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An holistic approach to understanding the changing nature of organisational structure

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Abstract

Purpose – The purpose of this paper is to report on an exploratory study to revisit and critically reappraise the impact of IT upon organisational structure, by exploring how the deployment of ERP, when accompanied by a specific strategic orientation, impacted upon the host organisation's structural design.

Design/methodology/approach – The study was initially enacted through a postal questionnaire survey of IT managers within a sample of China's largest manufacturing organisations. Follow-up interviews were then conducted with senior managers, who had first-hand experience of working on ERP implementations, to help to more fully understand the impact of ERP upon organisational structure.

Findings – The study found that the implementation of ERP technology and the strategic orientation of the host organisation are both likely to modify the structural design of Chinese manufacturing organisations. Moreover, it has been found that the success of an ERP deployment is a stronger predictor of organisational form than the scale of the deployment. The results of the study would also suggest that ERP is more likely to affect structural changes, when deployed in the presence of a complementary "prospector" corporate strategy.

Practical implications – The study provides clear new evidence that ERP is likely to have a significant impact upon organisational structure, but, because of the complexity of the technology and the uniqueness of every organisational context, the authors offer no simple prescriptions or panaceas as to how it should be managed. However, managers should be aware that an ERP implementation will almost certainly affect organisational structure, and then take steps to ensure that such changes are carefully and proactively managed.

Originality/value – There is already a rich and established literature with regard to the impact of IT upon organisational structure. However, it could be argued that by focussing upon ERP, by explicitly modelling the effect of strategy and by taking a holistic view of organisational structure, the paper is able to offer a far more subtle view of the complexities of the relationship between IT and organisational structure than prior studies.

Keywords Manufacturing resource planning, Corporate strategy, Organizational structures, Manufacturing industries, China

Paper type Research paper

1. Introduction

Because of its critical role in support of the day-to-day operations and the strategic positioning of the modern business enterprise, information technology has become a ubiquitous and increasingly significant part of the fabric of most organisations. Consequently, the implementation of information technology within organisations almost invariably results in a wide variety of, often very significant, impacts upon the design of the business, its economic performance and the working conditions of members of staff (Markus and Robey, 1988; Clegg *et al.*, 1997; Doherty and King, 1998);

technical change is the catalyst for organisational change. Information technology cannot, however, be viewed as a deterministic artefact, as it does not generally behave in a well ordered and predictable manner (Grint and Woolgar, 1997). Organisational stakeholders have the potential to interpret, appropriate and ultimately shape their information systems in a wide variety of ways (Orlikowski, 1992). This view – typically termed "social constructivism" (Bijker, 1995) – is supported by the wealth of evidence that shows how the application of identical technologies, in very similar organisational contexts, can often result in radically different organisational impacts (Orlikowski, 1993). For example, Sahay and Robey (1996) have demonstrated how the implementation of a particular geographical information system, in two very similar governmental agencies, resulted in two very different organisational outcomes: a significant impact on working practices in one county government organisation, as opposed to very limited change in another. Consequently, a significant problem facing the systems developer and the systems sponsor is that the impacts and outcomes of introducing a new information system cannot generally be predicted at the project's outset, as the system may be interpreted and appropriated in multifarious ways, during the development period, as well as throughout its operational life (Orlikowski *et al.*, 1995).

Based upon this constructivist logic, it might appear unwise to attempt to study the incidence of organisational impacts from the application of a specific class of technology and expect any clear patterns or regularities to emerge. However, the wisdom of such a strategy may well depend upon the type of artefact under investigation, the types and significance of the impacts being sought, and the context in which the study were to be conducted. As we will argue in the following section, it was envisaged that the structural impacts of ERP systems in Chinese manufacturing companies would make a legitimate and significant target for our study because as well as addressing an under researched topic, there was also a strong likelihood that such impacts would share some commonality across similar organisations. However, given the significant role that corporate strategy can also play in an organisation's structural design (Galan and Sanchez-Bueno, 2009), we also chose to explicitly include this important, yet under-researched construct. Having used the literature, in the second section, to justify and delineate our research focus, the next sections are used to review the research methods employed and present the study's findings, before critiquing their contribution and implications in the concluding section.

2. Literature review and theory development

The aim of this section of the paper is to review the literature, and in so doing, provide a focus for the paper that would give a new and very different perspective on the much debated question of how IT might affect organisational structure. More specifically we wanted to re-evaluate this rich and established stream of literature, and in so doing, provide explicit answers to the following questions:

- What dimensions of organisational structure to use for the dependent variable?
- What type of information technology to choose as the independent variable?
- Should any additional independent variables be included in the study?
- In what organisational context should the study be conducted?

The remainder of this section explicitly addresses each of these questions, before presenting the set of research objectives that were derived from this review, to ensure that the study would ultimately deliver important new insights into the role of IT in shaping organisational structure.

2.1 The dimensions of organisational structure

The serious study of the organisational effect of IT implementations on organisational structure probably began in the 1950s with Leavitt and Whisler's (1958) seminal paper, which predicted that information technologies were likely to: "change the role and scope of middle managers" and encourage "large organisations to recentralise". Since then, there has been a steady flow of empirical and conceptual studies that have explored the impact of a variety of types and configurations of information technology on a range of different structural characteristics (e.g. Simon, 1977; Zuboff, 1988; Cyert and March, 1992; Klein, 2001; Dibrell and Miller, 2002; Sauer and Willcocks, 2003). However, despite the longevity of this stream of research, previous contributions can be criticised because of the narrow conceptualisations of organisational structure, which have been adopted when modelling the dependent variable.

In prior studies of the impact of IT upon organisational structure, the most persistent and intensive scrutiny has been applied to the potential of information technologies to modify the locus of decision making, in terms of its level of centralisation (e.g. Robey, 1977; Pinsonneault and Kraemer, 1993; Hitt and Brynjolfsson, 1997). Another reasonably common theme in the organisational literature has been the impact that new technologies might have on the standardisation and formalisation of working practices and procedures (e.g. Wijnhoven and Wassenaar, 1990; Dewett and Jones, 2001; Spanos *et al.*, 2002), although such studies have tended to address centralisation, as well as standardisation. By contrast, the impact of IT on other important dimensions of organisational structural – such as the span of control, the degree of horizontal integration, or the number of hierarchical layers – has been rather neglected. This partial and narrow focus of previous studies means that it is difficult to get an overall and holistic view of the impact of IT on organisational structure (Robey, 1981).

2.2 The impact of ERP on organisational structure

It is also possible to criticise the way in which the independent variable – the adoption of information and communications technologies has been represented in previous studies. For example, many early studies focused upon the amount of IT hardware in use, particularly computer terminals (Whisler, 1970; Storey, 1987), whilst others have sought to assess the overall level of investment in information technologies (Hitt and Brynjolfsson, 1997). Yet another common approach has been to try to evaluate the extent to which each, of a variety of different technologies, have been used in an organisation (Spanos *et al.*, 2002; Wijnhoven and Wassenaar, 1990). Whilst all of these studies have helped to further our understanding of the impact of IT on structure, they can be criticised for their fairly naïve modelling of the IT artefact, which does not allow for a clear causal relationship between technology and structure to be hypothesised. Another key criticism of existing studies is that they only attempt to model the adoption of technology, rather than its successful operation. Given the unacceptably high rates of systems' rejection, failure or sub-optimal operation (e.g. Clegg *et al.*, 1997; Doherty and

King, 2001), it would seem unlikely that that simply deploying a portfolio of technological artefacts is going to engender significant organisational impacts. However, significant structural changes may be realised once the technology has been successfully appropriated, and it is routinely delivering benefits, in areas such as enhanced information quality and improved service quality (DeLone and McLean, 2003).

Against this backdrop, we wanted to conduct a study which focused upon a single, clearly defined technology, which could then be modelled, in terms of both its scale and its success, but which particular technology to focus upon. Once more, the literature was very helpful in establishing a clear candidate, namely the enterprise resource planning (ERP) package. ERP is typically acquired in the form of packaged software, with integrated modules that support all major business functions across an organisation, such as production, distribution, sales, finance and HR management (Kumar and Van Hillegersberg, 2000). Moreover, ERP implementations are promoted on the basis that they incorporate "best practice" (Miranda, 1999), and encourage organisations to streamline and standardise their business processes across the organisation and within individual business units (Nah *et al.*, 2005).

It was envisaged that ERP technology would make an excellent focus for this study, as not only does it present a single and well defined type of software application, which is increasingly common, also the potential of ERP to engender significant organisational impacts has been widely recognised. For example, Markus *et al.* (2004) have argued the introduction of a highly integrated ERP system, within a manufacturing company, is likely to have a significant impact on that organisation's business processes, structure, culture and enterprise level performance, as well as the motivation, job specifications and performance of individual employees. Moreover, whilst the impact of ERP on organisational structure has been widely recognised (Fahy, 2001) there has, to date, been very little empirical analysis to ascertain the nature, form and circumstances of such structural impacts. A further justification for choosing to focus upon the impacts of ERP systems, for the purposes of this study is that due to their relatively low "interpretive flexibility" (Doherty *et al.*, 2006), there was a reasonable chance that any resultant impacts would reflect a relatively high degree of commonality, across a sample of manufacturing organisations. As Kallinikos (2004, p. 11) notes:

> Contextual adaptation and re-shaping of such packages (ERP systems) cannot undo the logic and very pre-suppositions on which the package is predicated.

2.3 The impact of strategy upon organisational structure

When attempting to model the impact of a technology upon an organisation's structure, it is important to recognise that other organisational characteristics might also shape structure. For example, it has been argued that organisational strategy will strongly influence an organisation's structural configuration (Lynch, 2000). In particular, the configuration theories clearly suggest that organisational structure should be arranged in such a way to serve its strategy and strategic priorities (Doty *et al.*, 1993). However, there is a growing debate as to whether strategy shapes structure (Galan and Sanchez-Bueno, 2009) or whether strategy follows structure (Fredrickson, 1986). In one of the most recent contributions to this debate, Galan and Sanchez-Bueno (2009) have found that in the long-term strategy both shapes and follows organisational structure, but that it is the shaping effects of strategy, which are the stronger. Given its important

role in shaping structure, it is clear that any study of the structural impacts of IT should also take into account the potentially influential role of organisational strategy, but, in practice this approach has been adopted in precious few prior studies.

2.4 The uptake and impact of ERP in Chinese manufacturing companies

Many previous studies of the impact of IT on organisational structure can be criticised because they do not focus upon a clearly defined organisational context, and therefore it can be difficult to determine the extent to which variations in the impacts might be associated with differences in the company's size, operational sector or cultural context. Consequently, we wanted to focus our study upon a single size of company, operating in a single homogenous sector, within just one country. Moreover we wanted to focus upon a homogenous group of companies that had not been the subject of much previous scrutiny: to this end, we targeted large, manufacturing organisations operating in China.

Although there have been many previous studies with respect to the uptake and application of ERP within western countries, few studies have been specifically focused on developing countries, in general, or China, in particular. Moreover, those few studies that have focused upon the uptake and application of ERP implementation in China (e.g. Huang and Palvia, 2001; Westrup and Liu, 2008; Newman and Zhao, 2008) have not explicitly addressed the organisational impacts. Moreover, it was envisaged that as ERP packages reflect a "western" management philosophy (Martinsons, 2004), it would be interesting to ascertain whether any of the structural impacts or alterations might be needed to adjust to this "western" model of best practice, embedded in the package.

2.5 Critique of literature and research objectives

As this review of the literature has demonstrated, the relationship between IT and organisational structure is a topic that has already attracted a great deal of attention from organisational researchers, as has the uptake, application and impact or ERP. However, it has still been possible to identify a number of important gaps in this body of literature, which have helped to shape the study presented in this paper. In particular, in designing this study, the multi-faceted nature of organisational structure and differing ways of measuring ERP deployment were both explicitly recognised. Moreover, the need to explicitly model the influential role that strategy might have on organisational structure was also recognised, as was the importance of locating the study in a developing market economy, such as China. With these themes in mind, the following four research objectives were derived:

RO1. To explore the extent to which the deployment of ERP, when coupled with a particular strategic orientation, has engendered changes to the hierarchical configuration (span of control/structural layers) of Chinese manufacturing companies.

RO2. To explore the extent to which the deployment of ERP, when coupled with a particular strategic orientation, has resulted in changes to the centralisation of decision-making within Chinese manufacturing companies.

RO3. To explore the extent to which the deployment of ERP, when coupled with a particular strategic orientation, has modified the extent to which Chinese manufacturing companies are standardised.

RO4. To explore the extent to which the deployment of ERP, when coupled with a particular strategic orientation, has transformed the level of horizontal integration within Chinese manufacturing companies.

It was envisaged that in tackling these objectives, an important contribution to the literature would be made by providing new insights into the ways in which technology shapes organisational behaviour.

3. Research methods

Past studies addressing the organisational impacts of IT can be divided into two broad categories according to when they were undertaken, and also the methods that they employed. Most early studies employed a quantitative approach, underpinned by a positivist research philosophy, with the express purpose of generalising from research findings to other situations. By contrast more recent studies have tended to employ qualitative research methods, based upon an interpretivist philosophy, with a view to uncovering richer insights into the "meaning" of IT in organisations (Rose and Jones, 2004). In so doing, interpretive approaches do not explicitly seek, or indeed recognise the legitimacy of seeking replicable patterns, and consequently, they offer little in terms of generalisability.

Consequently, there has been something of a methodological dichotomy, with regard to previous studies of the impact of IT on organisational structure, with the result that most have provided rather limited and unbalanced views of these increasingly important phenomena. To avoid falling into this same trap and to take advantage of the growing recognition that quantitative and qualitative research can play complementary roles in organisational studies (Cavaye, 1996) both were employed in this particular study. Moreover, our research philosophy can best be described as "pluralist", as it incorporated both interpretive and positivist elements, as recommended for the study of complex technologies, in organisational contexts (Mingers, 2003). The initial questionnaire survey was executed using positivistic principles, but when analysing the rich database of interview transcripts, we attempted to adopt more of an "interpretive" style, as our overarching aim was to gain "knowledge of reality" through the study of social constructions (Klein and Myers, 1999). The aim of this section is to firstly review how a questionnaire was designed, validated and executed, before describing the methods employed for the follow-up qualitative study.

3.1 Design, validation and targeting of research instrument

A detailed questionnaire was used to collect the data necessary to explore the research objectives presented in the previous section. The questionnaire was organised into the following four sections:

(1) *Background information*. Respondents were asked to provide some background information, about their host organisation, primarily in terms of its size and the industrial sector, in which it primarily operated.

(2) *The structural configuration*. The purpose of this section of the questionnaire was to use a series of Likert scales, each addressing a key aspect of organisational design, to explore how the respondents perceived their organisation's structure. In total 20 different item measures were used to

assess organisational structure, which could be grouped into the following four critical categories: organisational configuration (flatness of structure and wide span of control etc.); centralisation of decision-making; standardisation of processes and practices and level of horizontal integration.

(3) *The strategic configuration.* For this study, the strategy typology suggested by Miles and Snow (1978) has been adopted. Ginn (1990) argued that Miles and Snow's work could be said to be one dimensional and consequently their four distinct strategic typologies could be put sequentially onto a single continuum, with the "prospector" and "defender" strategy anchoring either end of this continuum. In this context, "prospector" organisations can be characterised as those that have a large portfolio of products and are actively seeking new market opportunities, whilst "defender" organisations typically have a narrow product market scope, which they seek to protect aggressively.

(4) *The deployment of ERP.* Respondents were asked whether their organisation had adopted ERP, and if they had, a series of questions assessing the scale and success of their ERP deployment, was posed. More specifically, the following two broad themes were investigated: scale of deployment (physical diffusion and freedom of use); and success of deployment (organisational and informational benefits).

As there are few, if any, previous survey-based, empirical studies that explicitly address the structural impacts of ERP, it was not possible to adapt specific questions and item measures from the existing literature. Consequently, once a draft questionnaire had been created, from the related literature, it was necessary to subject it to a rigorous validation process. More specifically, the draft questionnaire was initially validated through a phased pre-testing regime, to refine the questionnaire and to identify errors. In the first phase, the survey was pre-tested by suitably qualified academics and research students In the second stage, the English version questionnaire was firstly translated into Chinese and validated by "back translation" (Luo and Peng, 1999), to avoid any distortion in meaning. The translated questionnaire was then further tested by five Chinese managers to ensure that the meaning and purpose was clear to potential respondents. The pre-tests were very useful, as they resulted in a number of significant enhancements being made to the structure of the survey and the wording of specific questions. Having refined the questionnaire, a pilot study exercise was also undertaken, which provided valuable insights into the likely response rate and analytical implications for the full survey.

As we were primarily seeking insights into the organisational impacts of information technology, it was recognised that the most appropriate group of individuals to target would be managers and executives who had been involved in the development, management and usage of ERP systems. Consequently, in line with the research objectives, we wanted to target the questionnaire at practicing managers from large, Chinese manufacturing companies. As it was not possible to find an existing list of large Chinese manufacturers that had already adopted ERP, two popular web search engines (Google and Baidu) were used to identify likely candidate organisations. Ultimately, a total of 1,200 questionnaires were posted to the CEOs, or the general managers, of a sample of manufacturing companies and a total of 156 valid responses were returned from the sample of targeted companies. Based upon these figures, it was

possible to determine that the response rate of the survey was a respectable 13 percent. It should be noted that as 32 of the responding organisations had not, at that time, fully implemented their ERP systems, these responses were excluded from the multi-variate analyses.

3.2 Qualitative study – purpose and execution
A series of interviews was undertaken with practicing managers, to help explain, enrich and validate the findings from the statistical analyses. The interview style chosen was a semi-structured approach in order to explore issues that arose from the quantitative data and in order to leave space for respondents to expand on some issues (Bryman, 2006). The design of the interview script was influenced both by the literature, and the results of the pilot study that had already been conducted for the quantitative study. To pilot test the interview design four interviews were conducted, which resulted in a number of important modifications to the interview script. A list of potential interviewees, all of whom were conveniently located in the North of China, had been derived from the sampling frame, used for our quantitative study. Each potential interviewee was contacted, and ultimately, 26 senior managers, form 21 distinct organisations, agreed to be interviewed. As can be seen from the final list of interviewees (see Appendix 1) each was a senior manager. However, to check their credentials at the start of each interview, the respondents were asked to confirm that they were in a position to be able to knowledgeably comment on their organisation's strategy and ERP implementation.

Each interview was conducted in Chinese and tape-recorded to ensure that interviewees' comments were accurately collected. Each tape recording was then fully transcribed into Chinese, before being translated into English, in readiness for analysis. The data analysis strategy commenced with a within-case analysis, in which key chunks of text from the interview transcripts were highlighted, and annotated with *in-vivo* codes – that is codes derived from phrases used repeatedly by informants (Strauss and Corbin, 1990). Following the within case, a variable oriented cross-case analysis (Miles and Huberman, 1994) was conducted to identify key themes and patterns across the sample. To ensure that a rich and valid interpretation of the data was achieved, the within-case and cross-case analysis was not conducted in a single iteration. Indeed, the researchers sought to "understand the whole" by continually revising it in "view of the reinterpretation of the parts" (Myers, 1994, p. 56). Consequently, the researchers continued to re-visit the documentary evidence and the interview responses to help integrate the individual pieces of evidence into a coherent whole (Butler, 1998).

4. Quantitative analysis
The section aims to critically review the influences that the implementation of ERP, when coupled with a particular strategic orientation, may have on a range of organisational structural dimensions – configuration, centralisation, standardisation and interdepartmental relationships – as illustrated in Figure 1. It should be noted that these findings are based exclusively on an analysis of the quantitative data, whilst the qualitative data are presented, in the following section, to help interpret and explain the results of the statistical analysis.
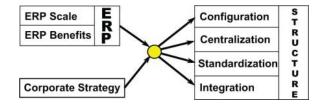
4.1 Data reduction through the identification of factors

Given the high number of individual item measures included in the survey, a series of factor analyses were used to establish whether this data could be consolidated into a smaller number of distinct factors. Factor analysis is a means of summating information contained in a large number of variables into a smaller set of new composite factors, with a minimum loss of information (Hair *et al.*, 1998). To simplify interpretation, independent factor analyses were run on each of the seven variable sets, as shown in Figure 1. The ratio of the number of variables to the sample size is an important prerequisite for factor analysis success. Hair *et al.* (1998) suggest that the minimum for an acceptable ratio is at least five observations for each variable included in the analysis. In this study, the ratios of responses to variables were all very comfortably over this threshold, with the lowest ratio being 10.4:1, for the "ERP Benefits" item measures. Furthermore, it was established that the measure of sampling adequacy (MSA) scores, for each factor, as measured using the KMO and Bartlett's test of sphericity, were all well within tolerance. Consequently, it was confirmed that factor analysis was an appropriate tool to use in these circumstances.

Principal components factor analysis, with a varimax rotation, was the chosen method for the factor analysis, as it is easier to interpret the results Hair *et al.* (1998). The application of the Scree test and a review of the Eigen values were used to determine the most statistically significant number of factors for each of the variable sets. Ultimately, a total of eight factors were identified from the seven variable sets, each of which was given a factor name, which was chosen to best represent the nature of its constituent items. The factor names and their characteristics have been presented in Table I. Having successfully isolated and named eight distinct factors, it was also important to test their validity and reliability. The internal reliability of each factor

Figure 1.
ERP deployment and organisational structure

No.	Construct	Items	Mean	High value	Low value
1	Hierarchical configuration	3	3.41	Very flat structure	Very hierarchical structure
2	Centralisation of decision-making	4	4.67	Highly centralised	Highly de-centralised
3	Formal standardisation	3	4.89	Very standardised	Not very standardised
4	Horizontal integration	4	4.82	Very integrated structure	Very strong boundaries
5	ERP coverage	5	4.40	Wide ERP coverage	Narrow ERP coverage
6	ERP informational benefits	7	5.34	Significant benefits	Insignificant benefits
7	ERP operational benefits	8	5.07	Significant benefits	Insignificant benefits
8	Strategic orientation	6	4.98	"Prospector" orientation	"Defender" orientation

Table I.
Factors created for use in the statistical analyses

was, therefore, examined using Coefficient alpha. Ideally, alpha scores should exceed 0.70, although scores of 0.60 and above are acceptable (DeVellis, 1991). In this instance, three of the factors can be classed as "ideal" (factors: 6-8), whilst a further three can be classed as "acceptable" (factors: 1-3 and 5). Unfortunately, the Cronbach's alpha value for the remaining factor (#4) had dipped under the threshold of 0.60, but as it was still comfortably over 0.50, Kaiser (1974) has argued that such results are valid, when conducting "exploratory" studies, such as this one.

4.2 The relationship between the ERP adoption/strategic orientation and organisational structure
The relationship between the four independent factors (ERP coverage; informational benefits; operational benefits and strategic orientation), and the four dependent factors that measure the organisations' structural arrangement was explored using multiple regression analysis. Multiple regression analysis was deemed appropriate, as the data met the assumptions for a regression analysis and the ratio of independent variables to cases was 39:1, which comfortably exceed the threshold value of 5:1 (Hair *et al.*, 1998). A stepwise regression approach was adopted, to allow the contribution of each independent variable to be assessed iteratively. As can be seen from the results of these analyses (Table II), a series of highly significant regression models could be found to help explain changes in organisational structure, as reflected in the level of centralisation, standardisation configuration and horizontal integration. The remainder of this section takes each of these structural dimensions, in turn, and explores how they might be impacted by ERP and strategy.

4.2.1 The impact of ERP/strategy upon configuration. One effect of ERP adoption might be that it helps managers increase their span of control through more efficient and effective information provision and better communication, and in so doing facilitates a flattening of organisational structures (Avgerou, 2000). Alternatively, if ERP is viewed as a mechanism for downsizing, but the structure is not modified, then the span of control may be reduced. A third possibility is that the hierarchical configuration is primarily a function of the organisation's strategy, which the implementation ERP simply reinforces.

To explore these potential relationships between ERP, strategy and hierarchical configuration, a step-wise linear regression was conducted to better under the most

Regression no.	Constant (α)	$\beta1 = $ 1st variable (coefficient)	$\beta2 = $ 2nd variable (coefficient)	Dependent variable (R^2)
1	0.89	ERP operational benefits (0.241)	Strategic orientation (0.232)	Configuration (0.142)***
2	5.84	ERP operational benefits (−0.232)		Centralisation (0.055)*
3	1.53	ERP informational benefits (0.430)	Strategic orientation (0.240)	Standardisation (0.215)***
4	0.54	ERP coverage (0.787)		Integration (0.781)***

Notes: ***Significant at the 0.001 level; **Significant at the 0.01 level; *Significant at the 0.05 level

Table II.
Results of multiple regression analyses

significant influences. The results of this analysis (see Table II: equation 1) suggest that both the organisation's strategic orientation and the success of the ERP implementation, in terms of the realisation of operational benefits, have a significant affect upon the degree to which the organisation's structure can be categorised as either flat or hierarchical. More specifically, the results suggest that as an ERP implementation starts to deliver meaningful operational benefits, then the need for a steep chain of command is reduced, and the organisational structure can be flattened. A plausible interpretation of this result might be that a successful ERP implementation can facilitate improvements in process efficiency and customer responsiveness (Chand *et al.*, 2005; Velcu, 2007), which can help organisations to more effectively manage its workforce, and thereby flatten the organisational hierarchy by removing redundant layers of management. What seems clear from these results, is that successful ERP adoption allows its powerful information processing and communications capability (Kumar and Van Hillegersberg, 2000) to be realised, which allows managers to make decisions, monitor staff, and communicate decisions more efficiently and effectively (Pinsonneault and Kraemer, 1993).

Whilst the successful adoption of ERP is shown to have the most significant impact upon the configuration of organisational structure, it can also be seen from the results, presented in Table II, that strategic orientation also appears to influence configuration. More specifically, the more closely an organisation's strategy conforms to the "prospector" archetype, the more likely it will be that it flattens its structure. This result supports Miles and Snow's (1978) hypothesis that "prospector" organisations will typically avoid the traditional, multi-layered, bureaucratic structures, which are prone to "information distortion" (Fincham and Rhodes, 1999), in favour of flatter structures, which help them to respond positively to emerging problems and opportunities. A final interesting observation from the quantitative analysis is that the scale of an ERP implementation, in terms of its breadth of coverage, does not appear to have any impact upon organisational configuration. Simply implementing a large-scale ERP system will not be sufficient to flatten structures. It appears that efforts to flatten structures and reduce the span of control will only begin once an implementation is operating successfully, and delivering meaningful benefits, particularly when this is coupled with a prospector orientation.

4.2.2 The impact of ERP/strategy upon centralisation. This subsection aims to explore the combined influence of ERP adoption and strategic orientation on the degree of organisational centralisation. On the one hand, it can be hypothesised that the scale and success of an ERP implementation should be positively associated with the degree of organisational decentralisation: the dissemination of information to employee workstations, across the enterprise, should facilitate employee empowerment (Psoinos *et al.*, 2000). An alternative, yet equally plausible, hypothesis is that ERP adoption will facilitate the centralisation of decision-masking (Torkzadeh and Doll, 1999). Equally, it could be that an organisation's decision-making stance is primarily dependent upon its strategic orientation, and that ERP simply plays a secondary role in this respect.

As illustrated by Table II (equation 2), a significant negative association has been found between ERP operational benefits and the resultant level of organisational centralisation. More specifically, the negative association between operational benefits and organisational centralisation suggests that as the system becomes more successfully embedded within the organisation, then the more likely it will be that it

starts to decentralise its decision-making processes. One plausible interpretation of this result is that once the daily operation of the organisation can be easily dealt with by virtue of successful ERP implementation, lower level staff can also make decisions, an activity they did not enjoy before the adoption of ERP. In the case of the centralisation construct, neither the organisation's strategic orientation, nor the scope of its ERP implementation were found to have any significant relationship with this important dimension of organisational structure.

4.2.3 The impact of ERP/strategy upon standardisation. Although there has been a paucity of field studies exploring how ERP will influence organisational standardisation, it might be reasonable to hypothesise that ERP adoption will result in a more standardised organisational structure. This is because ERP is a process-oriented technology, designed to integrate the whole organisation together (Davenport, 2000). Thus, organisations will need to standardise their working practices in order to satisfy the requirements of an ERP implementation (Hall, 2002).

In terms of the nature of the relationship between ERP and standardisation, the results of the multiple regression (refer to Table II; equation 3) suggests that there are significant associations, between the realisation of "informational benefits" and the resultant degree of standardisation". One plausible interpretation of this result is that once an ERP implementation is delivering high quality information and enabling organisational activities to be more effectively monitored, then the more likely it will be that it can standardise its working practices and business processes, across the organisation. As with the configuration and centralisation constructs, the scale of the ERP implementation was not found to have any significant association with the degree of standardisation.

The positive association between the standardisation of working practices and the adoption of a prospector-oriented strategy, is perhaps more surprising and therefore worthy of comment. Miles and Snow (1978) originally postulated that as "prospector" organisations needed to be more responsive to market conditions, they would therefore need to adopt more flexible, and less standardised, working practices. However, as prospector organisations are also typically flatter and less centralised (Miles and Snow, 1978), it can be argued that they need to adopt more standardised processes and practices, to enable flexibility, whilst avoiding fragmentation (Child and McGrath, 2001).

4.2.4 The impact of ERP/strategy upon horizontal integration. It has often been argued that as ERP has a strong process-orientation, its implementation is likely to play an important role to play in facilitating higher levels of horizontal integration, within the business enterprise (Davenport, 2000; Oakland and Porter, 2000). However, in their study of the influence of ERP upon team working, Koch and Buhl (2001) found that team working, across departments, was not reinforced though ERP adoption. Against this backdrop we were keen to revisit this relationship, in the context of ERP adoption amongst Chinese manufacturing companies. The results of the multiple regression analysis (see Table II: equation 4) suggest, that in the case of horizontal integration, it is wide-scale deployment of ERP, rather than its success or the host organisation's strategic orientation that are most likely to engender improvements in the level of horizontal integration. This result is perhaps not surprising as the mechanisms for inter-departmental integration are typically hard-wired into the ERP software, and will therefore be activated as soon as the technology has been widely deployed.

5. Results of qualitative survey

The results from the multi-variate analysis of the questionnaire data suggest that both strategic orientation and the successful adoption of ERP have a significant impact upon organisational design. However, these findings provide no real insights as to whether such impacts were an explicit part of the host organisation's ERP plan, or whether they were perceived to have occurred by happenstance. Moreover, it is not possible to determine from the results of the quantitative analysis whether successful ERP adoption was perceived to have been the catalyst for organisational change, or whether it simply helped to reinforce pre-existing strategies. These two questions were addressed through a series of qualitative interviews with a sample of senior organisational mangers, all of whom had experience of ERP implementations, the results of which are reported upon in the remainder of this section.

It has previously been suggested that the primary drivers for the adoption of ERP are internally-oriented technological and business imperatives (Markus and Tanis, 2000), such as the need to replace aging legacy systems, a requirement for increased system capacity, the need for customer-oriented information or the desire for higher levels of process-integration. The results of this analysis suggest that, in China, the stimuli for ERP adoption are both external and internal, in terms of their orientation. For example, in six out of the 20 companies, in which interviews were conducted, it was reported that ERP was implemented in response to a directive from their head office, or from a controlling government ministry. For example, as the Finance Director of one state-owned enterprise (C13) noted:

> ... the decision was taken by our supervisory government ministry, as before our company was listed on the stock exchange, the government had promised our external investors that our company would do this. The ministry wanted to deliver a clear message to our external investors that we will standardise our company and offer them more transparent information.

In another organisation, the HR Director (C6) noted that the decision to adopt ERP had been taken in response to a request from a powerful customer, whilst the IT manager (C19) of a state-owned enterprise noted that:

> ... ERP was implemented to send a message to the market-place that we would operate in a way they would understand.

In the remaining organisations, the justification for ERP adoption had been more internally oriented, most commonly to cope with expansion, to improve process design and integration or to provide better information. Indeed, in many organisations, interviewees did acknowledge that structural changes, most commonly in the areas of enhancements to standardisation and integration, were explicit drivers for ERP implementation. As one IT director (C10) noted:

> Our first priority was to integrate the whole company's businesses and processes, that is, to solve some historic problems.

He went on to note that his organisation wanted to standardise its processes and practices around western models of management, and in so doing, "eliminate the influence of traditional Chinese management practices". Consequently, we found a mixed situation in which an explicit desire to modify organisational structure was often perceived to have been one of many drivers for ERP adoption, but not by any means the dominant driver.

When it comes to whether or not ERP and strategy were perceived to have had a direct impact upon organisational structure, it became apparent that the nature of the relationship was dependent upon the type of structural change, under consideration. For example, there was a fairly strong consensus that successful deployment of ERP had facilitated improvements in the level of horizontal integration and the degree of process standardisation. For example, with regard to standardisation, one interviewee noted (C15):

ERP makes clear the entire department's responsibility and all departments have quite clear procedures to do the job. ERP formalises those responsibilities and procedures so that all staff do their job and duties according to the ERP system in order to guarantee normal running. If they don't, then management can easily locate the problematic link.

Indeed, the majority of interviewees acknowledged that the standardisation of working practices had been both an express aim of the ERP implementation, and something that had been witnessed in practice, once the system was operational. With regard to integration there was a very clear consensus that ERP had helped to integrate business processes and working practices, across functions, and in so doing, it had greatly improved inter-departmental communications. As the CEO of one organisation (C3) noted, before the introduction of ERP everyone concentrated on their own job, without worrying about how this might impact upon any of the downstream processes.

By contrast, there was far less evidence that ERP implementation had engendered any changes to the host organisation's configuration. In only three organisations (C8, C9 and C10) was ERP believed to have directly facilitated a reduction in the number of hierarchical levels, primarily through its ability to deliver improvements in efficiency and routinisation. In the majority of organisations, interviewees either argued that ERP implementation did not have any impact upon organisational configuration, or that their ERP implementations had been tailored to suit their existing hierarchical arrangements. For example, in six of the participating organisations, it was noted that corporate structures had been flattened in recent years, but the managers who were interviewed regarded this process to have been primarily as a result of strategy, rather than ERP adoption. As one director (C12) noted the company had flattened its structure in the late 1990s, and that this change had been strategy led: he noted that ERP adoption had helped to reinforce and embed this strategy within the company.

Modifications to the degree to which decision-making is centralised/decentralised is the final, and perhaps most interesting area, in which the impacts of ERP were explored, as the results of the quantitative study had presented a rather mixed picture. In a slim majority of organisations (11/21), the interviewees felt that the adoption of ERP had not had any discernable impact upon the centralisation of decision-making. Indeed, these interviewees suggested that the style of decision-making is primarily dependent upon leadership style and strategy, rather than ERP adoption. This view was reflected strongly by one manager (C3) who insisted that there had been no change to decision making as: "... a strict hierarchy is necessary for staff to be strictly controlled". By contrast, five of the interviewees from five organisations felt that their organisations had been able to decentralise their decision-making processes, because ERP was able to provide junior managers with more timely and accurate information. In the remaining organisations, interviewees perceived that ERP had reinforced centralisation, in some areas, but facilitated empowerment elsewhere. In addition to commenting on the degree to which ERP had engendered more or less centralisation, a

number of interviewees also noted that some decision rights had been "absorbed into" (C6), "prescribed by" (C14) or "been transferred from managers to" (C1) the ERP software. Indeed, one interviewee (C4) went as far as suggesting that "ERP helps to reduce the level of human discretion".

A common theme voiced, across our sample of interviewees, was that although a successful ERP implementation could modify organisational structures, it might take many months before these changes became apparent. For example, one IT director (C8) explained that initially ERP had no immediate effect on staffing levels, but once it had been operating for a number of months they had been able to significantly reduce the number of managerial levels, and the headcount, particularly within the accounting area. He went on to predict that "with such significant improvements in operational efficiency, it is inevitable that there will be further reductions in management levels". However, he acknowledged that this was likely to "take some time; you can't expect management levels to be reduced immediately after the adoption of ERP".

6. Discussion and concluding remarks

This research revisits and critically reappraises an important and much debated topic – namely the impact of IT on organisational structure. In so doing, an important contribution has been made by explicitly addressing many of the deficiencies of prior works: this study adopted a richer and more holistic model of structure; focused upon ERP, a well defined technology with a low interpretive flexibility, and targeted a well bounded and under-researched research context (large, Chinese manufacturing companies). Moreover, by explicitly recognising that corporate strategy is also likely to have a significant impact upon an organisation's structure, we have attempted to provide a more complete account of the organisational impact of IT. In so doing, we have been able to offer a more subtle and richer view of the complexities of the relationship between ERP and organisational structure; different dimensions of structure are related with different characteristics of ERP and different strategic orientations. For example, the results of the quantitative analyses suggest that the configuration of an organisation is influenced by ERP benefits and strategic orientation, but not by the ERP scale. Similarly, organisational standardisation is also influenced by both ERP benefits and strategic orientation. By contrast, the degree of centralisation is primarily influenced by the operational benefits of ERP, but not by its scale or the host organisation's strategic orientation. Finally, horizontal integration is strongly affected by the scope of an ERP implementation, whilst ERP benefits and strategic orientation have no discernable impact upon the level of integration.

Given that the quantitative study has provided important, rather than resounding, evidence that ERP deployment is likely to have a wide ranging impact on organisational structure, the follow-up interviews were seen as an important mechanism to help confirm and further interpret the results of the statistical analyses. In brief, the analysis of the 26 substantive interview scripts indicated that the successful deployment of ERP was, indeed, felt to have resulted in more standardised working practices, more distributed decision-making and a higher degree of horizontal integration. However, the interviewees were generally less convinced that ERP deployment has facilitated changes in organisational configuration; as it was generally reported that any changes to the hierarchical arrangements were more likely to have been influenced by strategy than through the deployment of ERP. By reviewing the quantitative and qualitative results in their entirety, what seems clear is that when a

large-scale and successful ERP system is deployed in an organisation with a Prospector orientation, then there is a strong likelihood that the organisation will become flatter, the decision-making will be less centralised, the level of horizontal integration will increase and its working practices will become more standardised. However, the interview results suggest that this broad generalisation is likely to unfold in a multitude of ways, depending upon the nature and priorities of the host organisation. As many previous studies (Elbanna, 2008; Gregor *et al.*, 2007; Palomino Murcia and Whitley, 2007) have found, an ERP implementation is an extremely complex and problematic undertaking, and consequently, it is likely that every organisation will witness its own unique set of organisational impacts.

The relationship between the success of an ERP implementation and the re-shaping of organisational form is a further area in which this study makes an important contribution to the literature. Most prior studies into the impact of IT upon organisational structure have assumed that it is simply the scale and the functionality of the technology rollout that will ultimately determine the extent to which organisational structures are reconfigured (Cyert and March, 1992; Klein, 2001; Dibrell and Miller, 2002). However, in finding that it is the success of an ERP deployment that plays the dominant role in reshaping corporate structure, we have uncovered an interesting new result, to which there are two plausible interpretations. The first interpretation is that ERP systems will only deliver benefits in circumstances in which the host organisation's structure is already well aligned, with the structural models and assumptions that are embedded within the ERP system (Morton and Hu, 2008). The competing hypothesis is that management teams will only be prepared to make any significant changes to their organisations' structure, to better align it with ERP, once the ERP implementation has proved its worth, and started to deliver important benefits. Although our research does not prove any conclusive answers to this debate, the interview results do tend to suggest that by and large it is successful ERP adoption that is driving structural change.

Although we have sought to adopt systematic and rigorous research approaches, there is only so much ground that a single study can cover. In particular, we would have liked to have been able to probe the role of strategic orientation a little more fully, as we have highlighted its importance, but did not have the opportunity to fully explore its interactions with ERP and structure, when conducting the interviews. Consequently, there are important opportunities for follow-up studies, which are explicitly designed to build upon and extend our reported findings. Of particular interest, will be detailed longitudinal studies of organisations that are adopting ERP, so that its structural impacts can be studied over an extended period. In so doing, a more complete picture of the impact of information technologies upon organisational structure may start to emerge.

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Appendix

Company code	Interviewee roles	Type of company
C1	Vice president IT manager	State owned enterprise
C2	Marketing director	State owned enterprise
C3	Chairman CEO	Private venture
C4	Technical director	State owned enterprise
C5	IT manager	State owned enterprise
C6	HR director	Private venture
C7	Finance director	Private venture
C8	IT director	State owned enterprise
C9	IT director	State owned enterprise
C10	IT director	State owned enterprise
C11	Vice director	State owned enterprise
C12	Director of purchasing	Foreign owned enterprise
C13	Finance director	State owned enterprise
C14	IT manager	State owned enterprise
C15	Purchasing manager	Foreign owned enterprise
C16	IT director	Private venture
C17	IT director ERP consultant	Foreign owned enterprise
C18	IT manager general manager	Private venture
C19	IT manager	Private venture
C20	Vice director IT manager	Private venture
C21	IT director	Private venture

Table AI.
Summary of
interviewees' role and
company

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