Effects of ERP Systems in China: Cultural Influences in the Manufacturing Industry

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Abstract

To gain a competitive advantage in the global market, many Chinese manufacturing firms have invested heavily in implementing Enterprise Resource Planning (ERP) systems. Evidence shows, however, that ERP system use has varied significantly between firms. This study addresses such variances in performance in the Chinese manufacturing context, particularly at a plant level. The Gattiker and Goodhue model was adapted for our investigation incorporating a survey instrument. Data were collected from 59 Chinese manufacturing firms. The data collected were analysed using Structural Equation Modeling in association with the Partial Least Squares technique. The results show that the level of interdependence, differentiation between plants, time elapsed after ERP system implementation, high context communication in the Chinese culture, and personal relationships (guanxi) have significant impacts the performance of on firms that use ERP systems. The results also indicate that a better fit between ERP systems and Chinese culture will lead to a higher performance. Particularly, personal relationships (guanxi) have a positive influence on the use of ERP systems, while high context communication has a negative influence. The findings have significant implications for IS researchers and practitioners in the Chinese social context.

Keywords: ERP system, system use, Manufacturing, China, Culture

Introduction

An Enterprise Resource Planning system (ERP system) is a large scale information system that enables the integration of a firm's business processes into a single computerised platform. Over the past decade, ERP systems have been widely adopted by manufacturing firms worldwide (Shi et al., 2008; Zhu et al., 2010). This has also been the case in China, as it emerged as a global manufacturing hub. Many Chinese manufacturing firms have thus invested heavily in implementing ERP systems to gain competitive advantages in the global marketplace (Wang et al., 2005). Firms that implement ERP systems hope to gain benefits from integration of data and business processes across different business functions, such as marketing, inventory management, accounting, and human resources. Nonetheless, while ERP systems provide promising potential, it is reported that only 10% of firms that implemented ERP systems have gained substantial benefits (Yusuf et al., 2006). Some researchers have pointed out that success rate of ERP systems adoption in China is significantly less than the reported success rates in Western countries (Huang and Palvia, 2001; Zhang et al., 2005). For instance, Soh and colleagues (2000) assert that a cultural misfit of ERP implementation in Asia is greater than Western countries, arising from the assertion that business model underlying most ERP systems reflect European and US practices rather than indigenous Asian practice. This presents a catalyst for our study to further investigate the role that Chinese culture plays in ERP systems diffusion and use among Chinese manufacturing firms.

Another motivation for us to conduct this study is a theoretical gap in the research where the key concepts of system use and the diffusion of ERP systems in the Chinese cultural context intersect. Previous research on ERP systems has often focused on vendor selection and the implementation processes (Botta-Genoulaz et al., 2005; Ehie and Madsen, 2005; Hakkinen and Hilmola, 2008; Jacobs and Bendoly, 2003; Moon, 2007; Pairat and Jungthirapanich, 2005). Very few studies have investigated the ERP system use issues (Zhu et al. 2010), that is the period when a system is in the production stage. For instance, Avison and Malaurent (2007) conducted a case study on a French owned company's subsidiary in China. They found that cultural differences could dominate technical aspect in the global rollout of ERP systems. The significantly increasing numbers of Chinese manufacturing firms implementing ERP systems present a greater need for research on the issues that arise after ERP systems become operational. However, there is minimal research investigating the use of ERP systems at a manufacturing plant-level, which also incorporates a cultural perspective (Avison and Malaurent, 2007). Thus, this study extends this line of analysis beyond the implementation process of ERP systems by exploring the role of the Chinese national culture during the systems' use.

Literature Review: ERP Adoption in China

Previous research has pointed out to some prohibitive issues faced by Chinese firms when adopting ERP systems. A study conducted by Zhang and Wang (2008) point out that there is no significant difference between operational performance of Chinese manufacturers that have implemented ERP and those who have not. This could be due to difficulties often encountered in the adoption of

ERP systems in China, which include a lack of top management support, cost and time consuming issues, cultural differences, technical complexity, lack of professional personnel, and organisational resistance (Yusuf et al., 2006). Avison and Malaurent (2007) assert the main cultural barriers to ERP implementation in the Chinese environment are language and communication difficulties, such as 'losing face' and not understanding system use instructions written in English. As well, complex bureaucratic organisational structure of Chinese firms imposes strong respect for the organisational hierarchy. Woo (2007) indicates that the critical success factors found in the Chinese electronics manufacturing industry are very similar to those of western counterparties, except for one factor, cultural characteristics. In addition, based on the findings of an interview with the CIO of a large Chinese state-owned-enterprise in the manufacturing sector, Marble and Lu (2007) conclude that ERP systems adopted in China should be modified to support based business practices that are based on the Chinese culture of personal relationships (guanxi).

Another important factor is the proposition that information systems (IS) have built-in biases reflecting cultural values of the social contexts in which they are originally developed, a cultural misalignment is likely to occur when an IS developed in one culture is adopted by organisations in another culture (Burton and Obel, 2004; Heales et al., 2004; Kangas, 2003; Vatanasakdakul et al., 2007). ERP systems were originally developed in western countries and therefore have emerged from western cultural values, which may impact their effective implementation and use in non-western contexts (Soh et al., 2000). Nonetheless, while studies on ERP implementation have been widely conducted in relation to technical and organisational implications, the implications of cultural misalignment of ERP systems are rare, particularly in the Chinese context.

To address the knowledge gap, we pose the following research question: *What factors affect the use of ERP systems among Chinese manufacturing firms?* The study has adapted a research model originally proposed by Gattiker and Goodhue (2005) for analysing the issues affecting ERP system performance among manufacturing firms in the United States. To serve the purpose of this study, the model was extended by incorporating Chinese cultural variables. A questionnaire was used to gauge the impact of Chinese culture on the use of ERP systems among manufacturing firms at an individual plant level. We use the term "plant" to refer to a subunit of a manufacturing firm in line with Gattiker and Goodhue (2005). The following section presents a review of their study and addresses the need for incorporating cultural variables.

Research Model and Hypotheses Development

Several studies have investigated ERP system use (e.g. Calisir, 2004; Hakkinen and Hilmola, 2008; Nicalaou, 2004; Nicolaou and Bhatacharya, 2008; Yu, 2005). Of particular relevance to our project is the study conducted by Gattiker and Goodhue (2005) who introduced a research model (Figure 1) to investigate the use of ERP systems at a plant-level in the United States manufacturing industry. Their research model was derived from the organisational information processing theory (OIPT). OIPT suggests that firms will achieve a better performance when they implement highly integrated systems that fit with organisational subunits. This level of fit is however influenced by interdependence and differentiation among subunits. The model has been extended to evaluate the performance of ERP systems in different contexts. For example, Chou and Chang's (2008) studied Taiwanese manufacturing firms, and Dickover (2009) investigated manufacturing in the US public sector.

Gattiker and Goodhue (2005) assert that ERP systems may bring more profit and improve a firm's performance. However, this does not happen automatically, as there are intermediate effects that lead to those observable overall benefits. Two intermediate benefits, are incorporated in Gattiker and Goodhue's (2005) model. Intermediate benefits are the pathways through which ERP systems can enable firms to achieve higher profits and gain greater overall ERP systems related results. Gattiker and Goodhue (2005) propose that intermediate benefits need to be investigated since an overall or aggregate-level impacts cannot occur directly without the existence of intermediate impacts. These intermediate benefits include efficiency generated by integrating business processes and improved coordination among subunits of a firm. In turn, these intermediate benefits are affected by interdependence, differentiation, and time elapsed since implementation, considered as independent variables.

Furthermore, the data quality shown in the model is used as a control variable. Gattiker and Goodhue (2005, p.567) suggest that in "attempting to discern the impacts of differentiation on coordination and task efficiency benefits, it is important to control for the effects of data quality on those benefits." They also suggest that data quality is fundamental in gaining many other benefits from ERP and may have a direct relationship to overall benefits.

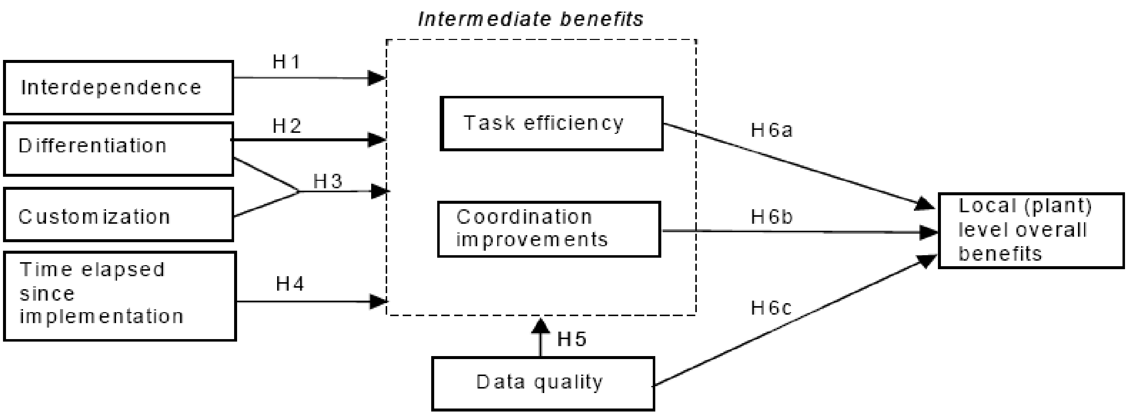

Figure 1: The Gattiker and Goodhue Model

For the purpose of this study, the Gattiker and Goodhue's model (2005) was extended by incorporating Chinese cultural variables of *high context communication* and *personal relationships (guanxi)*, which are discussed in the following sections. The proposed research model is shown in Figure 2. Although in the original model coordination improvement and task efficiency are proposed as ERP intermediate benefits, while data quality is treated as a control variable, in the extended model, data quality is included as an intermediate benefit. This research takes the view that ERP systems could assist in improving quality of data consequently contributing to a better firm performance (Greef et al., 2004). In addition, control variables including type of manufacturing, number of employees, number of IT staff, number of plants and ERP skills, are also included in the model. The development of hypotheses is discussed in the following subsections.

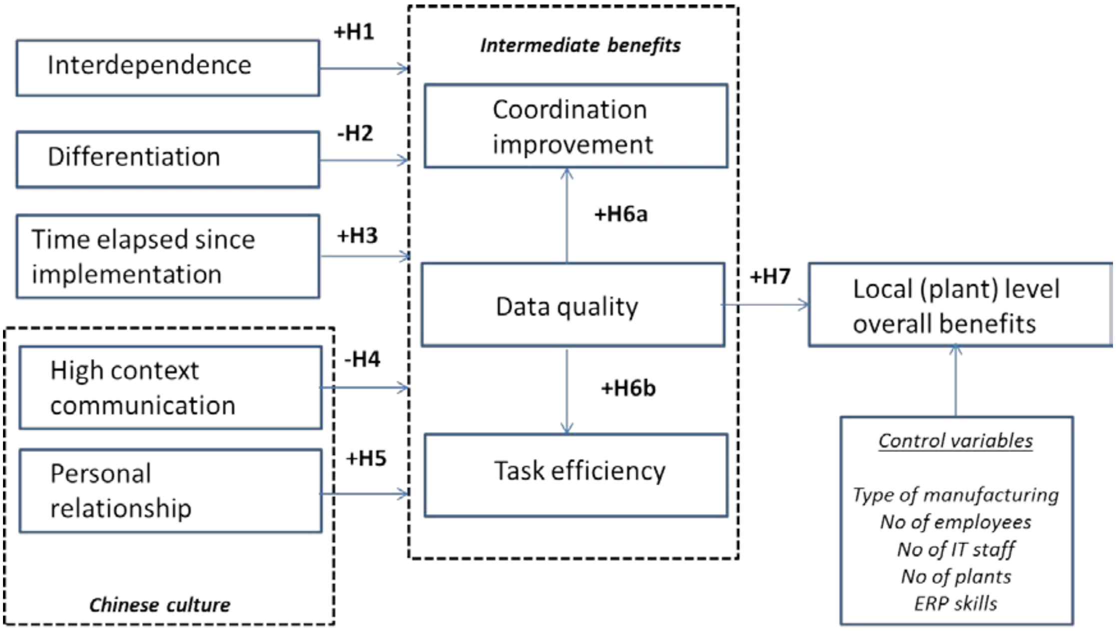

Figure 2: Research model of this study

Interdependence

The concept of interdependence refers to the extent to which activities in one unit are affected by activities in other units in an organisation (Gattiker and Goodhue, 2005). Gattiker and Goodhue (2005) argue that since subunits are interdependent and require high level of coordination, their need for data integration would also be high. This is because a change of conditions in one unit is likely to impact on the other units. In the same light, ERP systems provide integration among units in one computerised platform. In the context of manufacturing plants, it is expected that an ERP system will improve coordination among plants because the system connects better the data and facilitates data flows. Gattiker and Goodhue (2005) assert that the degree of the intermediate benefits will vary among manufacturing firms and even among plants within the firm because of the varying degrees of interdependence among them. Similar to Gattiker and Goodhue, we propose that:

> H1a: In a Chinese plant using an ERP system, the greater the interdependence of one plant with other plants in the organisation, the greater the ERP related coordination improvement in that plant.

H1b: In a Chinese plant using an ERP system, the greater the interdependence of one plant with other plants in the organisation, the greater the ERP related data quality in that plant.

H1c: In a Chinese plant using an ERP system, the greater the interdependence of one plant with other plants in the organisation, the greater the ERP related task efficiency in that plant.

Differentiation

Differentiation is defined as an inherent property of an individual plant (Gattiker and Goodhue, 2005). It refers to a level of difference between plants in a manufacturing firm. This includes the differences in a number of key characteristics in terms of production and operational processes, such as the volume and variety of products made. When a plant's operation process is significantly different from other plants in the same organisation, difficulties in utilising the ERP system are more likely to be encountered since the system allows limited flexibility in customising the requirements for each plant (Gattiker and Goodhue, 2002, Jacobs and Bendoly, 2003). In other words, when an ERP system is not a good fit for a plant's unique business process, it is likely that they will achieve smaller intermediate benefits. Thus, it is hypothesised that:

H2a: In a Chinese plant using an ERP system, the greater the differentiation of a plant from the other plants in the organisation, the smaller the ERP system-related coordination improvements in that plant.

H2b: In a Chinese plant using an ERP system, the greater the differentiation of a plant from the other plants in the organisation, the smaller the ERP system-related data quality in that plant.

H2c: In a Chinese plant using an ERP system, the greater the differentiation of a plant from the other plants in an organisation, the lower the ERP related task efficiency in that plant.

Time elapsed after ERP implementation

Bendoly and Jacobs (2005) suggest that time is a critical prerequisite for extracting value from ERP systems. Time lag, therefore, must be considered when evaluating the performance of IT investment (Lee and Kim, 2006). Shang and Seddon (2002) also found that more benefits are likely to be derived from ERP systems after additional experience has been gained by the users, which could be a consequence of an organisational learning process. Nicolaou (2004) found that there was a time lag of at least two years before ERP adopters began to reap the differential positive financial benefits. Gattiker and Goodhue (2005) also suggest that ERP impacts are expected to increase with time, but at a decreasing rate. Therefore, it is hypothesised that:

H3a: In a Chinese plant using an ERP system, the longer the time of using the ERP system, the greater the coordination improvements in that plant.

H3b: In a Chinese plant using an ERP system, the longer the time of using the ERP system, the greater the data quality in that plant.

H3c: In a Chinese plant using an ERP system, the longer the time of using the ERP system, the greater the task efficiency in that plant.

High context communication

Understanding the relationship between culture and communication is essential for contextualising this research. Communication is a process whereas culture is the structure through which communication is formulated and interpreted (Hall, 1976). This study proposes that Chinese culture and its' orientation to communication may influence the use of ERP systems in China, as ERP systems are an emerging mechanism for organisational communication. The anthropologist, Edward Hall (1976), studied the interrelationship between culture and communication. He distinguishes between low context communication (LC) and high context communication (HC) cultures. Examples of LC cultures include Australia, England, Germany, Sweden and the United States, while China, Japan, Malaysia and Mexico are considered HC cultures.

In a LC society, the mass of information is vested in explicit code. Although people in LC societies may recognise a non-verbal message, they tend to focus more on the verbal message. People in LC societies feel the need to speak in a way that is consistent with their feelings therefore, making their thoughts clear and explicit. In contrast, in a HC society, little has to be said or written because most of informing is carried non-verbally, such as by body language. Individuals from HC cultures prefer historical accounts, previous decisions, and subjective opinions for understanding the background of the people involved in a relationship.

Therefore, in the high context of Chinese culture, messages have little meaning without an understanding of the personal context. Chinese people prefer communication channels that are able to convey a great deal of contextual information and social presence, such as face-to-face interactions (Chen et al., 2008). However, ERP systems are designed for enforcing written procedures and reports and reducing face-to-face communication among plants. These properties may not fit with the preferred way of communication in the Chinese high context culture and can result in smaller intermediate benefits associated with ERP systems. Thus, we propose the following hypotheses:

H4a: In a Chinese plant using an ERP system, greater high context communication is associated with lower coordination in that plant.

H4b: In a Chinese plant using an ERP system, greater high context communication is associated with lower data quality in that plant.

H4c: In a Chinese plant using an ERP system, greater high context communication culture is associated with lower task efficiency in that plant.

Personal Relationship/Guanxi

One of most representative of the Chinese cultural values is the concept of guanxi which loosely translates to 'personal relationship' in English. Guanxi refers to the act of drawing on connections in order to secure personal favors (Luo, 2007). It imposes implicit mutual obligations, assurances, and understanding among Chinese individuals, and it has a great influence on Chinese attitudes toward long-term social and business relationships. Generally, guanxi implies a continued exchange of favors in interpersonal relationships, so it extends beyond mere friendship. It can be argued that such interpersonal connection exists, to some extent, in every human society; however, guanxi plays comparatively a more fundamental role in the daily life of the Chinese society (Luo, 2007). It refers to personal networks among individuals, not relationships among organisations. The exchanges which take place amongst members of the guanxi network are not solely commercial, but also social. In western business networking, relationships often grow out of deals, while in Chinese business networking, deals often emerge from relationships.

Of significant relevance to this research is a study conducted by Marble and Lu (2007) which asserts that successful ERP systems implementations need to support the Chinese guanxi-based business practices. The guanxi among Chinese employees in each plant using the ERP system may be increase the use of ERP, and therefore firms will receive greater intermediate benefits. Guanxi is included in our research model in order to measure its implications for the use of ERP systems in China. The following hypotheses are proposed:

H5a: In a Chinese plant using an ERP system, a greater personal relationship culture is associated with a greater coordination in that plant.

H5b: In a Chinese plant using an ERP system, a greater personal relationship culture is associated with a greater data quality in that plant.

H5c: In a Chinese plant using an ERP system, a greater personal relationship culture is associated with a greater task efficiency in that plant.

Data Quality

Data quality refers to the accuracy and relevance of data generated by ERP systems (Gattiker and Goodhue, 2005). Vosbuerg and Kumar (2001) assert that data quality is essential to many benefits derived from ERP systems. In essence, ERP systems play the role of an information highway that connects all planning levels and links various decision support systems to a central repository of data (Puigjaner and Heyen, 2006). This research takes the view that data quality can indeed be viewed as a benefit of ERP systems (Greef et al., 2004) and may influence the coordination improvement and task efficiency (Gattiker and Goodhue, 2005). In the original model of Gattiker and Goodhue (2005), coordination improvement and task efficiency are proposed as ERP intermediate benefits, while data quality is treated as a control variable.

In this study, data quality is included as an integral component of intermediate benefits, where a corresponding relationship between data quality improvement and overall benefits will be tested. Organisations with higher data quality (accurate and relevant data), are also likely to experience a greater coordination improvement and a higher task efficiency when using ERP systems. However, if the data is of a low quality (inaccurate or irrelevant) to the business process, firms may find it harder to achieve coordination enhancements and improve task efficiency (Gattiker and Goodhue, 2005). Therefore, data quality is a central element of successful ERP systems. Hence, it is hypothesised that:

> H6a: In a Chinese plant using an ERP system, the greater data quality is associated with the greater coordination improvement in that plant.
>
> H6b: In a Chinese plant using an ERP system, the greater data quality is associated with the greater task efficiency in that plant.

Overall Benefits at Plant-Level

According to Gattiker and Goodhue (2005), overall benefits of ERP adoption can be measured at the level of organisation (overall, or as the average level of interdependence of an organisation) or at a subunit level (interdependence between a particular plant and other plants of the organisation). Ake and colleagues (2003) assert that many companies have obtained suboptimal benefits from their ERP systems because they lack an understanding of how ERP systems should be applied at the plant-level. This view is supported by Gattiker and Goodhue (2005). Similarly, this research proposes that overall benefits at the plant level will arise through intermediate benefits of task efficiency, data quality, and coordination improvement. Therefore, this study hypothesises that:

> H7a: In a Chinese plant using an ERP system, the greater coordination improvement is associated with the greater local (plant) level of overall benefits from ERP.
>
> H7b: In a Chinese plant using an ERP system, the greater data quality is associated with the greater local (plant) level of overall benefits from ERP.
>
> H7c: In a Chinese plant using an ERP system, greater task efficiency is associated with greater local (plant) level of overall benefits from ERP.

Control Variables

Several control variables have been considered as these variables are likely to affect the robustness of the model. The control variables are the type of manufacturing, number of employees, number of IT staff, number of plants, and level of ERP skills. Firms in different manufacturing types may have different operational processes, these differences may affect the way the firms use ERP systems. Size of organisation, which is measured by the number of employees and the number of plants, is also controlled for. This is because large organisations could possess a higher ability of adopting ERP systems than do small organisations (Liang et al., 2007). Number of IT staff is controlled for in order to make the plants comparable on technical support. Lastly, the users' experience and skills with an information technology are positively related to adoption of the technology since they increase the willingness or opportunities to use the technology (Vatanasakdakul, 2007); therefore, level of ERP skills is set as a control variable.

In summary, to investigate the post implementation of ERP systems among Chinese manufacturing firms, this study adapts a research model based on Gattiker and Goodhue's (2005) study of the use of ERP systems in the US manufacturing industry, specifically at the plant level. The data collection for this study was done in China. To account for cultural influences, we incorporated two core aspects of Chinese culture, high context of communication and guanxi, in the model. A summary of research hypotheses is presented in Table 1, followed by a discussion of research methodology detailing data collection and analysis.

Table 1: Summary of research hypotheses

Causes	Effects	Relationship	Hypotheses
Interdependence	Intermediate benefits	+	H1a, H1b, H1c
Differentiation	Intermediate benefits	-	H2a, H2b, H2c
Time elapsed since ERP implementation	Intermediate benefits	+	H3a, H3b, H3c
High context communication	Intermediate benefits	-	H4a, H4b, H4c
Personal relationship	Intermediate benefits	+	H5a, H5b, H5c
Data quality	Coordination improvement & task efficiency	+	H6a, H6b
Intermediate benefits	Overall benefits	+	H7a, H7b, H7c:

Data Collection and Analysis

Quantitative empirical data were collected through a survey questionnaire between August and September 2008. The survey was administrated in China by one of the authors, who is a native

Chinese speaker. The English version of the survey was translated into the Chinese language and the translated version was verified by two bilingual linguistic experts. Individual manufacturing plants are our unit of analysis. The data were collected from manufacturing firms in the provinces of Jiangsu, Zhejiang and Shanghai. These three regions are located in south-eastern China, which is renowned for its high concentration of manufacturing firms. A list of 150 local manufacturing firms in those three regions was randomly obtained from the online Chinese Yellow Pages. The list included company names, addresses, industry types, and contact phone numbers. To find out whether a company uses an ERP system, each company on the list was contacted by phone. They were also asked about the number of plants they have. Companies without ERP systems and who have only one plant were excluded from the list. Finally, paper-based surveys were sent to 612 senior plant managers who were involved in the daily operations of ERP systems in 59 Chinese manufacturing firms. The response rate of valid surveys was 39% at the firm level and 13% at the plant level. Responses by location were as follows: Jiangsu province (45.57%), Zhejiang province (29.11%) and Shanghai (25.32%).

The majority of the respondents were small to medium enterprises (SMEs). Specifically: 22.8% were small enterprises, 64.6% medium enterprises, while large organisations constituted 12.7% of the sample. In addition, about 50% of the respondents had an average of 2 to 7 manufacturing plants per firm; 54.4 % of the respondent indicated that they had an average of 100 full-time staff per plant; and 68.4 % had between 1 to 5 full time IT staff per plant. Interestingly, 67.1% used local ERP systems produced by Chinese firms, while 29.1 % used international ERP systems. About 43 % had implemented and used ERP systems for 1 to 3 years; 32.9 % for 3 to 5 years; and 20.3 % for more than 5 years. For other characteristics of the sample see Table 2 in Appendix.
A seven-point Likert scale was used to measure respondents' attitudes to ERP benefits. Please refer to the appendix for the survey questions. The measurement items of all variables, except personal relationship and high context communication, were adopted from Gattiker and Goodhue (2005). Measurement items of personal relationship were adopted from Vatanasakdakul (2007). Measurement items of high context communication were developed for this study.

Data collected were analysed using Structural Equation Modeling (SEM) with Partial Least Squares (PLS) technique. The model was operationalised and analysed in PLS-graph Version 3.0. The PLS approach was preferable for this study because it provides a better prediction capability and it is effective in the analysis of a high complexity model with small sample size compared to a large number of independent variables. In addition, it imposes no requirement of a normal distribution assumption which suits the nature of the data collected (Chin, 1998). Importantly, the measurement model was tested to ensure the reliability and validity of the survey instrument. The results will be discussed in the following section.

Findings

Evaluation of Measurement Model

To ensure the accuracy of the structural model analysis, the validity and reliability of the scale developed need to be tested. Table 3 in Appendix presents the descriptive statistics for measurement items that include minimum value, maximum value, mean and standard deviation. Table 4 in Appendix presents the results obtained via the bootstrapping procedure including PLS loadings, T-statistics, Significance level, Composite Reliability, Average Variance Extracted (AVE) and Cronbach's alpha. The results suggest that our measurement model demonstrates sufficient discriminant validity and internal consistency. Chin (1998) suggests that the loading should be greater than 0.707. Most of the reflective scales demonstrated acceptable performance above the minimum value of composite reliability, which is greater than 0.7. Overall, the condition of the loading scores was met in this study and the T-statistics revealed that all the items were at a significant level of 99%. Two measurement items of personal relationship variable (PSNREL1 (0.6470) and PSNREL 2 (0.6690) present scores slightly lower than the threshold, but are in an acceptable range.

Composite reliability calculated by PLS is suitable for assessing internal consistency (Chin, 1998). All the reflective scales demonstrated acceptable performance above the minimum value of composite reliability, which is greater than 0.7. Additionally, the standard for reliability dictates that the AVE scales should exceed 0.5, indicating that "50% or more variance of the indicators should be accounted for" (Chin, 1998: 321). Cronbach's alphas were obtained by SPSS. A Cronbach's alpha of greater than 0.7 is regarded as an acceptable level of variable reliability. It can be seen that all the scales performed acceptably on this standard, with an exception of personal relationship. Given that it is a new variable and has AVE and composite reliability scores in an acceptable range, we included personal relationship in the model.

Furthermore, the discriminant validity can be evaluated by comparing the AVE of the latent variables and the correlations among the Latent Variables (LVs). Table 5 in Appendix presents the correlation of variables and the variables' respective square roots of AVEs obtained by PLS analysis. It can be seen that most of the square roots of AVEs are significantly greater than their corresponding correlations, with an exception of task efficiency that shows slightly higher scores to data quality and overall benefits variables. This confirms that most of the indicators measuring a particular LV do not improperly overlap with other LVs' concepts and that discriminant validity has been met. In addition, the result of the cross-loadings analysis presented in Table 6 in Appendix shows that the loading of each item on its corresponding variable is higher than the loading of items on any other variables. The results from the square roots of AVE and cross loading analysis demonstrate that all measurement scales have discriminant validity in an acceptable level (Zhu et al. 2010). It is acknowledged that the loadings for task efficiency are moderately higher than the loadings of data quality and overall benefits. Following the confirmation of validity and reliability of the measurement model, the results of the structural model are presented below.

Structural Model Results

The results of the structural model generated by PLS are presented in Figure 3. The predictiveness of the model can be assessed by the R^2 of the dependent variables. The results show that R^2 of the overall benefits at plant-level is 0.614, which indicates that intermediate benefits (coordination improvement, data quality, and task efficiency) accounted for 61.4% of the variance of the overall benefits variable. Among the intermediate benefits related variables, data quality highly contributes to overall benefits (0.414 of path coefficient), followed by task efficiency (0.325) and coordination improvement (0.214). In addition, task efficiency has the highest R^2 (0.625), as compared to data quality (R^2 = 0.497) and coordination improvement (R^2 = 0.418).

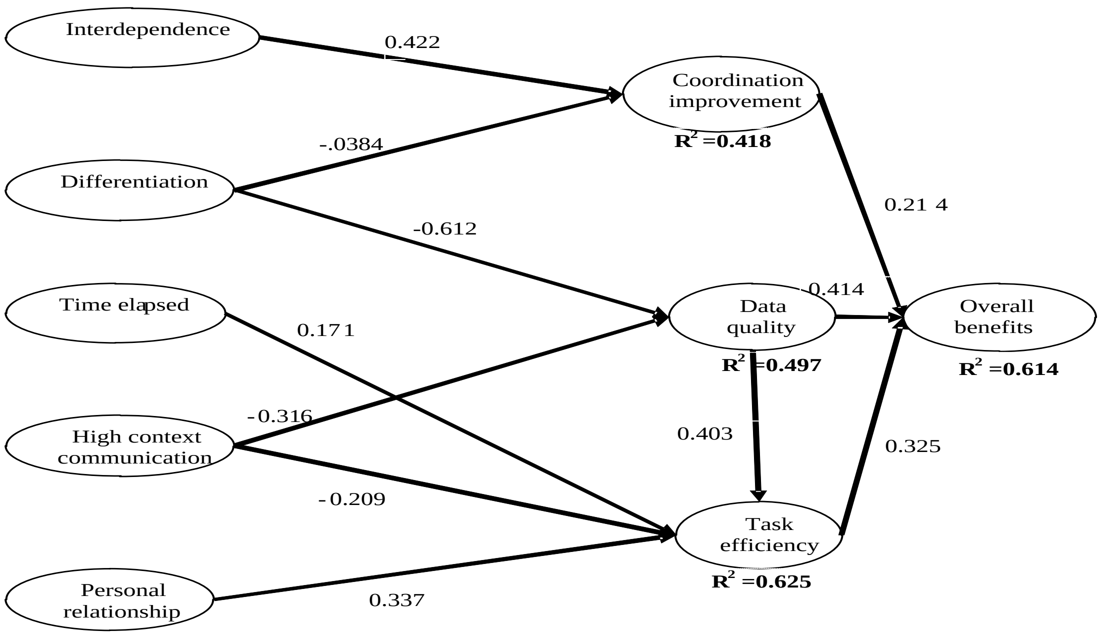

Figure 3: Results of statistical analysis

Table 7 presents the statistical outcome obtained through the bootstrapping procedure of PLS (that is actual effect, path coefficient, T-statistics, and significance level). Specifically, the research model hypothesizes that interdependence between the plants in a manufacturing firm influences the intermediate benefits gained from ERP systems. The statistical findings support hypotheses 1a and reject hypotheses 1b and 1c. This indicates that in a plant using an ERP system, interdependence among plants has a significant positive effect on coordination improvement. The path coefficient between interdependence and coordination is 0.422 at a 99% significance level. This implies that when the manufacturing plants are highly interdependent, they are likely to receive more intermediate benefits in terms of coordination through ERP systems. This finding is consistent with the results of Gattiker and Goodhue's (2005) in the US context. Interdependence only effects coordination improvement.

In terms of differentiation, Gattiker and Goodhue (2005) assert that ERP systems can create operational difficulties for a subunit whose products and production processes are different from other subunits within the same organisation. This result of this study reveals that the level of differentiation between plants within a Chinese firm that implemented an ERP system is found to have a significant and negative impact on the coordination improvement and the data quality at 99% significance level. This implies that a higher level of differentiation between plants results in lower intermediate benefits. Notably, differentiation among plants is an influential factor in determining the realisation of coordination improvement and data quality among Chinese manufacturing firms. Therefore, hypotheses H2a and H2b are accepted and H3c is rejected.

Table 7: Summary of path coefficient test results

	Actual Effect	Path Coefficient	T-statistics	Significance Level
Interdependence (H1)				
Coordination	+	0.422	4.427	0.01
Data Quality	+	0.033	0.347	Not significant
Task Efficiency	+	0.060	0.775	Not significant
Differentiation (H2)				
Coordination	-	-0.384	2.694	0.01
Data Quality	-	-0.612	6.259	0.01
Task Efficiency	-	0.198	1.623	Not significant
Time elapsed (H3)				
Coordination	-	0.097	1.526	Not significant
Data Quality	-	0.010	0.178	Not significant
Task Efficiency	+	0.171	2.134	0.01
High context Communication (H4)				
Coordination	-	0.196	1.512	Not significant
Data Quality	-	0.316	2.704	0.01
Task Efficiency	-	0.209	2.108	0.01
Personal relationship (H5)				
Coordination	+	0.053	0.469	Not significant
Data Quality	+	0.036	0.310	Not significant
Task Efficiency	+	0.337	2.629	0.01
Data quality (H6)				
Coordination	-	0.015	0.099	Not significant
Task Efficiency	+	0.403	3.243	0.01
Overall benefits				
Coordination	+	0.214	2.400	0.01
Data Quality	+	0.414	3.222	0.01
Task Efficiency	+	0.325	3.020	0.01

These findings are largely consistent with the results of the Gattiker and Goodhue's (2005) study. Firms could gain greater intermediate benefits from ERP systems when differentiation among plants is low and interdependence is high. To improve work coordination among plants, firms need to consider the interdependence and differentiation between plants when implementing ERP systems. Moreover, the results demonstrate that time elapsed since ERP implementation has a significant impact on task efficiency. Hypothesis 3c is accepted, while hypotheses 3a and 3b are rejected. This implies that the longer time has elapsed since the ERP has gone live, the higher the task efficiency. Although this relationship is relatively weaker in this study, the result conforms to the findings of Gattiker and Goodhue (2005). In addition, Bendoly and Jacobs (2005) also suggest that time itself is a critical prerequisite for extracting value from ERP and that value derived from using ERP is consistent with the time spent on using the system.

In relation to the high context communication characterising Chinese culture, hypothesis 4a is rejected, while hypotheses 4b and 4c are accepted. The results of this study, therefore demonstrate that high context communication could reduce the intermediate benefits in terms of the data quality and the task efficiency, but it does not reduce coordination processes. It is likely therefore that the system complements existing communication channels in this high context environment. Beyerlein et al. (2005) assert that people in HC cultures rely on situational cues for meaning when communicating with others, hence nonverbal cues, such as position or status, convey messages more powerfully than do spoken or written words. While ERP systems promote a systematic process in an organisation by documenting all transactions in an integrated platform, Chinese employees still prefer face-to-face interaction rather than utilising ERP systems when communicating with their colleagues. Consequently, the intermediate benefits of ERP systems in terms of improving data quality and task efficiency will be reduced in an environment where face-to-face communication is preferred to electronic communication through ERP systems. Interestingly, the results indicate that personal relationship/guanxi has a significant and positive impact on the task efficiency (path coefficient = 0.337). Thus, hypothesis 5c is accepted, while hypotheses 5a and 5b are rejected. It may be possible that employees use guanxi to stimulate the use of ERP systems. Similarly, Liang and colleagues (2007) assert that normative pressures which are exerted by top managers' personal relationships with their counterparts in other organisations and officials in various government agencies could impact the level of ERP usage.

These findings enhance our understanding of Chinese culture and extend upon Avison and Malaurent's study (2007) on ERP implementation in China. The authors found that Chinese culture presents barriers to ERP implementation success in terms of communication and language. Due to a relative English language deficiency in the Chinese workplace, Chinese employees may be reluctant to use ERP systems with their colleagues because they may be concerned with losing face due to misunderstandings, particularly when such communication is electronically mediated. In addition, a high context communication of Chinese culture makes it more difficult for Chinese employees to use ERP systems. Xue and colleagues (2010) assert that language and communication are a major challenge in promoting the use of ERP systems. Chinese language is often difficult to translate to English. Inaccurate translations may result in confusion and conflict. This could perhaps explain, in part, why Chinese people prefer face-to-face communication rather than the use ERP systems.

Our study also explored the relationship among intermediate benefit variables. The results indicate a significant relationship between the data quality and task efficiency. Thus, hypothesis 6b is accepted and could be validated by Starinsky's (2003) assertion that data quality is a fundamental principle which determines the success of an organisation when implementing ERP systems. Olson (2003) also takes the view that better data quality provided by ERP systems can increase the task efficiency among plants within an organisation. However, unlike Gattiker and Goodhue's findings (2005), the relationship between coordination improvement and data quality was not found in this study.

Hypotheses 7a, 7b and 7c are all accepted. Coordination improvement, data quality and task efficiency have significant impact on overall benefits. These three factors together constitute a substantial amount (R^2 = 0.614) of the variance of plant-level overall benefit. Among these factors, data quality has the most impact on the overall benefits (0.414 of path coefficient), followed by task efficiency (0.325) and coordination improvement (0.214). This implies that data quality has the most impact on the overall benefits of ERP systems, while coordination improvement is the least impacting. This strongly reinforces the importance of data quality in reaping the targeted benefits from ERP systems. Data quality is negatively related to differentiation and high context communication. This implies that the data quality can be improved when differentiation between plants and high context communication are low. In terms of task efficiency, it is positively related to time elapsed since ERP implementation, and personal relationship and negatively related to high context communication.

The relationship between time elapsed since implementation and task efficiency is relatively weak in the Chinese context (path coefficient = 0.171). This could imply a lower significance as compared to Gattiker and Goodhue's (2005) study, which found that the longer the time since firms have implemented ERP systems, the more likely they are to receive greater benefits as employees would be more familiar with the systems. In addition, over time, firms can benefit from guanxi networks geared toward using ERP systems and hence lead to better task efficiency outcomes. However, high context communication in the Chinese culture could hinder the task efficiency as Chinese employees may prefer face-to-face communication as opposed to using ERP systems. The level of interdependence and differentiation among plants in a manufacturing firm will determine the degree of coordination improvements when ERP systems are implemented. Furthermore, control variables were tested and did not show significant impact on the model.

Discussion

Our results highlight a high degree of consistency with Gattiker and Goodhue's (2005) model, but also expand on such model by incorporating cultural factors, hence enabling further investigation of

ERP systems in different cultural contexts. Moreover, our findings suggest that data quality is a fundamental intermediate benefit contributing to the overall benefits of ERP systems in organisations.

The results demonstrate a consistency with Gattiker and Goodhue's (2005) in pointing out the positive influence of the interdependence among plants on coordination improvements, as well as noting the negative influence of differentiation on such improvements. Operational synergies among plants are therefore important to attain coordination improvements, and should be investigated, analysed, and modeled by systems engineers, business analysts, and operational managers in order to contribute to the attainment of ERP benefits. Likewise, similar to Gattiker and Goodhue's (2005), longer time of using ERP systems is found to have a positive influence on task efficiency, as staff becomes more proficient in using the systems.

On the other hand, our extended model demonstrates a more complex relationship between culture and ERP benefits. Our analysis indicates the positive effect of personal relationships which may assist in promoting task efficiency, possibly through decision makers mobilising their personal networks towards standardising tasks and procedures through the systems. Conversely, the negative effects of high context communication are significant, as they are likely to detract from the reliance on ERP systems in a context where indirect communication is taken as part of the social norm and relied upon for determining the underlying messages. Obviously, communication through an ERP system assume and encode a rationalist perspective based on direct quantitative modes of communication, which would likely clash with the high context communication characterising the Chinese context. This may contribute to the negative effects of such predisposition on data quality and task efficiency factors.

Moreover, while the positive influence between data quality and task efficiency is clear and consistent with previous findings by Gattiker and Goodhue (2005), the fact that no significant relationship was detected between data quality and coordination improvements in the Chinese context conflicts with the findings in the US context and necessities further investigation. We posit that this may be driven by cultural practices that promote coordination improvements outside the scope of the ERP system and hence is perceived as independent from the data quality improvements generated by the system itself – which will indeed require more investigation into the complex intertwining between culture and ERP systems' operations and benefits.

Finally, it is imperative to note the congruence in our findings with Gattiker and Goodhue (2005) in relation to the relationship between intermediate benefits and the overall benefits of ERP systems at a plant level. This further validates the need to consider intermediate benefits, by researchers and practitioners alike, as important intermediaries to achieving overall benefits and potential success. Notably, the inclusion of data quality as an intermediate benefit seems essential, particularly given its higher contribution to overall benefits in our study as compared to task efficacy, and coordination improvements, making it an essential element for improved analysis and deliberation for future studies.

Conclusion

This research investigated the factors affecting ERP system use at a plant-level. The findings indicate that interdependence, differentiation, the period of using ERP systems, high context cultural and personal relationship can explain how ERP system use among plants is varied in terms of coordination improvement, data quality and task efficiency. We found that Chinese cultural values have proven to have a substantial impact on the intermediate benefits of ERP systems. Firms could gain greater intermediate benefits from ERP systems when they are implemented in a low context communication culture and a high personal relationship context. This research and its findings may hold important implications for both academics and practitioners.

A key theoretical implication of this research relates to the extension of Gattiker and Goodhue's (2005) model to incorporate cultural variables - personal relationships and high context communication. Both variables were derived from established cultural theories and suit the Chinese cultural context. This study also provides a comparison between the Gattiker and Goodhue's (2005)'s study on ERP systems among US manufacturing firms and Chinese manufacturing firms. Overall, the result of this study shows highly consistent results on factors contributing the intermediates effects and performance between the two contexts. Moreover, the study also contributes to advancing understanding of ERP systems in China by providing empirical evidence from the Chinese manufacturing sector. The micro-focus on manufacturing plants also enriches the understanding of mediating factors leading to overall ERP benefits.
Finally, the research focuses on the use stage of ERP systems, while the bulk of prior research was focused on adoption (implementation) issues. This study contributes to understanding the utilisation and organisational benefits ensuing adoption if ERP systems.

The findings discussed above hold important lessons for Chinese organisations deploying ERP systems. Firms should ensure that the business processes and salient policies between plants are synchronised and aligned, as smaller differentiation would lead to better data quality and efficiency. Furthermore, the influence of the time period of using ERP systems on task efficiency implies that an adequate program of organisational learning and training to use ERP systems should be encouraged. Another implication relates to guanxi. Plant managers can indeed use guanxi as an ERP system enabler, by using their personal relationships with stakeholders, particularly employees to encourage ERP system uptake and utilisation as well as acknowledge key individuals and groups responsible for the achievement of intermediate benefits (Liang et al., 2007). Over time this may create a virtuous cycle of favors and public acknowledgements that helps attain greater ERP system utilisation and benefits.

This study has been limited to Chinese manufacturing industry. This study can be extended by using a larger sample size, a variety of industrial contexts and a greater coverage of regions and provinces in China. Although the three selected provinces have a stronger manufacturing base, an extension of this study to other provinces may be beneficial for a complete understanding of the entire Chinese manufacturing sector. In addition, other organisational aspects such as support from top management (Zhu et al., 2010) could be introduced and thoroughly investigated in future studies. Moreover, measurement of all variables had been performed at organisational level. While the Chinese cultural variables were assessed at the individual level, which presents a limitation. Although we targeted the boundary spanners, such as plant managers, to represent their overall attitude about the plants and its culture, future research should target a wider range of stakeholders. We suggest that such a research can be conducted through qualitative methods that may help in explaining our unexpected findings (the missing relationships between guanxi, on one side, and data quality and coordination improvement).

Finally, the fact that the majority of respondents reported using locally developed ERP systems poses a new question: Does the homegrown ERP software incorporate local cultural values or simply mimic western models? This question would yield interesting answers that would further elaborate upon our findings, and may further explain the deployment of ERP systems in Chinese manufacturing.

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Appendix

Survey questionnaire

Interdependence

INTERDE1	If this plant's communication links to other plants were disrupted things would quickly get very difficult.
INTERDE2	Frequent information exchanges with other plants are essential for this plant to do its job.
INTERDE3	Close coordination with other plants is essential for this plant/branch to successfully do its job.

Differentiation

DIFF1	Overall, how do you rate the difference in size between your plant and other plants?
DIFF2	The degree to which products are made to customer specifications, instead of to stock.
DIFF3	The number of new design introductions per month.
DIFF4	The average number of design changes per month.

Personal relationship

PSNREL1	Establishing personal relationship is important to me.
PSNREL2	I prefer to establish personal relationship for communicating with my colleagues in other plants rather than using the ERP system.
PSNREL3	Establishing personal relationship with my colleagues in other plants/branches would help me complete tasks more efficiently than using the ERP system.

High context communication

HOLCCOM1	The decision making process in my company is centralised.
HOLCCOM2	I often follow the decisions made by my superiors.
HOLCCOM4	There is little need to communicate with other plants/branches on decisions stipulated by top management.

Coordination improvement

COODIMP1	ERP helps this plant adjust to changing conditions within other plants/branches.
COODIMP2	ERP has improved this plant's coordination with other plants/branches.
COODIMP3	ERP helps this plant synchronise with other plants/branches.

Task efficiency

TASKEF1	Since we implemented ERP, plant employees such as buyers, planners and production supervisors need less time to do their jobs.
TASKEF2	ERP saves time in jobs like production, material planning and production management.
TASKEF3	Now that we have ERP it is more time-consuming to do work like purchasing, planning and production management.
TASKEF4	ERP helps plant/branch employees like buyers, planners, and production supervisors to be more productive.

Data Quality

DATAQUA1	The information from the ERP system has numerous accuracy problems that make it difficult for employees to do their jobs.
DATAQUA2	The information that the ERP system provides to employees in this plant/branch is accurate.
DATAQUA3	The ERP data that plant employees (planners, supervisors, etc.) use or would like to use are accurate enough for their purposes.
DATAQUA4	It is difficult for plant employees to do their jobs effectively because some of the data they need are missing from the ERP system.

Overall benefits

PLOI1	In terms of its business impacts on this plant, the ERP system has been a success.
PLOI2	ERP has seriously improved this plant/branch's overall business performance.
PLOI3	ERP has had a significant positive effect on this plant.
PLOI5	Overall, ERP has provided significant benefits to this plant.

Table 2: Additional characteristics of the sample

		Frequency	Percent
Type of manufacturing industry	Industrial machines and equipment	22	27.8
	Domestic electronic appliances	12	15.2
	Textile	10	12.7
	Apparel	5	6.3
	Petroleum refining and related products	3	3.8
	Primary or fabricated metal products	5	6.3
	Motor vehicles	2	2.5
	Cosmetics	1	1.3
	Commodities	1	1.3
	Others	18	22.8
Company size	Small (0-300 full-time employees)	18	22.8
	Medium (301-2000)	51	64.6
	Large (>2000)	10	12.7
Number of plants in the company	2-4 plants	17	21.5
	5-7 plants	23	29.1
	7-9 plants	21	26.6
	>9 plants	18	22.8
Number of full-time employees in the plant/branch	0-100	43	54.4
	101-200	9	11.4
	201-300	10	12.7
	301-400	6	7.6
	>400	10	12.7
	Missing	1	1.3
Source of ERP	Domestic	53	67.1
	International	23	29.1
	Custom made by internal IT department	2	2.5
	Missing	1	1.3
Time elapsed since the ERP has been implemented	<1Yr	3	3.8
	1-3Yrs	34	43.0
	3-5Yrs	26	32.9
	>5Yrs	16	20.3
Level of ERP skills	None	0	0.0
	Very little	1	1.3
	Little	7	8.9
	Somewhat familiar	23	29.1
	Familiar	34	43.0
	Very familiar	9	11.4
	Expert	5	6.3

Table 3: Descriptive statistics for measurement items

Measures	No of items	Min.	Max.	Mean	Std. Deviation
Interdependence	3				
INTERDE1		2	7	5.35	1.075
INTERDE2		2	7	5.66	0.815
INTERDE3		2	7	5.54	0.945
Differentiation	4				
DIFF1		1	7	4.72	1.617
DIFF2		1	7	4.68	1.668
DIFF3		2	7	4.76	1.232
DIFF4		2	7	5.00	1.423
Personal Relationship	3				
PSNREL1		1	7	5.84	0.993
PSNREL2		2	7	4.78	1.216
PSNREL3		2	7	4.76	1.040
High Context Communication	3				
HCCOM1		2	7	3.77	1.493
HCCOM2		1	7	3.22	1.411
HCCOM3		1	7	3.11	1.414
Task Efficiency	4				
TASKEF1		2	6	4.81	1.099
TASKEF2		2	7	5.14	1.047
TASKEF3		2	6	4.56	1.141
TASKEF4		3	7	5.11	1.000
Data Quality	4				
DATAQUA1		1	6	4.56	1.238
DATAQUA2		2	7	4.91	1.146
DATAQUA3		3	7	4.62	0.924
DATAQUA4		2	6	4.43	1.173
Coordination Improvement	4				
COODIMP1		4	7	5.59	0.870
COODIMP2		4	7	5.59	0.670
COODIMP3		3	7	5.35	1.050
Overall Benefits	4				
PLOI1		2	7	5.15	1.210
PLOI2		2	7	4.94	1.004
PLOI3		3	7	5.15	0.907
PLOI4		4	7	4.96	0.898

Table 4: A summary of statistics for evaluating measurement model

Types of variables	Variables and items	PLS loadings	T-statistics	Significance level	Composite Reliability	AVE	Cronbach's Alpha
Independent	**Interdependence**				0.886	0.723	0.804
	INTERDE1	0.727	10.414	0.01			
	INTERDE2	0.908	34.965	0.01			
	INTERDE3	0.904	29.115	0.01			
Independent	**Differentiation**				0.907	0.710	0.860
	DIFF1	0.770	12.451	0.01			
	DIFF2	0.886	29.208	0.01			
	DIFF3	0.835	23.699	0.01			
	DIFF4	0.874	25.385	0.01			
Independent	**Personal Relationship**				0.768	0.529	0.579
	PSNREL1	0.648	5.177	0.01			
	PSNREL2	0.669	3.662	0.01			
	PSNREL3	0.848	4.782	0.01			
Independent	**High Context Communication**				0.870	0.693	0.789
	HCCOM1	0.771	7.908	0.01			
	HCCOM2	0.944	14.848	0.01			
	HCCOM3	0.770	6.736	0.01			
Mediating	**Coordination Improvement**				0.845	0.646	0.757
	COODIMP1	0.878	37.778	0.01			
	COODIMP2	0.825	11.952	0.01			
	COODIMP3	0.785	13.915	0.01			
	COODIMP1	0.776	16.857	0.01			
Mediating	**Data Quality**				0.881	0.648	0.789
	DATAQUA1	0.806	18.081	0.01			
	DATAQUA2	0.782	11.545	0.01			
	DATAQUA3	0.808	20.806	0.01			
	DATAQUA4	0.824	14.972	0.01			
Mediating	**Task Efficiency**				0.889	0.667	0.814
	TASKEF1	0.878	37.778	0.01			
	TASKEF2	0.825	11.952	0.01			
	TASKEF3	0.785	13.915	0.01			
	TASKEF4	0.776	16.857	0.01			
Dependent	**Overall Benefits**				0.880	0.648	0.815
	PLOI1	0.828	24.472	0.01			
	PLOI2	0.881	24.417	0.01			
	PLOI3	0.731	7.753	0.01			
	PLOI4	0.772	14.911	0.01			

Table 5: Correlation of variables compared to square root of AVEs

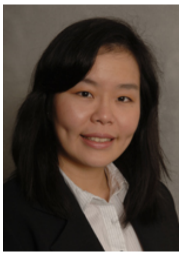
Measures	Interdependence	Differentiation	Task efficiency	Data quality	Overall benefits	Coordination improvement	Personal relationship	High context communication
Interdependence	**0.850***							
Differentiation	-0.178	**0.843**						
Task efficiency	0.164	-0.524	**0.817**					
Data quality	0.130	-0.562	0.704	**0.805**				
Overall benefits	0.463	-0.482	0.677	0.693	**0.805**			
Coordination improvement	0.515	-0.517	0.394	0.360	0.444	**0.804**		
Personal relationship	-0.056	-0.359	0.244	0.126	0.246	0.196	**0.727**	
High context comm.	-0.329	0.127	-0.339	-0.374	-0.342	-0.299	0.135	**0.799**

**Figures in bold are the square roots of AVEs.*

Table 6: Cross-loadings results

	Task efficiency	Data quality	Overall benefits	Interdepen-dency	Coordination	Different-iation	Personal relationship	High context
TASKEF1	0.883596	0.605072	0.510029	0.026402	0.270841	-0.46050	0.16672	-0.25365
TASKEF2	0.81848	0.545111	0.565701	0.233799	0.368939	-0.37192	0.276398	-0.32381
TASKEF3	0.770518	0.486791	0.503695	0.034186	0.175631	-0.44773	0.167793	-0.2664
TASKEF4	0.758813	0.504634	0.494254	0.235286	0.429831	-0.42569	0.258608	-0.21741
DATAQUA1	0.556811	0.765368	0.467568	0.072361	0.314574	-0.53593	0.008144	-0.37746
DATAQUA2	0.577803	0.729968	0.548594	0.199452	0.325779	-0.40109	0.148892	-0.35752
DATAQUA3	0.523608	0.820409	0.526867	0.036694	0.167594	-0.45934	0.181679	-0.18824
DATAQUA4	0.514115	0.791624	0.549198	0.238521	0.336152	-0.41538	0.035593	-0.31948
PLOI1	0.583815	0.523064	0.789487	0.229738	0.416076	-0.54141	0.217745	-0.36651
PLOI2	0.588615	0.600892	0.886809	0.474306	0.373634	-0.37668	0.161197	-0.36603
PLOI3	0.312411	0.355565	0.679367	0.497517	0.334877	-0.16138	0.086962	-0.3253
PLOI4	0.535489	0.419346	0.812649	0.428503	0.404756	-0.40948	0.309383	-0.05544
INTERDE1	0.197131	0.210489	0.454499	0.73197	0.362202	-0.2491	-0.07607	-0.31384
INTERDE2	0.157021	0.107496	0.381158	0.877579	0.504687	-0.11189	-0.06764	-0.28979
INTERDE3	0.108653	0.055536	0.400346	0.884225	0.455411	-0.06225	-0.03123	-0.22365
COODIMP1	0.441834	0.364237	0.454031	0.417539	0.849568	-0.54064	0.317144	-0.15108
COODIMP2	0.274794	0.279347	0.269075	0.406231	0.80848	-0.38219	0.05887	-0.24203
COODIMP3	0.189926	0.19973	0.26855	0.444637	0.745146	-0.24095	-0.01133	-0.31134
DIFF1	0.459794	0.485898	0.428332	0.06181	0.436886	-0.75357	0.195614	-0.08222
DIFF2	0.54034	0.569259	0.511013	0.065347	0.404358	-0.88399	0.358144	-0.07031
DIFF3	0.478629	0.424171	0.456716	0.198499	0.479478	-0.8751	0.464114	-0.07542
DIFF4	0.508738	0.53400	0.525161	0.20564	0.408298	-0.86937	0.267305	-0.15225
PSNREL1	0.172909	0.146945	0.197912	-0.04972	0.156810	-0.26773	0.702925	-0.04479
PSNREL2	0.177851	0.086226	0.288497	0.017225	0.033769	-0.20241	0.689269	0.250119
PSNREL3	0.169573	0.077665	0.089601	-0.10621	0.189872	-0.37908	0.678326	0.277644
HCCOM1	-0.21595	-0.21215	-0.21565	-0.18906	-0.21430	0.128804	-0.0127	0.784871
HCCOM2	-0.35693	-0.41909	-0.33885	-0.31759	-0.27708	0.109943	0.213479	0.928867
HCCOM3	-0.09926	-0.12823	-0.116	-0.23204	-0.26921	-0.06724	0.196938	0.721695

Authors' Biographies



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