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A hybrid system of enterprise resource planning (ERP) and informality

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Abstract

One of the current research trends in Enterprise Resource Planning (ERP) involves examining the critical factors for its successful implementation. However, there is limited beyond system implementation, focusing on flexibly of ERP to respond to changes in business. Therefore, this study explores a combination system, involving an ERP system and informality, which focus on providing a company with efficient and flexible performance simultaneously. The paper aims to understand the constraints of using a single ERP system, and to define a new system corresponding to these problems, which is achieved by studying four Chinese companies operating in different industries. The study reveals that an ERP with pre-determined business activities cannot react promptly to unanticipated changes in a business. Incorporating informality into an ERP can react to different situations by using different procedures that are based on the practical knowledge of frontline employees.

Keywords: enterprise resource planning (ERP), enterprise social system, case study

1.0   Introduction

The Enterprise Resource Planning (ERP) system is one of the most essential enterprise software products. It has mainly been used to support business efficiency by integrating cross-functional business processes or intra-company processes via a centralised database (Brown and Vessey, 2003), achieving, as a result, seamless transaction automation across an entire organisation (Bancroft et al., 1998). However, a conventional belief about the ERP system is its inflexibility: for example, the system is a given artifact, and is not open to change (Pozzebon et al., 2006). In practice, ERP systems are also notable for their high failure rate, because the fixed design planning system cannot satisfy flexible performance requests (Al-Mashari, 2002). The inflexibility problem exists in the history of ERP research. This research categorise ERP into three generations.

2.0   Literature review

As illustrated in Table 1, Before the 2000s, the ERP system was a standard software package that entailed gaining knowledge of best business practice and applying this to improving existing performance or replacing legacy practices. For example, Gable

(1998) defines the ERP system as a comprehensive software package that seeks to integrate the complete range of business processes and functions in order to present a holistic view of the business from a single information and information architecture (Al-Mashari et al., 2003). During this period, most of the ERP systems were off-the-shelf software packages that dealt with the complexity of implementing the system, such as the technical and managerial choices and challenges(Markus et al., 2000; Wu and Wang, 2007). The key benefits of a standard ERP system are the integration of the business processes of an entire organisation; inherent best practice for different industries; the automation of millions of business transactions; and co-ordination of different functional groups or organisations within a standardised information platform (Davenport, 1998; Shang and Seddon, 2002; Akkermans et al., 2003). During that time, people emphasised the selection of software vendors and system implementation (Ahn and Choi, 2008). Business process redesign is involved in the implementation of an ERP to redefine a firm's business processes to fit the standard model of the software (Kraemmerand et al., 2003). However, trying to align the system and an organisation can become an insoluble problem that sends budgets soaring, and can ultimately lead to the ERP system not being adopted at all. For example,Wagner and Newell (2004) challenges a standard ERP system that fails to align with the diverse practices of an organisation.

As illustrated in Table 1, in the early of 2000s, a customised ERP system with continuous improvements emerged to mitigate the misalignment problem (Wei et al., 2005; Sia and Soh, 2007). This was the second generation of ERP as a dynamic configurable system aimed at fulfilling specific needs and tasks within an organisation. For example, the Industry ERP (IERP) aligns with specific industry requirements that can be continuously examined and refined (Wu et al., 2009). The system is an ongoing cycle of design, use, and modification, intended to connect technology and its users (Leonardi and Barley, 2008). However, developing a customised ERP system and then carrying out continuous system improvements involves high costs and long delays in using the system. In addition, business customer demands continue to change ever more rapidly, and the system is unable to respond flexibly to these changes (Akkermans et al., 2003). Current research into embedding SOA (service-oriented-architecture) and computing techniques in an ERP allows for flexible configuring and reconfiguring of the system (Cheng et al., 2010),

but the customised system (i.e. SAP Business by design system) is still based on a prototype of an industry that embeds standard industrial practices. Furthermore, according to Slack and Lewis (2011:187) real world operations are complex, entailing problematic business tasks that cannot be tackled by using process technology (i.e. ERP). Human processes are required in parallel to the ERP system, since certain problems are inherently non-computable. In particular, when a company provides a service to customers, a system cannot hold a conversation with the same sensitivity as a person.

Therefore, the main gap in existing ERP research is that system inflexibility has not been solved. On one hand, the system is inflexible in keeping pace with the changes in the business. On the other hand, the system is inflexible to use when a company needs to solve a non-computable problem.

2.3   Revising the gaps in existing ERP research

The following outlines three-fold gap in the existing ERP studies.

2.3.1   Gap 1: System inflexibility

First, the system has always been criticised for being highly flexible in the beginning, but more rigid later (Davenport, 2000, p. 16). For example, Rom and Rohde (2006) claim that an ERP system and its processes can be planned, but its subsequent use cannot. Moreover, Bendoly and Jacobs (2004) in particular point out that an ERP is limited to flexibly fulfilling customer orders with tailored processes. Thus, improving the flexibility of the ERP is highlighted in the existing research (Gaimon et al., 2011; Newell.S et al., 2003).

The latest ERP system embracing SOA and cloud computing techniques is used to achieve flexibility in system configuration (Cheng et al., 2010). This flexible system can only be dynamically configured or re-configured with new business models and processes (Maurizio et al., 2007), which have flexible and saleable architectures. However, existing ERP systems still cannot support the flexibility in dealing with business uncertainties. With regards to increasing the flexibility of an ERP, some research mentions extending an ERP with e-business functions (e.g. JIT) (Boersma and Kingma, 2005b), although the ERP only resolves emerging problems that are

predictable. The limitation of existing ERP research is that the system is not flexible in responding to unanticipated business events with a wide range of disparate operational practices. The practices may be based on the intelligence of the employees on different levels or in disparate fields within an organisation. Thus, this research focuses on the flexibility of a system that can respond promptly to business uncertainties.

Moreover, as Slack and Lewis (2011: 193) pointed out, a trend in process technology (e.g. ERP) of enhancing flexibility while still remaining reasonably efficient, and vice versa, due to market pressure. A challenging and demanding market requires a company with the mixed performance factors of efficiency and flexibility. However, a single ERP cannot fulfil these mixed operating needs, so the importance of this research is that it explores a mixed system, which not only efficiently processes business transactions, but also flexibly reacts to unanticipated business situations.

2.3.2   Gap 2: Lack of study beyond system implementation

The second gap is that most of the extant literature on the ERP system tends to focus on system adoption, the implementation of success factors, and methodology (Mabert et al., 2003; Poba-Nzaou et al., 2008; Forslund and Jonsson, 2010). The first generation ERP focuses on the development of an ERP software package in business, and the second generation of ERP highlights ongoing system improvement in the post-implementation stage. Yet there is little empirical evidence for the system beyond system implementation and exploring its IT functions, particularly in placing emphasis on the relationship between the ERP system and human behaviours in an organisation. 'Sociomateriality' theory indicates that system (e.g. ERP)-based structured practices and the behaviours of human beings mutually impact on each other, and are therefore both essential to daily business activities (Orlikowski, 2007). Unlike other research concentrating on ERP system implementation or its IT functions, this thesis focuses on two types of business practices enabled by a system - business processes supported by an ERP system and activities derived from the knowledge of human beings.

2.3.3   Gap 3: Failure to consider the ERP system from both a managerial and individual standpoint

Finally, existing research shows the benefits of the ERP at both a managerial and individual level (Amoako-Gyampah, 2004). On a managerial level, the system as an "all-in-one" solution supports automation, standardisation, integration and cooperation. The first generation of ERP is mainly used to achieve managerial objectives. However, on an individual level, an ERP needs to be flexible, agile, and to align with practical needs. The second generation ERP goes some way to providing more scope on an individual level. Most of studies merely emphasise embracing system users' knowledge in supporting system implementation or ongoing development (McGinnis and Huang, 2007; Elmes et al., 2005; Cadili and Whitley, 2005), but there lacks a parallel study to look at whether the system's supposed advantages complement the day-to-day operation of a company. This research will study an ERP system in parallel with human practices, how they impact on each other to foster a hybrid model, and ERP's influence on different management levels.

2.4 The third generation of ERP: combining both formal and informal processes

As the gaps in the above research indicate, this study will focus on exploring a new system, with the mixed performance of efficiency and flexibility as proposed ERP generation III (Table 1). Chinese companies particularly require both types of operational performance, as the business environment is increasingly complex and turbulent (Huang et al., 2012) Informality is a significant feature of Chinese firms, as the business culture is shaped by personal and high-context communications, non-systematic decision-making and unstructured business processes (Yeh and OuYang, 2010; Choi et al., 2013).

Thus, embedding informal processes in the ERP system may be of benefit to these firms. The following table summarises the key features of the two existing types of ERP, and proposes a third type of ERP, which combines both formal and informal processes. The ERP-based formal processes are related to pre-definable processes that can be characterised by the fixed definition of tasks, and the order of execution. Informal processes, by contrast, are non-routine processes (Xu, 2011), not codifiable with experience, difficult to document in detail, ephemeral and transitory (Ray and Clegg, 2005).A company implementing informal processes might be able to flexibly

respond to the emerging changes in the market in which frontline employees voluntarily participate.

As this new system will be interested in a company with an informal culture, the following studies will focus on 'ERP' and 'informality'.

	ERP Generation I	ERP Generation II	Proposed ERP Generation III
Concept	Standard ERP software (Best of breed/off-shelf/prototype)	Customised software with continuous improvements (IERP) (SAP BYD system)	Combine both pre-defined procedures and non-routine processes to perform business tasks
Focus on	Selection & implementation	Post-implementation & maintenance	System efficiency and flexibility
Benefit	Integration Inherent best practice Coordinate different organisational sites with a standard information system	Ongoing improvements Customisation	Flexibly respond to business changes
Theory	Business process redesign	Business alignment	Sociomateriality
Examples	(Light et al., 2001; Davenport, 1998; Soh et al., 2000)	(Cuellar and Gallivan, 2006; Cadili and Whitley, 2005; Leonardi and Barley, 2008)	N/A
Problems with existing literature	Misalign with the business context	Inflexible in reacting to changes Inflexible in solving non-computable problems	N/A

Table 1.   A comparison table of three ERP systems.

3.0   Research methodology

The paper presents an empirical study of four manufacturing firms through semi-structured interviews of IT managers, senior managers and key users. Following the theme, information from the case study research is corroborated by other data sources to ensure its validity, including company handouts, websites, presentations and organization charts. The data analyses uses the replication approach (Yin, 2009: 56) in which the underlying logic of this method is replication, that is conducting a series of cases on related topics, with each case serving to confirm or disconfirm the hypotheses. The cases in this study are all Chinese manufacturing firms who have implemented ERP systems over an extended period. Table 2 summarises company

profiles consisting of firms' background, ERP system usage, the attitudes towards 'informality' and organisational contexts. In general, all companies have the following characteristics:

- They are all in Chinese firms;
- They all have a clear and long-term vision;
- They have implemented ERP for 3 years or longer;
- They meet different emerging problems in the adoption of ERP systems.

Company	A	B	C	D
Company background				
Production type	Food (meat process)	Electronic equipments (i.e. televisions, projectors, LCD televisions)	Display Technologies applied in digital, communication devices	Commercial mall operator (focus on home-furnishing products)
Year of creation	1993	1996	2002	1995
No. of employees	3000+	1000+	1000+	1000+
Capital structure	Local Chinese manufacturer	Sole corporation, subsidiary of a Japanese firm	Sole corporation, subsidiary of a Korea firm	Local Chinese shopping mall
The usage of the ERP system				
Start of adoption year	1996 2006 (2nd implementation)	1997	2002	2009
Adoption method	SAP standard software + ongoing improvement by IT dept.	SAP (standard software from HQ)	Customized system based on Oracle by sub-company (phased)	Digital China
Functional coverage of the ERPs	Production, purchase, plan, sale, finance, logistics	Production , purchase ,planning, EDI	Procurement, material mgt. , production+ HR	Leasing service, point-of-sales in mall, finance & accounting, business
Informality characteristics				
Organization structure	Hierarchical	Team work	Team work & loose structured with informal groups	Flatted structure (4 management regions)
Communication method	Top down	Top down	Bottom up	Bottom up
Leadership approach	Formal, rigorous	Formal, rigorous	Empowerment	Empowerment

Table 2. **Characteristics of Chinese manufacturing companies**

4.0　Case studies

One of major outcomes of this research is to conceptualise the concept of informality for companies' implementation of ERP systems. This is achieved by an analysis of four cases revealing both variability in how an ERP is utilised in practise and also the constraints imposed by ERP systems.

4.1　Technology in Practice

Company A feels that it does not require 'informality' as the firm is only focused on the use of ERP systems for support operations. It used MRP II in the 1990s, and then changed to use ERP in early of 2000s. However, the hierarchical structure in the organization means that end-users are not able to have frequent interactions with senior management which is a barrier against them solving problems that are occurring in the processes. This lack of communication is described by an IT manager at the company.

> *"The logistic system systemic analyses and calculates the weight of each production lot. However, in practice the company has made mistakes in delivery. For example, the delivery carrier found that the initial system designer had forgotten to calculate the size of the delivery box. Sometimes, workers arrange the delivery job by themselves. Nearly every 6 months senior managers noticed the problem and realized they needed more flexibility and timely changes in order to react to the problems that are experienced by end users."*

Thus informality in the manufacturing firm could assist in communicating the practical experience of workers to managers who could then make timely changes to production practices. We define this dimension of informality for manufacturers as the "technology-in-practice" concept introduced by Orlikowski and Scott (2008). This concept highlights the need for an ad hoc process for knowledge-intensive management The first finding of 'technology-in-practice' means bringing the practical knowledge of shop floor employees to align the system based practices and business reality. The organisation context motivates to employees share 'informal knowledge' that resides in individuals' minds, which is tacit, unstructured and un-codified (Tsoukas and Vladimrou, 2001). Company A shows, when an ERP system is used, the practical knowledge of system participators is valuable and contributes to aligning the system performance and the understanding of the changes. The latest research also

indicates the importance integrated emergent knowledge in practice to support IS changes (Lyytinen and Newman, 2008). In case A, if the firm can perform informally that embedding human practice with real-time improvements on system, the factory does not need to endure heavy losses, due to the wrong delivery over such long time.

4.2   User flexibility

Company B has high quality IS support from HQ, and they implemented EDI to support the e-procurement system. However, even if company B used EDI platform to interact with suppliers effectively, the risk due to the inflexibility of the ERP is not solved. Moreover, the firm's orders are unpredictable and changeable, which are assigned by HQ. This means that sometimes they need to work informally to react to uncertainty as the technical department manager recalls,

> *"For example, initially, say we had orders for 15 million units. But two days later, HQ reduced the orders to 10million. We changed the purchasing orders to suppliers in the e-procurement system immediately. But in China, a supplier needs to confirm all the orders with a written contract, even if we change the e-procurement system. Suppliers are not willing to reduce orders after a written request to supplier is already set. We received the extra 5 million raw materials, but we cannot input the information in the system, as the stock information links with the MRP planning system. All the production plans might be in a mess! We will add extra material information into the system for the following month, so that next month the actual amount of purchasing order is less."*

There are two type of flexibility in information systems (IS) of 'flexibility-to-use' and 'flexibility-to-change'. The former one is defined as integrating a range of process requirements into an information system (IS) without major changes to the system itself, while the latter one is required to change a given IS (Gebauer and Lee, 2008). We define this dimension of informality in manufacturers as enabling "user flexibility" that allows users to flexible change the production order or production process. An important aspect of user flexibility concerns the importance of 'informal control'. Informal control concerns empowering knowledge workers to engage in everyday business. This is an organisation condition that allows employees to flexibly change a

production order or production process under different situations. According to Ignatiadis and Nandhakumar (2007), "too much control can serve to streamline the operations of a company, but at the same time can decrease the resilience of the company to respond to future changes." Case B faced the problems of unanticipated changes of the production orders. However, due to rigorous inventory control embedded in the ERP system, the organisation experienced misalignment that the system does not synchronize with reality. Even worse, turbulent operation occurred because of inconsistent information in the system to support day-to-day operations. If the ERP is used in a control-driven context with formalised working processes that misaligned with the sub-units' organisation context, it will disrupt operations in an organisation. Therefore, informality is represented as an empowering environment in a subsidiary that allows interdependence of frontline employees, and they can make their interpretations on the operations in the business, so as to align the ERP-based practices with the business practices in reality.

4.3   Trusted human networks

Compared to company A and B, company C has an harmonious working environment but any benefits gained from informality are unintentional. Manufacturer C have problems of low quality goods and losing or damaging goods due to delivery because its goods are fragile. What is more, HQ requires the company to implement a "zero inventory" management approach. The IT manager and HR manager discuss how the firm could deal with these uncertainties.

"We can either work overtime, or can reschedule the production plan. From HR's perspective, working overtime is difficult to implement, as most of the employees are not willing to do so. The planning department are not willing to reschedule the production plan, as it is complex and takes time to re-run the MRP and purchasing plan for the whole orders. Sometimes, the production department complains that there is not enough capacity on the production line to do the additional orders. So we have a group called "TASK" composed of a few people from different departments to work together and to discuss the best solution for the issue. The people in the "TASK" group also link with the other colleagues in the IG group. Thus, nearly all the employees sit

> *together to discuss the solution through our "collaboration" platform*
> *(online discussion forums).*

Company C requires an informal system to react unexpected production problems. The informality from company C is 'trusted human networks' that emphasises on work collaboratively through establishing a social relationship. The finding of this case illustrates the importance of 'informal communication' to flexibly react to unexpected production orders. The communication is supported by an informal system, for example of the online discussion forums in company C. The enterprise 2.0 technology is able to achieve collaborative intelligence that generates answers from a dispersed group (McAfee, 2009, p.139). The informal system is able to collect informal knowledge, that is, tacit and uncodified knowledge based on personnel's experience, which can complement the limitation of the formal enterprise system – the ERP only focuses on the collection of formal knowledge (documented knowledge) in a system database. As a consequence, the combination system benefits the firm co-ordinates operations with aligned actions in different functional departments by using the ERP system, and achieves cooperative operations among individuals in disparate fields, so as to produce a solution to unforeseen circumstances with diversified views. Thus, the informal communication network supports the delivery of emergent solutions for uncertainties in the business. Here we can see that informality for a manufacturer also means to have "trusted human networks" (Zhao and Rosson, 2009) to work collaboratively. The networks here are not merely a physical communication platform, but it is an organisational climate that supports emotional interactions and establishes a social relationship. The solutions to the uncertainties are found through collective members.

4.4   Flexible reaction to uncertainty

Company D has relatively high levels of uncertainty and is required dealing with t the variability of changes. First, the requests of tenants on stalls change frequently, such as the number, size and the location of stalls. To fulfil the request, the firm needs to flexibly adjust the stall to satisfy their request. As a Leasing Department manager stated:

> *"...we need to deal with changes in layout of the stalls frequently, in*
> *order to reduce the vacant stalls in our mall, while the ERP system*

does not allow us to achieve it flexibly. If two stalls were originally separate but are going to be combined, it could cause problems for us. Sometimes, the contracts of two tenants expire at different times. One tenant's contract will have expired, whereas the other's won't have. If the new tenant is willing to rent the two stalls, we need to combine two stalls. However, the ERP system does not allow for a stall to be operated by two people. Thus, we cannot provide a formal contract for the new tenant until the existing tenants have left…"

Secondly, unpredictable changes also lead to the adjustment of the shop layout in the firm, such as the changes of shoppers' interests, government policy on relocation estimate and the variability in seasonal demands of stalls. According to a Branch manager :

"….as the standard of living goes up, so too do the demands of customers - through continually enhancing the mall's product structure and positioning and layout, we are able to satisfy these ever-increasing needs of consumers…"

Under such circumstances, the employees in the store attracted new retailers to the shop, who were able to accommodate the needs of the shoppers in the local market. When the company achieved a good adjustment in production structure, the sales of tenants were increased, which in turn meant that the store's revenue could be increased. As a consequence, these tenants had priority over ordinary tenants in signing a lease contract in the mall.

Eventually, Head Office decided to implement ERP and office assistant (OA) simultaneously to improve the flexibility of using ERP systems. The OA system as an informal system supported interactions between experts/senior managers and employees, including sharing business reports, publishing business notices, document approval and a communication forum. As experts play the important roles in approving business activities on the system, this research also calls it an 'expert online system'. On this platform, any report and document of an informal process and informal contract may be replied to and discussed by the senders and the receivers. In

order to solve the inflexibility of ERP, OA connected to the ERP system to enhance communication in the 'informal process' and to maintain flexibility in reacting to the variability of demands based on the experiences of employees. It is mainly used to support system users and for expert groups to hold discussions on this platform. The informal process may still be operated by frontline employees, as company D believes only frontline workers can respond to the needs of tenants effectively, as they have valuable insight into the local market. However, all of these activities need to be carefully examined and approved by the experts to mitigate individual bias in selecting which tenants can enjoy the privileges. Finally, informal contracts are documented in the system in order to support the further financial analysis with enterprise-wide information.

Based on these cases, 'informality' as an organisational management approach is considered, with the following four traits:

- Participative management embeds the practices from frontline employees to mitigate the inconsistency between system-based performance and reality; this is called 'informal control' in this research.
- User interpretive flexibility allows the user to interpret the appropriate operational approaches by frontline employees, in order to operate an enterprise system, in line with the local operation strategy; this is called 'informal knowledge' in this research.
- Human interactive network coordinates personnel from disparate fields, so as to produce solutions to unanticipated circumstances from diversified points of view; this is called 'informal communication network' in this research.
- Operation flexibility performs flexibly to meet the varied market demands, which means business activities are not strict at predetermining responsibilities and procedures; this is called informal process in this research.

5.0   Discussion

Companies C and D illustrate that a hybrid system contains formal and informal elements. A formal system is an ERP system, and an informal system is an enterprise social system applied by a company to support frontline employees' informal performance based on their knowledge. Company C, for example, uses a formal system that is an ERP and an informal system that is an internal communication website, containing discussion forums and blogs, which is named 'collaboration'. At company C, low-level personnel use both of these to cope with production uncertainties, but they are indeed two discrete systems in the company. In this research, we call the enterprise systems at company C a hybrid system, since the company emphasises the need to develop an organisational environment to combine formal and informal systems. The environment is based on the idea of 'trust' by which managers trust low-level employees to use their knowledge to solve unanticipated

orders, and motivate them to communicate with their peers to spark new ideas. By contrast, company D implements a real hybrid system that connects formal and informal systems via one integrated system platform. The formal system at company D is a service ERP that mainly supports lease management, while the informal system is an online expert help system called 'OA'. These two systems are based on one central database.

According to company D, the hybrid system contains a formal system with the core business processes and essential functional modules of a firm, while an informal system allows users to execute activities based on their tacit knowledge which can be called upon when the firm is in unforeseen circumstances (Figure 1). In company D, the informal system allows frontline employees to work informally, based on their experience, and although these transactions are not valid in an ERP unless they have been authorized by experts. The hybrid system makes data transparent and visible to everyone within the organisation, since formal and informal systems are interconnected via one central database. Low-level employees work on the basis of their practical knowledge. The data related to the informal activities (informal data) are stored in a staging database. As soon as experts approve these experience-based (informal) activities, transactions can be conducted in an ERP by system users, and the informal data is automatically valid in an ERP database.
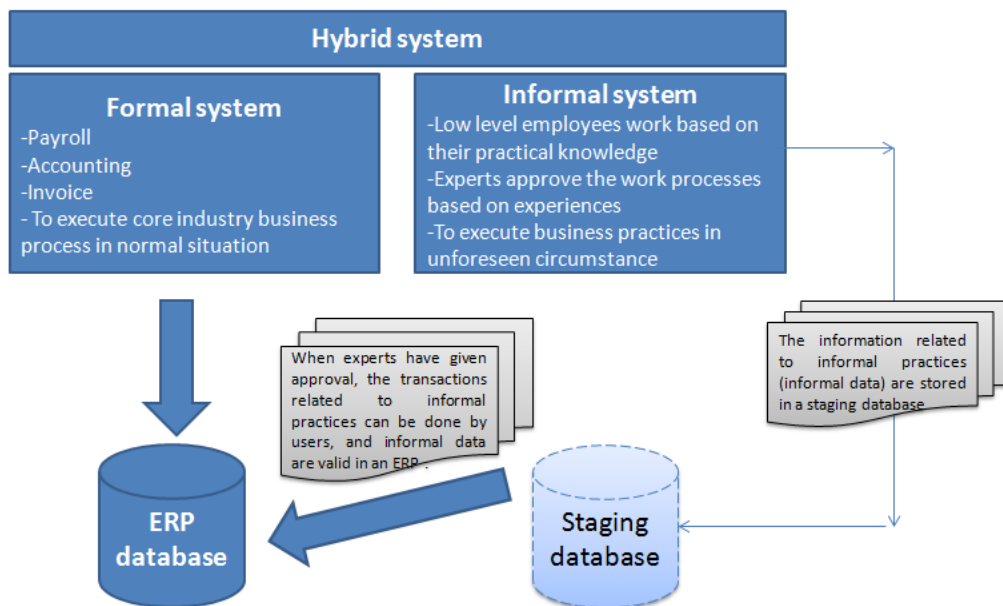

Figure 1.   Hybrid system model

5.1 Comparison the hybrid system with existing ERP systems

There are three differences between the hybrid system and the existing ERP systems.

5.1.1 Beyond a technical tool

Firstly, the hybrid system is more than a technical tool. Rather, it is a fairly comprehensive mechanism that bridges the gap between 'human' and 'machine' for IS management. As Paul (2007) stated, IT is a collection of devices, software and accessories that delivers an applicable mechanism for any IS that can use it. The hybrid system is more than a combined IT system, as it incorporates the strengths of humans' knowledge into the ERP.

However, the first two generations of ERP emphasise its IT nature. As illustrated in Figure 3, first-generation ERP is a standard software package that produces a standard business solution for an organisation, as it integrates business process across functional departments and embeds the best practices of a particular industry (Al-Mashari et al., 2003), which allows automating of business transaction and coordinating of different functional departments or organisations (Davenport, 1998; Shang and Seddon, 2002; Akkermans et al., 2003). The second-generation of ERP focuses on organisational changes and individual work. This means that the software can be shaped and improved in order to keep the system continually aligned with changes in the organisation (Niu et al., 2011; McGinnis and Huang, 2007).

As shown in the following Figure 2, the first turning point is 'misalignment'. Misalignment arises from existing business processes, practices, and the value and culture of a company cannot be supported by an ERP system (Wagner and Newell, 2004; Wei et al., 2005; Sia and Soh, 2007). Past ERP systems place greater emphasis on exploring their IT functionalities, and fitting the software design with organisational requirements.

This hybrid system is not a human-centred technology that involves a continuous process of designing, analysing and refining the software (Sharplesa.M et al., 2002), but is rather a way of using ERP uniformly upon individuals, when the system has already been adopted in an organisation. Thus, the use of the informal system does not affect the change in the existing program coding of an ERP. But the system aims to solve business uncertainty and the effects of changing the input parameters or the

sequences of performing business transactions in an ERP. For example, company C changes production plans in an ERP that works overtime when the firm meets urgent production tasks. Meanwhile, company D changes floor plans and service activities in an ERP, when the firm met the unforeseen increase or decrease in customer demands.

5.1.1.1 What do we mean by 'system'?

According to Slack and Lewis (2011: 167), no technology operates continuously, and completely in isolation, without ever needing some degree of human intervention. Here, we mean that the 'information system' (IS) involves interactions between technologies (i.e. ERP, social media) and the employees. As Alter (2008) defined it, 'IS' is a work system in which human beings or machines performing work (processes and activities) using information, technology or other resources to produce specific products or services for specific customers. A hybrid system, indeed, is a work system that is beyond simply a technical tool, but which highlights the context within which organisational members perform their assigned work. The hybrid system is made up of organisational members, technologies (i.e. ERP, enterprise social system), work tasks undertaken by members, work processes, and human behaviours related to work with the technologies, as well as interactions between human beings.

Therefore, the 'systems' at both companies C and D can be defined as hybrid in nature. Although the information systems of company C are not as homogeneous as the hybrid system at company D, in which the ERP and informal system are connected via one system platform (Figure 1), ERP can be used informally, and this allows employees to carry out business tasks based on their intelligence, instead of rigidly following system–system approaches. Rather than the limited offering of the first two generations of ERP, which emphasised only power, speed and general physical abilities (i.e. automation, integration), the hybrid system also includes the flexible, intuitive and analytical abilities of human beings. Slack and Lewis (2010: 187) and Newell et al., (2003) also support this point, namely, that it is necessary in ERP to embrace human intelligence, so as to complement the inflexibility of the ERP system (Figure 2).

Additionally, this research focuses on a modelling 'system' as a means by which organisational members can perform business tasks. For instance, in the single case

study, we model how the personnel at company D perform four types of letting service in three operating conditions: 1) an informal system, where the company provides letting services without any system; 2) a formal system, where the firm works with an ERP to deliver these services; and 3) a hybrid system, where the company works with a hybrid system to perform business tasks.

5.1.2 Involves both formal and informal activities

The reason why our hybrid system supports both efficiency and flexibility is that it involves both planned and situated actions, which is the third difference between the hybrid system and existing ERP systems. According to Olsen and Sætre (2007b), "Gluing together different systems we can achieve a holistic IT solution." Can the hybrid system produce a holistic IT solution for a company?

5.1.2.1 What do we mean by 'hybrid'?

Firstly, the definition of 'hybrid' is related to the interactive relationship between human beings and technologies, as has been pointed out by Orlikowski and Scott (2008): "Work practices are continuously (re)configured by human beings and technology." The cases C and D show that the working patterns in a system are impacted by the intuitive sense-making and the contextual knowledge of organisational members. This perspective is also confirmed by (Johnson et al., 2007, p. 28), who support the view that a company has two types of business practices. 'Organisational practice' is the formalised practice in which people engage in order to carry out business strategy, including system procedures, which is related to 'formal activities' in this research. 'Performative routines', which are what people actually do in relation to strategy, are 'specific actions, by specific people in specific places and times', which are non-routinised behaviours and closely related to the organisational context. Hence, these activities cannot be pre-determined in an ERP in relation to 'informal activities'.

Based on the study of company D, this research finds that it is difficult for a company to accomplish business tasks strictly, following a series of pre-determined business activities embedded in an ERP system: there are some other activities that are also important, insofar as they are based on employees' practical knowledge; they are situated actions to react to unanticipated changes in tenant demand, and they emerge

from informal (unintentional) interactions. They are also inherently intangible, based as they are on a need to support the maintenance of good relationships with prestige tenants. As Suchman (2007: 72) stated, "some course of action is frequently only on acting a present situation that its possibilities becomes clear, and we often do not know ahead of time, or at least not with any specificity, what future state we desire to bring about." Thus, besides these predetermining activities, 'informal activities' are important in a hybrid system, making use of the intelligence of the personnel which enables them to react to different situations with different procedures, and offering the benefits of coping flexibly with business uncertainty.

The 'planned' nature of ERP systems has been criticised in the existing literature. Hald and Mouritsen (2013) in their summary of existing ERP research in operations management, describes ERP as a 'straitjacket' for an organisation as it represents highly formalised, standardised and rigid planning. ERP, with its planned scheme of action, is characterised by rational and organised action, as it contains production plans and subsequent actions must be taken in accordance with these plans. However, when the plans change, the system cannot follow these changes. For instance, company B and company C both have advanced ERP systems to support day-to-day operations. However, while company C, with an informal system that works alongside an ERP, can cope with unpredicted orders, such unanticipated orders cause a serious problem at NS.

Therefore, we summarise the second turning point in Figure 3, the existing ERP system highlights only standardised activities for supporting routine work, whereas it cannot cope with business uncertainty that is non-computable. However, based on the findings from company C, a hybrid system can compensate for the limitations of an existing ERP system, as the system promotes interpersonal interactions and integrates knowledge from different parts of the organisation, which increases the adaptability to a changing environment. In this way, a hybrid system achieves a holistic solution by enriching people work with both planned and situated actions.

In short, "hybrid" means that two types of business activities co-exist in a company: the formal activities are based on work routines and the informal activities are based on human intelligence. A hybrid system is an ad hoc ERP that consists of an ERP with

formal activities to perform the regular business tasks, and an informal system that maintains informal activities to deal with business uncertainties based on the intelligence of human beings (Figure 2).

5.1.3 The definition of the hybrid system related to the gaps in existing ERP studies

In short, the research contributes to determining the hybrid system corresponding to three gaps of existing ERP,

- **Highlight human knowledge**: by determining the hybrid system, informality is important to define at first place, which is an organisational context that motivates employees to embed themselves in everyday practice, and use their knowledge to react to unexpected business events; however, current ERP systems only emphasises the processing regular business tasks and it is lack of flexibility to react to the unanticipated events.

- **Combine technology and human beings as a working system**: this research highlights the study of a system in relation to its operation performance to day-to-day business tasks that is beyond the enterprise system implementation. The 'system' determined as a working system that is involves the interactions between technology and human beings, rather than fitting software design to organisation requirements.

- **Determine a system with formal and informal processes**: 'hybrid' means that the system contains 'formal process' to support work routines efficiently, and 'informal process' to flexibly respond to business uncertainties based on human knowledge. This can fill the gap that existing studies are limited in considering the benefits for low-level employees and their practical knowledge. Thus the hybrid system produces the complementary benefit for both managers and individual members in an organisation.
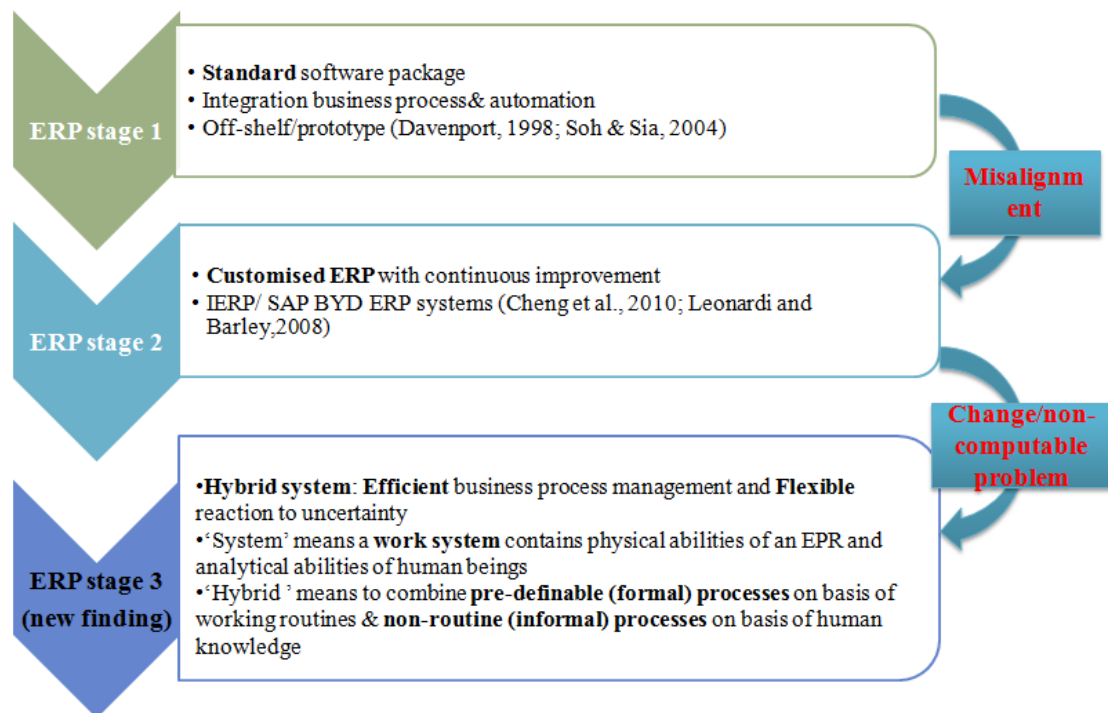
Figure 2 Comparison of the hybrid system with the first two ERP systems in past research

6.0   Conclusion and contributions

In summary, this study reveals that an ERP with pre-determined business activities cannot react promptly to unanticipated changes in a business. A hybrid system incorporates informality into an ERP can react to different situations by using different procedures that are based on the practical knowledge of frontline employees. The new system consists of two parts. An ERP contains formal activities that are routine behaviours to perform regular business tasks, while an informal system (i.e. enterprise social systems: 'collaboration' & 'OA') maintains informal activities with a situated response to cope with business uncertainties based on human intelligence. This paper discussed the new system by comparing it with existing ERP systems (Figure 2). Unlike existing ERP systems emphasise the continuous alignment of IT functions, this study defines a new system (Figure 1) that focuses on exploring how a company works with the system to adapt to environmental changes, and to respond to business uncertainties.

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