A Delphi Examination of Inhibitors of The Effective use of Process Industry Enterprise Resource Planning (Erp) Systems: A Case Study of New Zealand's Process Industry

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Abstract: An ERP System is among the core information system (IS) software being adopted in the process industries globally. Such systems are claimed to offer strategic and operational improvement to firms' supply chain effectiveness. Prior studies have shown that most adopting firms are not achieving the strategic business value identified in the project justification due to employees' ineffective use of the system. The gains that such firms have achieved by implementing ERP systems in terms of increase in operational efficiency are often accompanied by daunting ineffective usability problems. Building on Technology–Organization–Environment (TOE) theory, Task-Technology Fit (TTF) theory and the theory of usage inhibition, this study examines the inhibitors of the effective use of ERP systems. The study used the Delphi technique to draw from the experiences of a few ERP adopters from New Zealand's process industries. Findings suggest that non-collaborative training among employees, low absorptive capacity and system misfit are the top most critical inhibitors. Others inhibitors include inadequate ERP expertise, ERP default attributes, lack of continuous improvement and poor vendors' support. The theoretical and practical implications of these findings are discussed in the concluding section.

Keyword: Enterprise resource planning system, Effective use, Delphi methodology, Process

1. Introduction

Many large and small-scale process industries in both developed and developing economies have invested in Enterprise Resource Planning (ERP) systems (AberdeenGroup, 2008). The adoption of such systems replaces outdated legacy systems in order to meet the ever-changing business environment (Esteves, 2009; Hsieh and Wang, 2007). One significant reason for the adoption of ERP systems by these organisations is to account for the standardized process and integration of the business unit functions for decision-making (Hakkinen and Hilmola, 2008). Obtaining inter-organizational value chains and transactional backbone for e-business collaboration with clients, partners and suppliers have also been major drivers of ERP wide adoption by firms (Jasperson et al., 2005, Wang et al., 2008).

There have been discussions in much of the extant literature on ERP implementation failures (Yu, 2005). However, it continues to be the most widely adopted information systems (IS) globally (Esteves and Bohorquez, 2007). Several studies have shown that the enormous investments in ERP systems could only achieve transactional efficiency, leaving the emergent strategic value of the system under-utilized (Chen, 2001; Hsieh and Wang, 2007; MacKinnon et al., 2008). Though the benefits of such systems are enormous, users frequently take advantage of only the most basic use, instead of effectively using the system to create business values (Sousa and Goodhue, 2003). The effective use of ERP systems is not just the mandatory basic use (Hsieh and Wang, 2007; Sousa and Goodhue, 2003). Rather, it is the exploratory and exploitative use of the features of the application to enhance organisations' productivity (Boudreau, 2002; Loftus, 2008; Sousa and Goodhue, 2003). Effective use is to get users to move beyond the routine use demanded by their assigned task(s) in the workplace and uncover new ways of using the system features (Sousa and Goodhue, 2003).

To effectively utilize ERP systems in the process related industries (such as Chemical, Food & Beverage, Pharmaceuticals, Metals & Mining, Pulp and Paper Industries) has been a lingering problem (Aarde, 2007; AberdeenGroup, 2008; Hameri and Lehtonen, 2001; Lail, 1999; Shah, 2005). Although deployment of ERP systems originated in the discrete industries, process industries are increasingly adopting such systems to support their cyclical business operations (Aarde, 2007; Lail, 1999). Due to the vertical structure in the organic growth of this type of industry, ERP systems have replaced their legacy sets of IS to support supply chain operations (Hameri and Lehtonen, 2001; Lail, 1999). The supply chain operation stems from optimal utilization of the existing plant capacity through operation planning and scheduling (Thompson, 2000). Such planning and scheduling demand effective use of ERP systems in mass customization, not in the products, for the industry operates low

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volume functional products, but in the services associated with the products (Akkermans et al., 2003). The functional products characterised by a high degree of variability distinguish the process industries from the discrete industries (Aarde, 2007). Usability problems in ERP have been attributed to poor business performance and low managers' productivity in these types of industries (Iansiti, 2007; Lail, 1999; Shah, 2005). Although ineffective use is among the major challenges confronting ERP post-implementation success, little research has been conducted on this issue, especially in the process industry (Hamerman, 2007; Hsieh and Wang, 2007).

Often, scholars have observed that individual usage of ERP systems is impacted by social, organizational, environment and individual adoption factors (e.g., Al-Mashari et al., 2003; Amoako-Gyampah, 2007; Chang et al., 2008; Hakkinen and Hilmola, 2008; Hsieh and Wang, 2007; Ifinedo, 2008; Nicolaou, 2004). Most of these factors, which cut across the implementation and post-implementation phases of ERP life cycle, are labelled as enablers of the system usage (Cenfetelli, 2010). However, there exist inhibitors that serve solely to discourage effective system usage and are distinctly different from enablers of such usage (Cenfetelli, 2010). Cenfetelli (2010) defined inhibitors as those negative factors that discourage IT usage (in this case ERP systems) when present, but do not necessarily favour such usage when absent. This asymmetric effect implies that inhibitors are not necessarily the mirror opposite of enablers, but are qualitatively distinct constructs that are independent of but may coexist with enablers (Cenfetelli, 2010; Bhattacherjee and Hikmet, 2007). To focus on such inhibitors, which have received less attention from prior studies, requires the views of experienced users of ERP systems. The perceptions of such users will assist in establishing the link between the inhibitors and the effective use of ERP systems as well as in ranking them for managerial attention. The study tends to focus on the process industry because a recent study by Zhu et al. (2010) notes that the relative effects of the factors on the post-implementation success of ERP differ across different industries. Hence, in order to obtain a broader view of these inhibitors, Technology-Organization-Environment (TOE) framework, Task Technology Fit (TTF) and the theory of usage inhibition by Cenfetelli (2004) are used as lenses to guide the study. The purpose of integrating these theories is to offer a suitable framework for the categorization of the inhibitors before subjecting them to empirical testing. Consequently, two research questions are incorporated to focus the investigation:

- 1) What factors do managers in the process industry consider to be inhibitors to the effective use of ERP systems?
- 2) Which of the factors / inhibitors should managers in the process industry consider more deserving of their attention?

The study is particularly interested with the strategic managers since they are the ones to drive the effective use of the system (Ifinedo, 2008; Loftus, 2008). A Delphi approach is adopted to systematically identify and rank the major inhibitors. The Delphi technique further grants the study the opportunity to engage multiple perspectives of ERP key users considered as experts in the use of the systems from New Zealand's process industries.

The rest of this paper is organized as follows: Section 2 consists of the literature review that focuses on the need to re-conceptualize ERP usage and the theoretical background with relevant literature on ERP usage. Section 3 describes the Delphi research methodology and the findings. Section 4 discusses the findings and presents the implications of these findings to both research and practice, the limitations of the study, and future research directions. Section 5 concludes this paper.

2. Literature review

2.1 Reconceptualising ERP Usage

Special attention to critical success factors (CSF) in ERP implementation is evident from the bulk of literature associated with the implementation phase (Esteves and Bohorquez, 2007). By drawing from Robertson et al. (1996) four-phase process model of ERP life cycle, it is evident that the implementation phase (i.e. installation, configuration and change management process) constitutes the third phase of the process model. Other phases include agenda (i.e. preparation to adopt the ERP system) as the first phase, design (redesign business process to fit the workability of the ERP system) as the second phase, and appropriation (use, routinization, infusion and continuous improvement of the ERP system in the organization) as the fourth and the last phase. Considering the process nature of the model, trends in literature that focus on the implementation phase, poses a limited understanding of the other phases of the ERP life cycle (Kamhawi, 2008). Perhaps, either the focus on CSF is to forestall the rampant implementation failures, or it may be that such scholars treat ERP

implementation as an all-inclusive process spanning this four-phase model. However, treating ERP implementation as an all-inclusive process for whatever reason(s) limits the crucial and holistic understanding of each of the phases of the ERP life cycle. To avoid such will help in the proactive seeking of relevant solutions for achieving success at each specific phase. Without diagnosing every phase of the ERP innovation process to understand the weakest link, we argue that the overall ERP success will be conceptualised vaguely.

The realisation of ERP business values has often been assumed to be met when implementation success is achieved. In many cases, however, such an assumption has proven to be incorrect over time (Markus and Tanis, 2000; Soja and Paliwoda-Pekosz, 2009; Yu, 2005; Zhu et al., 2010). In fact, ERP failure cuts across the four phases of the ERP life cycle, with significant and enduring negative consequences in the appropriation phase when the enormous resources expended in the installed systems did not yield an appreciable business value due to underutilization (Zhu et al., 2010). This brings us to the urgent need to understand the concept of "use" in the ERP research domain and, on the basis of this understanding, will the inhibitors of effective use be identified and empirically validated.

Being often considered as an obscure territory, the concept of "use / usage" and its ambiguous application in the ERP research domain has been contentious (Brown et al., 2002; Nah et al., 2004). The ambiguity associated with this concept (use), stems from researchers equating ERP systems to any other IS (Ifinedo, 2008). ERP systems are different from traditional IS due to their ability to impact significantly on the "…technological, operational, managerial, strategic, and organizational components of the adopting firm" (Ifinedo, 2008, p.552). It is mandatory for users to utilise the installed ERP system as it reorganises an adopting firm to fit into its default business logics, popularly expressed as "best practise" (Yu, 2005). Its nature of sophistication demands that firms solicit external consultants to assist in developing and transferring their ERP knowledge skills to the adopting firms (Ifinedo, 2008; Soja and Paliwoda-Pekosz, 2009). Even prior to implementation, it is expedient for firms to understand how to effectively use the system to achieve their organisational goals (Ifinedo, 2008). A lack of appreciation of the uniqueness of ERP can cause the demise of the adopting organisation, after having expended enormous resources (Chen, 2001; Ifinedo, 2008; Yu, 2005). Consequently, it is evident that frequent application of the concept use to measure ERP success, demands re-conceptualization to reflect its uniqueness and specific design features that need not to be generalized to other IT artifacts (Gable et al., 2003; Nah et al., 2004). To do this depends on the accurate understanding of the mandatory and the non-mandatory nature of adopting ERP systems. Therefore, it is inappropriate due to bias to employ the construct "use / usage", "user acceptance" or "intention to use" to evaluate ERP, since users are already obligated to use the application in their everyday tasks. This study argues that these constructs (i.e. "use", "user acceptance" or "intention to use") that stem from attitude-intention-behaviour theories are inconsequential and highly prone to bias, since it is obvious that employees are mandated to use such systems in their organisation, especially during the early individual's adoption to get his or her job going. Extant literature (e.g., Brown et al., 2002; Gable et al., 2003; Nah et al., 2004) has also criticised employing these constructs to assess a mandatory phase of ERP success. However, as users gather experience with the system, individual usage of ERP shifts to the non-mandatory phase driven by the users' intrinsic motivation to learn more of the system capabilities. Therefore, a more robust and parsimonious construct termed "effective use" or "extended use" could be employed to assess ERP systems (Boudreau, 2002; Hsieh and Wang, 2007; Loftus, 2008; Sousa and Goodhue, 2003). Sousa and Goodhue (2003) note that the effective use of an ERP system is discretionary and significantly driven by the users' business knowledge, the conceptual knowledge of the application and its procedural knowledge and motivation. Paraphrasing Sousa and Goodhue (2003), exploratory and exploitative use of the system cannot be mandated; despite not being part of the formal job expectations per se, it contributes significantly to organisational productivity. Boudreau (2002) noted the erroneous view of assuming "use" to mean "effective use" as he observes that the degree of use does not necessarily translate to effectiveness. Boudreau classifies "effective use" to mean "quality of use", which is an exploitative use of the functionalities of the system for organisations' competitive advantage (Boudreau, 2002; Loftus, 2008; Sousa and Goodhue, 2003).

A clearer understanding of this concept of "use", especially in the ERP environment, can also be derived from the earlier work of Lassila and Brancheau (1999). Lassila and Brancheau (1999) classified "use" in the context of organisational environment to have four "equilibrium states" depicting the increasing sophistication of use in the ERP environment. These four states pictured: (1) limited "use" (i.e. low-integration), (2) "use" as to support existing processes (i.e. standard adoption / basic

use), (3) “use” as to redesign existing work processes (i.e. expanding), and (4) “use” as to exploit the capabilities of ERP to align with the ever changing business environment (i.e. high integration) (Boudreau, 2002). Therefore, the effective use of ERP revolves around ‘expanding’ to ‘high integration’ where users have gone beyond the mandatory use (i.e. low-integration and standard adoption) to a discretionary exploitation of the system for competitive advantage (Loftus, 2008; Sousa and Goodhue, 2003).

2.2 Theoretical background

The appropriation phase of the ERP life cycle being the focus of this research consists of use, routinization, infusion and continuous improvement of the ERP system in the organization as noted earlier (Li et al., 2006; Robertson et al., 1996). Routinization describes the state where system use is institutionalized within the organisational culture of the adopting organisations (Hsieh and Wang, 2007). Infusion refers to the process of embedding an ERP system deeply by reason of exploratory and exploitation use of the system within an individual’s or organization’s work systems (Hsieh and Wang, 2007). Unfortunately, employees’ attainment to the appropriation phase, where the system should be effectively utilized for the realization of the business value, has been hindered by some factors. Drawing from the theory of usage inhibition by Cenfetelli (2004), or the dual-factor model as it is popularly called; such factors that dissuade system usage (in this case ERP system) are classified as inhibitors (Cenfetelli, 2004; 2010). The dual-factor model primarily focuses on the fact that factors associated with IS usage are determined by a simultaneous examination of enabling and inhibiting factors. As noted, prior research drawing from the IS success model (DeLone and McLean, 1992; 2003) and behavioural theories such as TAM (Davis et al., 1989) or innovation diffusion theory (IDT) (Rogers, 2003) have almost exclusively focused on eliciting enabling factors that influence system usage, with an implicit assumption that the opposite of such enabling factors equates to inhibitors (Cenfetelli, 2004). However, inhibitors are distinct and unique from the multiple arrays of enablers that have been studied in prior IS literature (Cenfetelli, 2010). The basis of inhibitor uniqueness in dissuading system usage lies in the asymmetrical negativity bias and perceptual bias prompted by the mere sighting of the presence of inhibitors in the systems usage. Asymmetrical negative effects serve to obviously signal a user that the system in use has poor features despite possessing positive features (Cenfetelli, 2004; 2010; Bhattacherjee and Hikmet, 2007). At the same time, the perceptual bias effect produces a much more diagnostic cue that can dissuade system usage behaviour or even negatively reduce the positive valence of the enabling factors (Cenfetelli, 2004; 2010; Bhattacherjee and Hikmet, 2007).

Bringing this concept of inhibitors theory to the ERP research domain, ERP default complexities associated with system features, such as difficulty in accessing the correct functionality, system output limitations, poor support in error situations and complexity of the system, have been attributed to ERP usage inhibitors (e.g., Hamerman, 2007; Iansiti, 2007; Topi et al., 2005; Soja and Paliwoda-Pekosz, 2009; Van Everdingen, 2000). Sousa and Goodhue (2003) conceptualize the effective use of ERP to be influenced by employees’ understanding of the system’s procedural knowledge (i.e. syntax, semantics and commands), application knowledge (the understanding of the business processes’ workflow mapped in the application) and business context knowledge (the understanding of the processes specific to the business across the organizational functions). However, poor acquisition of such knowledge, due to low absorptive capacity and inadequate training to acquire such knowledge and systems inflexibility, constitute the major inhibitors of ERP system usage (Al-Mashari et al., 2003; Iansiti, 2007; Kouki et al., 2006; Topi et al., 2006; Soja and Paliwoda-Pekosz, 2009; Sousa and Goodhue, 2003). Drawing from Task-Technology Fit (TTF) theory, a system misfit to the employees’ assigned tasks / business process has been noted to impact negatively on ERP individual performance (Kositanurit et al., 2006; Soja and Paliwoda-Pekosz, 2009; Somers and Nelson, 2003; Smyth, 2001). Lack of continuous improvement strategy from the top management, poor vendors’ service support, poor communication and lack of motivation among the employees are also considered as inhibitors to ERP system usage (Al-Mashari et al., 2003; Chang et al., 2008; Soja and Paliwoda-Pekosz 2009).

To categorize the enablers from prior studies, the TOE framework (Tornatzky and Fleischer, 1990) has been noted to be commonly used (Pan and Jang, 2008; Zhu et al., 2010). As generic theory of technology diffusion, the TOE framework can as well be used for studying related factors that dissuade ERP usage adoption. The TOE framework identifies three facets of the IS adopting organisation’s contexts, namely the technological, organisational and environmental context. The technological context describes both the internal and external technologies relevant to the

organisation. The organizational context consists of descriptive measures such as a firm's size and scope, centralization, formalization, and complexity of managerial structure, the quality of human resources, and the amount of internal slack resources. The environmental context is the arena in which a firm conducts its business: its industry, competitors and dealings with government (Tornatzky and Fleischer, 1990). Prior studies of ERP adoption drew from TOE to elicit enabling factors that positively impact on ERP success or performance (e.g., Pan and Jang, 2008; Shahawai and Idrus, 2010; Zhu et al., 2010). Consequently, building on the dual-factor model, TOE can as well be used to elicit inhibitors of effective use of ERP systems, since IS usage is determined by a simultaneous examination of enabling and inhibiting factors (Cenfetelli, 2004).

3. Methodology

3.1 A Delphi approach

Due to the nature of the study's research questions, the Delphi technique is deployed to address them. The Delphi technique provides a structured approach to collect data in a subjective environment of complex issues with aims to rank the issues identified (Broomfield and Humphries, 2001). The Delphi method allows for a systematic, interactive, iterative collection of expert opinions and critically evaluates them. Thereafter, the participants are encouraged to revise their earlier answers in view of the replies of the other experts to research a consensus. The process stops when either consensus has been reached among the participants or when sufficient information has been gathered (Okoli and Pawlowski, 2004). Generally, the Delphi technique is a procedure to obtain the most reliable consensus of a group of experts by a series of intensive questionnaires interspersed with controlled opinion feedback. With the Delphi approach, the experts' mental processes rather than statistical formulas are the primary processors of facts for convergence on the "best" estimate.
The ranking-type approach of Delphi proposed by Schmidt et al. (2001) is adapted and used for this study as shown in Figure 1. Such an approach overcomes many of the criticisms of the Delphi method as not having a valid statistical measure of consensus (Miaskiewicz and Kozar, 2006). The ranking-type approach is composed of three phases: brainstorming, narrowing down, and ranking. Consensus among the rankings of the participants is measured by using the Kendall's W non-parametric statistic. Schmidt et al. (2001) proposes that a Kendall's W value of 0.7 indicates high consensus among the experts. The round 2 and round 3 of the Delphi method were conducted electronically by the emailing of the questionnaire in a 5-point Likert scale (critical barrier (5) to not a barrier(1)) for round 2 and (deserves critical attention (5) to deserves no attention (1)) for round 3. Such emailing allows the participants to submit their responses online as well as to reduce the lengthy time associated with a Delphi research. Apart from ranking the inhibitors in round 3 of the Delphi study, the panellists were also asked to comment on how the inhibitors were reflected in their respective companies and suggest ways of improving them. The panellists were encouraged to do this because as Gummesson (2000) put forth "… those who are closest to a problem are also those who are best suited to identify the problem and suggest solutions" (p. 41). We therefore gleaned their comments to enrich the discussion section of the paper.

3.2 Expert's selection and sampling technique

Three major process companies in New Zealand as well as their SAP consultants were selected for this study. We use the pseudonyms PaperCO, DairyCO, AgroCO to represent the process companies and OxySAP to represent their SAP consultant to maintain confidentiality. PaperCO is into pulp and paper manufacturing, DairyCO produces dairy products, AgroCO is into animal husbandry and Agro allied products. These organisations were selected for three reasons. First, the three process companies are among the largest process companies in the Australasian region with a minimum number of around 10,000 staff. Second, the three process organisations have a mature SAP environment. Third, these organisations have adopted modules beyond the core financial modules since 1999, which include sales & operational planning (S & OP) of SAP, supply chain management (SCM) module comprising sales and distribution (SD) module and a material management (MM) module. Other modules include a strategic enterprise management (SEM) module for business analytics and SAP solution manager. It was on the basis of the contacts made in these companies that a three-round, non-anonymous Delphi technique, which was suggested by von der Gracht et al. (2008), was used.

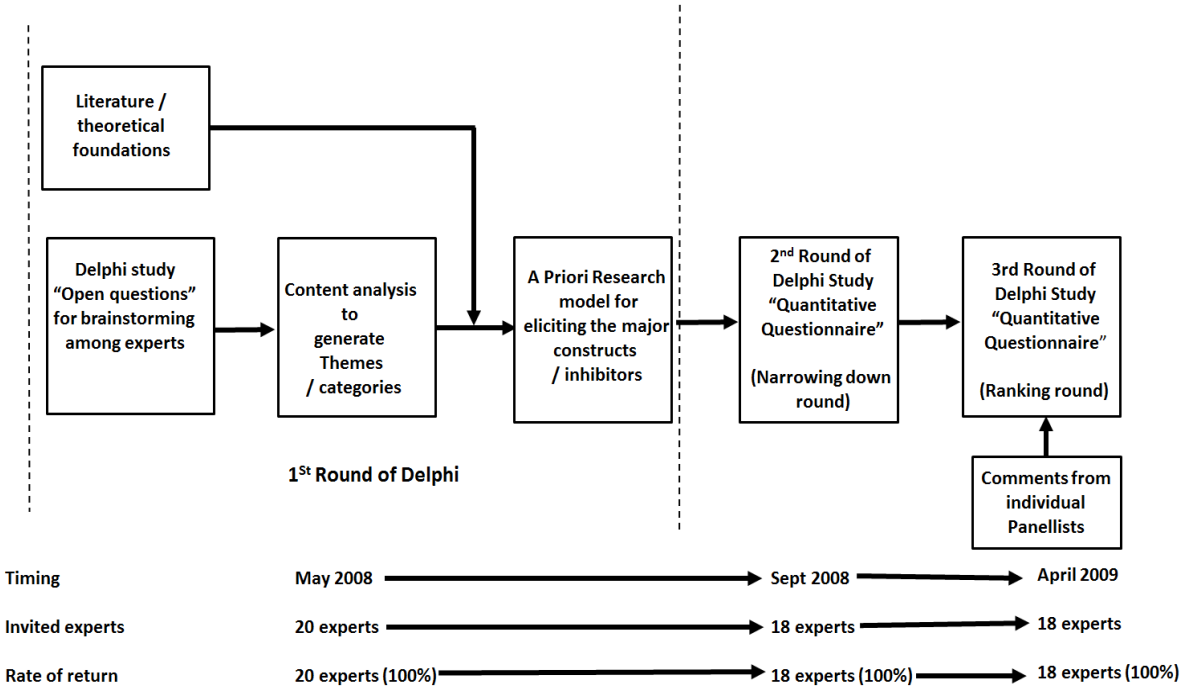

Figure 1: Steps of the Delphi study

Experts within these three companies were selected based on their great knowledge and minimum of 5 years experience in ERP systems usage (Cantrill et al., 1996). Consequently, 3 groups of managers in the strategic position were invited by snowballing sampling to cover a wide variation of experts for the Delphi process (Yeoh et al., 2008). These are 7 key users of SAP from PaperCO as well as 10 members of New Zealand SAP User Group (NZSUG) consisting of 6 member from DairyCO and 4 members from AgroCO. Three members from SAP vendor /consultant were also invited. NZSUG consists of key users of SAP licensed customers in New Zealand from the three major process industries mentioned above in New Zealand. The researcher solicited the help of influential persons to encourage participants to cooperate with the researcher (Hsu and Sandford, 2007). Top management personnel in PaperCO and the Chairman of NZSUG, who also participated in the Delphi approach, were the motivators.The researcher also had a face-to-face meeting with the panellists, to encourage more participation and commitment (Hsu and Sandford, 2007). The 20-member panel has been reported to be an appropriate sample to elicit information in complex issues using Delphi technique. Delphi sample size does not depend on statistical power, but rather on group dynamics for arriving at consensus among experts (Anderson and Schneider, 1993; Okoli and Pawlowski, 2004).

For 11 months (May 2008 – April 2009), the panel members assessed the content standards and indicators that make up the three rounds stated earlier. To improve the content standards of the issues under investigation in each round, the panel members were asked for suggestions. After each round, the standards were revised based on their judgments and comments after analyses by the researcher then sent to the panel members as feedbacks.

3.3 First round: Qualitative brainstorming session

The first round of the qualitative Delphi is focused on eliciting the factors considered to be inhibitors by the experts. Two open questions were used such as: *"How can we explore the use of SAP beyond the basic use we are currently doing? Have we maximized SAP capabilities in our everyday job challenges if not why?* The 20 panel members' responses that lasted for an hour were tape-recorded and transcribed. The open questions avail the experts the opportunity to brainstorm on the issues at stake with the researcher moderating the session with the aim of getting the experts focused. The use of open questions has been advocated by scholars (e.g., Collins et al., 2009; Hübner-Bloder and Ammenwerth, 2009; Nayan et al., 2010; Okoli and Pawlowski, 2004) for its appropriateness in eliciting the constructs or items especially in round one of Delphi.

The transcribed texts were imported into Nvivo qualitative software for content analysis and coding to elicit categories. First, we labelled the dimensions of the categories according to the "meaning they evoke", "words of respondents" or "borrowed from literature" (Strauss and Corbin, 1998). The main categories consist of non-repetitive, non-overlapping statements, which were identified as the meaning units of experience. In the next step, we went line-by-line through the texts in which we assigned each text phrase to a category. If a text phrase did not match the established categories, we defined a new category (inductive categorization). The whole system of categories was revised and adapted with regard to the subject and aims of the qualitative Delphi approach (i.e. eliciting inhibitors to the effective use of ERP systems from the experts) before finalizing the analysis. The resulting list of categories reflected the possible inhibitors. The overall categorization was done by the researcher and assisted by an independent coder; any differences in opinions were resolved by discussion. The categorization items include inadequate ERP expertise, ERP default attributes, non-collaborative training among employees, low absorptive capacity, poor user involvement, lack of continuous improvement, system misfit, consultant's ineffectiveness, and poor vendors' support. Drawing from TOE framework, TTF theory, the dual factor model and the findings from the qualitative content analysis in round one, a priori conceptual framework for the research was developed as shown in Figure 2. This framework is a conceptual taxonomy of inhibitors identified for further investigation in rounds two and three of the Delphi. It is meant to be representative, not causal; hence, there are no arrows.

3.4 Second Round: Quantitative Survey – The Narrowing Down Round

The nine categorized items in the first round were converted to questionnaires based on a 5-point Likert scale (critical barrier (5) to not a barrier (1)) as stated earlier. The questionnaires were emailed to the 18 panellists - for two of the panellists had withdrawn citing lack of time. As in other Delphi studies, systematic e-mail and telephone reminders were sent to the panellists for the questionnaires to be returned (approximately) on time and to support the response rates (Okoli and Pawlowski, 2004).Table 1 shows the analysis from SPSS 16.0; the quartile deviation value for all elements is less than 1. This means all experts agreed with all items given, with strong agreement among 7 items that have quartile deviation of 0.0- ≤ 0.5 (Nayan et al., 2010). Two items were valued as average, meaning that the panellists still have consensus, but within the middle range with a quartile deviation value between 0.6- ≤ 1.0 (Nayan et al., 2010). Two items (poor user involvement and consultants' ineffectiveness) were pruned out to ensure parsimony, having a median split value less than 3.5 for a 5-point Likert scale and a quartile deviation of value of 0.6- ≤ 1.0 (Bradley and Stewart, 2002; Nayan et al., 2010).

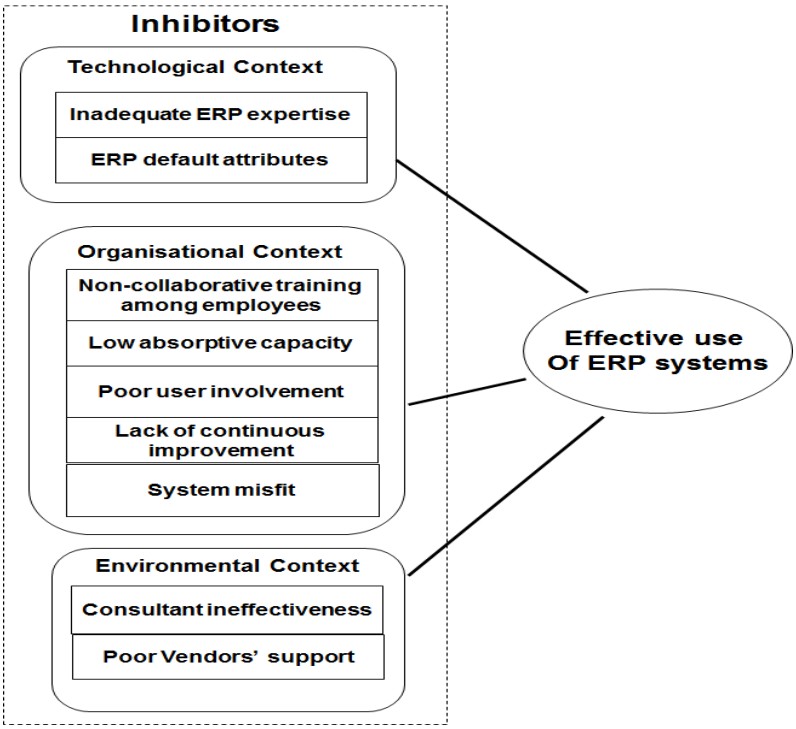

Figure 2: A conceptual taxonomy of inhibitors of effective use of ERP systems

Table 1: Item analysis for Round 2

S/N	Items	Mean	Median	Q3	Q1	Quartile Deviation
1	Non-collaborative training among the employees	4.7	5	5	4	0.5
2	System misfit	4.3	4	5	4	0.5
3	Inadequate ERP expertise	3.9	4	4.25	3.75	0.25
4	ERP default attributes	4.4	4.5	5	4	0.5
5	Low absorptive capacity	3.9	4	4.25	3.75	0.25
6	Poor user involvement	3.2	3	4	2.75	0.625
7	Lack of continuous improvement	4	4	5	4	0.5
8	Consultant ineffectiveness	3.3	3	4.25	3	0.625
9	Poor vendors' support	4.5	5	5	4	0.5

Quartile deviation of 0.0- ≤ 0.5 = 7 items and 0.6- ≤ 1.0 = 2 items

3.5 Third round: quantitative survey – The ranking round

The panellists were told to rank the selected items / inhibitors from round 2 in order of priority to arrive at the most inhibitors deserving of the manager's attention. In line with a prior study by Schmidt et al. (2001), multiple ranking rounds were conducted to reach an acceptable level of consensus by the panellists. Kendall's coefficient of concordance (W) was computed using SPSS version 16.0 in each ranking round to arrive at the panellist consensus. The ranking rounds stopped when the coefficient of concordance indicated a strong consensus (W ≥ 0.76). Earlier work by Schmidt (1997) stipulates the interpretation of Kendall's coefficient as shown in Table 2.

Table 2: Interpretation of Kendall's W

W	Interpretation	Confidence in Ranks
0.1	Very weak agreement	None
0.3	Weak agreement	Low
0.5	Moderate agreement	Fair
0.7	Strong agreement	High
0.9	Unusually strong agreement	Very high

The three ranking round results are shown in Table 3. Round 3 of the mean ranking, where Kendall's W is (0.76 < p 0.05), indicates a strong agreement among the 18 panel members (Schmidt et al., 2001).

Table 3: The three round Ranking of Inhibitors (n=18)

		Mean Ranks		
	Inhibitors	**Round 1**	**Round 2**	**Round 3**
1	Non-collaborative training among employees	4.7	4.6	5.0
2	Low absorptive capacity	3.9	4.0	4.5
3	System Misfit	4.4	3.9	4.4
4	Inadequate ERP expertise	3.5	4.5	4.0
5	ERP default attributes	3.8	4.3	3.8
6	Lack of continuous improvement	4	3.7	3.7
7	Poor vendors' support	4.5	3.6	3.6
	Kendall's W	**0.30**	**0.57**	**0.76**

To ensure the practical relevancy of this research we synthesised the empirically developed list of 7 inhibitors of effective ERP usage, as shown in Table 3, with what was gleaned from the comments the panellists made in round 3. As noted earlier, the comments emanate from the panellists' answers to the question on how such barriers reflect their companies' situations and the suggested ways of resolving them. From the developed items, only non-collaborative training among employees that is within the organisational context is considered as a critical inhibitor and most deserving of managers' attention, as shown in Table 3. From those three important inhibitors, only two (low absorptive capacity and system misfit) are related to organisational issues, while one (inadequate ERP expertise) is related to technical issues. Among the three moderate inhibitors, one (ERP default attributes) belongs to technical issues, while lack of continuous improvement is of organisational issues and the last inhibitor (poor vendors' support) falls within environmental issues.

We first focus on training issues since it is the most prevalent inhibitor to effective use of ERP systems. In the area of training, the implications are that process industries in New Zealand are experiencing misfit in their training process. It is incorrect to envisage that the strategic users are not trained; rather there are misalignments in the training process according to panel members. Management should, in the future, engage consultant trainers that will work in collaboration with the active users to develop their unique business context related training. The research strongly

supported the views of other scholars (e.g., Al-Mashari et al., 2003; Soja and Paliwoda-Pekosz, 2009; Sousa and Goodhue, 2003) that users have to be trained. However, the findings from the study suggests that users should be trained on the appropriate knowledge levels i.e. procedural knowledge, application conceptual knowledge, and business context knowledge (Sousa and Goodhue, 2003), in a participatory manner among the employees themselves. In doing this, the employees therein will develop a healthy psychological ownership of the system, and to personally identify innovative users to share their experience (Soja and Paliwoda-Pekosz, 2009; Sousa and Goodhue, 2003). In this way, management could reduce the resources expended in organizational learning in the future. The resources could be channelled to innovativeness by tapping into the users' unique insight of the business through effective use of the systems (Gupta, 2000; Sousa and Goodhue, 2003).

Second, low absorptive capacity among the employees, being defined by Cohen and Levinthal (1990) as the firm's inability to appreciate an innovation, to assimilate and to apply it to new ends, strongly requires organisational prior relevant knowledge and its investments in acquiring new knowledge (Ravichandran, 2005). ERP, being a complex system, imposes a heavy learning curve and, as such, the more a firm possesses prior ERP related knowledge, the more effective is its usage. ERP's low absorptive capacity and its default attributes of being complex as well as the perceptions it generated among employees gave rise to inadequate ERP expertise. To lessen the effect, the right type of training and individual skill development is highly needed (Calisir and Calisir, 2004; Soja and Paliwoda-Pekosz, 2009).

Third, the presence of system misfit, where the system is not aligning with the business process, contributed to ineffective system usage (Soja and Paliwoda-Pekosz, 2009). A typical example is in the area of process industry supply chain (SC) operations. ERP's support in SCM is of two dimensions: operational and strategic (Akkermans et al., 2003). For operational, panellists are of the view that the systems is compatible enough to support SC transactional functionality. However, in supply chain design, the panellists emphasised the inflexibility of ERP to support SC design and knowledge knowhow. For example, channel differentiation is used to service different market segments in the process industry, but their present ERP is not flexible enough to support such without much customization. Customization on its own is done with every necessary caution to avoid too much cost in keeping the consultants on site and to avoid subsequent upgrade difficulties (MacKinnon et al., 2008). For these reasons, the industry did not consider ERP as a critical enabler of Supply Chain, the panel members commented. One key area vendors normally advice is redesigning the industry business process to fit the functionality of the ERP systems to lessen customization (Soja and Paliwoda-Pekosz, 2009). However, this does not encourage competitive advantage as everybody is doing the same thing overtime. Another long-term issue the panellists revealed is the reengineering initiatives in ERP systems to support the industry. The panellists highlighted that such initiative demands a strategic leap that needs top management support (Ifinedo, 2008). It also demands external mediating agents such as the local vendors / consultants whose services are noted to be inefficient, probably due to inexperience, and the cost of hiring tested consultants outside New Zealand is usually prohibitive.

Fourth, the inadequate ERP expertise is heightened by the complex default attributes of ERP systems and lack of continuous improvement. Default attributes of ERP systems as an inhibitor stems from employee's difficulty in accessing the correct functionality to support their work-related tasks as well as the system's poor support in error situations. Based on this, the employees tend to lack expertise in handling the ERP system to achieve their dynamic and strategic job roles in the New Zealand process industry.

Fifth, a lack of continuous improvement by top management in not upgrading the ERP system heightens the ineffective use of ERP systems. Several ERP vendors in their recent updates tend to address users' complexity issues, improve on the system's flexibility and its business process adaptability. However, if the adopting organisations are not appropriating the upgrades on time they will continue to face usability challenges. This situation was buttressed by one panellist's comment that "*they now have a legacy ERP system"*, suggesting that after the implementation the management shows less concern in upgrading the system. Top management on their own are not committed to upgrades due to the risk associated with it and the huge financial implications (Soja and Paliwoda-Pekosz, 2009; Van Everdingen, 2000).

Lastly, poor vendors' support also contributes to ineffective use of ERP by strategic managers. ERP vendors tend to be proactive and very much concerned with implementation success. However, once the system "goes live" they seem to relax in their pragmatic approach to assist the adopting organisations to ensure effective use of the system (Hakkinen & Hilmola, 2008; Pan et al., 2007). The adopting organisation should in the future liaise with vendors to adopt collaborative usability mechanisms. Such mechanisms will encourage vendor-client collective understandings in dealing with ineffective use of the system among strategic managers.

4. Contribution of the study

By addressing the research questions, one important contribution of the study was in identifying the seven inhibitors we have earlier discussed, seen to have impacted negatively on the effective use of ERP systems in the process industry. By ranking such inhibitors in the order of relevance, the study presents non-collaborative training among employees as the top-most inhibitor to deserve manager's attention followed by other inhibitors as its second major contributions. By such rankings the managers could prioritise their strategic interventions in line with the available resources earmarked for IS continuous maintenance by the top management. These inhibitors are classified as internal inhibitors; the only exception was poor vendors' support that is classified as an external inhibitor. Internal inhibitors can be resolved within the adopting organisation by the strategic managers since their attentions have been drawn in this study using Delphi technique, while the external inhibitor need to be addressed by collaborating with the vendors of ERP systems in this case SAP. These contributions have addressed the extent to which the study has answered the research questions. Besides, it has also addressed the limitations of the existing literature, which seems to concentrate more on enablers of ERP usage adoption, with an implicit assumption that the opposite of such enabling factors equates to inhibitors. By integrating the commonly used theories in IS, the study has been able to categorize and rank the inhibitors that are qualitatively distinct from the enablers as factors that could inhibit the effective use of ERP systems in New Zealand's process industries.

5. Limitations

The study was not without limitations. Specifically, since the Delphi method requires participants with varied expertise, the researcher had to rely on the recommendations of other experts considered as motivators to populate the panels. This process is known as daisy chaining and has the potential to form cliques. The study considers only process industries with SAP installed base; therefore the findings might not be generalized to other ERP software such as Oracle or Microsoft ERP products (Navision, Axapta), especially on findings related to ERP default attributes. Delphi multistage probing requires considerable time, and, in addition, the fact that participants inevitably drop out after the first round of the three round iteration process might slightly affect the result.

6. Conclusion and further research

The empirical findings of the study suggest that ERP adopters in New Zealand's process industries are not achieving the strategic business value identified in the project justification due to employees' ineffective use of the systems. It has also further heightens the need for ERP adopters to evaluate every phase of the ERP innovation process to understand the weakest link, especially in the appropriation phase. Apparently, ERP adopters in New Zealand's process industries have witnessed implementation success, but this study takes it further to reveal that despite that, there are inhibitors to the effective use of the systems.

By integrating TOE framework, TTF and IT inhibition theories as well as using the Delphi technique, we highlight the top-most inhibitors that support ineffective use of the ERP systems in the organisations seen as distinct and unique from the multiple arrays of enablers of ERP use that have been studied in prior IS literature. With hardly any research in New Zealand to determine inhibitors of effective use of ERP systems, this study has shown that while the firms have registered implementation success, they are hindered from achieving the strategic business value because of the prevailing constraints, some of which are more specific to New Zealand's process industries, especially in the areas of collaborative training among employees and poor vendors' support. Consequently, the next dimension that emerged in this study was the proffering of solutions to overcome such prevailing inhibitors by the strategic managers seen as expert users who were eager to go beyond the basic use of the ERP systems. By proffering such solutions for top management's attention by the managers themselves who occupy various strategic roles in the adopting organisation, confirms the practical relevancy of the study, which has not been the focus of prior ERP studies. Several IS researchers have highlighted the need for IS studies to be relevant to practitioners

as well as maintain the dictates of a rigorous academic research (e.g., Benbasat & Zmud, 1999; Rosemann & Vessey, 2008). In summary, by way of answering the research questions, the study has been able to: (1) identify the inhibitors plaguing New Zealand's process industry, (2) prioritised them for management's attention, and (3) suggest practical solutions to overcome such inhibitors for managerial interventions. Besides, for us to pay heed to the previous section remarks on limitations of the study, a further research could consider other types of ERP software packages with reference to other industries in New Zealand.

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Appendix: Delphi Brainstorming Session and Survey Questionnaires

Delphi Investigation to Identify the Barriers to Effective Use of Process Industries' ERP systems in New Zealand

Round 1 – Brainstorming Session

Dear Valued Participants,

I thank you for agreeing to take part in this Delphi 3 round study. We are starting with the brainstorming session that will take an hour of your time. Having made huge investments in implementing ERP systems, the study aims to identify the supposed barriers that could restrain the users from maximizing the business value of the systems in New Zealand's process industries.

The questions for our deliberation are: *"How can we explore the use of SAP beyond the basic use we are currently doing? Have we maximized SAP capabilities in our everyday job challenges if not why?.*
I posted these questions to you all prior to the brainstorming session for your reflections. To avoid cliques, please do not share your reflections with any of your colleagues prior to the brainstorming session.
The venue for the brainstorming session is Waikato Management School auditorium; the attached camus map will assist you to easily locate it. It will begin at 10:30 am on May 15 2008

Once we have received responses from all participants during the brainstorming session your tape recorded voice will be transcribed and coded to derive themes and formulate the first questionnaire, which you should receive within the next two weeks. To minimise the time between successive rounds

of the Delphi survey it would be appreciated if you could return each questionnaire within two weeks of receipt via email: gerrychi@gmail.com
We would like to remind you that individual responses will be strictly confidential to the research team and will not be divulged to any outside party.

If at any time you would like to discuss the Delphi study, please do not hesitate to contact me.

Regards

Chidi Ononiwu

Department of Management Systems
Waikato Management School Hamilton

Delphi Survey to Identify the Barriers to Effective Use of Process Industries' ERP Systems in New Zealand

Round 2 – The Quantitative Survey Round

Dear Valued Panellists,

Thank you very much for your 100% attendance in the first round of our research and the tremendous contributions you made during the brainstorming session. Based on that, we have identified nine key barriers to effective use of process industry ERP in New Zealand, namely:

1) Inadequate ERP expertise
2) ERP default attributes
3) Non-collaborative training among employees
4) Low absorptive capacity
5) Poor user involvement
6) Lack of continuous improvement
7) System misfit
8) Consultant ineffectiveness
9) Poor vendor support

I converted these nine key barriers into questionaries as shown below for the second round of the Delphi study. Please indicate your answers by means of a tick in the appropriate box. If there are any objections to these barriers we have gleaned from the brainstorming session you are highly encouraged to comment on them.
All information provided will be treated in the strictest of confidence and in line with ethic codes of the university. If you do not want to receive further emails on this subject you are equally free to indicate.

Thank you for your valued participation

Regards

Chidi Ononiwu

Department of Management Systems
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	Please check which ERP system you use in your organisation. You can tick more than one depending on your usage.	SAP ☐	Oracle ☐	Elixir ☐	Microsoft Navision / Axapta ☐	Best of breed (BoB) and Others ☐
	Please check according to your level of perception to any of these factors you consider as being barriers to effective use of your ERP systems Please check only one box in a row from here	*not a barrier* 1	*minor barrier* 2	*moderate barrier* 3	*important barrier* 4	*critical barrier* 5
1	Inadequate ERP expertise	☐	☐	☐	☐	☐
2	ERP default attributes	☐	☐	☐	☐	☐
3	Non-collaborative training among employees	☐	☐	☐	☐	☐
4	Low absorptive capacity	☐	☐	☐	☐	☐
5	Poor user involvement	☐	☐	☐	☐	☐
6	Lack of continuous improvement	☐	☐	☐	☐	☐
7	System misfit	☐	☐	☐	☐	☐
8	Consultant ineffectiveness	☐	☐	☐	☐	☐
9	Poor vendor support	☐	☐	☐	☐	☐
In your opinion, what other barriers of effective use of ERP systems in your organizations? Please describe it fully in this space.						

Thank you very much for participating!

Delphi Survey to Identify the Barriers to Effective Use of Process Industries' ERP Systems in New Zealand

Round 3 – Ranking Round

Dear Valued Panellists,

Thank you very much for your reply in the second round of our research. This is the final round of the Delphi survey. Generally, it has been very impressive and I commend you all for that. However, we have not yet reached consensus. In the previous rounds we only had two drop outs citing lack of time to continue. Please see the results of round 2 and if there are any objections you are free to comment.

Table 1: Item analysis for Round 2

S/N	Items	Mean	Median	Q3	Q1	Quartile Deviation
1	Non-collaborative training among the employees	4.7	5	5	4	0.5
2	System misfit	4.3	4	5	4	0.5
3	Inadequate ERP expertise	3.9	4	4.25	3.75	0.25
4	ERP default attributes	4.4	4.5	5	4	0.5
5	Low absorptive capacity	3.9	4	4.25	3.75	0.25
6	Poor user involvement	3.2	3	4	2.75	0.625
7	Lack of continuous improvement	4	4	5	4	0.5
8	Consultant ineffectiveness	3.3	3	4.25	3	0.625
9	Poor vendor support	4.5	5	5	4	0.5

Quartile deviation of 0.0- ≤ 0.5 = 7 items and 0.6- ≤ 1.0 = 2 items

Table 1 shows the analysis from SPSS 16.0; the quartile deviation value for all elements is less than 1. This means all experts agreed with all items given, with strong agreement among 7 items that have quartile deviation of 0.0- ≤ 0.5 (Nayan et al., 2010). Two items were valued as average, meaning that the panellists still have consensus, but within the middle range with a quartile deviation value between 0.6- ≤ 1.0 (Nayan et al., 2010). Two items (poor user involvement and consultants' ineffectiveness) were pruned out to ensure parsimony, having a median split-value less than 3.5 for a 5-point Likert scale and a quartile deviation of value of 0.6- ≤ 1.0 (Bradley and Stewart, 2002; Nayan et al., 2010).

Based on the result of roll 2 we now have 7 key barriers. You are now asked to rank these 7 key barriers in the order of importance for managers' attention. The ranking round will be done three times until we achieve consensus. Also you have to comment on how the barriers reflect your present company situation and suggest ways of improving them. We encourage you to do this because as Gummesson (2000) put forth "*… those who are closest to a problem are also those who are best suited to identify the problem and suggest solutions" (p.41)*.

	Rank these 7 barriers in the order of importance to deserve managers' attention **Please check only one box in a row from here**	*Deserves no attention* **1**	*Deserves minor attention* **2**	*Deserves moderate attention* **3**	*Deserves important attention* **4**	*Deserves critical attention* **5**
1	Inadequate ERP expertise	☐	☐	☐	☐	☐
2	ERP default attributes	☐	☐	☐	☐	☐
3	Non-collaborative training among employees	☐	☐	☐	☐	☐
4	Low absorptive capacity	☐	☐	☐	☐	☐
5	Lack of continuous improvement	☐	☐	☐	☐	☐
6	System misfit	☐	☐	☐	☐	☐
7	Poor vendor support	☐	☐	☐	☐	☐
Please comment on how the barriers reflect your present company situation and suggest ways of improving them in this space.						

All information provided will be treated in the strictest of confidence.

Thank you for your valued participation

Regards

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