1986). Statistical Thinking and W. Edward Deming's teachings in the administrative environment, National Productivity Review, Vol. 5, No. 3. p271-280.

Bryman, A., and Bell, E., (2003). Business Research Methods, Oxford Univeristy Press, p53-56.

Burke, W., (1995). Organisation Change What we Know, What we need to know, *Journal of Management Inquiry*, Vol. 4 No. 2, p158-169.

Carter, J. R., and Narasimhan R., (1993). Purchasing and Supply Management: Future Directions and Trends, *International Journal of Logistics Management* Vol. 4, No.1, p1-12.

Cassell, C. and Symon, G. (2004). *Essential Guide to Qualitative Methods in Organisational Research*, Sage, Chapter 26, p323-340.

Checkland, P., (1990). *Systems Thinking*, Systems Practice, Chichester: John Wiley.

Christopher, M., (1992). *Logistics and Supply Chain Management: Strategies for reducing costs and improving services*, Pitman Publishing, London.

Chu, S., and Fang, W., (2006). Exploring the relationship of trust and commitment in Supply Chain Management, *The Journal of American Academy of Business*, Cambridge, Vol. 9, No. 1, March.

Collins, J. C., and Porras, J. I., (1996). Building your Company's Vision. *Harvard Business School Publishing*, Boston.

Connolly, K. P., Sullivan, E., Brennan, L., and Murray, J., International Supply Chain Management A Walk Around the Elephant, *The Irish Journal of Management*, p149-162.

Cooper, M., and Ellram, L., (1993). Purchasing and Logistics Strategy, *International Journal of Logistics Management*, 4, No.2.

Cooper, M., Ellram, L.M., Gardner, J. T., & Hanks, A. M., (1997). Meshing Mutiple Alliances, *Journal of Business Logistics*, Vol. 18, No 1, p 67-89.

Count, J., (2000) *Organise Yourself*, Clays Ltd, St Ives Plc.

Covey, S. R., (2004). *The 7 Habits of Highly Effective People, Powerful lessons in personal change*, Simon and Schuster UK Ltd.

Cox, A., (1996). *Innovations in Procurement Management*, Earlsgate Press, Boston.

Cox, A., and Hines, P., (1997). *Advanced Supply Management: The Best Practice Debate*, Earlsgate Press, Boston, August, p31-49.

Craig, D., Roy, R., (2004). Developing a Customer Focused Culture in the Speculative House Building Industry *Total Quality Management* Vol. 15, No. 1, p73-87, January.

Croom, S., Romano, P., and Giannakis, M., (2000) Supply Chain Management: An Analytical Framework for Critical Literature Review, *European Journal of Purchasing and Supply Management*, Vol. 6, p67-83.

Daneke, G. A., (2005). The Reluctant Resurrection: New Complexity Methods and Old Systems Theories, *Journal of Public Administration*, Vol. 28, p89-p106.

Daneke, G., (2005). The Reluctant Resurrection: New Complexity Methods and Old Systems Theories. *Journal of Public Administration*, 28: 89-106.

Deming, W.E., (1986). *Out of the Crisis: Quality, Productivity and Competitive Position*. Cambridge: Cambridge University Press.

Drucker, P., (1955). *The Practice of Management*, New York: Harper & Row.

Drucker, P., (1971). 'What we can learn from Japanese management'. *Harvard Business Review,* 49, March-April, 11-23.

Drucker, P., (1982). *The changing world of the executive*, Heinemann, London, p3.

Eckes, G., (2001). *Making Six Sigma Last*, John Wiley & Sons, Canada

Eisenhardt, K., M., (1999) Building Theories from Case Study Research, *Academy of Management Review*, Vol. 14, No. 4, p532-550.

Feldman M.S., (1995). *Strategies for Interpreting Qualitative Data*, SAGE Publications, Inc. p1-69.

Forrester, J. W., (1958). Industrial Dynamics: A major breakthrough for decision makers, *Harvard Business Review*, Vol. 38, July-August, p37-66.

Galt, J., and Dale, B., (1991). Supplier Development a British Case Study. *International Journal of Purchasing and Materials Management*,.

Gattorna., (2006). *Living Supply Chains How to mobilize the enterprise around delivering what your customers want.* Pearson Education Ltd.

Gersick., (1988). Time and Transition in Work Teams, *Academy of Management Journal*, Volume 31, p9-12.

Ghauri, P., and Gronhaug, K., (2005). *Research Methods in Business Studies*, FT Prentice Hall p114-120.

Ghoshal, S., and Bartlett, C. A., (1995). 'Changing the role of top management: beyond structure to process'. *Harvard Business Review*, Vol. 73, January-February, p86-96.

Gibson, B. J., Mentzer, J. T., and Cook, R. L., (2005). Supply Chain Management The Pursuit of Consensus Definition, *Journal of Business Logistics*, Vol, 26, No. 2, p17-25.

Gillham, B. (2000). *Case Study Methods*, British Library.

Glaser, D. G., and Strauss, A. L., (1967). *The discovery of grounded theory: strategies for qualitative research*, Newark: Aldine.

Goldratt, E., and Fox, R., (1987). Revolutionizing the factor floor, Management Accounting 68, May, p18-22.

Goldsby, T. J., Griffis, S. S., and Roath, A. S., (2006). Modelling Lean, Agile and Leagile Supply Chain Strategies, *Journal of Business Logistics*, Vol. 27, No. 1, p57-80.

Gray, D.E,, (2004). *Doing Research in the Real World*, Sage, chapter 6, p123-151.

Hahn, C., Watts C., and Kim K., (Spring 1990). The Supplier Development Program: A conceptual model*, Journal of Purchasing and Materials Management,* Vol. 26, No 2, p2-7.

Hammersley, M., (2000). *Case Study Research Method*, Sage.

Harland, C., Lamming R. C., and Cousins P. D., (1999) Developing the Concept of Supply Strategy, *International Journal of Operations and Production Management*, 19, p650-673.

Harland, C., Zheng, J., Johnsen, T., and Lamming, R., (2004). A Conceptual Model for Researching the Creation and Operation of Supply Networks *British Journal of Management*; Vol. 15, p1-21, 21p.

Harry, M. J., (2000). A new definition aims to connect quality with financial performance*, Quality Progress*, Vol. 33 , No 1 , p64-66.

Harry., and Schroeder., (2000). *Six Sigma: The Breakthrough Strategy Revolutionizing the Worlds Top Corporations*, New York, Doubleday.

Hartley, J. L., and Choi, T. Y., (1996). *Supplier Development:* Customers as a catalyst of process change. *Business Horizons* July-August p37-45.

Hay, E. J., (1989). Driving down downtime; *Manufacturing Engineering*; Vol. 103 Issue 3, p41-44.

Hayes, R. H., Wheelwright, S. C., and Clark, K. B., (1988). *Dynamic Manufacturing* , Free Press, New York.

Heap, D., (2004) National Statistics Feature, *Redundancies in the UK*, Labour Market Trends.

Hines, P., (1994). *Creating World Class Suppliers - unloading mutual competitive advantage,* Pitman Publishing, London, p6, 140-205, 220, 227, 228, 273.

Hines, P., Lamming P., Jones D., Cousins P., and Rich N., (1997). *Value Stream Management, Strategy and excellence in the supply chain,* 1st Edition Financial Time Prentice Hall, p191, p196-197, p324-325.

Hines, P., and Rich, N., (1998). Outsourcing Competitive Advantage*, The second world-wide research symposium on purchasing and supply management,* 1-3 April p268-294.

Hines, P., Taylor, D., (2000). *Going Lean*, Published by Lean Enterprise Research Centre.

Hines, P., and Rich, N., (1997). The Seven Value Stream Mapping Tools, *International Journal of Operations & Production Management,* Vol 17, No 1, p46-64.

Hoerl, R. W., (1998). Six Sigma and the future of the quality profession, Quality Progress, June p35-42.

Hoerl, R. W., (2001). Six Sigma Black Belts – what do they need to know? Journal of Quality Technology, Vol. 33, p391-406.

Holweg et al., (2002). 3 Day Car, *Towards a Customer Driven System*, Lean Enterprise Research Centre website.

Houlihan, J.B., (1988). International Supply Chains: A New Approach, *Management Decision*, Vol. 26, No.3 p13-19.

Johansen, P., and McGuire, K.J., (1986). A lesson in SMED with Shigeo Shingo; *Industrial Engineering*; Vol. 18, Issue 10, p26-33.

Jones, T., and Riley D. W., (1985). Using inventory for competitive advantage through supply chain management, *International Journal of Physical Distribution and Material Management*. Vol. 15, p16-26.

Larcker, D. F., and Meyer, M.W., (2003). Subjectivity and the weighting of Performance Measures: Evidence form a balanced scorecard, *Accounting Review*, Vol. 78. No. 3, p725-759.

Jones, D. T., (2001). Thinking Outside the Box, *ECR Journal*, Vol. 1, No. 1, Summer.

Jones, D. T., (2001). UK Manufacturing The Route to the Future, *Manufacturing Engineer*. February.

Kaplan, R. S., and Norton, D. P., (1996). *The Balanced Scorecard: Translating Strategy into action.* Boston, MA: Harvard Business School Press.

Kaplan, R. S., and Norton, D. P., (1996). Using the Balanced Scorecard as a strategic management system, *Harvard Business Review*, Vol. 74. No.1, p78-p92.

Katz, D., and Kane, R.L., (1966). *The social psychology of organisations*, New York: John Wiley & Sons.

Kauffman, D.R., (1980). *Systems: An introduction to systems thinking.* The innovative learning series, edited by S.A. Carlton (Minneapolis; The Innovative Learning Series.

Knights, D., and Willmott, H., (1993). 'It's a very foreign discipline': the Genesis of Expenses Control in a Mutual Life Insurance Company, *British Journal of Management*, Vol. 4, p1-18.

Kolb, D., and R. Fry., (1975). *Towards a theory of applied experiential learning in Theories of group processes*, John Wiley: Chichester.

Kotter, J., (2004). *Matsushita Leadership: Lesson from the 20th century's most remarkable entrepreneur,* London: Free Press.

La Londe., Bernard J., and James M., (1994). Emerging Logistics Strategies: Blueprints for the Next Century, *International Journal of Physical Distribution and Logistics Management*, Vol. 24, No. 7, p35-47.

Lambert, D. M., (2005). An Evaluation of Process Orientated Supply Chain Management Frameworks. *Journal of Business Logistics*, Vol. 26. No. 1. p25-51.

Lamming, R. C., (1996). Squaring Lean Supply with Supply Chain Management, *International Journal of Operations and Production Management*, Vol 16, No. 2, p183-196.

Lamming, R., (1993). *Beyond partnership*. London: Prentice-Hall.

Lascelles, D.M., and Dale, B.G., (1989). The Buyer-Supplier Relationship in Total Quality Management, *Journal of Purchasing and Materials Management*, Summer.

Lean Learning Academy (2006). Publicity Brochure for the London Learning Academy Programme, funded by the London Development Agency and European Union. www.leanlearningacademy.co.uk

Lee, R. G., and Dale, B. G., (1998). Policy deployment: an examination of the theory. *International Journal of Quality & Reliability Management*, Vol. 15, No. 5, p520-540.

Lee, R. G., and Dale, B. G., (1999). Policy deployment: A case analysis, *Production Planning & Control*, Vol. 10, No. 5, p493-501.

Lemak, D., and Henderson, P., (2004). A new look at organizational transformation using systems theory: an application to federal contractors. *Journal of Business and Management.* Vol. 9. Winter Number 4.

Lemak, D. J., Henderson, P. W., and Wenger, M. S., (2005). A New Look at Organizational transformation using systems theory: An application to federal contractors. *Journal of Business and Management*, Winter. Vol. 9, No. 4. p407-424.

Leseure, M. J., Bauer, J., Birdi, K., Neely A., and Denyer, D., (2004). Adoption of promising practices: a systematic review of evidence, September/December. International Journal of Management Reviews, Vol. 5/6, Issue 3 & 4, p169-190.

Lummus R. R., Demarie S. M., (2006). Supply Chain Management Metamorphosis into corporate strategy. *Industrial Engineer*. June, p38-42.

Lysons, K., (1996). *Purchasing*, Fourth Edition published in Great Britain,

Macbeth D., (1994). The role of purchasing in a partnering relationship. *European Journal of purchasing and supply management.* Volume 1 (1994) no. 1.

Macbeth D., et al., (1993). *Partnering relationships barriers to progress.* PSERG 2nd International annual conference. April 1993.

Macbeth, D., & Ferguson N., (1993). *Partnership Sourcing: an integrated supply chain approach*, London Financial Times. Pitman.

Maylor, M. and Blackmon, K. (2005). *Researching Business and Management*, chapter 8, p241-264.

McCartney, L., and Massey, L., (1996). Managing Supply Chain Development, *IPSERA and CIPS International Conference*.

Mentzer, J. T., (2004). *Fundamentals of Supply Chain Management*, Sage Publications, p292.

Mentzer, J. T., De Witt, W., Keebler, J. S., Min, S., Nix N. W., Smith C. D., and Zacharia, Z. G., (2001). Defining Supply Chain Management, *Journal of Business Logistics*, Vol. 22, No. 2., p1-26.

Merli, G., (1990). *Total Manufacturing Management - Production Organisation for the 1990s.* Productivity Press.

Miles, R. (1982). Qualitative data as an attractive nuisance: The problem of analysis, *Adminstratiive Science Quarterly*, Vol. 24, p590-601.

Mintzberg, H., (1990). The Design School, Reconsidering the basic premises of Strategic Management, *Strategic Management Journal,* Vol. 11, p171-195.

Monden, Y., (1983). *The Toyota Production System*, Cambridge, MA, Productivity Press.

Monden, Y., (1986). Applying Just In Time, *The American / Japanese Experience, Industrial Engineering and Management Press*, Norcross, Georgia.

Morris, J., and Wilkinson, B., (1995). The transfer of Japanese management to alien institutional environments. *Journal of Management Studies*, Vol. 32, No. 6, p719-730.

Nanda, V., (2003). A Process for the Deployment of Corporate Quality Objectives, *TQM & Business Excellence*, Vol. 14, No. 9, November, p1015-1021.

Naylor, B. J., Mohamed, N M., and Berry, D., (1999). Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of Production Economics*, Vol. 62, p107-118.

Oakland, J. S., (2000). *TQM Text with Cases,* Butterworth-Heineman, Oxford.

Pascale, R., (1990) *Managing on the edge*, How successful companies use conflict to stay ahead, Penguin Books.

Peck, H., and Juttner, U., (2000). Strategy and relationships: Defining the Interface in Supply Chain Contexts. *International Journal of Logistics Management,* Vol. 11, No. 2, p33-44.

Peter, T., and Waterman, R., (1982). *In Search of Excellence - Lessons from Americas best run companies*.

Porter, M. E., (1990). *The competitive advantage of nations*. New York: Free Press.

Porter, M. E., (1996). What is strategy? *Harvard Business Review*, Vol. 74, November-December, p61-78.

Priestman, S., (1985). SQC and JIT: partnership in quality, *Quality Progress*, Vol. 18 No. 5, p31-34.

Quayle, M., (2000). Supplier Development for UK Small and Medium Sized enterprises. *Journal of Applied Management Studies*, Vol. 9, No. 1.

Robertson, I.T., an d Cooper C. L., (1987). *Human Behaviour in Organisations*, Pitman Publishing, p16-21.

Robinson, A. G., and Schroeder, D. M., (1993). Training, Continuous Improvement and Human Relations *California Management Review*, Winter.

Robsen, C., (2002). *Real World Research*, 2nd edition, Blackwell, p177-185.

Rosen, M., (1991). Coming to terms with the field understanding and doing organisational ethnography, *Journal of Management Studies*, p1-23.

Rother, M., and Shook, J., (1998). *Learning to See,* Ann Arbor, Michigan.

Rufasha, K., (2005). *A cross case analysis of the role of teams in venture growth.* Doctor of Philosophy, Nottingham Trent Business School.

Rumenyi, D., Willisam, B., Money, A. and Swartz, E. (1998). *Doing Research in Management and Business*, Sage, Chapter 10, p160-187.

Sadgrove, K., (1995). *Making TQM Work*, Kogan Page Ltd., London

Sako, M., (1992). Prices, quality and trust: Inter-firm relations in Britain and Japan. *Cambridge Studies in Management*, p18.

Sarantakos, D., (2005). Social Research, 3rd Edition, Palgrave Macmillan.

Saunder, L., and Thornhill., (1997). *Research Methods for Business Students*, Pitman Publishing, London.

Schein, E. H., (2001). *Kurt Lewin's Change Theory in the Field and in the Classroom: Notes towards a Model of Managed Learning*, available from http://www.sol-ne.org/res/wp/10006.html.[Accessed 2nd October2001]

Scott C., and Westbrook R., (1991). New Strategic Tools for Supply Chain Management, *International Journal of Physical Distribution and Logistics Management*, Vol. 21 No. 1. p23-33.

Schnonberger, R., (1987). Frugal Manufacturing, *Harvard Business Review*, Vol. 65, No. 5, p95-100.

Sepheri, M., (1987). Case studies of manufacturing productivity improvement, *World Productivity Forum and Industrial Engineering Conference Proceedings*, Washington DC, P 35-39.

Senge, P., (1990). *The leader's new work: Building learning organisations.* Sloan Management Review, p7-23.

Siems, F. T., (2005). Who Moved my Cheese? Supply Chain Management in a Global Economy p6-p21, *Business Economics*, October.

Silverman, D., (2005). *Doing Qualitative Research*, Sage, chapter 9.

Simchi-Levi, D., Kaminsky P., and Simchi-Levi, E., (2003). *Designing and Managing the Supply Chain*, Concepts, Strategies and Case Studies, 2nd Edition, New York: The McGraw-Hill companies.

Smuts, J.C., (1926). Holism and Evolution (London: MacMillan).

Soy, S., (1998). *The Case Study as a Research Method*, Uses and Users of Information, LIS 391D.1, Spring 1997.

Stake, R. (1995). *The Art of Case Study Research*, Sage.

Stevens, G. C., (1989). Integrating the Supply Chain, *International Journal of Physical Distribution and Materials Management*, Vol. 8, p3-8.

Stichweh, R., (2000). Systems Theory as an Alternative to Action Theory? The Rise of 'Communication' Theoretical Option, *ACTA Sociologiga,* p5-p13.

Strebel, P., (1998). *Why do Employees Resist Change?*, Harvard Business School Publishing, Boston.

Suzaki, K., (1987). *The New Manufacturing Challenge*, Free Press, New York.

Swink, M., (2006). Building Collaborative Innovation Capability, March-April, Industrial Research Institute, *Research Technology Management* p37-47.

Syson, R., (1992) *Improving Purchase Performance*, Financial Times Prentice Hall.

Tan, K. C., (2002) Supply Chain Management: Practices, Concerns and Performance Issues, Journal of Supply Chain Management, Vol. 38, No. 1, p42-54.

Temple, M., (2001). *Catching up with Uncle Sam*, The EEF final report on UK and US manufacturing productivity. December.

Turney, P. B. B., (1996). *Activity Based Costing - The performance breakthrough*, Kogan .

Turney, P. B. B., and Anderson, B., (1989). Accounting for continuous improvement, *Sloan Management Review*, Vol. 30 No. 2, p37-47.

Tuomela, T. S., (2005). The interplay of different levers of control : A case study of introducing a new performance measurement system, *Management Accounting Research 16*, p293-320.

Vergnani, S. A., (1999). *Explorations in Teacher Education, Action Research: A case study.* Vol. 7, No. 2.

Wang, F., Timon, D. C., and Eldon, L. Y., (2004). Applying Six-Sigma to Supplier Development, *Total Quality Management,* Vol. 15, No. 9-10, p1217-1229, November-December.

Watts, C. A., and Hahn C.K., (1993). Supplier Development Programs: An Empirical Analysis, *International Journal of Purchasing and Materials Management*, p11-17.

Welch, J., and Welch, S., (2005). *Winning*, Harper Collins Publishers.

Whyte, W.F., (1991). *Participatory Action Research*, Sage Publications, p20 and p40.

Witcher, B., and Butterworth, R., (2001). Hoshin Kanri: Policy Management in Japanese-owned UK subsidiaries. *Journal of Management Studies*, Vol. 38, No. 5, Blackwell Publishers Ltd.

Womack, J. P., Jones, D.T., and Roos, D., (1990). The *Machine that change the world.* New York: Rawson Associates.

Womack, J., and Jones, D., (1996). *Lean Thinking: Banish waste in and create wealth in your corporation.* New York: Simon & Schuster.

Wyper, B, and Harrison, A., (2000). Deployment of six sigma methodology in Human Resource Function: a case study*, Total Quality Management*, vol. 11, p720-727.

Yin, R.K., (1984). *Case study research: Design and methods*. Newbury Park, CA: Sage.

Yin, R.K., (1989). *Case study research: Design and methods*. Newbury Park, CA: Sage.

Appendix 1: Glossary of Terms

This glossary of terms has been established to assist the reader with any company phrases, jargon and abbreviations. The main majority of definitions are working definitions found within the companies investigated.

Expression (Acronym)	**Definition**
Added Value	An activity or process that people carry out which is what the customer is willing to pay for our a contribution to physically changing the form of shape of a product.
Benchmarking	Improvement process in which a company measures its performance against that of best-in-class companies and uses the information to improve its own performance. The subjects that can be benchmarked include strategies, operations, processes, and procedures.
Capability	The ability of a product or a process to produce / supply consistently to a previously defined quality/satisfaction level.
Cells	Also known as cellular manufacture, it is a physical area where all the machines needed to produce a product are all located together on the shop floor.
CITT	Continuous improvement through teamwork.
Consignment Stock	Stock held on the customer's site that is the suppliers until the customer uses it. At this point in time the supplier is then paid.
Contingency Stock	A buffer of extra stock to support what if situations.
Corrective action	Action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence (ISO 8402).
Corrective Action Plan	A plan that is established to get to the root cause of quality problems.
Costs of non quality (CONQ)	The total cost of products/services not achieving the Customer requirements specified. Costs incurred through internal failures (scrap, rework, modification), failure of externally supplied products/service and the additional actions taken and loss of value adding performances of both resources and equipment.
Cross-functional team	Team of people with difference skills from different disciplines. Such as financial, production, technical, manufacturing, engineering, project and purchasing.
Corrective action	Disposition of an existing nonconformity by repair, rework or adjustment (ISO 8402) (See also 'preventive action').
Customer Satisfaction	The perception of your customer who is receiving the product or the service.
Defect	A non fulfilment of quality from a process or a part.
EDI (Electronic Data Interchange)	The inter company, computer to computer communication of standard format that permits the receiver to perform the

	intended transaction. (Sokol, 1989).
E-purchasing tools	Methods using electronic data processing from purchasing requisition of order eliminating paper from the system.
ERP	Enterprise resource planning, the latest manufacturing production method.
Frame Agreement	A joint agreement produced between the customer and strategic supplier to generally outline their operating principles and performance expectations.
Gap reduction	Activities made in order to improve performance to a level that equals an indicator assessed.
Gate review	A number of checkpoints within a process that ascertain that key criterion have been fulfilled before moving to the next stage of development.
Integration	The linking or interfacing of parts or processes.
Interfaces	Point where the processes of different organisations converge: some inputs or outputs are shared. There must work together people of different processes or organisations.
ISO 9000	Certification of a quality system, performed by an internationally recognised and independent organisation, e.g. QS 9000, BS5750, EAQF.
Kanban	A pull system, which pulls, required materials for a buffer stock or the previous operation.
Key commodity	Strategically important or vital purchased part.
Key supplier	Supplier supplying key commodities.
Kits	Small batches of different parts and components, which will be assembled together and are delivered together on the assembly line.
Materials management policy	The definition & objectives of how products & materials are co-ordinated into production and transferred for final delivery to the Customer
Milestone	Key stages positioned in a project processes that target when key objectives or deliverables need to be achieved before a Gate Review.
Non-conformity	Non-fulfilment of a specified requirement (ISO 8402). This requirement may be a product, procedure or process.
Partnership policy	A policy aiming to develop the use of partnerships with supplier.
Pilot suppliers	The initial supplier used to supply products / parts / materials / services. May be used on a long term basis but could be for just initial trails or production.
Policy	Overall intentions and direction of an organisation, as formally expressed by top management (ISO 8402).
Policy and Strategy	Mission, values, vision, direction
Potential Suppliers	Suppliers proposed by Sourcing, which could be able to design or manufacture Products.

Preventive action	Action taken to eliminate the causes of a potential nonconformity, defect or other undesirable situation in order to prevent occurrence (ISO 8402).
Procedure	A written or documented procedure usually contains the purpose and scope of an activity; what shall be done and by whom; when, where and how it shall be done; what materials, equipment and documents shall be used; and how it shall be controlled and recorded. (ISO 8402).
Process	Set of inter-related resource's and activities which transform inputs into outputs. Resource's may include personnel, finance, facilities, equipment, techniques and methods. (ISO 8402).
Process Development	Reviewing every single task in the company network of activities to seek continuous improvement of these tasks.
Prototype	Model of a product, manufactured with a non-industrialised process and so non-representative of the series, but used to validate design concepts before volume production.
Purchase Order	The contractual document used to order parts, materials, services
Purchase order acknowledgement	The notification of receipt of an order document
Purchasing card	A visa or barclaycard used to procure materials or services.
Quality	Totality of characteristics of an entity that bear on its ability to satisfy stated and implied customer needs.
Quality Assurance (QA)	All the planned and systematic activities implemented within the quality system.
Reliability	Ability of a product to perform its intended function under specified conditions without failure for a given period of time.
Set up Reduction	See SMED
Short term	A period of time shorter than 1.5 years
Short term Business Plan	A schedule that details actions and objectives to be made within a short period. No longer than 1.5 years
SMED	Single Minute Exchange of Die also refered to as set up reduction which concentrates on reducing set up time by breaking all activites down and then seperating them into external and internal activities. Internal activities are jobs which have to be carried out why the machine is switched off and external which can be carried out while the machine is running.
Sourcing department	Department responsible for the selection, negotiation and follow-up of suppliers (as former Purchasing departments), but that also must share responsibilities with other functions involved in the supply chain for the control of the total Sourcing cost. (Stretch 30).
Sourcing Reviews	A regular review of Suppliers performances (QCD, technical, legal, confidentiality) to check the continued suitability of suppliers to meet ALSTOM requirements. It is lead by

	ALSTOM Sourcing department and involves Engineering, Manufacturing and Quality departments
Specification	Documentation stating requirements. Notes: 1. A qualifier should be used to indicate the type of specification such as 'Product', Specification, Test specification. 2. A specification should refer to or include drawings, patterns or other relevant documents and indicate the means and the criteria whereby conformity can be checked. (ISO 8402)
Sourcing Policy	Defines what is expected from the Sourcing organisation in executing the business strategy. It must be in line with the overall strategy and its main criteria. For example shareholders' value, commercial focus. it will indicate the relative importance of each of the key dimensions of Sourcing performance and fix clear targets for the most important ones
Strategic intent	A driving force compelling leadership toward its vision.
Strategic supplier	Supplier supplying strategic commodities. This status may be different for every ALSTOM units.
Supplier	Organisation that provides a product or service to a customer.
Supplier award	An award given to a Supplier who has made an outstanding improvement, contribution or performance. Awards can congratulate suppliers on different periods: 'supplier of the month award', 'supplier of the year award', etc.
Supplier back up plan	Measures performed to minimise the risk of not being delivered parts by suppliers (e.g. warehouse stocks, 2 suppliers, etc).
Supplier Classification	Class applied to Suppliers, indicating their performance level and based on a rating and assessment system. The suppliers could be graded in numerical or alphabetical levels A or 1 being 'Preferred Suppliers'.
Supplier conference	Meeting or convention held with all the Suppliers to communicate ALSTOM expectations and requirements in fields of quality, productivity, etc. Usually done after organisational or process changes that affect Suppliers, or at the launch of a new product.
Supplier Performance Rating System	Regular measurement of supplier performance. Frequent performance measures used include quality, cost, delivery and technology.
Supplier portfolio	List of all the suppliers known by ALSTOM and which buyers are authorised to deal with (buying to or only consulting).
Supplier quality	Agreement with the Supplier stating the expected level of quality (e.g. parts per million levels), volume etc. This is a means to follow-up objectives and measure progresses.
Supplier Quality Assurance (SQA)	The process that helps assure QCD criteria is achieved by the Supplier.
Supplier review	A regular meeting with suppliers' to review performance.

The ship to line	Parts and/or materials directly delivered to the manufacturing area without any inspection.
TPM	Total preventative maintenance. A system to plan and control maintenance, develop flexible working and autonomous teams.
Traceability	Ability to trace the history, application or location of an entity by means of recorded identifications.
Validation	Confirmation by examination and provision of objective evidence.
Values	The worth, desirability, or utility of a thing, or the qualities on which these depend. One's principles or standards; one's judgement of what is valuable or important in life. Values describe the Company's preferred way of doing things. For a value to be a value it must consistently drive behaviour.

Appendix 2: Supplier Development Policy Statement

1 ***RHP PURCHASING***

The RHP purchasing mission is to continuously meet agreed customer requirements at the lowest total cost, whilst actively pursuing environmental goals.

2 ***SOURCING POLICY***

The RHP policy is to source long term with at least one technically approved supplier for each strategic product.

3 ***SUPPLIER DEVELOPMENT MISSION***

To build long term relationships with our strategic suppliers, by developing and maintaining a cost effective supply chain built on trust and mutual gain.

4 ***SCOPE OF SUPPLIER DEVELOPMENT ACTIVITY***

To proactively share and transfer continuous improvement techniques with RHP's selected strategic suppliers. RHP's initial focus will be on Manufacturing activities and seek to improve Quality, Cost, Delivery and People (QCDP) performance.

5 ***RHP ORGANISATIONAL SUPPORT***

RHP's central Purchasing Department will be responsible for controlling the supplier management system. The supplier development activities will include relevant people who add value to the team.

6 ***STRATEGIC SUPPLIER SELECTION***

The criteria for selecting and reviewing strategic suppliers will be based on the following:

- Relationship development attitude
- Importance of product
- RHP spend and contribution to supplier turnover
- Level of Performance measured by RHP
- Product / Process Innovation
- Technological development (IT/R&D)
- Strategy and Business Plans

7 ***SUPPLIER DEVELOPMENT PERFORMANCE MEASURES***

RHP shall select strategic suppliers for development based on business priorities. RHP will carry out perception surveys with purchasing, quality, engineering and Manufacturing. Selection will be annually and internal quarterly progress reviews will be carried out.

8 ***SUPPLIER DEVELOPMENT PERFORMANCE MEASURES***

RHP will support selected strategic suppliers with deployment of a QCDP philosophy. This is essential for providing a focus for improvement activities, by measuring where we are, where we want to be and assigning jointly agreed improvement targets

Typical performance measures include:

- Right first time
- Delivery schedule achievement
- Manufacturing people cost

- Stock turns
- Overall equipment effectiveness
- Value added per person
- Floor space utilisation

9 ***SUPPLIER DEVELOPMENT TRAINING WORKSHOPS***

RHP use a range of continuous improvement skills. For example, 5 S's, waste removal, Total Productive Maintenance (TPM) and visual management. A joint workshop with RHP and the selected strategic supplier/s will be carried out focusing on the relevant improvement skills needed to fulfill the particular focus of development (project objective). The workshop will include practical application and will be delivered by NSK-RHP.

10 ***MANAGEMENT AND COMMUNICATION***

RHP and selected strategic suppliers shall undertake agreed monthly reviews. This will ensure an ongoing supplier development continuous improvement philosophy to be deployed.

11 ***CONFIDENTIALITY***

Any information shared within the projects that is identified and recorded as confidential shall only be exchanged following the signing by all parties who receive the information of an RHP Confidentiality Agreement.

12 ***CAPITAL INVESTMENT***

Where investment is made in technology or tooling an individual agreement is made and signed between both parties.

13 ***JOINT BUSINESS PLAN***

RHP and the selected strategic suppliers will jointly establish a focused five year business plan aimed at continuous improvement and cost reduction targets.

14 S***UPPLY CHAIN DEVELOPMENT***

RHP will work with selected strategic suppliers to continuously seek new ways to more effectively manage and develop the supply chain. We the undersigned agree in principle to the supplier development policy outlined above.

.....
Managing Director

.....
Purchasing Manager

Appendix 3: Supply Chain Manager Survey

Name: Position: Sex:

Age: Length of Service:

Based on your experience what are your inhibitors to effective performance in supply chain management?

1.
2.
3.
4.
5.
6.
7.

Based on your experience what are your enablers for effective performance in the supply chain management?

1.
2.
3.
4.
5.
6.
7.