Strategic Management and Leadership for Systems Development in Virtual Spaces

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Chapter 10
Designing and Managing ERP Systems for Virtual Enterprise Strategy:
A Conceptual Framework for Innovative Strategic Thinking

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ABSTRACT

The business environment today is transforming towards a collaborative context compounded by multi-organizational cooperation and related information system infrastructures. This chapter aims to examine Enterprise Resource Planning (ERP) systems development and emerging practices in the management of multi-organizational enterprises and identify the circumstances under which the so-called 'ERPIII' systems fit into the Virtual Enterprise paradigm; and vice versa. An empirical inductive study was conducted using case studies from successful companies in the UK and China. Data were collected through 48 semi-structured interviews and analyzed using the Grounded-Theory based Methodology (GTM) to derive a set of 29 tentative propositions which were then validated via a questionnaire survey to further propose a novel conceptual framework referred to as the 'Dynamic Enterprise Reference Grid for ERP (DERG-ERP)'; which can be used for innovative decision-making about how ERP information systems and multi-organizational enterprises – particularly the Virtual Enterprise may be co-developed.

INTRODUCTION

Enterprise Resource Planning (ERP) systems have developed extensively over the last decades in response to changing business requirements, technological developments, and new organizational strategies. According to the *APICS Dictionary* (11th Edition) (Blackstone & Cox, 2005), ERP is defined as a "framework for organizing, defining, and standardizing the business processes necessary to effectively

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plan and control an organization so the organization can use its internal knowledge to seek external advantage" (p. 38). This definition also indicates that ERP can be viewed as an information management strategy which enables the integration of various business units through a common system platform; this is echoed by other scholars (Beheshti, 2006; Johnson et al., 2004; Klaus et al., 2000).

It has been noted that most extant research on ERP systems design and management focuses on improvements in ERP functionality within a single unitary organization (Chen, 2001; He, 2004; Michel, 2000). Nevertheless, it is generally acknowledged that manufacturing and service companies today are facing a dynamic turbulent business environment, and therefore, can be encouraged to think differently and move beyond traditional single organizational boundaries whilst becoming involved in multi-organizational collaborations (Hoffmann, 2007; Rayport & Sviokla, 1995). This has stimulated the emergence of a new operations strategy in which competitive advantage is based on the development of relationships with partners (Walters, 2004). This chapter follows this premise and thereby uses the European Commission's definition of an *enterprise* to explore how ERP systems can be designed and managed to effect changes in multi-organizational enterprise structures and *vice versa*; in turn, identify the circumstances under which the Virtual Enterprise paradigm can be realized by using the next generation ERP systems coined in this chapter as 'ERPIII'. The EC's definition of an *enterprise* is, "… an entity including partnerships or associations that can be made up of parts of different companies" (European Commission, 2003). This chapter builds on this definition and *does not* therefore consider manufacturing and service operations to be single legal entities operating in isolation, but instead embodies the (multi-organizational) *enterprise management* concepts (European Commission, 2003), where parts of companies work with parts of other companies to deliver complex product and service systems.

Some operations management researchers already realize that multi-organizational enterprises – particularly the Virtual Enterprise strategy cannot be described through simple contractual exchanges; but are better thought of as operational interdependencies based on complex interactive of operations and information technology (IT) (Banker et al., 2010; MacBeth, 2002). Likewise, information systems (IS) researchers suggest that integrated technical solutions – particularly ERP systems, which could make the multi-organizational enterprise management concept a full technical reality, are not far away (Chorafas, 2001). These works emphasize the fact that successful multi-organizational (virtual) enterprise strategy relies on the correct type of ERP information systems being used, as well as highlighting the importance of investigating how an ERP system fits into the multi-organizational operation and structure, in order to properly pursue the Virtual Enterprise strategy.

There is an emerging body of studies beginning to advocate the inter-organizational information systems (IOIS) (Saeed et al., 2011; Vathanophas, 2007). There is however a perennial pressing challenge for alignment between multi-organizational (virtual) enterprise management thinking and ERP systems design, adoption and development; which is imperative to provide a useable decision-making framework for thinking innovatively about co-development of ERP systems and multi-organizational collaboration – particularly the Virtual Enterprise paradigm. Thus this chapter aims to empirically examine ERP systems development and emerging practices in the management of multi-organizational enterprises and identify the circumstances under which the so-called 'ERPIII' systems fit into the Virtual Enterprise strategy; and *vice versa*. This aim is fulfilled by achieving three research objectives:

1. Summarize developing trends in ERP systems;
2. Describe the principles of Virtual Enterprise (VE) paradigm whilst confronting it with the Extended Enterprise (EE) and Vertically Integrated Enterprise (VIE) forms; and

3. Propose and describe a new conceptual framework known as the Dynamic Enterprise Reference Grid for ERP (DERP-ERP) to improve the concomitance between strategic operational thinking and ERP systems design and management within the context of multi-organizational (virtual) enterprises.

The remainder of the chapter is structured as follows. The next section critically review the literature related to ERP systems development and multi-organizational enterprise paradigms – particularly the Virtual Enterprise. This is followed by a description of the grounded theory-based research methodology. The findings and theoretical discussion are reported in the subsequent section; leading from this, a useable framework is then proposed. Finally, the chapter concludes by highlighting the contributions to the body of ERP-Virtual Enterprise knowledge and identifying the implications for future work.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

ERP Evolutionary Trend: From ERP to ERPII and On towards ERPIII

Traditional ERP systems are internally integrated information systems which are used to gain operational competitive advantage (Blackstone & Cox, 2005, p. 38; He, 2004) by primarily supporting core internal functions such as operations and production, and which may be extended to include other closely related functions such as sales and distribution, and accounting and finance (Al-Mudimigh et al., 2001; Davenport, 1998). These traditional ERP system types (sometimes also referred to as ERPI) typically have a high degree of proprietary in-house development requiring considerable financial commitment to implement and integrate with other organizational applications; such as Product Data Management (PDM) and Decision Support System (DSS) (Stevens, 2003; Themistocleous et al., 2001).

The origins of ERP systems are firmly based in manufacturing and their fundamental structure built upon Material Requirements Planning (MRP) (Harwood, 2003; Shehab et al., 2004), Manufacturing Resource Planning (MRPII) (Wight, 1984) and later Computer Integrated Manufacturing (CIM) (Jacobs & Weston Jr., 2007; Rashid et al., 2002). Apparently, traditional ERP does not necessarily support the increasing scope of future business requirements for Internet based commerce (Bond et al., 2000; Moller, 2005; Songini, 2002; Vazquez-Bustelo & Avella, 2006). In response, further functional modules are developed as 'add-ons' to form ERPII systems and the mantra of "ERP is dead – long live ERPII" is often used by contemporary systems developers (Eckartz et al., 2009). Thus, traditional ERP systems are slowly usurped by ERPII (sometimes also known as 'XRP' – eXtended Resource Planning); as ERPII is recognized as an integral part of business strategy enabling multi-organizational collaborations through extension of operations to close and trusted partners (Bagchi et al., 2003). Modules such as Advanced Planning and Scheduling (APS), Supply Chain Management (SCM), Customer Relationship Management (CRM), Demand Chain Management (DCM), Vendor Managed Inventory (VMI), Business Intelligence (BI), and Data Warehouse (DW) are all parts of ERPII systems (Kumar & van Hillegersberg, 2000); giving the potential for multi-organizational operations and Internet based commerce (Davenport and Brooks, 2004). One might say that the first generation of ERP primarily supported and enhanced *single* organizational operations (Akkermans et al., 2003) whilst ERPII supports "… resource planning co-operations *between* different organizations at a meta-level" (Daniel & White, 2005).

Currently ERPII is the dominant type of system to support modern manufacturing enterprises. However as competition increases and markets become even more turbulent, many manufacturers are trying to re-design their operations and ERP systems to have even greater flexibility (Anussornnitisam and Nof, 2003). As a result information systems solutions based on technologies such as Enterprise Application Integration (EAI), Service-Oriented Architecture (SOA), SaaS (Software as a Service) (Bass and Mabry, 2004; Sharif et al., 2005), utility and cloud computing technologies (Maurizio et al., 2007; Rappa, 2004; Sharif, 2010) and open-sources applications (Benlian and Hess, 2011) are becoming more prevalent. These technologies bring with them further flexibility, agility, efficiency, scalability and re-configurability for ERP systems and operations; because they provide the potential for multi-organizational connectivity (Torbacki, 2008; Wilkes and Veryard, 2004) – particularly for the Virtual Enterprise structure.

The future for ERP systems is still uncertain though as SOA, SaaS, Utility and openly-sourced enterprise applications bring new challenges around granularity of data-sharing, business privacy and decentralization of strategic objectives (Candido et al., 2009; Xu et al., 2002). Despite these new challenges one can observe these emerging technologies changing the way that ERP systems are currently being perceived and developed. For instance one can find 'Virtual Enterprise Resource Planning (VERP)' and 'Federated ERP' concepts being deployed using cloud computing, SOA, SaaS and PaaS (Platform as a Service) technologies (Cummins, 2009; Pal and Pantaleo, 2005). These new technical and conceptual information systems developments may provide more sustainable competitive advantage and make the (multi-organizational) enterprise management concept – particularly the Virtual Enterprise a future reality. For managers who may be seeking to temporize their structure and operations strategy in response to economic turbulence and uncertainty, this is an important trend to be aware of.

In this chapter the author refers to the *next generation* of Enterprise Resource Planning systems as 'ERPIII'. The author defines ERPIII as a *flexible, powerful information system incorporating web-based technology which enables enterprises to offer increasing degrees of connectivity, collaboration and dynamism through increased functional scope and scalability*. This definition considers contemporary management thinking about multi-organizational enterprise concepts (e.g. Virtual Enterprise) brought out by academic literature cited in this chapter. Table 1 summarizes recent ERP systems development trends outlined above; from traditional ERP to ERPII, and on towards ERPIII on which the new contingency framework described towards the end of this chapter is partially founded.

The Multi-Organizational Enterprise Management: VE, EE, and VIE

The concept of applying (multi-organizational) enterprise strategy is important because it is widely accepted that embracing new business partnerships and collaborative arrangements (e.g. virtual enterprise) can contribute to the sustainability of a business (Achrol & Kotler, 1999). For instance, Tencati and Zsolnai (2009) state that the 'enterprise' concept helps a business fit better within its business environment, social, and culture contexts. Likewise Binder and Clegg (2006) claim that, "… the success of collaborative enterprise management depends on the ability of companies to intermediate their internal core competences into other participating companies' value streams and simultaneously outsource their own peripheral activities …". Similarly Li and Williams (1999) indicate that "firms should focus on their core competences and share expertise and risks with each other in order to develop inter-firm collaboration in strategic processes …" This thinking indicates that competitiveness relies on the overall performance of all partners in an 'enterprise' rather than just one company's internal operations. This chapter herein focuses on the three main types of multi-organizational enterprises: the Vertically Inte-

Table 1. Summary of ERP trends: ERP to ERPII, and on towards ERPIII

Key Element	ERP	ERPII	ERPIII
Role of system	Single organization optimization and integration (Akkermans et al., 2003; Park and Kusiak, 2005; Scott and Vessey, 2000)	Multi-organisation participation with some collaborative commerce potential (Bagchi et al., 2003; Daniel and White, 2005; Zrimsek, 2003)	Multi-organisation, Internet based, with full collaborative commerce functionality (Hauser et al., 2010; Ponis and Spanos, 2009; Torbacki, 2008)
Business scope	Manufacturing and distribution, automatic business transactions (Al-Mudimigh et al., 2001; Chen, 2001)	Often sector-wide offering upstream and downstream integration (Bendoly et al., 2004; Bond et al., 2000)	Facilitating cross sectors strategic alliances (Muscatello et al., 2003; Wilkes and Veryard, 2004; Wood, 2010)
Functions addressed	Manufacturing, product data, sales and distribution, finance (Davenport, 1998; Monk and Wagner, 2009)	Most internal organisational functions supported with some limited supplier and customer integration (Li, 1999; "Ted" Weston, 2002, 2003)	All internal functions supported plus core inter-company processes (Hauser et al., 2010; Wood, 2010)
Processes supported	Internal, hidden, with an intra-company boundary (Al-Mashari et al., 2003; Markus and Tanis, 2000)	Externally connected with intra-enterprise (i.e. inter-company) focus (Bond et al., 2000; Moller, 2005; Songini, 2002; Tapscott et al., 2000)	Externally connected, open network to create borderless inter-enterprise/ industry-wide focus (Muscatello et al., 2003; Ponis and Spanos, 2009; Wood, 2010)
Information system architecture	Web-aware closed and monolithic (Hicks and Stecke, 1995; Stevens, 2003; Themistocleous et al., 2001)	Web-based, componentized, non-proprietary (Callaway, 2000; Monk and Wagner, 2009) Internally and externally available, often subscribed to by joint ventures (Ericson, 2001; Li, 1999; Moller, 2005)	Web-based communication, service-oriented architecture (Hofmann, 2008; Ponis and Spanos, 2009) External exchange via open source and cloud computing (Buco et al., 2004; De Maria et al., 2011)

grated Enterprises (VIE), the Extended Enterprises (EE), and the Virtual Enterprises (VE) to illustrate multi-organizational enterprise management behavior, as well as confronting the VE – as the targeted strategy with the VIE and EE forms.

Vertically integrated enterprises (VIE) operate as large single well-integrated multi-functional firm striving for scales of economy, they typically have bureaucratic reporting hierarchies (Lynch, 2003) which evolve as, "a response to pre-existing market power problems or as a strategic move to create or enhance market power in upstream and downstream markets" (Joskow, 2003, p. 25). A VIE will typically process ultraraw materials through to end-consumer products and services to embed a firm within an industry (Harrigan, 1985; Vallespir & Kleinhans, 2001). A classic example is the Ford Motor Company is in its 20th century heyday (Monteverde & Teece, 1982; Crandall, 1968). As a result competitiveness maybe gained through reduced transaction costs (Harrigan, 1984, 1985; Mahoney, 1992), strong quality control, higher barriers to new entrants (Rothaermel et al., 2006), and rapid response to volume changes (Richardson, 1996). However, the competitive damage created by excessive vertical integration can be substantial, as in the examples of the U.S. automobile and steel industries in 1983. Hence, instead of building VIE, quasi-integration and joint ventures should be formed to obtain strategic flexibility. Firms could have components engineered to their tight and highly specific instructions by outsiders rather than fully own and control adjacent business units in the vertical chain, as do Japanese automobile manufacturers, for instance. In turn, some research suggests that 'make-or-buy' decisions (Anderson and Weitz, 1986; Vallespir & Kleinhans, 2001); strategic outsourcing or global sourcing (Chung et al.,

2004) and alliances make further enhancements to a VIE set-up (Arya & Mittendorf, 2008). Therefore, the downside to VIEs (Argyres, 1996) is that their structure and size can inhibit engagement with other organizations – particularly within the virtual business environment; hence the rate at which changing market requirements are addressable in collaboration with other organizations is reduced. To combat the downsides of VIEs – the extended enterprise structure and strategy should be used instead.

The 'extended enterprise' (EE) concept, in contrast to the VIE, is defined by Davis and Spekman (2004, p. 20) as "… the entire set of collaborating companies … which bring value to the marketplace …" and by Lyman et al. (2009) as "… a business value network where multiple firms own and manage parts of an integrated enterprise". This allows practices such as just-in-time (JIT) supply chain logistics (Sutton, 2006), collaborative innovation (Owen et al., 2008), and data warehouse interoperability (Triantafillakis et al., 2004) to be deployed more easily across company boundaries (Childe, 1998; Jagdev & Browne, 1998). This is because an EE structure allows organizations to focus on their core business and technical activities whilst outsourcing non-core activities to other members in their extended enterprise (Stalk et al., 1992; Thun, 2010). Thus extended enterprises are deemed to be more agile than vertically integrated enterprises. But despite reduced cross-company boundaries (O'Neill & Sackett, 1994), even EEs cannot manage to follow very highly economic turbulence and unpredictability because they operate in a partially restricted environment operated by known, trusted and willing members.

Highly turbulent and unpredictable market behaviors are best coped with by 'virtual enterprise' (VE) (Byrne & Brandt, 1993; Katzy & Dissel, 2001) rather than an EE or a VIE as virtual enterprises (VEs), in contrast to the EEs and VIEs, are the most agile type of enterprises. VEs are best thought of as a jigsaw of operations and information systems from more than one business entity loosely governed by decentralized specific objectives which delivers value in an agile manner towards its market opportunities (Goldman et al., 1995; Martinez et al., 2001). Virtual inter-organizational relationships like these can facilitate innovative agile manufacturing or supply chain more easily (Cho et al., 1996; Sharp et al., 1999) and deal with dramatic dynamic market changes (Madu & Kuei, 2004) through Internet based information and communication technologies (ICTs) (Hyvonen et al., 2008; Jagdev et al., 2008; Lipnack & Stamps, 1997). This is because firms' tendencies towards temporizing structure and strategy are more easily addressed. For example the book publishing business is constantly changing due to newly emerging digital technologies (e.g. Lightning Source's Internet based 'print-on-demand' (POD) publishing service is able to integrate hundreds of thousands of suppliers and buyers rapidly into a 'cost effective' deliver system; see lightningsource.com/process).

Browne and Zhang (1999) summarize that the EE and VE can be seen as two complementary enterprise strategies as their similarity lies in the fact that they both pursue multi-organizational partnerships in order to achieve business success in a very competitive environment. The main different is represented by the 'temporary' and 'dynamic' nature of the VE in comparison to the EE. Similarly, Jagdev and co-workers (1998; 2001) unveil that unlike EE, VE is a manifestation which is inherent in agile manufacturing, and which is made possible by heavily utilizing ICT systems; therefore, EE can be considered as a special case of the VE. Moreover, as manager seek to re-engineer companies – the SMEs in particular (Hanna & Walsh, 2000; Jagdev et al., 2008; Kaihara & Fujii, 2002) in response to uncertain business environment, the VE tends to replace the VIE (Daniels, 1998) and the EE because virtual enterprises are more suitable as they are, "opportunistic aggregations of smaller (business) units that come together and act as though they were a larger, longer-lived enterprises" (Goranson, 1999).

Table 2 summarizes the comparison between vertically integrated enterprises (VIE), extended enterprises (EE) and virtual enterprises (VE) types as discussed above using key elements which both characterizes and differentiates them on structural, strategic operations and IS bases. The multi-organizational enterprise types in Table 2 are used as partial bases for the new contingency framework given towards the end of this chapter.

RESEARCH METHODOLOGY

Considering the nature of the research subject and the above theoretical debate an exploratory and qualitative empirical approach was used based on inductive Grounded Theory-based methodological approach (Glaser and Strauss, 1967; Strauss and Corbin, 1990). This was generally structured into three phases: data collection, data analysis, and data validation. It should be noted that data collection and analysis were not conducted sequentially but iteratively until theoretical saturation was achieved.

Data Collection Phase (Choosing Interviewees)

Data collection was deployed by conducting 48 semi-structured face-to-face interviews from a variety of industries (construction, printing, electronics, logistics and banking) in the UK and China; covering 8 companies who deliver complex products and services across organizational boundaries whilst using

Table 2. Comparison between VIE, EE, and VE

Key Element	Vertically Integrated Enterprise (VIE)	Extended Enterprise (EE)	Virtual Enterprise (VE)
Characteristic of core competencies	Mature and well accepted Large scale of economies	Semi-mature with pilot experience Ideal for production ramp-up scenarios	Quick respond to the changing market and environment Low overheads
Strategic aims	Long term objectives	Medium-long term objectives	Short-term objectives
Partnership purposes	Long-term indefinite co-operation	Medium-long-term collaboration on variety of projects and products	Temporary team-working for single project or products
Organization stability	Stable hierarchy and inflexible structure	Relatively stable across the product value chain	Dynamic organizations with core competences
Organization type	Command & control unity Concern more on scales of economies	Product/service value chain based	Frequently project or niche market based
Co-ordination of partnership	Original equipment manufacturer supervises relationship with the partners	Manufacturer or prime contractor supervises the partnership	The most strategically influential member (‘orchestrator’) supervises the co-operation
Operational challenges	Legacy system transferring approaches (e.g. big bang vs. incremental ways)	Synergistic among complementing core competencies Compatibility around partners and IS/IT	Dynamic operating and unpredictable business environment Psychological issues
Risk degree	Comparative low	Moderate	Intensely high
IS/IT facilitators	In-house development of proprietary systems with traditional ERP system for intra-integration	Advanced IS/IT ERP merged with other new functional modules (e.g. SCM, CRM, VMI)	Sophisticated Web-based technologies (e.g. SOA, cloud computing, SaaS)

ERP systems to support their operational strategies. Interviewees were from operations, manufacturing, supply chain, IT, client service and finance functions. All the interviews took place between March 2011 and August 2011, lasting between 1 – 1.5 hours (producing 53 hours and over 800 pages of validated transcript). Key characteristics of the interview and background information on each of the case study sites are given in Table 3.

Table 3. Overview of the case companies and interview sample

Company	Industry Sector	Number of Interviewees	Role of Interviewees	Management Level	ERP Systems
Print-on-demand-Co (UK)	Printing manufacturer	6	Managing director	Senior	Content management system (CMS) Oracle (and PeopleSoft)
			Operations director	Senior	
			Manufacturing manager	Middle	
			Client service manager	Middle	
			IT system manager	Middle	
			Supply chain manager	Middle	
Printing-Co (UK)		5	Managing director	Senior	Print-Pack MIS systems
			Client service manager	Middle	
			Account director & sales manager	Middle	
			Production & administration manager	Middle	
			Studio manager	Middle	
Electronic-Co (UK)	Semiconductor manufacturer	6	Supply chain programme manager	Senior	SAP (ERP) systems
			Supply chain technologist	Middle	
			Finance manager	Senior	
			Logistics & manufacturing manager	Middle	
			B2B technologist	Junior	
			Supply planning & customer manager	Middle	
Logistics-Co (UK)	Transport and logistics service	9	Group service director	Senior	Sage (ERP) systems SAP (ERP) systems
			Head of sortation auto	Senior	
			Operations director	Senior	
			Group commercial director	Senior	
			Senior financial controller	Junior	
			IT director	Senior	
			Head of transport	Senior	
			Head of human resource	Senior	
			Operations control team manager	Middle	

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Table 3. Continued

Company	Industry Sector	Number of Interviewees	Role of Interviewees	Management Level	ERP Systems
Zoomlion (China)	Crane manufacturer	7	Executive manager	Senior	SAP (ERP) systems
			Chief information officer	Senior	
			Logistics manager	Middle	
			Regional marketing & sales manager	Middle	
			Regional director	Middle	
			Credit manager	Junior	
			Business sales assistant	Junior	
Lanye (China)	Concrete and mixer manufacturer	5	General manager	Senior	Alutex (and GPS) ERP systems
			Chief information officer	Senior	
			Logistics director	Middle	
			Production manager	Senior	
			Chief executive officer	Top/executive	
Wanghai (China)		4	Chief executive officer	Top/executive	Three Prosper Technology
			Human resource manager	Senior	
			Inventory manager	Middle	
			Chief information manager	Senior	
Metrobank (China)	Banking	6	Chief executive manager	Top/executive	SAP (ERP) systems
			Head of human resource	Senior	
			Compliance manager	Senior	
			Chief finance officer	Senior	
			Chief operation officer	Senior	
			Chief information officer	Senior	

Data Analysis (Grounded Theory-Based Coding)

The textual analysis of over 800 transcribed pages of data via codification was done using the QSR NVivo 9.2 software tool based on the constant comparative method of Grounded Theory-based Methodology (Glaser and Strauss, 1967). Strauss and Corbin's (1990) hierarchical coding paradigm was applied. The author use *open*, *axial* and *selective coding* in order to reach the necessary conceptual density. It was applied at the intra- and inter-case level (each interview reflecting one individual case) as suggested by Strauss (1987).

Firstly, codes and categories were identified in an unrestricted *open coding* of the empirical data – during the coding process, memos were created that explained how the data were opened up to get a greater understanding of the responses, and 1367 free nodes were extracted. Secondly, *axial coding* of these provisional categories gave further insight into the inter-relationships of these categories; this technique revolves around the axis of core category at a time (Strauss, 1987) (giving 133 useable codes,

23 analytical categories, and 19 sub-categories). Finally, top-down *selective coding* was used to develop seven high level *core categories* or 'themes' that pulled together all the other detailed categories conceptually. These themes are

1. Industrial impact,
2. Enterprise structure and strategy design,
3. Enterprise structure and strategy governance,
4. ERP systems design,
5. ERP systems management,
6. Competence and competitiveness as main contingency factors, and
7. Organization and people management. A generic overview of the final coding diagram is presented in Figure 1.

The coding process produces datum types and records the frequency of their occurrence. It also aggregates the analysis, reduces researcher bias and highlights the main issues from which propositions can be written. The codification process is therefore the provenance for the 29 tentative propositions; these parsimoniously summarize all the main issues contained the interview transcriptions and tie the theoretical debate to industrial practice. The resulting tentative propositions are presented in a theoretical narrative later in this chapter and can be seen in full in Table 4.

Data Validation (Questionnaire Survey)

The tentative propositions were constructed into a self-administered questionnaire survey and then validated using 116 industry experts (with backgrounds in purchasing, R&D, quality assurance, production

Figure 1. Generic coding diagram

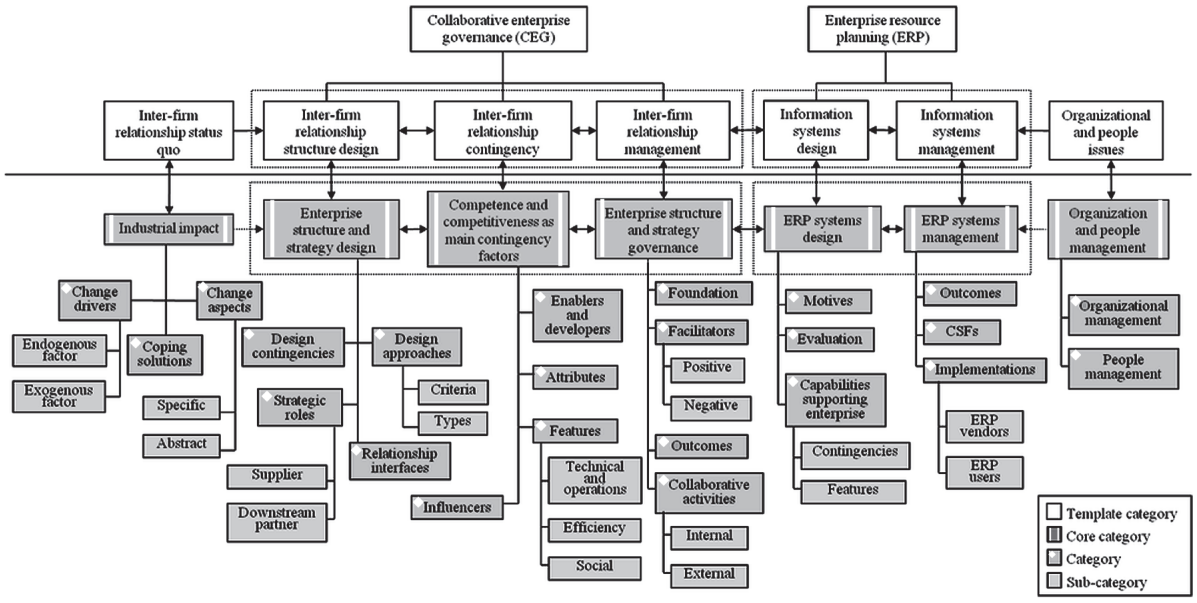

Table 4. Validating propositions relating to ERP systems and inter-organizational enterprise collaboration (N = 116)

Core Category	No.	Propositions Relating to	Mean Agreement	Mean Importance
Inter-firm relationship status quo (Industrial impact)	#1	Change in the manufacturing and service-driven industries is driven by a combination of dynamic globalization, internal organizational issues and general industrial forces	1.76	5.40
	#2	Increasing business complexity, cost-effectiveness and shorter turnaround time requires organizations to move towards more collaborative strategies	1.83	5.45
Inter-firm relationship structure design (Enterprise structure and strategy design)	#3	Inter-organizational relationships change over time, which is dependent upon individual core competencies	1.04	4.89
	#4	Inter-organizational relationships change over time, which is dependent upon the end product or service being delivered	1.39	4.99
	#5	Types of inter-organizational relationships and collaborative practices are determined by an industry-specific context	1.34	4.93
	#6	Service based inter-organizational collaborations have greater propensity to become virtual than product based inter-organizational collaborations	0.60	4.30
	#7	Organizations could use different approaches to inter-organizational collaboration, structure and strategy within different supply networks simultaneously	1.51	5.03
Inter-firm relationship structure management (Enterprise structure and strategy governance)	#8	Responsibilities and functional roles of each different organization needs to be clearly defined within the supply network	1.99	5.54
	#9	Collaboration with new external organizations requires internal business processes to be reengineered to accommodate new changes	1.38	5.20
	#10	In the context of inter-organizational collaboration, product-based organizations predominantly focus on the portfolio and quality of products, and the standardization of business processes	1.35	4.95
	#11	In the context of inter-organizational collaboration, service-oriented organizations predominantly concentrate on consumers' experiences	1.64	5.32
	#12	There is need for a leader or a 'broker' organization within the supply network who has core competencies and responsibilities to supervise, evaluate and manage cooperation between other organizations	0.91	4.89
	#13	Organizations are more willing to collaborate with other organizations who have a proven track record of successes in inter-organizational business collaborations	1.79	5.23
	#14	Once organizations obtain a similar set competences at a similar level of maturity as their partner organizations, the partnerships could change as a result	0.98	4.68
Information systems design (Enterprise resource planning systems design)	#15	The role of ERP systems in supporting operational business has evolved from intra-organizational optimization and integration into multiple inter-organizational collaborations	1.58	4.93
	#16	Future ERP systems should be designed based on web-based technologies by deploying service oriented architectures and cloud computing applications instead of being based on proprietary in-house enterprise information systems	1.47	4.90
	#17	'On-demand' ERP solutions will benefit and enable organizations to access technologies without significant individual investment cost in inter-organizational systems integration	1.24	4.87
	#18	There is a high degree of compatibility between 'cloud-based ERP' and service oriented architectures and hence the two will grow in unison	1.09	4.82

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Table 4. Continued

Core Category	No.	Propositions Relating to	Mean Agreement	Mean Importance
Information systems management (Enterprise resource planning systems management)	#19	Information security and flexibility of ERP systems will be key determinants in their adoption and use in inter-organizational collaborations	1.94	5.62
	#20	Inter-organizational integration requires different organizations within the same collaborative supply network to use ERP system(s)	1.02	4.71
	#21	Inter-organizational integration requires ERP systems within the same collaborative supply network to use the same ERP system to become highly integrated	0.61	4.42
	#22	The tighter inter-organizational collaborative structures and strategies become; the more integrated and flexible ERP systems also need to become	1.33	5.04
	#23	Third-party consulting organizations are becoming increasingly responsible for handling web-based ERP system implementations, which could make non-web-based ERP vendors lose their influential positions over end-users	0.41	4.24
	#24	Inter-organizational collaboration can be facilitated best by integrating 'best of breed' functional modules from different ERP solutions, rather than customizing a single 'one-size-fit all' solution	0.66	4.44
Inter-firm relationship contingency (Competence and competitiveness as main contingency factors)	#25	Initial motives for inter-organizational collaboration are based upon the attractiveness of an organization's core competences	1.37	4.97
	#26	Collaboration between different organizations can create new meta core competencies and specific systems resulting in 'end-to-end' product-service solutions	1.50	4.98
	#27	Building inter-organizational collaboration is an effective way to reduce cost and lead time, increase the efficiency, improve flexibility and reactivity to demand; and encourage innovation	1.77	5.31
Organizational and people issues (Organization and people management)	#28	Organizational cultural diversity, trust issues and resistance to change have to be managed when adopting ERP systems, especially in inter-organizational collaboration	2.00	5.63
	#29	Organizational behavior is a key challenge when adopting and managing web-based ERP systems in inter-organizational collaborations	1.64	5.26

& manufacturing, logistics, marketing & sales, inventory management, IT and strategy development) from 16 different companies who were asked to assess each tentative proposition on two dimensions of perception "agreement" and "importance" using 7-point Likert scales as follows:

1. Agreement (strongly agree = 3, agree = 2, mildly agree = 1, neutral = 0, mildly disagree = -1, disagree = -2, strongly disagree = -3); positive scores indicate agreement and negative scores indicate disagreement.
2. Importance (extremely high importance = 7, very high importance = 6, high importance = 5, medium = 4, low importance = 3, very low importance =2, extremely low importance = 1); all positive scores were used as this was a weighting factor.

The validating ratings for the 29 final tentative propositions are given in Table 4.

FINDINGS AND THEORETICAL DISCUSSION

Data analysis and validation showed that enterprise resource planning systems design and management and multi-organizational enterprise governance is generally regarded as an effective perspective to maintain and achieve competitiveness for the whole 'enterprise' (e.g. virtual enterprise) and its individual value members as well as the 'enterprization of operations' (Clegg and Wan, 2013) with long-term and short-term effects (cf. propositions #26 and #27). Each member of the multi-organizational enterprise is affected by a variety of industrial forces; thus different multi-organizational enterprise structures and strategies may change over time (cf. propositions #3 and #4) and should be supported by different ERP information system types under different circumstances (cf. propositions #15, #20, #21, #22, and #24), in order to cope with the challenges of dynamic globalization, complex industrial changes, and shorter turnaround time required by the end consumers (cf. propositions #1 and #2).

In respect to the *enterprise structure and strategy design and governance*, managing core competencies is considered as a principal factor when making decisions to achieve the multi-organizational relationships and collaboration successfully as the competencies determine the role of the individual partners within the collaborative venture (e.g. virtual enterprise) (cf. propositions #3, #14, and #25) via the value or competitiveness they are creating for the entire virtual value chain. Also, becoming more influential within multi-organizational enterprise requires (the most influential or focal firms) managing competencies belonging to other member-companies. In addition, multi-organizational enterprise design may also be affected by the end (collaborative) products or service solutions being delivered by the 'enterprise', as well as different industry-specific contexts (cf. propositions #4, #5, #10, and #11). This is reflected by the fact that any type of multi-organizational collaboration in the service industries (e.g. 'print-on-demand' and logistics) will have greater propensity to become 'virtual enterprises' by using web-based enterprise information systems than those production-based strategic alliances (e.g. concrete manufacture) (cf. proposition #6). This is because most service-oriented business (e.g. parcel delivery and banking) require more flexible and agile operational performance with quicker and more accurate responsiveness to unpredictable market demands, owing to their inherent nature.

Furthermore, the existence of multiplicity of dynamic multi-organizational relationships within an 'enterprise' requires a differentiated management based on the respective relationship characteristics (cf. propositions #3, #4, #7, and #14). It also requires a leader or a 'broker' organization (e.g. the most influential or focal companies) that has core competencies and responsibilities to clearly define each functional roles and boundaries within an 'enterprise', as well as supervising, evaluating, and managing cooperation between the partners. This allows for a certain degree of autonomy within the collaborative venture (cf. propositions #8 and #12) and the ability to deploy or even create (new) competencies (e.g. 'end-to-end' product-service solutions/systems) through effective multi-organizational collaboration (cf. proposition #26). Besides, in the opinion of most interviewees, any effective multi-organizational collaboration with external organizations would require internal business processes of each individual (enterprise) member to be re-engineered to accommodate new changes (cf. proposition #9), which is a big challenge for multi-organizational enterprise management – particularly for the virtual enterprises which is highly dynamic and reconfigurable and aims for short-term business objectives. Hence, organizations – particularly the most influential or focal firms are more willing to collaborate with other organizations that have a proven track record of success within the multi-organizational enterprise business collaborations (cf. proposition #13).

With respect to *enterprise resource planning systems design and management*, firstly it was observed that the strategic role of ERP information systems in supporting operational business have evolved from intra-organizational optimization and integration into multiple inter-organizational collaboration (cf. proposition #15). This consequently gives birth to new IT technologies including SOA, cloud computing, and web services applications instead of traditional proprietary or monolithic in-house enterprise systems, which promise to provide quicker and less expensive cloud-based ERP services – as the next generation ERP systems – in order to establish and sustain new business partnerships and network structures (cf. propositions #16, #17, and #18). Specifically, the configuration and development of ERP systems supporting multi-organizational enterprises are expected to be linked to the adoption and spread in the use of service oriented architectures, with the uptake and increased maturity in one driving increased uptake and maturity in the other in a virtuous cycle, on the one hand (cf. proposition #18); and the 'on-demand' solutions based on web-based technologies could benefit and enable organizations – particularly (virtual) small and medium-sized companies to access innovative ERP systems without significant individual investment cost – in comparison to the 'on-premise' ERP solutions, in multi-organizational systems integration, on the other hand (cf. proposition #17).

In addition, it has been widely accepted that within the context of multi-organizational collaboration, different organizations (e.g. the most influential or focal companies) are requested to not only use ERP information systems but also use the *same* ERP information systems to become highly integrated and flexible via real-time information exchange (cf. propositions #20, #21, and #22). This may be facilitated by integrating 'best of breed' functional modules form different ERP solutions offered by different ERP vendors rather than customizing a single 'one-size-fit all' solution (cf. proposition #24) which is more time and cost-consuming. Moreover, information security, cost, and flexibility of ERP systems are considered as the most critical determinants in their adoption and use in multi-organizational enterprise collaborations (cf. proposition #19). Thus, sophisticated third-party consulting organizations are becoming increasingly responsible for handling web-based ERP system implementation, which could potentially make non-web-based ERP vendors lose their influential positions over end-users (cf. proposition #23).

The empirical findings of this research study also indicate that organizational cultural diversity, trust issues, and people's resistance to change have to be managed properly when adopting ERP systems in the context of multi-organizational enterprise (cf. proposition #28). Particularly organizational behavior is regarded as a key challenge for the web-based ERP systems use (cf. proposition #29), because members within an 'enterprise' might not be ready for the next generation of ERP information systems on the novel strategic concepts, i.e. the extended enterprises, virtual enterprises, and cloud-ERP information systems or SOA-based ERP infrastructure (a.k.a. ERPIII (Wan and Clegg, 2010)).

The New ERP Matrix

Successful ERP systems enabled multi-organizational enterprise design and management not only needs tools (e.g. Enterprise Matrix (Binder and Clegg, 2006)) to regulate collaborative activities (cf. propositions #12 and #25); but also requires tools to determine how enterprise information systems and technologies (e.g. ERP systems) are being used in different functional areas which make up the whole 'enterprise', i.e. connecting ERP functional modules within the multi-organizational enterprise (cf. propositions #22 and #24). Hence, drawing on the basics of virtual value chain (Rayport and Sviokla, 1995) and IT and

business alignment concepts the new 'ERP Matrix' tool was developed to illustrate the capabilities of different ERP systems (or functional modules) to accommodate varying multi-organizational enterprise structures and strategy in a systematic manner; this is shown in Figure 2.

Multi-organizational relationships and collaboration are based on transactions between heterogeneous value members (e.g. publishers, book printers, and channel distributors) that traditionally pursue diverse strategies but try to fulfill a common task (e.g. joint products or collaborative complex service solutions development and completion) by establishing a mutual *modus operandi* through sharing real-time knowledge and information, technical know-how, and core competencies (cf. propositions #3 and #4). Such integration of collaborative activities will require supporting enterprise information systems and technologies (e.g. inter-connected ERP systems, web-based EDI, and electronic portals) which are the greatest enablers towards forming an e-integration among value members (cf. proposition #22).

In this sense, the new ERP Matrix tool helps to optimize the ERP information systems configuration and adoption within the whole 'enterprise' operation (represented by the respective collaborative activity) through the allocation of the most suitable *ERP modules* to support the operational requirements in different stages of the value stream based on their capabilities; which are determined by their targeted enterprise paradigms, strategic roles, deployment approaches, and systems advancement (cf. propositions #15, #16, #17, #19, #22, and #24). Therefore, this kind of allocation bridges 'structural holes' between the value members' information systems in the multi-organizational enterprise through the establishment of common ground based on the ERP modules that consist of capabilities catering to the core competence-based unique tasks (in different stages of the value stream) and adjunct functionalities facilitating interface connections (cf. propositions #3, #15, #22, and #24). In other words, the ERP Matrix tool can be seen as an artifact that helps people better understand multi-organizational ERP systems design, implementation, and landscape transformation through providing an architecture along which the key capabilities of ERP modules can be placed into the required functional units to fundamentally

Figure 2. The ERP matrix: a tool for determining how ERP systems capabilities supporting collaborative activities in enterprises by linking process, enterprise structure, and ERP systems use

<table>
<tr><td colspan="6">ERP capabilities supporting inter-firm relationships and collaboration</td></tr>
<tr><td colspan="2">Collaborative activity:</td><td colspan="4">Value stream
Process start → Process end</td></tr>
<tr><td colspan="2">ERP functional module classification</td><td>Stage 1</td><td>Stage 2</td><td>…</td><td>Stage n</td></tr>
<tr><td rowspan="6">High usage rate
↑
ERP module(s)
↓
Low usage rate</td><td>ERP module 1</td><td>Operational requirements in 'stage 1' of the value stream is supported by 'ERP module 1'</td><td></td><td></td><td></td></tr>
<tr><td>ERP module 2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>ERP module 3</td><td rowspan="2">Interface connection between 'stage 1' and 'stage 2' is supported by adjunct portals or links ↔</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>…</td></tr>
<tr><td>ERP module n</td><td></td><td></td><td></td><td>Operational requirements in 'stage n' of the value stream is supported by 'ERP module n'</td></tr>
</table>

support the entire virtual value stream; which, in turn, achieves the most optimized 'enterprization'. It is thereby important to realize that the value stream, as shown by Figure 2, is supported *only* by the (sub-) information systems (i.e. the ERP modules) of the value members that can *actually* facilitate or add value to the collaborative activities (cf. propositions #3, #17, #24, and #25); whilst the parts of the entire (virtual) value chain are actively managed by the multi-organizational enterprise leader or governor (e.g. the most influential or focal firms) (cf. proposition #12).

A collaborative activity (see Figure 2) is a joint business activity in the multi-organizational enterprises and can involve collaborative products (e.g. crane, smart phones production), complex service solutions (e.g. print-on-demand realization), or a joint project (e.g. a construction project) that should be reasonably defined and circumscribed. This task should be conducted by a distinct leader or 'broker', e.g. focal manufacturer, the most influential service provider, or the joint project owner, who has the competence to i) evaluate the specific competencies of the value members, ii) allocate suitable core competencies to respective stages and tasks of the value stream, and iii) define the responsibilities of the boundaries between the value members (cf. propositions #8 and #12). Meanwhile, the corresponding ERP modules – as a set of powerful strategic weapons – need to be properly selected and implemented to facilitate multi-organizational (virtual) communication and collaboration needs, laying the foundation for external integration (e.g. supply network connectivity), allow simultaneous access to same data, as well as automating value stream processes. To be specific, in an 'enterprise' ERP modules can be effective means of optimizing planning applications, monitoring production constraints, managing demand forecasting, and keeping order delivery promises. In the cases of innovative print-on-demand service delivery, the value stream can be described as collaborative activities or processes right from the customer order placement (stage 1) to printing and packing books (stage 2), on towards the books distribution (stage 3), and ending up with establishing and managing relationships with the customers and end consumers (stage 4). In turn stage 1 may be supported by ERP module 1 with capabilities of 'electronic book storage'; stage 2 may be supported by 'content management and manufacturing' modules (i.e. ERP module 2); stage 3 may be supported by 'distribution management' module (i.e. ERP module 3) that could be adopted by *another* value member (e.g. downstream channel partner); and stage 4 may be supported by 'customer relationships management' systems (i.e. ERP module 4). However, in some cases, more than two value stream stages could be supported by a comprehensive ERP module or package (e.g. ERPII systems covering Data Warehouse, SRM, CRM, DSS, and e-business functionalities); and this indicates the necessity to rank the importance of different ERP modules by critically evaluating their *usage rate* (see Figure 2), i.e. how well the (ERP) module capabilities perform to support multi-organizational relationships and collaboration (cf. propositions #17, #19, and #22).

In addition, it is argued that the responsibilities of configuring and managing ERP systems within the context of (virtual) multi-organizational collaboration do not necessarily need to be occupied by a single value member (e.g. the focal firm or ERP vendor) but can involve various partners. In the semiconductor manufacturing industry it is, for example, often the case that the focal manufacturers define the overall multi-organizational ERP systems infrastructure and implementation approach; and select the suitable functional modules and the adjunct systems such as web portals, electronic hubs, and EDI technologies to form external linkages between trading partners. Their strategic choices on 'enterprise-wide' ERP design and management can be affected by targeted (multi-organizational) enterprise types (cf. proposition #22), IS deployment approach (cf. propositions #17 and #24), systems advancement (e.g. the intensity in use of web-based technologies) (cf. proposition #16), collaborative product attributes (cf. proposition #4), and partners' capabilities of using enterprise systems (cf. propositions #3, #20, and

#21). The multi-organizational enterprise governor of this e-integration project that is developed on, for instance, RosettaNet EDI connections or SAP i6 ERPII architecture, will then delegate the actual systems implementation to ERP vendors or third-party consulting companies (cf. proposition #23); whilst the significant value members (e.g. 1st tier OEMs and ODMs) might get involved in setting up the whole ERP platform. This, however, requires 'enterprise' leaders or facilitators to move away from their traditional roles as *tertius gaudens* and move towards *tertius iungens* (Obstfeld, 2005) or *primus inter pares* (Binder and Clegg, 2005b) (cf. proposition #29) whereas other key value members need to take more responsibilities for planning and managing multi-organizational enterprise-wide ERP project as well as establishing and integrating ERP systems (cf. propositions #20, #21, and #23).

As can be seen from Figure 2, the level of importance of ERP systems capabilities in the multi-organizational (virtual) enterprise, described by the *usage rate of ERP functional module* (see vertical axis in Figure 2) in the *collaborative activity* (see horizontal axis, i.e. value stream processes in Figure 2), can range from a high usage rate with the most strategic IS roles and effective IS capabilities in supporting multi-organizational relationships and cooperation (i.e. core modules) through the integrated backbone (e.g. SOA) (cf. propositions #16 and #24) to some sort of ancillary tools such as adjunct web-based portals and linkages for connecting the interfaces, which typically have less effect in facilitating multi-organizational enterprises integration. Therefore, the usage rate level of ERP modules is not only dependent upon their intrinsic IS functionalities and advancement (cf. propositions #16, #17, and #19) but also the stages of the value stream of the collaborative activity along with the value members' (core) competencies are delivered to (cf. propositions #3), as well as the targeted (multi-organizational) enterprise structures and strategy. For instance, during the concept phase of product research and development (R&D) ERP modules such as Product Content Management (PCM) and Product Lifecycle Management (PLM) that focus on centrally managing information about (joint) products and speeding up development processes can gain more influence within the 'enterprise' by contributing highly to the multi-organizational cooperation than ERP modules (e.g. MES, VMI, and EDI) that *only* deliver capabilities to the later stages of value stream (e.g. production and distribution) or allow simultaneous interface connections. Additionally, once the overall strategic orientation of the whole enterprise structure and strategy changes, e.g. moving from vertically integrated and extended enterprise paradigms towards virtual enterprise paradigm, a more integrated and flexible information systems infrastructure (e.g. SOA or cloud-based ERP information system) will be adopted at the highest (usage) rate, in order to connect (or even replace) the previous diverse and dispersed ERP modules (cf. propositions #16, #17, #19, and #22). Thus the new ERP Matrix is a vehicle for mapping and linking the architecture of ERP modules with capabilities in supporting different collaborative activities/stages of the value stream and the structure of the multi-organizational enterprises (cf. proposition #15).

The ERP Reference Grid

It has been observed in this research that traditional ERPI, ERPII, and ERPIII are *not*, as some would believe, enterprise information system types resulting from completely different information management strategies. This research study suggests that they are better thought of as a closed loop continuum of the same IS strategy focused on ERP systems enabled multi-organizational relationships and collaboration. In addition, the number and usage rate of different ERP systems types (or functional modules) for any one company participating in an 'enterprise' is closely aligned with the capabilities of supporting targeted (multi-organizational) enterprise structure and strategy and the feasibility of deploying their functional-

ities within the collaborative activities of the 'enterprise' (cf. propositions #16, #17, #19, #20, #21, #22, #24, #28, #29). This is referred to as 'enterprise supporting ERP capability of ERP information systems in the multi-organizational enterprises with regard to the respective collaborative activity (see Figure 2), i.e. the ability of an ERP module to be involved in the value stream due to its specific information systems competences (e.g. full collaborative commerce functionality, all internal functions supported plus core inter-company processes, and open network). In alignment with aspects of contingency theory, competence theory, and IT and business alignment view, the determination of an appropriate ERP systems design and management for the resulting multi-organizational enterprise-wide ERP information systems governance was identified to be dependent upon four main dimensions; these are

1. (Targeted) multi-organizational enterprise types,
2. Deployment approach,
3. (ERP) strategic roles in supporting enterprises, and
4. (ERP) systems advancement that are influenced by various technological and managerial factors.

In other words, the selection of an appropriate governance mode for ERP IS design and management within the multi-organizational enterprise is dependent upon various factors that influence the strategic capabilities (embedded in the ERP module) and implementation of ERP systems within the collaborative activity and ultimately in the 'enterprises'. The four identified dimensions, their related factors, and their impact on the 'enterprise supporting ERP capability' – reflecting in two key aspects, i.e. the intensity in use of web-based ERP information systems and the rate of change frequency of enterprise structure supported by ERP – are outlined in Table 5; which, in turn, can be linked up with the corresponding multi-organizational enterprise forms (i.e. VIE, EE, and VE).

For example, if the value members choose an *on-demand* ERP solution such as Software as a Service (SaaS) the enterprise systems deployment (approach) will be *simpler* than traditional ERP solution (i.e. *proprietary* or *on-premise*) since they do not have to purchase expensive equipment or make sure that they have sufficient infrastructure to handle the system. Rather, they just simply download a software application onto the computers and allow a hosting ERP vendors (or third-party consulting companies) to provide services (cf. propositions #16 and #17). This, therefore, gives stronger *flexibility*, *agility*, and accessibility for value members to adopt, access, and integrate different ERP modules within the multi-organizational enterprises resulting in *high* intensity in use of web-based ERP information systems that best serve the (multi-organizational) enterprise structure which has *high* rate of change frequency, i.e. the suggested 'enterprise' paradigm is dynamic *virtual enterprise*. In contrast, if the value members aim at *mature and well-integrated* (multi-organizational) enterprise type and *large scale of economies*, they aspire to deploy an ERP solution by hosting it internally on their own servers (i.e. *proprietary*) with great concerns about *internal operational integration and optimization*, as well as *security issues* (e.g. data protection), in order to have total control. Consequently, this requires *how* intensity in use of web-based ERP information systems because they want to keep the business data close to the source (with the central control in hands) instead of relying too much on an external Internet connection; this can best serve the (multi-organizational) enterprise structure which has *low* rate of change frequency, i.e. the suggested 'enterprise' paradigm is fully linked *vertically integrated enterprise*.

These examples show that the determination of an appropriate ERP systems design and management for the governance of enterprization (i.e. DERG-ERP) should not only based on the intensity in use of web-based ERP information systems but also on the rate of change frequency of enterprise structure

Table 5. Four dimensions influencing the enterprise supporting ERP capability in the enterprise

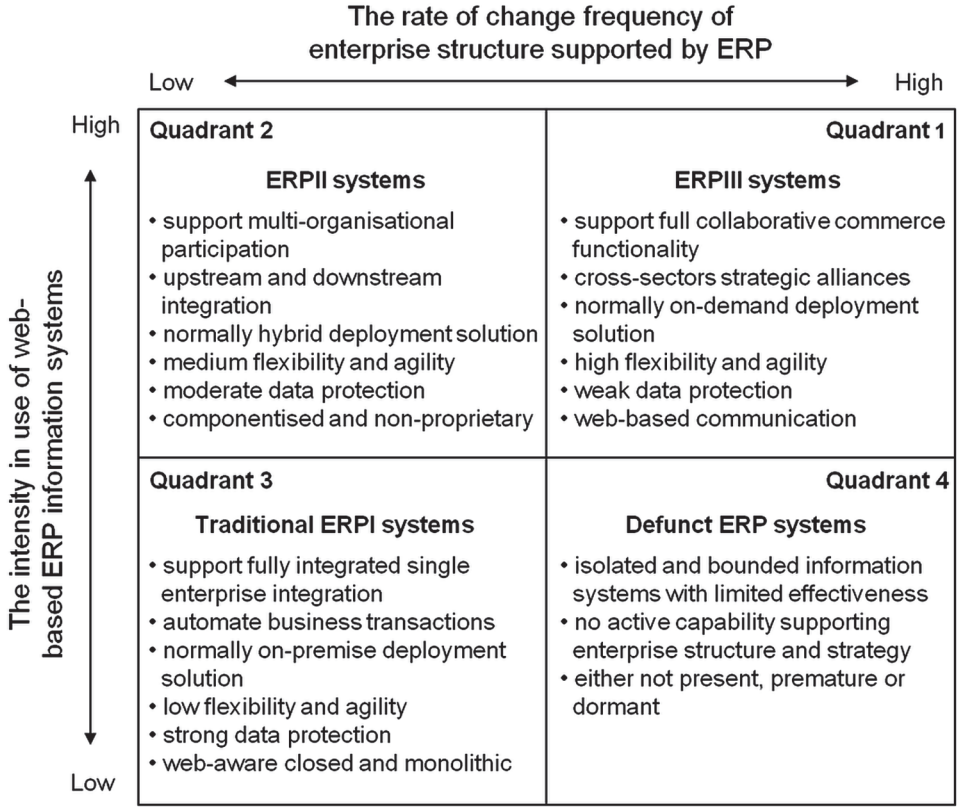
Four Key Dimensions	Related Factors	Impact on Enterprise Supporting ERP Capability (Correlation)		Suggested (Corresponding) Enterprise Strategy (Correlation)
		The Intensity in Use of Web-Based ERP IS	The Rate of Change Frequency of Enterprise Structure Supported by ERP	
(Targeted) enterprise types	• Mature and well-integrated • Relatively stable across the product/service value chain • Large scale of economies • Strategic outsourcing • Dynamic and temporary co-operation	Low Medium Low Medium High	Low Medium Low Medium High	VIE EE VIE EE VE
Deployment (approach)	• On-premise (a.k.a. proprietary) • On-demand (a.k.a. SaaS) • Hybrid ERP solution • Feasibility and simplicity	Low High Medium High	Low High Medium High	VIE VE EE VE (or EE)
Information systems strategic roles	• Internal operational integration and optimization • Multi-organization participation • Internet-based full collaborative commerce	Low Medium High	Low Medium High	VIE EE VE
(ERP) systems advancement	• Flexibility and agility • Security (a.k.a. data protection) • Technological compatibility between different systems	High Low Low	High Low Low	VE VIE VIE (or EE)

supported by ERP systems. Figure 3 summarizes the findings in a concise reference grid which shows four prevailing current and future ERP information system types and their enterprise supporting capability (ranked simply as 'high' or 'low' in terms of the two key aspects). In each of the quadrants the best suited ERP system type (or generation) (i.e. ERPI, ERPII, and ERPIII) depending on the intensity in use of web-based technologies and the rate of change frequency of the targeted (multi-organizational) enterprise structure is given with some of its key characteristics. Additionally, each quadrant of the ERP Reference Grid will be characterized in more detail in Table 6.

The Evolutionary Multi-Organizational ERP Configuration

The empirical findings show that, once established, multi-organizational relationships and their related governance (i.e. design and management) structures, as well as the supporting ERP information systems will and have to change over time (cf. propositions #3, #4, #5, #15, and #16) depending on the varying significance of contingency factors acting upon it (e.g. core competence, delivered products, strategic roles of ERP systems) (cf. propositions #3, #4, #5, #6, #7, #17, and #22). This is in order to stay adaptive to constantly and rapidly changing industrial, multi-organizational relationships, and information systems management requirements which reflects basic ideas of contingency and configuration theories in the sense that 'enterprise' structures and strategies and the supporting ERP information system types are complex adaptive systems that evolve within the 'ecosystem'. For instance, web-aware closed and monolithic (traditional) ERPI systems could be used to enable fully linked and stable multi-organizational

Figure 3. The ERP reference grid: determining appropriate ERP system types



enterprise optimization and integration whilst automating business transactions (Chen, 2001; Stevens, 2003). Alternatively, componentized web-based ERPII systems could be used to facilitate more flexible multi-organizational cooperation with some collaborative commerce potential whilst focusing on integrating upstream and downstream of value stream (Bendoly et al., 2004; Daniel and White, 2005; Monk and Wagner, 2009).

These changes of multi-organizational enterprise-wide ERP information system design and management types seem to be constantly reiterating and evolving, and occur partially (i.e. based on the reconfiguration of ERP functional modules) leading to a closed loop continuum of information systems strategy focused on ERP enabled multi-organizational relationships and collaboration. Figure 4 suggests the evolutionary configuration that ERP information system (IS) types may go through within the context of multi-organizational enterprises. According to the above discussion, when ERP IS type evolves from traditional ERPI to ERPII and towards ERPIII, the value members engaging in the multi-organizational enterprises are required to increasingly adopt web-based information technologies to support more flexible and cloud-based enterprise systems. On the other hand, when the rate of change frequency of 'enterprise' structure becomes higher (i.e. transforming from stable and inflexible enterprise structure to dynamic temporary enterprise structure), the corresponding ERP systems design and management strategies will be developed from (traditional) ERPI systems to ERPII systems and on towards web-based ERPIII architecture.

Table 6. An illustration of the new DERG-ERP concept using empirical examples and links to literature

(4) (5) DERG-ERP Conceptual Element			(6) Most Relevant Propositional Finding	(7) Illustration from Empirical Research (Qualitative Empirical Examples)
Static	**Dynamic**	**Theoretical Description (Provenance from Literature on Theory)**		
Quadrant 1 Virtual Enterprise (VE) with ERPIII		• ERPIII contains a flexible, agent-based ICT architecture • Quick and dynamic inter-firm collaboration through business process management • Psychological issues such as trust and conflict are critical success factors • Flexible, agility, loose, temporary, and dynamic project based collaborative venture • ERPIII systems accelerate quicker and more dynamic business network communication • Assisted by SOA, cloud computing, PaaS, SaaS, and other web-based tools • Potential high risk with fragmented resource base • High transaction cost • High inter-enterprise integration	2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29	Both print-on-demand-Co and printing-Co were setting up on a small venture embracing large amount of inter-firm collaboration supported by web-based ERP information systems or EDI. This is the future enterprise management and IS strategy for Zoomlion, which could make them loosely linked with other partners' operations through more mature and flexible ERP functionalities. Lanye applied the VE strategy for integrating plants in different locations assisted by VPN (Virtual Private Network) and web-based ERP systems.
Quadrant 2 Extended Enterprise (EE) with ERPII		• Enterprise strategy changes into goal seeking rather than issue based • Medium transaction cost with relatively lean resource base • BPR for medium degree of intra-enterprise integration • ERPII can enable high level integration of internal and potentially external operational processes • Moderate supplier-customer relationships and collaborative alliances are managed by SCM/ CRM systems approaching the virtual value chain concept • More stable, strategic, close, and permanent collaborative venture focused	2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 19, 20, 21, 22, 25, 26, 27, 28	Electronic-Co was trying to integrate with upstream and downstream partners by connecting different ERP systems via RosettaNet EDI and B2B connections. Zoomlion adopted a new business strategy to re-position its value members: joint partners, suppliers, customers, and even competitors; which is realised by SAP ERPII systems. Meanwhile, lean management concept and strategic outsourcing from CIFA and Powermole is applied.
Quadrant 3 Vertically Integrated Enterprise (VIE) with traditional ERPI		• Proprietary ERP supposedly built upon real-time information • High degree of functional units integration • Involving predominantly production processes • Potentially permanent with high degree of intra-integration • Promotes business process re-engineering • Extensive internal resource and low transaction cost • ERP used reactively • Business strategy is driven by 'top-down' approach	2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 20, 21, 22, 24, 25, 26, 27, 28	After ERP systems launch Zoomlion had a high level of intra-integration. Also, large contributions are noted from value members who engaged within intra-enterprise activities. Wanghai had fully achieved an internal resource integration by adopting a full ERPI system package (e.g. Yonyou ERP systems) and ancillary tools such as RFID technology.
Quadrant 4 Defunct Enterprise (DE) with limited IT/IS efficiency		• No profits achievable • Rare IT/IS implementation or no ERP • Fixed single company configuration • No active engagement in a current collaborative activity • IT driven strategy via 'bottom-up' approach • Company focuses on solving 'issue-based' problems	3, 4, 5, 7, 9, 13, 15, 20, 21, 22, 25, 29	Zoomlion was initially founded on a high-tech academic institution without any explicit profitable or commercial purposes. Wanghai was a scrap recovery plant without any enterprise management and ERP IS strategy.

continued on following page

Table 6. Continued

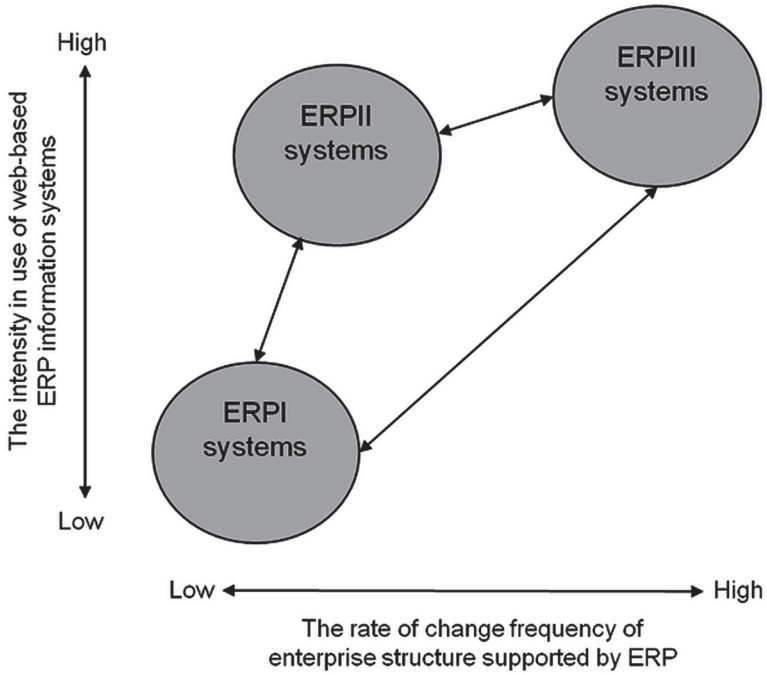
(4) (5) DERG-ERP Conceptual Element			(6) Most Relevant Propositional Finding	(7) Illustration from Empirical Research (Qualitative Empirical Examples)
Static	**Dynamic**	**Theoretical Description (Provenance from Literature on Theory)**		
	Quadrant 1 to Quadrant 2 From VEs to EEs by changing ERPIII into ERPII	• Strategic move for successful joint ventures depending on the existing mutual relationships and experiences • Effective partnership along with expertises, technology, and knowledge management is critical to establish common enterprise strategies regarding the culture, trust, and advanced IT/IS issues • Changing ERPIII to ERPII for better governing medium-long term relationships with suppliers whilst predicting customer's demands	1, 2, 3, 4, 5, 7, 9, 12, 14, 20, 21, 22, 25, 26, 28	In order to offer a complete printing solution, printing-Co moved from VE to EE based on its existing and successful partnerships whilst applying EDI with its trust partners. Lanye intends to apply EE to achieve a more stable organisational structure with medium-long term inter-firm relationships. In this enterprise context, ERPII could be used based on strategic alliances instead of web-based architecture.
	Quadrant 2 to Quadrant 1 From EEs to VEs by developing ERPII to ERPIII	• Transformation of EE to VE can be adopted incrementally • Upgrading from ERPII to ERPIII would increase the companies' flexibility and adaptability for coping with a quick response to the business environment • ERPIII, SCM, CRM, and e-business applications merged with SOA, SaaS, cloud computing, etc. can optimise global supply network integration • Successful stable ventures trigger the creation of new temporary, agile, and dynamic ventures • Requires open minded management with proactive IT/IS strategies • Focus on temporary market opportunity through short-term collaboration • Enterprise strategies shift from company centric into 'borderless enterprises'	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 28, 29	Electronic-Co planned to design and implement the SOA-based ERP systems to become more agile, flexible, and responsive to the customers. In the future Zoomlion may develop from EE into VE by upgrading ERPII to ERPIII to address cost-effectiveness, product uniqueness, business network optimisation, and short-temporary seamless issues with industrial third parties. Metrobank endeavoured to be more responsive to dynamic market conditions; whilst new legal and regulatory requirements demanded greater transparency and more accurate and timely information. Thus it has transformed from EE to VE by upgrading ERPII to ERPIII NetWeaver.
	Quadrant 2 to Quadrant 3 From EEs to VIEs by changing ERPII into traditional ERPI	• The enterprise with predominantly medium asset specific content and information systems move to adopt 'lock-in' tactics to gain industrial dominance and market share • For the purpose of achieving economies of scale; known as the 'shake-out' stage • Shifting ERPII systems into traditional ERPI but still keep the intelligent ICT applications such as SCM, CRM, DSS, DW, etc.	1, 2, 3, 4, 5, 7, 9, 10, 12, 14, 19, 20, 21, 22, 24, 25, 26	Print-on-demand-Co has gained a large scale of economies by integrating and cooperating with different functional legal entities such as channel distributors and logistics (e.g. Amazon), publishers, and IT providers in a whole.
	Quadrant 3 to Quadrant 2 From VIEs to EEs by developing traditional ERPI to ERPII	• Business processes are re-engineered and lean thinking must be adopted in parallel • The most valuable members who engaged in the entire value chain have transferred from outside the company boundary to inside the enterprise boundary • A new strategic partnership has revived an existing and proven enterprise module by deploying it in an EE context • ERPII replaces traditional ERPI with SCM and CRM tools to gain medium inter-integration rather than merely intra-integration • Shifting from 'issue-based' problem solving into goal seeking strategy formulation via business driven 'top-down' approach	1, 2, 3, 4, 5, 7, 9, 12, 14, 15, 20, 21, 22, 25, 26	Electronic-Co has developed its ERP systems by extending the functional modules to include SCM, CRM, and EDW to address the real business-to-business integration, as well as manage and control suppliers better. By re-classifying the value members and re-designing business processes, Zoomlion's new production line is based on collaborative alliances with ERPII information systems.

continued on following page

Table 6. Continued

(4) (5) DERG-ERP Conceptual Element			(6) Most Relevant Propositional Finding	(7) Illustration from Empirical Research (Qualitative Empirical Examples)
Static	**Dynamic**	**Theoretical Description (Provenance from Literature on Theory)**		
	Quadrant 3 to Quadrant 1 From VIEs to VEs by developing traditional ERPI to ERPIII	• Traditional VIE or M&A strategies try to seek new innovative ventures to remain competitive • ERPIII replaces traditional ERPI towards a more flexible and agile information systems • Web-based technologies and other ICT tools will assist this new enterprise management pattern	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 28, 29	By re-classifying the value members, Lanye has transformed from VIE into VE by setting up its own 'Virtual Private Network' (VPN) and ERP-GPS infrastructure for achieving agile or even the leagile manufacturing in response to the dynamic complex marketing demands.
	Quadrant 1 to Quadrant 3 From VEs to VIEs by changing ERPIII into traditional ERPI	• In the case of highly asset specific can be controlled or influenced by former partners internally • Try to extend business portfolio and product/ service differentiation to cover whole supply chain cycle via 'forward (vertical) integration' or 'backward (vertical) integration' strategies • Changing ERPIII to traditional ERPI aiming at in-house IT/IS development, in order to reduce the transaction cost	1, 2, 3, 4, 5, 7, 9, 10, 12, 14, 20, 21, 22, 24, 25, 26	As soon as completing the virtual business network across intra- and inter-organisational scopes, Lanye gradually changed its enterprise structure from VE into a more stable and fully linked VIE to gain more market profits and bargain power against its competitors within the same industry; whilst web-based ERP solutions need to be replaced by in-house ERP solutions.

Figure 4. The Evolutionary configuration of multi-organizational ERP information systems



This kind of adaptive IS strategy paradigm can be regarded as a 'dynamic information systems community'; each of these ERP system types (i.e. ERPI, ERPII, and ERPIII) is considered to be a 'dynamic equilibrium' within the ecosystem 'multi-organizational enterprise-wide ERP strategy' around which one ERP system type consisting of ERP functional modules is configured and implemented for a certain period until flipping over to another ERP type (bifurcation), in order to best serve the targeted multi-organizational enterprise structures and strategies (e.g. virtual enterprise). However, as opposed to the assumptions of mere quantum change of the (ERP) design and management applied in complexity theory this chapter also reveals evidence for step-by-step adaption and reconfiguration of ERP information system types to balance emergence and control between different ERP functional modules more in line with the argumentation of contingency and configuration theory (see examples for both in Table 6). Moreover, these examples show that the bifurcation from one design and management type to another can follow a two-way pattern (hence the double sided arrows in Figure 4) although the clockwise cyclical pattern from ERPI systems through ERPII systems to ERPIII systems is the most common and likely evolution (or IS development) to be observed in practice.

A PROPOSED CONCEPTUAL FRAMEWORK

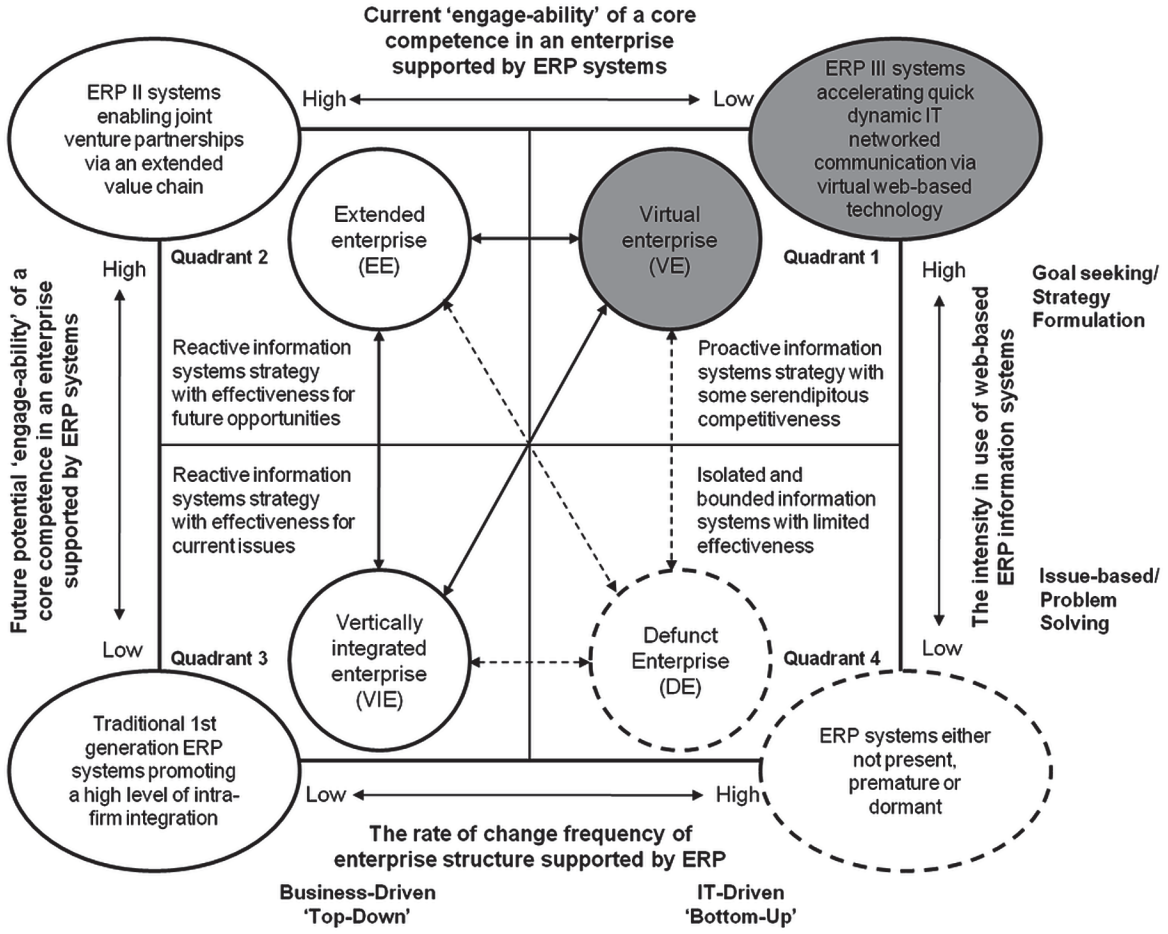
Figure 5 is a summary of the generalizable findings from the empirical studies presented as the final contingency framework known as the Dynamic Enterprise Reference Grid for ERP (DERG-ERP) which demonstrates how to guide the interactions between ERP information systems and the management of multi-organizational enterprises; and how to rightly pursue the virtual enterprise paradigm supported by the correct type of ERP systems to make a significant contribution to knowledge in the fields of information systems and multi-organizational enterprise management as well as for the application of this knowledge to practice. Thus the author believes it is a valuable and significant generalizable conceptual deliverable from this research.

The DERG-ERP as shown in Figure 5 is now described generically quadrant by quadrant; whilst the pairing VE-ERPIII in Quadrant 1 – the one that is mainly concerned by this chapter (in comparison to other two pairings VIE-ERPI and EE-ERPII) – is highlighted and suggested.

Traditional ERPI Systems Use in VIEs

In Quadrant 3 of the DERG-ERP in Figure 5 a VIE would be the most appropriate multi-organizational enterprise form using a traditional ERPI system which can support all core processes and provide some inter-departmental integration (within a single legal entity). Such system are relatively good at long term issue based (or detailed problem solving) tasks and help accomplish business driven top-down goals, although they do not contribute directly towards the strategic forward vision of a company because they are usually operational and transactional in nature; and so therefore tend to entrench current practice and become relatively reactive to strategic and environmental business changes, rather than being the driver of flexibility or change. Traditional ERPI system performs best when core competencies of strategic partners (a.k.a. value members) – particularly the most influential/focal firms in the multi-organizational enterprise are currently highly engaged, e.g. due to their mature, well-established, and widely useable

Figure 5. Dynamic Enterprise Reference Grid for Enterprise Resource Planning (DERG-ERP) contingency framework



capabilities, but could decline in attractiveness in the future, e.g. because of fears that profit margins are eroding or that their technologies may become obsolete; thus allowing transaction costs to be minimized and scale of economy to be maximized.

ERPII Systems Use in EEs

In Quadrant 2 of the DERG-ERP in Figure 5 an EE is the most appropriate multi-organizational enterprise form. The EE best serves medium-to-large sized operations aspiring to form closer (joint venture) partnerships within an extended value chain. ERPII systems are able to extend ERPI capabilities to cover SCM, customer relationship functions, and some collaborative commerce potential to encourage active participation from other legal entities. ERPII systems can therefore drive business driven top-down tasks which can be directly used for achieving goals and formulating strategy across company boundaries (e.g. supply chain policies and collaborative forecasting with suppliers). ERPII is most effective when core competencies of strategic partners in the multi-organizational enterprise are currently, and in the near

future, highly engaging, e.g. owning to their relatively mature nature and market success; this makes them highly attractive to other multi-organizational enterprise members, and therefore highly likely to be needed in new collaboration, with new *modus operandi*.

ERPIII Systems Use in VEs (The Mainly Concerned Pairing)

In Quadrant 1 of the DERG-ERP in Figure 5 a VE is shown. The VE best serves organizations (participating in the multi-organizational enterprise) which have aspirations for rapid growth (and so are likely to be relatively small) and see themselves as innovative and likely to be serial and parallel innovators or collaborators. ERPIII systems are able to facilitate temporary and highly agile operations using non-proprietary web-based technology for computer integrated manufacturing systems with decentralized operational control on a global scale and scope. ERPIII systems can therefore be used strategically to achieve strategic goals whilst still incorporating incremental IT driven changes required by bottom-up idiosyncrasies. ERPIII systems are considered to be pro-active IS with some almost serendipitous qualities (e.g. cloud-sourcing of innovative ideas) which fit well to the virtual enterprise type as long as the required security and trust-levels can be attained. Simultaneously, ERPIII is most effective when core competencies of strategic partners in the multi-organizational enterprise are currently lowly engaged but highly engaged in the future, e.g. because they usually have many newly emerging (core) competencies.

ERPIII applications are best used in multi-organizational (virtual) enterprise-wide operations within and across different legal entities (i.e. parts of companies). Based on traditional ERPI and ERPII principles, ERPIII based (virtual) enterprises will probably achieve the next level of business integration; namely to enable a strategic-level dialog between customers (or potential customers), an 'enterprise' integrator, and the extended supply chain using SOA, PaaS, SaaS technologies and Service-Level Agreement (SLA) management tools; and will most likely be maintained by a strategic IT/IS partner. Moreover, ERPIII type solutions could create truly integrated and borderless (virtual) enterprises; thus reaching near utopian levels of multi-organizational enterprise consciousness bringing about the simultaneous strengthening of operations, strategy, and IT interactivity, which the author refers to as the 'enterprization of operations".

Des and IS Misuse

Quadrant 4 of the DERG-ERP in Figure 5 shows a Defunct Enterprise (DE). Des occur when operations strategy, structural thinking, or information system policy have gone wrong or are premature; the challenge for operations and strategist in this business environment is to move to another more suitable types of multi-organizational enterprise (e.g. virtual enterprise) supported by corresponding ERP information systems as quickly as possible. In DEs ERP is often not widely used, used inappropriately or without any great effectiveness. Tasks are normally driven by bottom-up IT initiatives lacking strategic congruence.

Putting It All Together: Theory and Practice into a Useable Concept

To illustrate the implications of the developed concept of 'enterprization of operations' and the DERG-ERP contingency framework a structured recapitulation of the research presented above is given in tabular format in Table 6 which describes the 'static' typologies of (multi-organizational) enterprises and the supporting ERP systems, 'dynamic' changes they may undergo, theoretical description (a.k.a.

provenance from literature), relevant propositional findings, and qualitative empirical examples derived from 8 cases (i.e. an empirical illustration). Thus an illustration of the new DERG-ERP is based upon

1. A combination of conceptual interpretation of the empirical data (column 1 in Table 6) based on the characteristics of ERP and enterprise types (see Tables 1 and 2) combined with Figures 2 and 3;
2. The most relevant propositional findings (column 2 in Table 6); and
3. Empirical examples derived from the interviews (column 3 in Table 6).

Thereby, different examples are used to explain the 'static' and 'dynamic' components of the concept because this has been a cross-sectional study and not a longitudinal one. However, at an aggregated level Table 6 demonstrates the connection between the concept of 'enterprization of operations' (i.e. DERG-ERP) and the empirical examples which is representative of inductive grounded reasoning. In particular, the 'static' conceptual elements of 'VE-ERPIII' and the 'dynamic' transformational routes moving from VIE-ERPI, EE-ERPII, and DE with limited IT/IS efficiency to VE-ERPIII (i.e. Quadrants 2, 3, 4 to Quadrant 1) are highlighted and suggested.

CONCLUSION

This chapter summarizes recent trends in ERP systems development and examines the emerging practices in the management of multi-organizational enterprises. From 8 empirical cases 29 theoretical propositions were formed using Grounded Theory-based methodology. The new Dynamic Enterprise Resource Grid for ERP (DERG-ERP) conceptual framework is shown in Figure 5 which distills the generic principles from research into a single 'decision-making' framework, in order to assist managers in identifying the circumstances under which the so-called 'ERPIII' systems fit into the Virtual Enterprise structure and strategy; and *vice versa*.

The author claims that the generic DERG-ERP in Figure 5 is used to explain correlations between ERP system types and collaborative enterprise structures and strategy, from both manufacturing and service perspective. In all 8 cases it was observed that traditional ERPI was associated with VIEs, ERPII with EEs, ERPIII with VEs and limited IS/IT was observed in DEs. Therefore the author claims that there is a correlation between each of these pairings; which further explains and describes how and why ERP system develop from traditional ERPI and ERPII types to ERPIII type as well as how and why multi-organizational enterprise structures and strategy transforms from VIE and EE types to VE type – the one that is mainly concerned by this chapter.

The empirical findings specifically indicate that the core competence, expected competitiveness, and ERP information systems strategic capability (referred to as 'enterprise supporting ERP capability' in this chapter) are significant contingency factors that influence the design and management of multi-organizational enterprise structure and the supporting ERP systems. The DERG-ERP conceptual framework also suggests the evolutionary configuration that ERP information system types may go through within the ecosystem of 'multi-organizational enterprise-wide ERP strategy', which is determined upon two key aspects: (a) the intensity in use of web-based ERP information systems and (b) the rate of change frequency of multi-organizational enterprise structure supported by ERP information systems.

The new DERG-ERP framework gives some practical decision support and serves as a guideline to practicing information systems and multi-organizational enterprise managers. This study is also important to those companies grappling with the 'right' approach to steer their collaborative agile enterprise patterns such as virtual enterprise strategy and improve their company performance by adopting ERP systems, whilst seeking greater profits and efficiency by increasing their levels of multi-organizational collaboration. Besides this, the research will be of interest to those interested in the development of inter-organizational information systems and application of the new IT platforms and services designed to extend ERP modules and functionalities within the context of virtual operational environment (or e-collaboration).

DERG-ERP is limited by being based on 8 cases; and so is currently being tested and applied on other companies. This work contributes to a gap in extant literature about the correlation between ERP systems and multi-organizational innovation – particularly for the design and management of ERP systems supporting for virtual enterprise structure and strategy.

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KEY TERMS AND DEFINITIONS

Enterprise: An entity, regardless of its legal form, including partnerships or associations regularly engaged in economic activities. Practically this means parts of companies working with parts of other companies to collectively deliver complex product service systems.

Enterprise Resource Planning: An electronic information system includes a set of business applications or modules, which links various business units of an organization (or multi-organizational enterprises) into an integrated system with a common platform for flow of information across the entire business.

Enterprise Supporting ERP Capability: Enterprise Supporting ERP Capability determines the type and ability of ERP systems to be applied in the multi-organizational enterprise due to its specific information systems competences, capabilities supporting the targeted enterprise structure and the feasibility of deploying their functionalities within the enterprise.

ERPI: Internally integrated information systems used to gain operational competitive advantage by primarily supporting core internal (operational) functions.

ERPII: An enterprise information system recognized as an integral part of business strategy enabling multi-organizational collaboration through extension of operations to close and trusted partners.

ERPIII: A flexible, powerful information system incorporating web-based technology which enables (multi-organizational) enterprises to offer increasing degrees of connectivity, collaboration and dynamism through increased functional scope and scalability.

Extended Enterprise: Parts of companies working with parts of other companies to collectively deliver complex product service systems. This is a semi permanent multi-organizational enterprise structure designed to be flexible and agile.

Vertically Integrated Enterprise: Parts of companies working with parts of other companies to collectively deliver complex product service systems. A multi-organizational vertically integrated enterprise operates almost as large single well-integrated multi-functional firm striving for scales of economy.

Virtual Enterprise: Parts of companies working with parts of other companies to collectively deliver complex product service systems. A multi-organizational virtual enterprise is designed to be short term and highly agile.