Enabling Supply Networks with Collaborative Information Infrastructure

An Empirical Investigation of Business Model Innovation in Supplier Relation-ship Management

Nøkkentved, Chris

Enabling Supply Networks with Collaborative Information Infrastructures

Chris Nøkkentved

Enabling Supply Networks with Collaborative Information Infrastructures

An Empirical Investigation of Business Model Innovation in Supplier Relation-ship Management

Doctoral School of Organisation and Management Studies
CBS / Copenhagen Business School

PhD Series 3.2009

ISSN 0906-6934
ISBN 978-87-593-8380-3

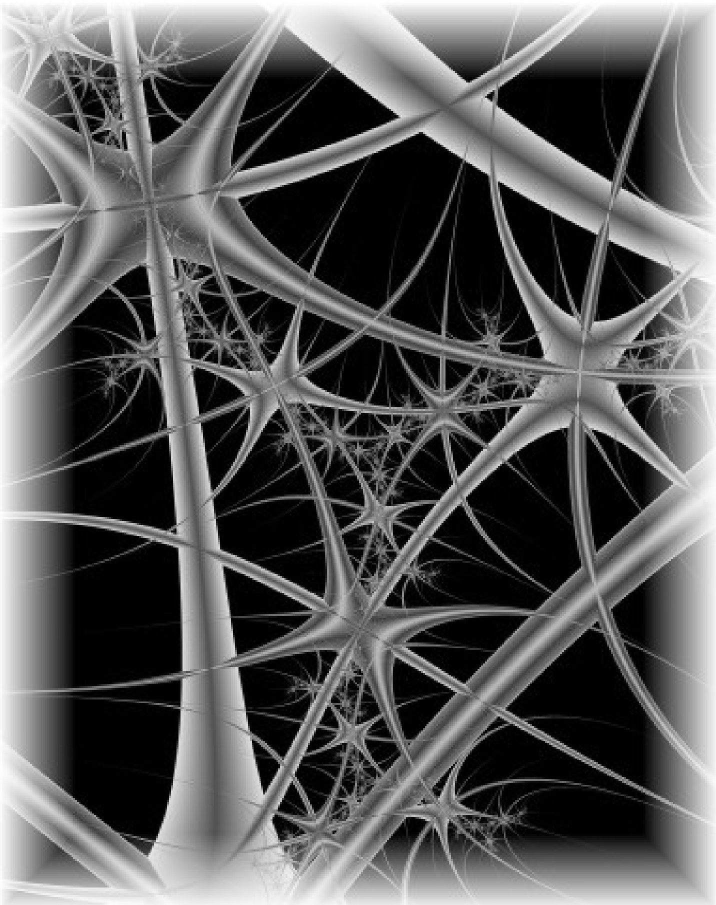
Enabling Supply Networks with Collaborative Information Infrastructures

Chris Nøkkentved
Enabling Supply Networks with Collaborative Information Infrastructures
An Empirical Investigation of Business Model Innovation in Supplier Relation-ship Management

1st edition 2009
PhD Series 3.2009

ISBN: 978-87-593-8380-3
ISSN: 0906-6934

Enabling Supply Networks with Collaborative Information Infrastructures



An Empirical Investigation Of Business Model Innovation in Supplier Relationship Management

Industrial Ph.D. Dissertation

February 2008

Chris Nøkkentved

Institute of Informatics (CAICT) and Institute of Management. Politics and Philosophy, Copenhagen Business School, Denmark

Dissertation title:	**Enabling Collaborative Supply Networks**
Author:	**Chris Nøkkentved**
Email:	chris.nokkentved@dk.ibm.com
Phone	(+45) 28 80 86 02
Academic Institution	**Copenhagen Business School**
PhD. Mentor:	**Niels Bjoern-Andersen**
Email:	nba@cbs.dk
School:	Copenhagen Business School (CBS)
Center:	Center for Applied Information Communication Technology (CAICT)
Institute:	Institute of Informatics
Address:	Howitzvej 60
Town	Frederiksberg
Postal code:	DK-2000
Country	Denmark
Phone::	(+45) 38 15 24 24
Company	**IBM Global Business Services**
Company Mentor:	**Mogens Rødbro**
Email:	mogens_roedbro@dk.ibm.com
Department:	IBM GBS Nordics
Address:	Nymøllevej 91, 4
Postal code:	DK-2800
Town	Lyngby
Country	Denmark
Phone:	(+45) 45 23 34 66

Cover Page Illustration: This is one of Mandelbaum's amazing Fractal Networks - one residing within the other till eternity!

Table of Contents

1. ACKNOWLEDGEMENTS

This has been an exciting journey that commenced nearly 20 years ago as I was reading "Strategies & Styles" by Goold and Campbell (1987). That book opened my eyes and gave me a brief glimpse into the tangled world of management and organizational transformation, so different from the seemingly ordered world of computer science in the mid 80's.

Now 20 years later and a multitude of books later, I am scribbling down these lines in the preface section of this research work that reaches some sort of a closure, while stretching back nearly a decade in its scope as it deals with many of my deliberations and wonderments. Yet, all of this would not have taken place and brought to fruition if there were not people believing and supporting this from the beginning till this end.

On the private front, a huge thank you to my fellow adventurer and wife, Pernille, for accommodating my nomadic tendencies and sponsoring my time even in disbelief that all of this would end. Without you and our kids, Nicolas and Sebastian, I would have been deprived of the meaning of life. Also need to thank my brothers, especially Alexandros, and then my wondrous Mother, for listening to my sprawling monologs, yet still urging me to go on.

From the Academic circle a big thank you to my initial and ultimate mentor, Professor Niels Bjørn Andersen for giving me the change to roam the steppes once again – knowing these wings for 20 years, I am still amazed how you can make things fly in your busy world. I also need to thank Professor Laurids Hedaa, who as a mentor opened my eyes to the world of the IMP Group and Business Networks and as a sponsor gave me access to CAM and to the PhD. Another person that I need to thank is Niels Arnfred (the director of CIMI Executive MBA) for believing in me and motivating me to pursue a double track in life. I also need to thank the Danish Academy of Technical Sciences for believing, pursuing and sponsoring this project. A final thanks here has to go to Axel Rosenø, now Associate Professor, my best, yet unattended friend – thanks for all these great years of joint wonderment and hard work with MPI, you still pushed and urged me to get on to work with this project as it was slipping off my fingers.

From the business side there are countless people within the PriceWaterhouseCoopers Consulting division that originally hired me in 1999, to IBM that continued to believe and support my endless pursuit. There are a number of people that cannot be left unmentioned as they meant a lot to me and this project.

On the Danish side, I express my gratitude to IBM's PhD. Mentor, Dr. Mogens Rødbro, for taking on this assignment and making things happen. Thanks for being patient with my frequent absence – your support was greatly appreciated! I also need to thank Claus Madsen, my business manager for his support and sponsorship which was needed to complete this assignment.

On the international front where I did spend most of my time these years, I need to start from Dr. Charlie Hawker, the SCOS Partner of the heydays, and a great mind that took me under this wings and guided me through the first tumultuous years within the SCM and eMarkets area. Then a big thanks to John Leffler that gave me my first grounded feedback 7 years ago on collaborative value chains and kept supporting me in his role as the Global SAP Leader for IBM GBS, in this endeavor till the end. In the European SAP community, how can I forget the learning years under Rolando Neiger, the then EMEA leader of IBM SAP – a mentor and manager, that taught me the intricacies of handling multiple stakeholders and sponsored my learning years. I especially need to thank Rudolf Niehus for being the concise, yet innovative personality that motivated and sponsored me to pursue the new and uncharted territories of SOA – you inspired me more than one can imagine. I need to thank Tom Rosinski, for always asking me about my degree and Adolf Allesch for making it easy for me to take the path of completing this assignment.

Finally, I am indebted to Henrik Knak (currently at Deloitte), for believing that the journey was plausible, and introducing me to the consulting world. Finally, David Duray, that 8 years ago gave me access and an entry ticket into the SAP Center of Expertise, which became such a central part of my professional and social life.

Espergærde, Denmark, the 1st of July 2007.

Chris Nøkkentved

1. INTRODUCTION

"Our Civilization lives on Software" Bjarne Stroustrup

1.1 Wonderland or Monstrous Hybrids?

The current global environment, marked by increased demand, decreased customer loyalty, accelerated product and innovation life-cycles, and mass-customization, forces companies to optimize costs, pursue higher productivity, and continuously improve the quality and variety of products and services. To meet these multiple challenges, companies have progressed from internal consolidation to process harmonization and currently turn their attention to external optimization[1] via B2B e-Commerce to ubiquitous-Commerce (Watson, et al. 2002), by increasingly cooperating with partners and competitors whose complementary capabilities can give their whole business network a competitive edge.

As the applications of information and communication technology (ICT or just IT) are converging and become more prevalent, intraorganizational systems like Enterprise Resource Planning (ERP) are increasingly permeating industrial networks of companies by impacting an increased number of cross-company processes. This has lead previous vertically integrated, hierarchically organized firms to evolve towards more flexible, networked forms of both organization and industrial structures, thus blurring the boundaries of firms and industries alike (Brynjolfsson & Mendelson, 1993). This network effect of ICT paired with the increased demands for competitive differentiation, cost optimization and manufacturing agility encourages companies to extend their supply networks (Zheng, 1998; Harland, 1996) with collaborative, interorganizational infrastructures[2] empowering buyer-seller relationships (Nøkkentved & Hedaa, 2000, 2001).

---

[1] In the last decade a rising number of companies have been working on improving, integrating and automating their intraorganizational processes realized via enterprise resource planning (ERP) systems. The wider deployment of ERP systems and innovations in messaging and tracking technologies that allow real-time management of supply chain activities, has resulted in more compatible process and information Furthermore, the Internet has emerged as an ubiquitous communication platform on which companies can collaborate with their partners, reduce cycle times and enforce data and security protocols, towards a joint, or collaborative advantage (Dyer, 2000).

[2] In the purchasing-side of the firm, such information infrastructures are realized by Internet-enabled applications also called eProcurement or recently *Supplier Relationship Management* (Hartmann et al.,2002). The latter provides a relational enablement of the upstream activities of a firm, by encompassing all sorts of strategic and operational, planned and/or unplanned purchasing and sourcing activities.

These large scale transformations are felt by many companies, and is in an evolutionary manner changing our perspective of IT from deliberate technology viewed as a portfolio resource, to emergent, layered information infrastructures (Hanseth & Braa, 1998). Some even take it to the extreme views stated by the French philosopher Latour, a decade ago in that:

> ”It is no longer clear if a computer system is a limited form of organization or if an organization is an expanded form of computer system. Not because, as in the engineering dreams and sociological nightmares, complete rationalization would have taken place, but because, on the opposite, the two monstrous hybrids are now coextensive” [Latour, 1996].

Without being as technology deterministic, and looking at the sensitivities and implicit dependencies of larger companies on large Enterprise Applications from an increasingly consolidated vendor base (i.e. SAP, Oracle and Microsoft), it is indeed evident that such a postulated “co extensiveness” is actually creeping in, whether we agree or not.

Professor Thomas Malone foresaw 2 decades ago the emergence of alternative business models[3] (i.e. electronic Marketplaces). He is another adamant, yet less controversial advocate of the social fabric consequences of IT-driven (i.e. socio-technical) transformations affecting individuals and companies. A couple of years ago he gave an interview where he elaborated on his views in an eloquent manner[4]:

> “I think we're in the early stages of an increase of human freedom in business that may, in the long run, be as important a change for business as the change to democracies has been for governments. The reason I think that's happening is because for the first time in human history it's now possible to have the economic benefits of very large organizations – like economies of scale — and at the same time have the human benefits of very small organizations – things like freedom, flexibility, innovation and creativity. And the reason that's possible is because a new generation of information technologies — like the Internet, the World Wide Web, e-mail and business intelligence — is now making it possible for huge numbers of people, even in very large organizations, to have enough information to make sensible decisions for themselves

[3] *Business Model* is often used to describe the key components of a given enterprise, especially popular after the emergence of E-businesses models (Mahadevan, 2000; Magretta, 2002). Within E-commerce, business model research descriptions and components of Ecommerce models were developed by Timmers (1998) who defined a business model as architecture for products, service, and information, including a description of the various business activities and their roles. Osterwalder et al.,(2005) provides a definition: “A *business model* is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams.”.

[4] Interviewed by Howard Dresner, (Gartner, Inc.), on March 8, 2005) at the SuperNova Conference 2005 – see full text at: http://www.gartner.com/research/fellows/asset_126360_1176.jsp

> instead of just following orders from someone above them in the hierarchy. So, it's the technology that's making it possible. But just because something is possible doesn't mean it will happen!”

So, as implied, technology leads to substantial social consequences, yet in itself is not a predictor of an improved organization. Change demands concerted action leading to deployment and usage. Moreover, while this proliferation of information technology is driven by the need for visibility and knowledge, it’s highly probable that these unforeseen societal and organizational changes will occur based on the desires of individual actors (i.e. workers):

> “What will drive these changes is what people want. And so, if we want to predict these changes — and especially if we want to shape these changes — we need to think much more deeply than we usually do about what it is that we humans really want. It turns out that when people are making decisions for themselves instead of just following orders, a bunch of good things often happen. They're often more highly motivated, they're often more dedicated, they're often more creative. They're able to be more flexible and respond to the individual local situation in which they find themselves rather than following some rigid rules set down from on high. And finally, they often just plain like it better. … technology would make it possible for — and our desires for flexibility and innovation will drive the change toward — more and more decentralized decision making over the next few decades.” [Malone interview 2005]

Beyond these societal effects of information technology, Malone also predicts that organizations are facing an increased pressure for *decentralized innovation*, given that:

> “… one of the main points of my book [The Future of Work, 2004] is that information technology is reducing one of the most important costs — the cost of communication. But there are also some costs of figuring out how to structure organizations in more decentralized ways. Just because you have the technology to do it doesn't mean you know who is going to make what decisions, what rules you'll follow and how responsibilities will be divided. And there are a lot of organizational inventions [of new kind of organizational process] that we need to make to figure out how to do these things in more situations.” [Malone interview 2005]

These last statements are in line with another MIT economist Eric Brynjolfsson, that emphasized early on that successful technology advancement is demanding complementary organizational transformations. Undoubtedly, any technological advancement has unforeseen consequences, yet given these substantiated view-points, and the realities of the world experienced by the author in a consulting environment appointed to support/drive such transformations, we need to mature beyond the argument of the position, denomination or even relevancy of IT. Just as businesses are evolving beyond typical structures towards modularity (Dyer, 2000), we need to lift ourselves away from an exclusively resource-based perspective of technology. On the other hand, it seems nonsensical to study the organizational performance consequences of deploying innovative information technology. Rather, there is a need to better understand the intermediacy of organizational co-innovations when we look at the effect of IT.

The more grounded objective of this dissertation is to study the actions and factors enabling such organizational or business model innovation[5] driven by and/or driving the use of information technology within a delimited business domain of Supplier Relationship Management (i.e. all procurement, sourcing and related internal and external activities, competences and roles). We will pursue this objective, yet try to avoid the one-sided trap or perspective of oft "hyped" technologists by cross-fertilizing our views on information infrastructures with recommendations from the industrial networks and supply networks traditions. Our hope is to be able to present our results of a series of interpretive qualitative and normative quantitative investigations leading to a model of contextual adoption factors[6] enabling the successful transformation of supply networks buy-side information infrastructures.

We will commence this introductory chapter with a brief overview of a recent global survey undertaken by the IBM Corporation that underpins and somehow justifies our exploratory endeavors. The inferences from this survey are in line with the latest empirical and theoretical constructs from a number of scientific communities that we will deploy in this research. As these will be explained in greater detail later, we will in the following section only provide a brief description. Subsequently, we will attempt to introduce the reader to the objectives of our research and the statements posed, and complete our introduction with the outline of our dissertation, which will briefly sketch the chapters to come.

---

[5] Linder and Cantrell (2000), have studied the process of change in business models, which creates the need to find a more conceptual and shared way of characterize them; the authors describe desired end-state models as "change models", further classified into four basic types: realization models, renewal models, extension models, and journey models, depending on how much the core business logic changes.

[6] *Adoption Factors* were elaborated by Pateli and Giaglis' (2004) research; they provided a comprehensive analysis of the business model literature classifying it into the following eight 'sub-domains of research'. Our research focuses on adoption factors in a business model.

1.2 "State of the Business" – The IBM Global CEO Survey 2006

Taking into consideration these socio-technical transitions contemporary businesses are going through, IBM's Institute of Business Value (IBV) launched a series of surveys to study the opinions of senior business executives across the world. In this section we briefly summarize some of the most important results that will also guide some of our research agenda.

IBV's recent, "Global CEO 2006 survey"[7], was based on in-depth, consultative interviews of over 765 CEOs, business executives and public sector leaders from around the world. The survey population spanned 20 different industries and 11 geographic regions including mature markets and from developing markets such as China, India, Eastern Europe and Latin America, offering a genuinely global perspective.

While a previous survey in 2004 found that CEOs were concerned with issues like revenue growth, cost reduction, asset utilization and risk management, in these recent interviews, those issues didn't dissipate, yet more detail emerged on how CEOs thought they were going to be able to achieve those goals through innovation. In summary:

- Two-thirds of them said definitively that they're looking to innovate, but they didn't all agree about what they needed to innovate.
- Those who are looking to innovate their business model seemed to feel that products and services can be copied, but their business models were the true differentiator.
- Most of the innovators thought that their business models were the toughest thing to duplicate, so that's where their competitive advantage does or should lie.
- Meanwhile, the product and service innovators are afraid that innovations in processes and business models are too ephemeral for their tastes.

Notwithstanding, CEOs were unambiguously in agreement about the transformation themes driving innovation in their enterprises and industrial networks:

- First, *Business Model innovation matters* in that competitive pressures have pushed business model innovation much higher than expected on CEOs' priority lists[8]. Yet, its

[7] To find out more about this study, please send an e-mail to GlobalCEOStudy@us.ibm.com.

[8] Here were some of the questions leading to this theme: a) How vulnerable is your business model? Are you playing in the right place in your networked industry value chain? b) How would your business model be different if you started with a clean sheet of paper? What would you

importance does not negate the need to focus on products, services and markets as well as operational innovation.

- Second, *External Collaboration is indispensable*[9] – CEOs stressed the overwhelming importance of collaborative innovation – particularly beyond company walls. Business partners and customers were cited as top sources of innovative ideas, while research and development (R&D) fell much lower in the list. However, CEOs also admitted that their organizations are not collaborating nearly enough.
- Third, *Innovation requires orchestration from the top through business and technology integration*[10] – CEOs acknowledged their primary responsibility for fostering innovation. But to actually orchestrate it, CEOs need to create a more team-based environment, reward individual innovators and better integrate business and technology.

Given the potential impact of *business model innovation*[11], CEOs highlighted how critical it is to introspect your business to identify the few essential differentiators, and then find innovative ways to obtain the rest. Many options were posed beyond basic shared services centers, outsourcing or insourcing – for instance, partnering with a competitor to gain a mutual advantage over the rest of the industry, or participating in a common, industry-wide utility (eMarket) that lowers everyone's costs. The financial implications of this theme were also interesting:

---

do if you were getting into your current business as a start-up located in Malaysia? c) What capabilities do you have that might fundamentally change the value chain in another industry? (IBM CEO Survey 2006).

[9] Here were some of the questions leading to this theme: a) Do you continuously explore new technologies that could change your business? Is technological change an input to your strategy development process? b) What are you doing to maintain or recreate an entrepreneurial atmosphere in which business and technology integration occur naturally? c) Are you shaping the technology agenda in your industry or following it? (IBM CEO Survey 2006).

[10] Here were some of the questions leading to this theme: a) How effectively do different product, geography and functional teams really collaborate in your organization? What results have you realized from this? b) How have you used collaboration to promote the sharing of best practices and ultimately to create specialized capabilities in your organization? c) What could you accomplish if you learned radical lessons from other sectors? (IBM CEO Survey 2006).

[11] *Innovation in Business Models* was described to the CEOs as the efforts applied to restructure and extend the enterprise, which included improving both the effectiveness and efficiency of functions and processes within your organization. *Operational Innovation* was defined as the efforts to improve effectiveness and efficiency of core functional areas, which included options like: a) enhancing communication & collaboration; b) eliminating redundancy; c) increasing organizational effectiveness; and d) increasing external partnering. Finally, *Innovations in Products, Services and Markets* were the efforts applied to customer-focused, go-to-market areas, i.e. a) Developing and launching innovative products or services; b) Entering new markets, c) Reaching out to new audiences, and d) Launching new channels and delivery paths (Source: IBM Global CEO 2006 Survey)

- Companies that have grown their operating margins faster than their competitors were putting twice as much emphasis on business model innovation as under performers.
- Business model innovation had a much stronger correlation with operating margin growth than the other two types of innovation (operational and product/service/market).

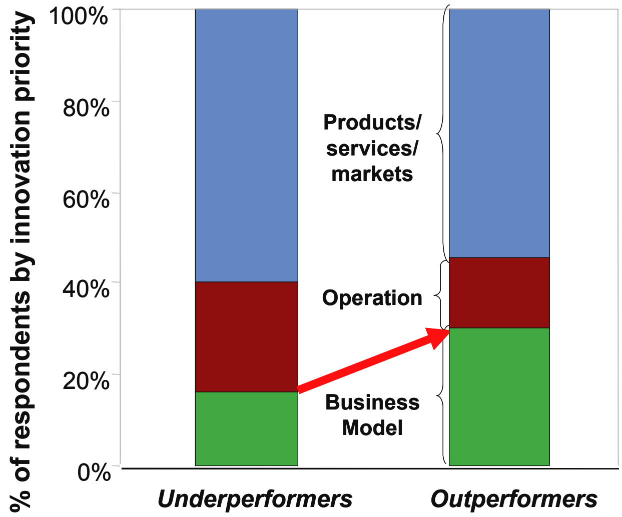


Figure 1: Innovation Priorities by Performance (Source: IBM CEO Survey 2006).

- Companies that are using business model innovation enjoyed significant operating margin growth, while those using products/services/markets and operational innovation have sustained their margins over time.

The survey showed that *Collaboration* on a massive, geography-defying scale literally opens a world of possibilities for how products, services, processes and business models are (re)designed and implemented. Distance, scale, language, company walls – limits that once seemed immutable are now broken on a regular basis. Nearly 80% of the CEOs agreed on the critical potential for *collaborative innovation*, yet of those only 51% said they were doing it to any great extent. These gaps between intentions and realities indicate that increased external collaboration is gaining momentum. There were significant differences between under- and over-performers in this area too:

- Looking across the top actions business model innovators were taking, the survey found that companies innovating through strategic partnerships enjoyed the highest operating margin growth.

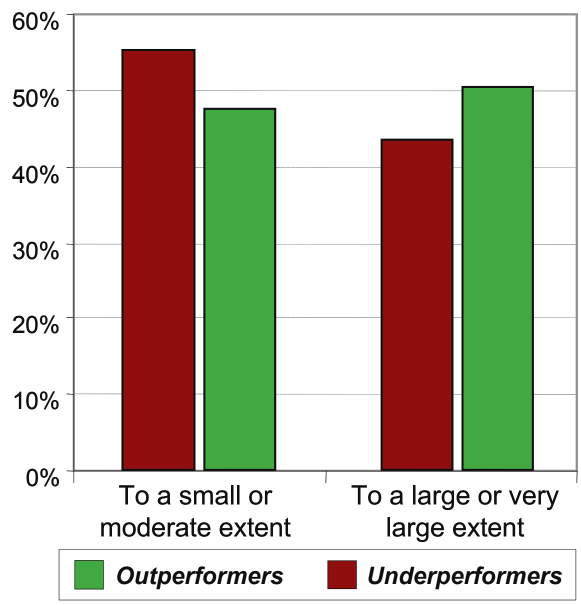


Figure 2: Extent of Collaboration by Performance (Source: IBM CEO Survey 2006).

- The study also found a strong link between collaboration and financial performance. Companies with higher revenue growth report using external sources (such as partners and customers) significantly more than slower growers do. Out performers used external sources 30% more than underperformers.
- Extensive collaborators outperformed the competition in terms of both revenue growth and average operating margin. When analyzing operating margin results over a 5- year period, over half of the extensive collaborators outperformed their closest competitors.

Most CEOs viewed *Technology* be a catalyst – both to drive innovation and to enable it. The responses provided insights into the vital part technology plays in new products, services, channels, market-entry strategies, operational transformation and industry-altering business models. Technology can even enable other innovation enablers such as collaboration. But capitalizing on all this potential requires combining business and market insights with technological know-how. Over time, technologies can become so ingrained in day-to-day operations that continued use and investment happens by default rather than by explicit choice, which was one of the dangers raised by the CEOs. Again, CEOs' responses provided a perspective of the financial impact of companies pursuing deeper alignment between business and technology – for example:

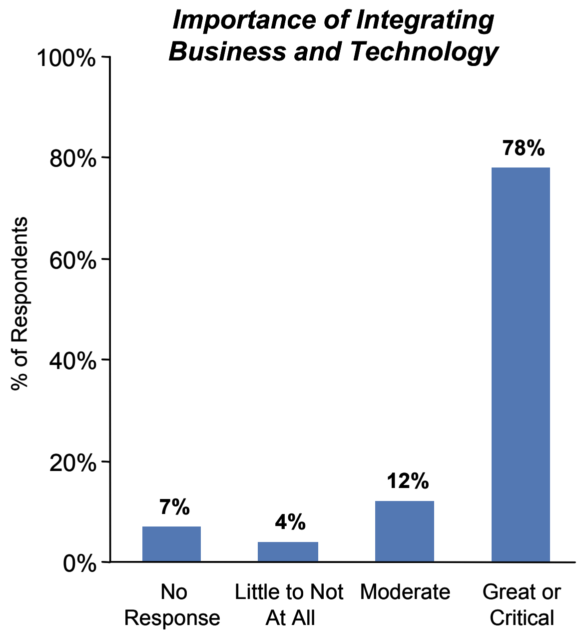


Figure 3: Importance of integrating business with technology (Source: IBM CEO Survey 2006).

- Extensive integrators reported revenue increases three times as often as companies that were less integrated. These views correspond to IBM's own financial comparisons that found extensive integrators were growing revenue 5 percent faster than their competitors.

When asked on the benefits of successful alignment of information technology and business requirements, the CEOs provided support for affected metrics such as Faster time-to-market, Access to Markets and Customers, and improvement in Quality and Customer Satisfaction. Hence, it is evident that better integration of business and technology is enabling CEO's to gain competitive advantages through business model innovation.

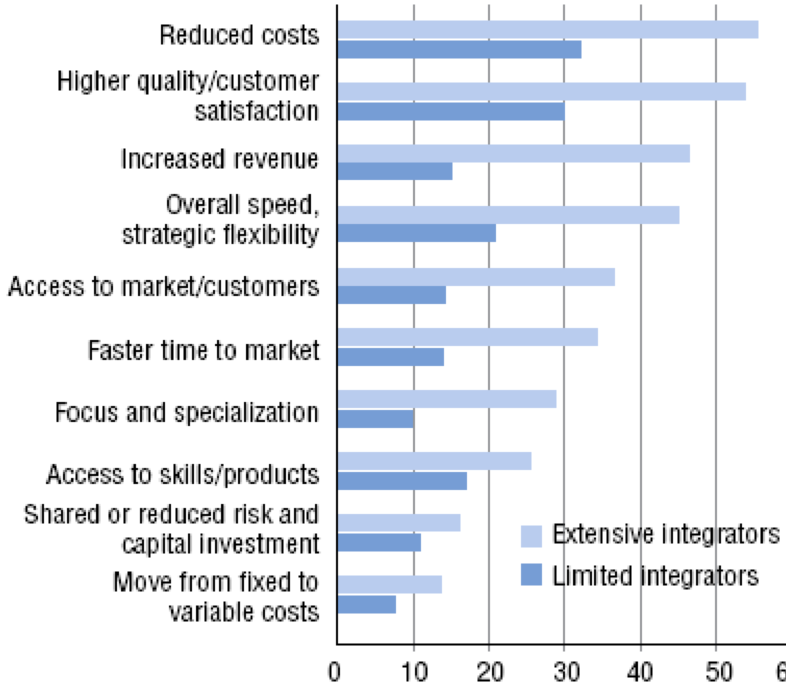


Figure 4: Benefits Realized through Integration of Business & Technology (Source: IBM CEO Survey 2006).

The majority of CEOs characterized their *creativity cultures* as highly collaborative, collegial and team-oriented – as opposed to being focused on individuals or predominantly confined to specific subgroups. It is also worth noting that companies in which the CEO orchestrates a more team-oriented culture were decidedly more profitable than organizations with segregated pockets of innovators (see Figure 5). Although a team-oriented environment is critical, 77% of the CEOs interviewed agreed that it was also important to recognize significant contributions made by individuals. Our analysis also noted a financial correlation associated with this choice. While many factors can contribute to financial performance, companies that reward individual contributions achieved 2 % higher operating margins on average and grew revenue nearly 3% percent faster than those that did not.

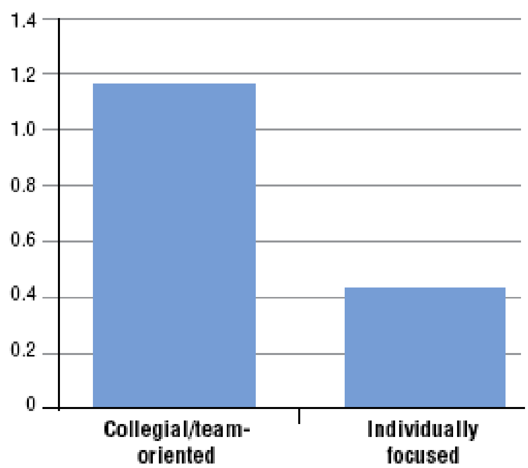


Figure 5: Margin performance associated with alternate cultural approaches – % of 5-year average operating margin in excess of peers (Source: IBM CEO Survey 2006).

Just like their academic counterparts, CEOs, were adamant on the importance and role of a business-aligned, and flexible usage of technology – those who reach that state also enjoy considerable benefits. Notwithstanding, when asked on the inhibitors of these transformations towards innovation most pointed to "soft" factors as culture and climate.

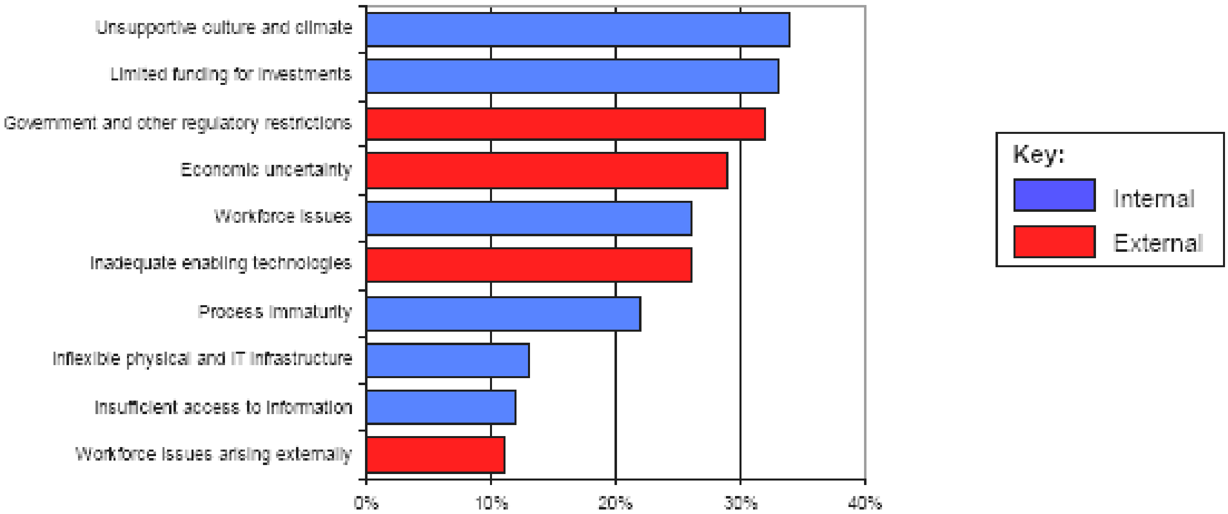


Figure 6: Many of the significant barriers to innovation are internal! (Source: IBM CEO 2006 survey).

It seems that enabling culture, workforce skills and well-defined processes are the internal "adaptable" parameters, hence the foundation of any internally seeded transformation. CEOs highlighted that innovation in products/services, operations and business models demands "soft" handles like risk taking and visible leadership, as well "hard" ones – clear incentives and measures – to encourage innovative behaviors in a game-changing environments. Just as Professor Malone eloquently described, innovative deployment of technology have to go hand-in-hand with behavioral changes – that enables new, differentiating capabilities that facilitate transition towards the specialized, loose and decentralized enterprises of the future.

In summary, most CEOs viewed continuous transformation as the norm. *External collaboration* was highlighted as indispensable to innovation, yet only half the respondents were executing successfully, which gives us a perspective on the challenges faced by most companies. Surprisingly, *Business Model Innovation* was seen as a key, inimitable vehicle to realize and bring to market product/service innovations. The figure 7 below provides a summary of some of the leading actions CEOs recommended or intent to pursue in order to drive and accelerate the rate of innovation in their organizations.

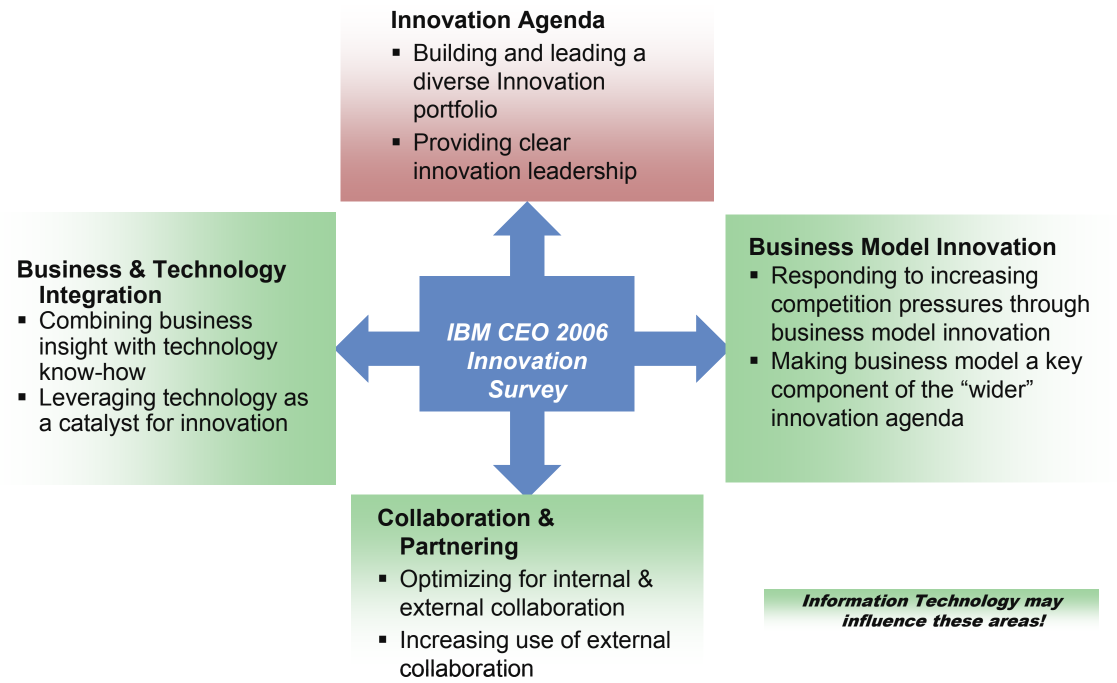


Figure 7: The Global CEO Study 2006 identified Clear Recommendations (Source: Adapted from IBM CEO 2006 Survey presentation)

We have so far provided you with a sparse glimpse into this comprehensive survey of 765 CEOs. Their responses provided us with rich backdrop into the *state of the business* – how companies currently react to trends of globalization, commoditization, higher cost structure, increased specialization. Consequently, Latour's propagandistic exclamations on the amalgamation of technology and business "monsters" seems not that implausible after all. Without commencing with an academic debate of opinions, we rather need to take a constructive view of these claims and examine the details of that apparent cross-fertilization of business and technology in collaborative environments of their supply networks – close to the heart of value creation of most companies.

With these thoughts we reached the end of the first part of our introduction that provided a glimpse on the visions and the realities of technology and innovation. In the following section we will attempt to "translate" some of these themes into our research journey.

1.3 Research Background and Objectives

The long standing commotion on the "value" of information technology (IT) investments (and their effect on productivity improvements and overall operational efficiency) has been a fertile ground for debate (Carr, 2003)[12]. While most argue about direct effects, earlier corroborative evidence presented by the economist Eric Brynjolfsson (1993), has questioned and subsequently provided empirical explanations of the "indirect" effects and time-lack of IT investments on efficiency. In line with Malone's statements, and IBM's CEO survey findings, Brynjolfsson's and Hitt's (1993, 2000) research highlighted how IT contributes to productivity and profit gains only when combined with comparable investments in process redesign, attention to human resources (i.e. change management) and a willingness to innovate around IT (Brynjolfsson & Hitt, 1993), in a inimitable way thus creating lasting competitive advantage (Orlikowski, 1992, 1996). IBM's recent CEO survey unequivocally supported these findings by highlighting the importance CEOs pose on the role of information technology in enabling the necessary and continuous transformation towards more *collaborative*[13] *business models*[14].

This dissertation attempts to pursue a similar, yet more constrained investigation of the performance consequences and antecedents of IT enabled business transformation (Venkatraman, 1994) in the area of Supply Networks[15]. It is based on a multi-year research effort of interpreting collaborative business models followed by a normative dash to prove the critical transformation practices of IT enablement within such networks with a blend of derived and theoretical constructs from the supply network research area (Gadde & Håkansson, 2001) of the Industrial Marketing and Purchasing (IMP) group (Ford et al., 1997, 1998, 2002). This

---

[12] IT has been reaching a maturity which implies that it can be handled as a utility. Yet, as Intel's Craig Barret stated in recent interview on Carr's article: "IT is not a commodity infrastructure like roads, the internal combustion engine and electricity, he absolutely misses the point…All of those common infrastructures are infrastructural elements that allow you to make or move material; they don't allow you to put intellectual content or value into what you are doing" (from ZDNet, 2004).

[13] Nøkkentved & Hedaa (2000), elaborated on *Collaboration* in three spatial categories – short, medium and long-term. In short term, collaboration refers primarily to the cooperation among different company actors (i.e. individuals, departments, business-units, or enterprise) aimed at meeting the needs of both usual and unusual demands for products and/or services. Collaboration in the medium term involves the sharing of responsibilities to synchronize product design and logistic capability in order to cope with growing demands for broader market offerings. Long-term collaboration or partnerships aims to create superior service capabilities through the setting of joint priorities and the sharing of capabilities (Lambert et al. 1997). Collaborative Business Models incorporate all three categories.

[14] Based on the previous definition footnote on Business Models, we consider that a business model may be conceived as a mediating architectural construct between technology development/deployment and business value creation.

[15] *Supply Networks* are defined as a set of supply chains, embodying the flow of goods and services from original sources to end customers (Harland, 1996). Supply Networks therefore not only comprise upstream suppliers but also downstream customers and/or distributors, and include those actors, resources and activities involved in the production and delivery of outputs. While they are distinct, they do often overlap with other types of networks like the innovation or learning network. These Networks are in essence Strategic Networks (Gulatti et al, 2000).

section will briefly delve into the theoretical background leading to some of the objectives of our research reported in this dissertation.

1.3.1 Theoretical Background – Transformation of Industrial Networks

Two distinct streams of research have influenced the recent creation of the concept of *Business Networks* (Johnsen et al., 2000): (1) the research on industrial networks conducted by the Industrial Marketing and Purchasing (IMP) group and (2) the operations- and logistics-based research on supply chain management (SCM). Members of the IMP group have developed models to provide a better understanding of business markets in terms of the nature of buyer–supplier relationships and the embeddedness of these in 'industrial networks', modeled as interconnected actors, activities, and resources (Håkansson & Snehota,1995). Some of the group's noteworthy contributions deployed in this research are the *interaction model*, the *ARA* (Activity links, Resource ties and Actor bonds) model[16], and *event-based business network*[17].

According to the *industrial network* model, business relationships, including supply chain relations, are outcomes of interaction processes where different actors try to influence one another. Any relationship consists of a combination of activity links, resource ties and actor bonds (the so called ARA model, Håkansson & Snehota, 1995) that together with other relationships form network structures. From an industrial network approach the supply chain perspective contributes substantially to our understanding of efficient flows of materials, but it fails to consider that relationships are not independent, but embedded (Gadde et al, 2002).

Much of the same language is used to describe the building blocks and nature of *supply networks* (Harland, 1996). Supply networks as a development from linear, supply chains were presented by Harland, (1996). One way of distinguishing between supply chains and supply networks is to analyze the types of interdependencies that exist. Supply chains may be defined by the long-linked technology that is employed by firms acting in what Porter (1985) has described as value systems, i.e. a set of connected value chains. Whereas value creation in

---

[16] In general, *actors, activities* and *resources* go into the description of external networks as independent factors (Håkansson & Snehota, 1995): a) *Actors* are characterized by their performing of activities and controlling of resources. Actors in an industrial network may be perceived broadly as individual persons, groups in organizational, or organizations. Which actor is going to be at the focus will depend upon the actual context. b) *Activities* are performed by actors when using and transforming resources and considered to be links in longer chains of activities. One such example is the chain of value added in the transformation of raw materials and other inputs into complex products and services. c) *Resources* are controlled by actors and the value of resources is determined by the activities in which they are to be used Examples of resources are technology, finance, capital and personnel (Ford, 1997).

[17] See Hedaa and Törnroos for a detailed description, 1997. Event-handling is a relevant view of the performance of such infrastructures.

supply chains equals a value chain logic, the same analogy cannot be made for supply networks. In other words, value networking firms relying on a mediating technology is not the only viable model in supply networks. Interdependencies in supply networks are not given, and intricacies of supply networks are not captured by Porter's (1985) value system. The analysis of value creation in supply networks should consider activities that various actors' rely upon.

Recent literature (e.g. Lamming et al, 2000; Gadde & Håkansson, 2001; Dubois, Hulthen & Pedersen, 2003), proposes that supply networks may be seen as an extension of supply chains, seeking to explain the commercial complexity associated with the creation and delivery of goods and services from the source of raw materials to their destination in end-customer markets. They also suggest that the supply network concept is more strategically relevant since it ties together the resource potential of the network in an effective manner. Industrial competition is therefore advancing from being between individual companies, to being between networks or clusters[18] of partnering corporations (Christopher,1992; Harland,1996). Hence, contemporary industrial organizations are progressing from the notion of the extended supply chain into *electronically-connected supply networks*, which facilitate and accelerate information sharing, transaction execution and collaboration among interorganizational relationships (Nøkkentved & Hedaa, 2000, 2001). We characterize such extended enterprise Supply Networks as Collaborative (Dyer, 2000).

This was made possible with the advent of integrated applications utilizing the Internet, enabling companies to develop information infrastructures to realize such supply networks. Porter (2001) acknowledges the impact of the Internet on the supply chain and asserts that the Internet is the most powerful tool available today for enhancing operational effectiveness as it allows the exchange of real time information thereby creating improvements throughout the value chain. But, he also cautions that the advent of internet technologies alone will not help firms achieve competitive advantage as traditional sources such as scale, human resources and investments in physical assets continue to play prominent roles. Indeed, the open nature of Internet technologies makes if easier for companies to use them. This minimizes the opportunity for them to deliver competitive advantage.

According to *Coordination Theory*, managing is a highly information-intensive activity and applying information technology (IT) to this area has a profound impact (Malone and Crowston, 1994). According to Malone (1997), the dominant logic of the future might be the

---

[18] Clusters within networks are mentioned by Håkansson and Snehota, 1995.

idea of "connected decentralization" enabled through a higher information technology intensity. Benjamin and Wigand (1996) have elaborated on the effects of IT and the potentials for reducing transaction and coordination costs when organizational units cooperate. This direct interrelation of IT performance and coordination costs compensates for the additional coordination requirements within networked environments. Therefore, IT enables extended networking among companies, a phenomenon called 'Electronic Strategic Networking Effect'.

IT has the potential for significant transformations in people's work, in organizational business processes, and in organization performance, thus being described as disruptive for organization's stakeholders (Markus, 2004; Cox, 2004). The phenomenon of IS-driven organizational change has been termed *IS innovation*[19], or more recently, a "*Technochange*"(for technology-driven organizational change) by Markus (2004). Previous research has provided ample evidence that IS innovations do not only involve information technology changes, but should often be augmented by comparative organizational innovations including new forms of organizational activities framed within business process (Markus, 2004). Beyond the intra-enterprise perspective, digital business networks provide business processes with capabilities for improving time-to-market and enriching innovation capabilities options to gain and sustain competitive advantage (Teece et al. 1997). To date, such *dynamic capabilities* approach[20] has been broadly applied in the context of Internet-enabled business models or e-Business and transformation theories are emerging. Wheeler (2002) proposed the Net-Enabled Business Innovation Cycle (*NEBIC*) as an applied dynamic capabilities theory for measuring, predicting and understanding a net-enabled firm's ability to create customer value through the use of innovative IT[21]. The strengths or weakness of these capabilities can be used to predict the firm's ability to create value in the face of technological change, yet organizational learning and communication facilitated by planning and control processes are essential to understand why firms may create or fail to create value from their change efforts (Nøkkentved & Rosenø, 1997).

---

[19] IS innovation can be broadly defined as innovation in digital and communications technologies and their applications (Swanson 1994).

[20] As articulated by (Peppard and Ward, 2004), "*Capability* refers to the strategic application of competencies, and *Competence* refers to a firm's ability to deploy resources". Therefore, capability alludes to the 'latent' or 'potential' ability to organize/reorganize/reconfigure resources. On the other hand, competencies are formed with the application of the ability, i.e., the 'kinetic' ability.

[21] Wheeler's (2002) NEBIC incorporated both variance and process views of net-enabled business (eBusiness) innovation and defined four essential capabilities, choosing new IT, matching economic opportunities with IT, executing business innovation for growth, and assessing customer value, along with the processes and events that interrelate them into a feedback-based, cyclical construct.

In summary, we will explore the transformation factors leading to the successful realization of such electronically enabled, formalized, collaborative B2B (business-to-business) infrastructures by using theories emerging from studies of information infrastructures (Ciborra, 2001; Hanseth, 1996). From the IS Research perspective our research builds on advances on the adoption of information infrastructures (Hanseth, 1996, Weill & Broadbent, 1998), theorized as the process of "dynamic transformation" via the Actor Network Theory (Callon 1993; Mattson, 2003).

1.3.2 Propositions and Process of Research

In order to reap the benefits of B2B, Easton and Araujo (2003) recommend to clarify the various "contextual contingencies" rather than apply generic solutions. Similarly, we propose that successful enablement is conditioned by a number of domain-specific[22] operational *contingencies* or "performance enablers" embedded in the current infrastructure (Subramanian & Shaw, 2001, 2002, 2004). Our scientific challenge was to unearth these tacit factors in an exploratory manner. As mentioned, the premise of our endeavor was supported by C*ontingency theory* (Lawrence & Lorsch, 1967), as we hypothesized the existence of a limited set of contextual denominators, or industry independent contingencies, functioning as "moderators" in the process of adopting such collaborative information infrastructures in supply networks. As we will present in our chapter on Research Method, we have initially used an "Interpretivist" approach (i.e. "Iterative Grounded Theory"), to define, evaluate and refine a set of contextual factors successful companies utilize or develop in order to realize an optimized and adaptive information infrastructure. Hence, IT-related organizational contingencies mediate successful improvements in operational efficiency[23].

These contingencies will be studied via a multi-stage, process-oriented approach that will initially outline first-order and higher-order factors, and then elaborate on their *direct*, *indirect*

---

[22] A overall distinction of the *Domains* of a Business Model were presented by Porter's (1985) Value Chain and Business System concepts, whereas the former is often characterized be Support and Operational subdomains, while the latter denotes the broader interorganizational interrelationships. Chopra and Meindl (2004) have identified three business domain with replicable macro processes that all companies participating in a supply chain have in common: (1) supplier relationship management (SRM), (2) internal supply chain management (SCM), and (3) customer relationship management (CRM).

[23] Operational efficiency, i.e. "efficiency", i.e. doing better with the same or less investment or resources", is the new rule of the game according to Hammer (2001), who states that: "Streamlining inter-company processes isn't just an interesting idea: it's the next frontier of efficiency." Companies need to continuously a) Redesign business processes; b) Be flexible to respond to competitive changes; c) Benchmark constantly to achieve best practice, d) Outsource aggressively to achieve efficiencies; e) Nurture core competencies to stay ahead of competitors; f) Constantly monitor and improve productivity, quality and speed; and g) Build and nurture a supporting process infrastructures

and *interactive* effects on the successful implementation of IT enablement (Barua et al. 1995). Our focus on process-orientation[24] was unsurprisingly advocated by Hammer (2001), who mellowed his early rhetoric by emphasizing not only on process orientation, but also on "soft" factors like distributed decision-making and collaborative style as requirements for successful cross-company collaboration. Unearthing these CSFs (i.e. Critical Success Factors) is imperative in order to distinguish the enabling information technologies and their business prerequisites impacting the overall infrastructure of the organization[25]. We have therefore, given our theoretical foundations, studied the CSFs of successful enablement of collaborative information infrastructures via a multi-stage approach.

1. We started by identifying professionals or subject matter experts within the Consulting Division of IBM, in charge of realizing such procurement and sourcing solutions. Then we carried an initial *exploratory qualitative survey* to summarize their transformation experiences.
2. While this exercise defined the transformation-related concepts and CSFs, a subsequent *qualitative evaluation process* refined and detailed them. We carried a series of workshops with a small group of evaluators (i.e. Council of Judges) that jointly reached consensus on the initial construct of our domain-specific factors.
3. In the final stage, we utilized the preliminary findings to seed a more normative, yet inductive evaluation. A *confirmatory quantitative survey* was carried out, enriching the derived qualitative contextual factors. A comprehensive statistical investigation leading to a structural equation model was undertaken to evaluate our overall transformation construct proposed on the adoption of Collaborative Information Infrastructures within the domain of SRM (Supplier Relationship Management), and its implications on the domain-related operational efficiency.

---

[24] *Information* comes in words, numbers, images, and voices. Adding or feeding information to processes, or making the right information available to the people who need it and at the right time, can greatly boost visibility and indeed the performance of a corporation as a whole. Information often travels with a process; like wagons on a train, loads of information are shunted on and off processes. But often information lacks attention as an area that requires deliberate management. In the words of Davenport (1993:72): "vast amounts of information enter and leave organizations without anyone's being fully aware of their impact, value, or cost. Information management is thus a natural target for a process orientation, and many executives we speak with feel implicitly that it will be key to their competitive success in the future." Thus, information is mutually dependent on processes (i.e. actions and interactions), and their design. An actor's action produces some type of information, some intentional and some not. Parts of this information is transmitted to other actors, some of it to the 'outside', some of it is stored, and some of it dissipates. With processes, we can state that an action is interesting only to the extent that information is produced and passed on, or stored for later use. Yet, it is no coincidence that process orientation has occurred in the age of information. IT facilitates the fast diffusion of knowledge across the organization letting processes tap into information that used to be restricted by functional or geographic boundaries. Thus, IT is often what makes a process approach possible in that it facilitates teams and collaboration; it also creates an infrastructure that is independent of geography, functions and formal structure.

1.4 Overview of the Main Research Themes

In broad terms we want to identify the *initiatives* that drive business model transformation and study their effect on performance. We also presume that such initiatives are primarily influencing the context-specific skills and priorities of the organization. Transformation initiatives leading to organizational and technological change are presumably constrained by resident capabilities (Hartmann et al.,2002, Håkansson & Waluszewski, 2002), the focus and state of the current operations (Subramanian & Shaw, 2002), hence they indirectly influence performance[26]. There are potentially additional environmental contingencies affecting those same domain-specific factors, of which we will investigate industry membership, region, and company size (Ford et al. 1997). Finally, we will explore whether different actors or leaders in-charge of such technology-oriented and organizational transformations have differences of opinion on the priorities of the firm (Håkansson & Waluszewski, 2002).

Causal Path Dependencies are one way of studying *Business Model Innovation*, yet as the results of any transformation are bi-directional, implying that state of the business, it's IT-enablement and state of performance may affect the initial factors. Thus, commencing with a new round of amendments or transformational initiatives is also plausible (Venkatraman, 1994, Wheeler, 2002) Figure 8 below attempts to summarize our construct describing our thinking, and guiding the subsequent elaboration and presentation in this dissertation. Our main effort revolves around a number of evident research themes that will be investigated and exposed during the course of our study. These are listed and depicted below:

T1. What *Business Models* exist that sufficiently describe Collaborative Supply Networks?

T2. What are the Transformation *Initiatives* that typically drive change in a Business Domain Model?

T3. What are the *Contextual Factors* that sufficiently characterize a *Business Domain Model*?

T4. Which Contextual factors are influenced by the *Business Domain Initiatives* driving transformation?

T5. Which Contextual factors influence *Business Domain Efficiency*?

---

[25] See the exposition of IT infrastructures in Hanseth's (1996) dissertation.

[26] In this study we measure performance primarily via operational efficiency, i.e. the ability to extract most value and productivity of the immaterial and material resources disposed by the firm (Teece et al. 1997).

T6. How does Contextual factors and Transformation Initiatives influence *Business Domain IT-enablement*?

T7. How does *Business Domain Capabilities* or *Skills* influence the Business Domain Initiatives?

T8. Which *Business Domain Skills* influence the Business Model Contextual factors?

T9. Are Business Domain Skills influencing the *Business Domain Efficiency*?

T10. How does *Other Contingencies* as Industry, Geography and Size affect our Construct?

T11. Does the state of *Business Domain Enablement* with IT influence Business Domain Efficiency?

T12. What are the *Value-related Metrics* that help us measure Business Domain Efficiency?

T13. What is the Role of *Actors* in defining the state, outcomes and priorities of *Business Domain Enablement*?

T14. Are Efficient Companies pursuing a broader set of *Contextual Factors* characterizing a Business Domain Model?

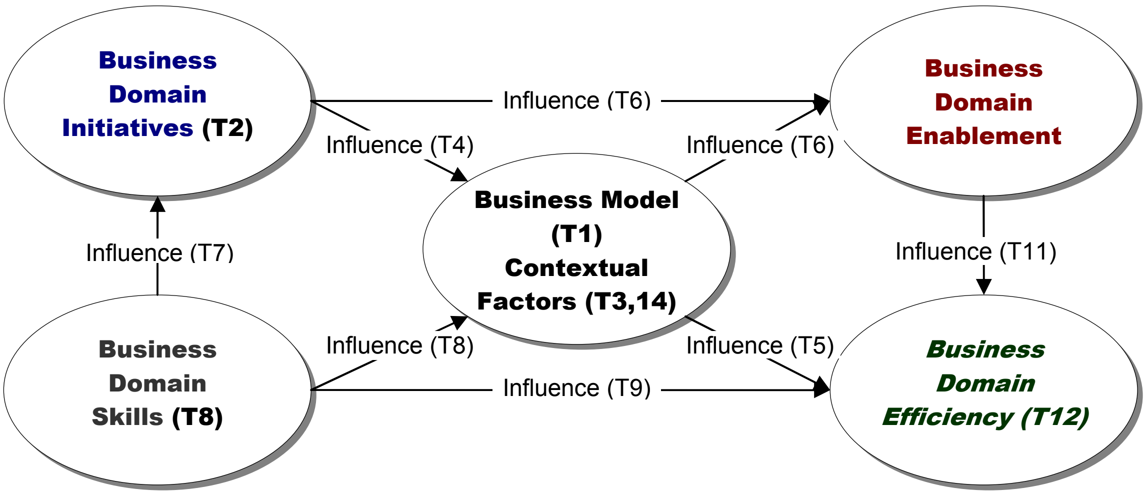


Figure 8: Overview of the *Business Model Transformation* Constructs and Interdependencies under Study (Note: Business Domain Efficiency is in *italics* as it will be viewed as the dependent construct)

When it comes to the *Business Domain Model*, we will provide an overview of the various business models and process infrastructures currently ascribed to *Supply Networks*. Nevertheless, given the immense amount of collaborative processes identified within the various business domains, we delimited the scope of our study to the upstream value-chain (Porter, 1985), oft characterized as Procurement & Sourcing, Supply Management, or just Source (SCOR, 1996). That also benefited our efforts to understand *Business Domain Enablement*, as more Business Models like *eMarkets* – public and private/eHubs, together with intra-organizationally realized eProcurement and eSourcing have been studied and reported (Turban et al, 2006). Consequently, we have concentrated our efforts to develop a “Technochange” construct (Markus, 1004), that will help us illuminate and investigate the viability of our research themes based on collaborative information infrastructures (Ciborra et al. 2001) enabling the Business Model domain of Supplier Relationship Management.

1.5 Outline of this Dissertation

This chapter has introduced the motivation, background, and objectives or themes of this study. In this final section we provide an overview of the outline of the dissertation chapters.

Chapter 2 commences with an explanatory overview of two central theoretical viewpoints that have influenced this study – Industrial Network and Information Infrastructure Theories. We describe the latest findings and theoretical viewpoints given our objectives and provide a synthesis that we use in our further investigations. We will also briefly describe Actor Network Theory, as it provides an interesting perspective for evaluating transformation.

Chapter 3, will define *Collaborative Supply Networks* as a core term in our study. This chapter will attempt to outline our first research theme (T1: What Business Models exist that enable Collaborative Supply Networks?). After a brief introduction into the field of Supply Chain Management and Supply Networks, we will present a detailed review of the latest, emergent business models. A synthesis will then be provided on the classes of potential composite relationships enabling new modes of interactions. The remainder of the chapter will expose in great detail the activities, actor/user roles, competences and benefits hinged into the collaborative supply network processes that have been developed during consultative assignments and verified with one of the major Enterprise Application Vendor – SAP AG. Within that section we will also provide brief review of two foundational and industry standard process frameworks – SCOR and CPFR, that have been driving convergence. These frameworks will be the foundation of the remainder of our investigations.

Chapter 4 will be a continuation of the aforementioned elaboration within our delimitated domain of *Supplier Relationship Management* (SRM). We will provide a brief definition and then explore the best-practice processes that drive the enablement efforts of the various independent software vendors. Then we will provide an overview of the *enablers* and *inhibitors* of an SRM information infrastructure. This approach of viewing beyond the process-perspective on the Critical Success Factors will be used as guidance in the following chapters.

Chapter 5 will delve into the method of our research investigation – it will provide an overview of our research model followed by a discussion of the research methodologies that will be employed. Research design will briefly explain the ramifications of these methodological choices as it will partition our investigation in two major streams – a qualitative and quantitative one.

Chapter 6 presents our empirical qualitative journey of investigation and interpretation. Initially, we will report on the qualitative survey conducted in 2001 among subject matter experts in the area of eProcurement and eSourcing. The results and critical success factors extracted from this survey were used to seed the discussion and background of the 2nd part of the qualitative study – the Council workshops. These intensive workshops were instrumental in defining and detailing the SRM transformation initiatives, their mutual interdependencies and interrelationships to contingencies like performance metrics, actions, competencies and processes within the SRM domain. This section will expose some central themes like T2 (What are the Transformation Initiatives that typically drive change in a Business Domain Model and indirectly affect the IT-enablement of the same?), T3 (What are the Contextual Factors that sufficiently characterize a Business Domain Model?) and finally T12 (What are the Value-related Metrics that help us measure Business Domain Efficiency?). Consequently, we will describe *why* and *how* we used Social Network Analysis (SNA) to analyze the above contextual interrelationships, and how we reached a set of conclusion of realization of these transformation initiatives. Finally, we will present the unified construct and report on the managerial implications of this effort.

Chapter 7 represents the shift from interpretation and hermeneutical abstraction to generalization. It is also a transition of our toolset from qualitative to quantitative – leading to the opportunity to utilize a rich set of statistical inference tools to investigate the generalizability of our construct. This is also a substantial chapter as it puts to the test most of our themes. Based on an IBM-driven survey conducted in 2004-5 among 344 corporations across the world in the area of procurement and sourcing led to a sub sample of 123 companies that have had experiences with eProcurement and eSourcing. This became our prime data set, yet we did deploy the broader sample too to evaluate some of our research themes. We will begin our reporting of the results in the following content-rich sections;

- First, we will report on the demographics of the study and provide an overview of the overall response-based univariate statistics for the construct parameters.

- Second, we will present the results of our evaluation of the Actor-dependency Theme (T13:What is the Role of Actors in defining the state, outcomes and priorities of Business Domain Enablement?).
- Third, we will evaluate our theme on the influence of IT-enablement on Operational Efficiency (T11: Does the state of Business Domain Enablement with IT affect the level of Business Domain Efficiency?).
- Fourth, we will delve into an exploratory analysis of our theme on emphasis and performance (T14: Are Efficient Companies pursuing a broader set of Contextual Factors characterizing a Business Domain Model?). That fourth section also concludes the use of standard multivariate statistics in our analysis.
- With the fifth section, we commence with an evaluation of our overall construct with PLS (Partial Least Squares) – a 2nd generation SEM technique prominent within recent MIS research (Goodhue, Lewis & Thompson, 2006). Accordingly, we will provide a detailed overview of this “soft” modeling SEM approach, its strengths and weaknesses, and the statistical inference process of evaluating and validating the results. Second, we will start the analysis of our research themes T4 to T10, by investigating the structure, variance explained and significant path coefficients among the latent factors in our construct. After the initial construct test, we will present a detailed examination of the interaction effects between our latent factors, which will lead to our final, plausible construct. To revert ungrounded deterministic inferences, and often cited criticism of normative studies, we will then evaluate more minimalistic models than the one we have proposed, plus a reverse causation model to accommodate feed-back relationships. Finally, we will briefly present our conclusions.

In the final analytical *chapter 8* we will present our findings using a more practical, normative approach outlining the concise findings of our survey and analysis in terms of immediate and applicable managerial implications.

The final *chapter 9*, will conclude on our study and draw a number of implications for current and future research. That brings the reader to the figure and literature references lists…

2. THE FOUNDATION – *INDUSTRIAL NETWORKS & INFORMATION INFRASTRUCTURES*

> *"Perhaps some of the most interesting effects of information technology will be the enabling of new organizational forms such as 'networks' …, 'adhocracies' or more complex forms." (Brynjolfsson et al. 1991 :29)*

The study of inter-organizational business relationships has been central in theories about *Business Networks* in the last three decades. These research efforts originate from Scandinavia and have been further developed by the Industrial Marketing and Purchasing (IMP) group. Some of the most noteworthy constructs are the *interaction model*, the *ARA* (Activity links, Resource ties and Actor bonds) model, and the *event-based business network.* This chapter will briefly expose the Industry Network research, and will continue with a detailed exposure of the Technology and transformational perspectives provided by research into Information Infrastructures. Finally, we will provide a synthesis that will be the foundation of our framework in the following chapters.

2.1 Industrial Network Theory and Perspectives

Theories pertaining to Business Networks will play a central role in the pursuit of our research objectives. In comparison to Supply Chain Management (SCM) research, network theorists have been studying business relationships and interactions for over 3 decades. Thus there is a rich test bed to delve into greater detail in our evaluation of the aforementioned themes, as the determinants of integration in process interactions. Additionally, we will be able to further explore a number of contingency factors affecting the design of the supply network. In this respect we will especially use the "interaction model" developed by IMP group (Ford, 1997) and depicted in Figure 9. Furthermore, in our quest to model supply network processes we have taken into consideration Hedaa and Törnroos' (1997) "event-based business network" construct as a major determinant of action in business networks.

2.1.1 About Network Theory

Networks are organizational structures in between markets and hierarchies (Thompson, 2003). Industrial Networks provide the larger system context for Supply Networks as they include actors, resources and activities relating to all elements of an interaction and/or specific exchange, not just product/service supply (Zheng et al, 2001).

Network theories aim to render organizational issues in inter-organizational networks, and focus on strategic positioning or power configurations (Cox et al., 2004). Networks typically exist in heterogeneous business-to-business (B2B) markets, because e.g. trust here is beneficial to all members as it allows the network to define its context and thus its immediate environment (Håkansson & Snehota, 1997). Network-theory emphasizes the importance of two basic questions: (a) Who does what?, and (b) How are their activities connected?

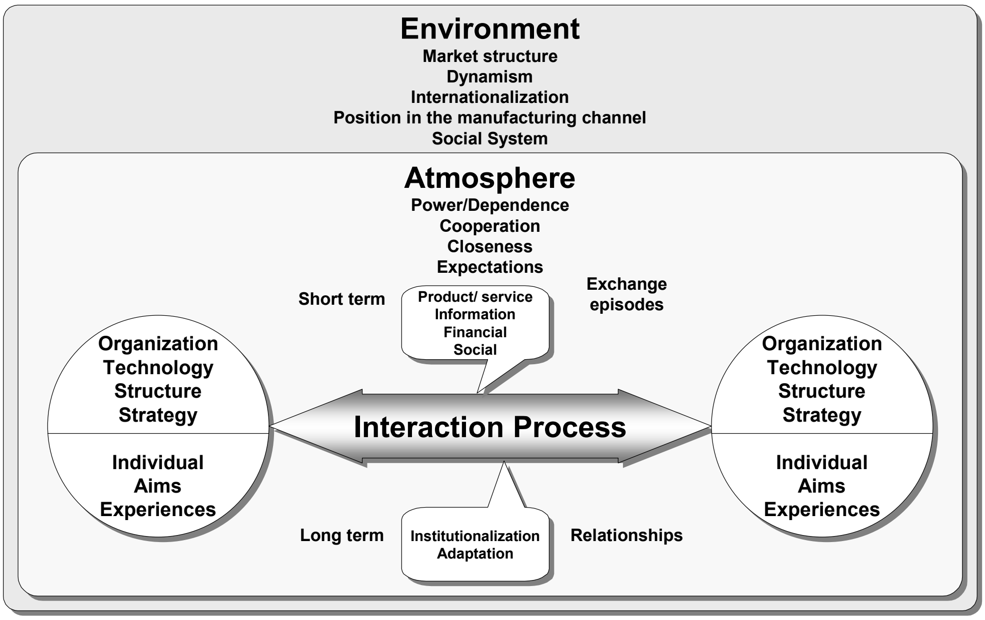


Figure 9: The IMP Group's Interaction Model (Source: Adapted from Ford, 1997:16)

Furthermore, theories on industrial networks highlight that companies should only perform those activities in which they may perform better than average compared to major competitors in the long run, i.e. focusing upon core competencies. Where networks focus on establishing and developing relationships, the industrial network paradigm adds at least three important factors: (1) power, (2) influence and (3) trust.

Similarly, research in Supply Chain Management (SCM) has been advocating quasi-integration with partner companies, i.e. participants with complementary roles in a supply network. The distinct strategic role of networking is subject to the fact that strategic identity, i.e. the basis of effectiveness, is achieved by the interaction behavior of individuals in relationships. In this perspective, interaction is defined as the stream of events that ultimately determines effectiveness in networks and SCM (Hedaa & Törnroos, 1997).

A particular interesting point of the network theory of organizations is that a company should not only be seen as an entity in a network with its environment, but also that the single company can be seen as an organizational network. According to Ford (1997), network theory is not one single theory but rather consists of various contributions. In general, various independent factors go into the description of external networks. Complex relations in networks are found in the activity chains, inside the companies and between companies and markets. Johansson and Mattson (1986), as leading representatives of the 'Uppsala School" explain networks as a cumulative interaction process, where relations, activities and market strategies are amplification mechanisms for the structure and stability of the network. Relationships or "organizational links" in this context are typically found to be: mutual orientation, investments, bonds and dependence. Examples of interactions are: the *exchange* processes (social, business and information), and the *adaptation* processes, i.e. products, production and routines.

According to L.M. Rinehart (1992), networking is perceived as an integrative strategy, relying heavily on information sharing. According to Thorelli (1993), networks can be defined as: "Two or more organizations involved in long-term relationships"; and he continues:

> "… a network can be viewed as consisting of "nodes" or positions (occupied by firms, households, strategic business units inside a diversified concern, trade association and other types of organization) and links manifested by interaction between the positions.... Network may be tight or loose, depending on the quantity (number), quality (intensity), and type (closeness to the core activity of the partners involved) of interactions between the positions or members"

In summary, the basic assumption of the *industrial networks* is that an individual company depends on resources controlled by other companies within the network, and that the company gets access to these resources by developing positions in the network (Ford et al, 1998).

2.1.2 About power and trust

The key to the dynamics in a network structure is the power and dependency structures it perceives and the behavior of companies to change or capitalize upon it (Cox et al., 2004). While the very existence of relationships implies some degree of cooperation, such cooperation does not subvert competitive goals of individual partners to that relationship. Thus, the orientation of relationships, the dominant direction of influence and the definition of the "rules" of the relationship will be determined by the distribution of power dimensions between partners. Thus, the power balance is dynamic in nature, which above all implies that major changes - e.g. a strategic shift by leading companies - induces internal threats for the companies with a weaker position or subsequently the entire network's existence. In a practical sense, the obligation to spearhead cooperation rests with the supply chain participant who enjoys the greatest relative power. Another key element in the network approach to business interactions is the concept of "trust", determining both risks and opportunities in network relationships. According to Ford ed. (1997), networking is in practice business, characterized by long lasting relationships between the actors or organizations in the value system. In effect, networks create conditions for bi-lateral monopoly with high risks for both/all sides of the mutual agreements. The partnership atmosphere must include both flexibility and incentives for improvements. Prerequisites for this common platform of operations and activities in networks (and supply chains) are according to Thorelli (1993)

- Mutual "trust" and absence of opportunistic behavior within the network;
- Supplementary resources or capabilities improving competitive advantage;
- Compatible (or even common) goals and objectives; and
- "Free" flows and access to information.

Trust may be viewed as confidence in the continuation of a mutually satisfying relationship and in the awareness of other parties subject to what this requires of their performance as network partners. Accordingly, trust is above all based on reputation and, more important on past performance. But personal friendship and social bonds, established in day-to-day interaction and manifested by mutual feelings of belongings and interdependence, also build it. The basic reason for developing mutual trust in networks, is subject to the very existence of imperfect information, bounded rationality, risk and uncertainty.

Trust may or can reduce (potential) risks in transactions (costs) subject to the potentials of opportunistic behavior. The reason is that trust between trading partners has a role in increasing the predictability of mutual behavior through the honoring of commitments made, while it facilitates dealing with unforeseen contingencies in a mutually acceptable manner. Both 'goodwill trust" and "contractual trust" imply the absence of opportunistic behavior; the suspicion that a network partner may be cheating or taking advantage amounts to distrust. However, in any case the verification of whether a network partner is worthy of trust is a matter relying partly on reputation before entering into new relationships and partly on experience to see whether the original expectations are fulfilled. Hence, trust, power and influence are an important set of contingency factors affecting an interaction between collaborating businesses in a supply network.

2.1.3 The Actor-Resource-Activity (ARA) Model

While the Interaction Model attempts to unveil the nature of buyer-supplier relationships, industrial networks can be described via the inter-connected actors, activities, and resources, where each can be viewed as an independent factor (Håkansson & Snehota,1995):

- *Actors* are characterized by their performing of activities and controlling of resources. Actors in an industrial network may be perceived broadly as individual persons, groups in organizational, or organizations. Which actor is going to be at the focus will depend upon the actual context.
- *Activities* are performed by actors when using and transforming resources and considered to be links in longer chains of activities. One such example is the chain of value added in the transformation of raw materials and other inputs into complex products and services.
- *Resources* are controlled by actors and the value of resources is determined by the activities in which they are to be used Examples of resources are technology, finance, capital and personnel (Ford, 1997).

2.1.4 Event-Based Business Network

Hedaa's *event networks* (Hedaa and Törnroos, 1997) view interactions as streams of events that ultimately determine effectiveness in networks. Events generated by extensive interactions can reveal exception-handling processes under uncertainty, and provide insights into the dynamics of network evolution[27]. Where strong inter-organizational relationships exist, another type of network that is neither market nor hierarchy, emerges: *network processes*[28]. These *network* or *collaborative processes* represent trust-based arrangements, and rely heavily on information

[27] This is especially articulate in the view of business networks as event networks (Hedaa and Törnroos, 1997).

[28] Network processes have been presented and elaborated by Easton's chapter in Ford ed.(1997)

sharing molded by the distribution of power and influence[29]. Better access to material and immaterial resources render some firms more powerful than others, thus stimulating them to pursue *network dominance* (Håkansson & Snehota,1995). For example, in supply networks, the obligation to spearhead cooperation often rests with a dominant, highly influential player that defines the ground-rules of collaboration by extending its processes across parts of its web of interactions. In contrast to this extended and enforced cooperation scenario (Browne et al., 1994), smaller companies, are more predisposed towards loosely coupled collaborative infrastructures[30]. The relative smaller size and consequently lower influence of the network participants create a situation where a company cannot dominate, but rather has to adapt to and cope with the network. Configuration of process interactions or links among multiple, equally influential partners are *negotiated* rather than dictated. This in turn requires more introspection of each member's process infrastructure (Nøkkentved & Hedaa, 2001).

These issues clearly indicate a rising need to investigate how companies that are linked via bilateral and multilateral relationships into loosely coupled process networks, can converge into open *Trade Exchanges* or *eMarkets* and/or tighter *Collaborative Communities* (private eMarkets or eHubs according to Tapscott et al. 2000). Buyer-seller relations between partners are becoming more opportunistic, endemic and dynamic in nature, while driven by compatible goals. In the face of the rising standardization of communication and data exchange, we do have to reconsider how relationships are evolving within such electronic business networks.

2.1.5 Industrial Networks Theory – Constrained Technology Perspective?

In the writings of the IMP Group, information technology is often characterized as a *technological resource* enabling the firm as a communicative unit (Gadde & Håkansson, 2001), affecting and being affected by relationships within the business network (Ford et al. 2003). We believe that the rich behavioristic traditions of the IMP group has led to a view of Technology as a resource-hinged concept – as a "Manageable" Resource/Facility. This has been recently moderated by an acknowledgement that technology has an influencing role, as expressed by Ford et al. (2003):

---

[29] According to Thorelli (1993), trust may be viewed as confidence in the relationship, based on awareness of reputation, past performance and reciprocal benefits and demands. Trust determines potential risks and opportunities in network relationships. On the other hand, power and dependency structures often con-strain opportunistic behavior, by defining dominant directions of influence.

[30] According to Hedberg et al. (1997), this trend is especially prevalent for Scandinavian corporations.

> "Large IT systems … may drive large sections of activity structures (and processes) within and beyond the company, "influence" actors roles and relationships and "form" the relationships that companies may be able to pursue".

However, recent evidence presented by Hanseth & Braa (1996), suggests that this view of large Information Infrastructures as a technological resource component seems too unidimensional. Beyond the pure infrastructural properties attributed to such IT systems, it is becoming increasingly apparent that large applications enabling a business network (both internal and external) are imposing their own logic on and constraining a company's strategy, culture and organization (Davenport, 1998). According to Hanseth (1996):

> "*a large information infrastructure is not just hard to change; it might also be a powerful actor influencing its own future life - its extension and size as well as its form.*"

Consequently, we need a "richer" picture of the infrastructure layers enabled by ICT that shapes, enables and constrains the organization and its business network.

2.2 Information Infrastructures – A Holistic Architectural View of IS

Information Infrastructures, is an attempt to describe the expansion of the previously intraorganizational Information Systems and Infrastructures enabled by large, multidivisional and global ERP systems, into the interorganizational domain, where companies have much less control (Johnston, 2002; De Burca & Fynes, 2001). Such interorganizational systems (IOS), have previously been undertaking data and document exchanges between companies (e.g. EDI). Modern day IOSs, are developing beyond pure integration of information into the realm of business process integration encompassing a multitude of partnering companies[31].

These large intra- and interorganizational information systems have start displaying properties of infrastructure[32], enabling and aligning many value-adding processes in an organization (Nøkkentved & Hedaa, 2001). In essence, modern information technology may transform a company and its industrial network by ordering resources, processes, people, and relationships, linking everyone electronically, and providing the foundation for business transformation efforts (Porter, 2001). It is in effect becoming embedded in the industrial network. This major restructuring of the modern enterprise has often been visualized as the firm resting within a network supported like a superstructure by series of layers, each representing an infrastructural element for the conduct of business and each being supported by an industry in its own right (Renkema, 1998, Barua et al., 2001) – see Figure 10.

Many companies are currently attempting to manage or "cope with" their information infrastructures in order to deliver effective information technology (IT) enablement by such initiatives as aligning strategy with IT architecture and key business processes (Hanseth et al, 2001; Henderson et al., 1996); universal use and access to IT resources; standardization; interoperability of systems and applications through protocols and gateways; flexibility, resilience and security (Hanseth, 1996; Ciborra et al. 2001).

---

[31] These last 20 years have seen an exponential growth in the permeation of information & communication technologies in the Activity System of the enterprise and its network of relationships. Large chunk of the formal & informal Activities are increasingly "mirrored" into the Digital world, thus constituting a "parallel" network – an infrastructure of business, which transcends the individual entity.

[32] In Webster's dictionary infrastructure is defined as: "a substructure or underlying foundation; esp., the basic installations and facilities on which the continuance and growth of a community, state, etc. depends as roads, schools, power plants, transportation and communication systems, etc."

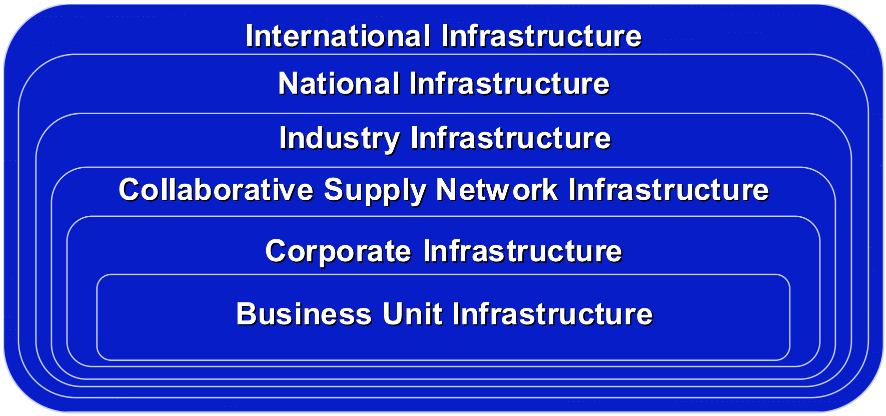


Figure 10: The Layered Infrastructure Model (Source: Adapted from Renkema, 1998)

2.2.1 What is an Information Infrastructure?

The term "*information infrastructure*" (**II**) has increasingly been used to refer to integrated solutions based on the now ongoing fusion of information and (tele)communication technologies. An Information Infrastructure constitutes a social construction containing people, resources and procedures enabled by IT, yet extending within and beyond the boundaries of the focal firm (Ciborra, 2001; Kling & Lamb, 1999), thus enabling processes and people across a supply network (Harland, 1996; Zheng et al, 2001).

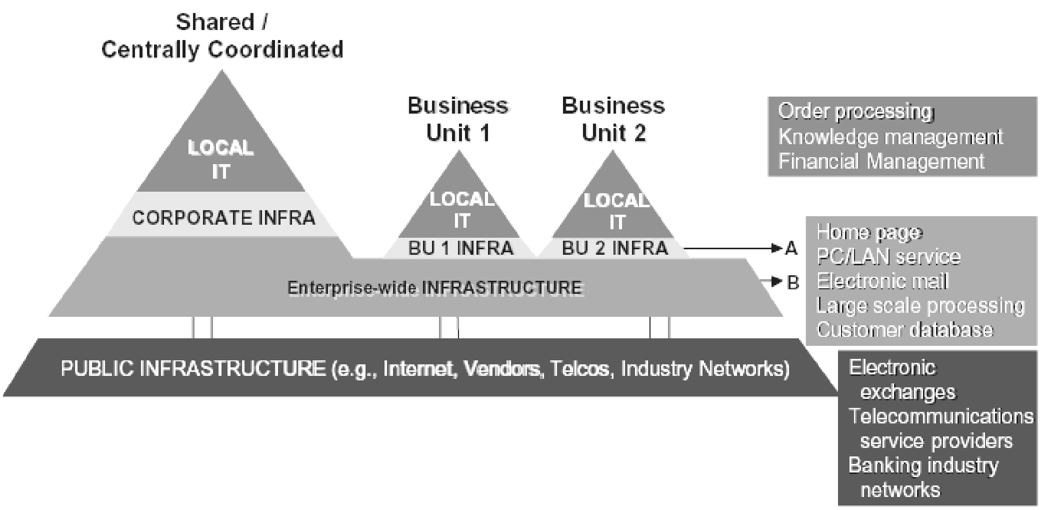


Figure 11: Information Infrastructure can be deployed at multiple levels (Source: Weill et al. 2002:3)

Such infrastructures encompass local industry-driven demand for variety with centralized planning and control over IT resources and business processes (Weill & Broadbent, 1998)[33].

[33] According to Weil et al. (2002:2): "IT infrastructure is the base foundation of budgeted-for IT capability (both technical and human) shared throughout the business in the form of reliable services that are centrally coordinated. Infrastructure links IT-based capabilities in the enterprise

While IIs bear connotations of the Internet-enabled information highway, companies have started using IT enabled technologies to create their own infrastructures covering often their own business network and beyond (Hanseth, 1996). Although the Internet provides one of the vehicles of communication, it doesn't contain any ability to execute processes. A corporate II utilizes information systems and communications networks to enable business activities across a supply network (Harland et al, 2004).

2.2.2 Attributes of Information Infrastructures

Contrary to the implicit association of infrastructure as a static, solid foundation, IIs are in a constant flux of realignment, thus being *emergent* (Hanseth et al. 1996). At the limit, infrastructures seem to "drift" (Ciborra, 2001), or being created by planning as well as by “improvisation” (Orlikowski, 1996), often influenced by other larger infrastructures beyond the control of the focal firm (like the Internet according to Barua, et al. 2001). Hanseth (in Ciborra, 2001) described some of the characteristics or attributes of information infrastructures as being:

- *Enabling* - This means that an infrastructure is design to support a wide range of activities, not especially tailored to one. It is enabling in the sense that it is a technology intended to open up a field of new activities, not just improving or automating something existing (Weil & Broadbent, 1998). This is opposed to being especially design to support one way of working within a specific application field. This enabling feature of infrastructures plays important roles in policy documents (Ciborra, 2002).
- *Shared by a larger Community* (or collection of users and user groups) - An infrastructure is shared by the members of a community in the sense that it is the one and the same single object used by all of them (although it may appear differently). In this way infrastructures should be seen as irreducible, they cannot be split into separate parts being used by different groups independently. An e-mail infrastructure is one such shared irreducible unit, while various installation of a word processor may be used completely independently of each other (Ciborra, 2002). However, an infrastructure may of course be decomposed into separate units for analytical or design purposes.
- *Open* - They are open in the sense that there is no limits for number of user, stakeholders, vendors involved, nodes in the network and other technological

to business partners, external infrastructures such as bank payment systems, and to public infrastructures such as the Internet. The concept of information technology infrastructure as services is very powerful [as] business managers can more readily value a service”.

components, application areas or network operators. This defining characteristic does not necessarily imply the extreme position that absolutely everything is included in every II. However, it does imply that one cannot draw a strict border saying that there is one infrastructure for what is on one side of the border and others for the other side and that these infrastructures have no important or relevant connections (Star, 1999).

- *Socio-Technical Networks*, thus more than "pure" technology – Infrastructures are heterogeneous concerning the qualities of their constituencies. They encompass technological components, humans, organizations, and institutions. An information system does not work either if the users are using it properly (Star, 1999).
- *Ecologies Of Networks* – Information Infrastructure are often members is multiple networks, some compatible and closely aligned, others incompatible and poorly aligned, which are superimposed, one on top of the other, to produce an ecology. Thus, infrastructures are connected into ecologies of infrastructures and in that respect they are layered as they link logical related networks and integrate independent components, making them interdependent (Star, 1999)..
- *Layered* – Infrastructures are layered upon each other just as software components are layered upon each other in all kinds of information systems. This is an important aspect of infrastructures, but one that is easily grasped as it is so well known (Renkema, 1998).
- *Heterogeneous*, in that the same logical function might be implemented in several different ways.
- *Extensions* or/and improvements of current “installed base” – Building large IIs is a considerable undertaking as it all elements are connected. As time passes, new requirements appear that demand further adaptations. Hence, the whole infrastructure cannot be changed instantly - the new has to be connected to or interoperated with the old. In this way the old - the installed base - heavily influences how amendments or extensions can emerge (Ciborra, 2001).

2.2.3 Information Infrastructures in Industrial Networks

Information infrastructures of competing firms may intersect to a degree where a co-opetitive environment is established as depicted below. We have recently witnessed the materialization such quasi-organizations leveraging intersections such as trade exchanges/ eMarkets, enabling collaboration (Nøkkentved & Hedaa, 2001).

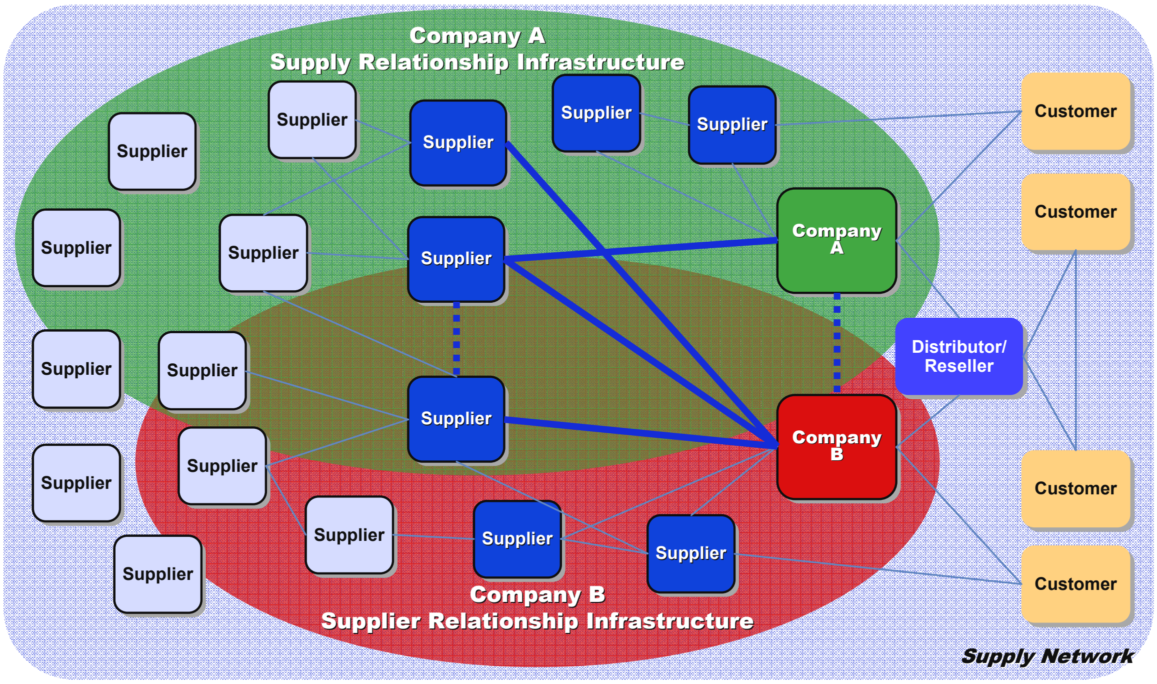


Figure 12: Infrastructure embedded in Networks? Yet IIs from different Companies may often overlap! (Note: Suppliers that are linked represent partners within the network ecosystem; bold links denote formalized and IT-enabled collaborative relationships as seen from the 2 major Companies in this Supply Network)

As mentioned in the previous section on attributes, Information Infrastructures may "embed" and drive formal and informal activity structures (i.e. processes) within and beyond the company, as well as "influence" actors' behavior, roles and relationships, and enhance or constrain the interactions that companies may be able to realize successfully (Ford et al., 2002). Thus, beyond singular episodes of interactions, information infrastructures may also affect the atmosphere of the focal firm's dyadic relationship as well as the environment permeating its business network. Although ubiquitous, such infrastructures are not always aligned with the business network surrounding the focal firm – they may extend well beyond the *horizon* of the actual supply network (Ford, 1997:231) potentially leading to inefficiencies (Hedaa, 1998).

With this perspective in mind, Information Infrastructures are present in most of the elements of the IMP Group's Interaction and Actor–Resource-Activity (ARA) constructs. They are present in the level of the firm, the relationship and the network. As depicted below, Information Infrastructures' creation, behavior & effects (e.g. value-creation) cannot be fully understood if we consider them individually, e.g. as a "Resource" or "Utility/Facility". Rather, different Information Infrastructures "mirror" the components of IMP's ARA model – they may be viewed as a parallel structure to a company's ARA! Consequently, Collaborative Information Infrastructures that enable Supply Networks can be studied via Networks of

Actors (or Roles), Resource Constellations[34] and Activity Patterns (or Collaborative Processes). Therefore, in order to study IIs effect on Industrial Networks transformation it is necessary to incorporate these construct elements in an enriched framework.

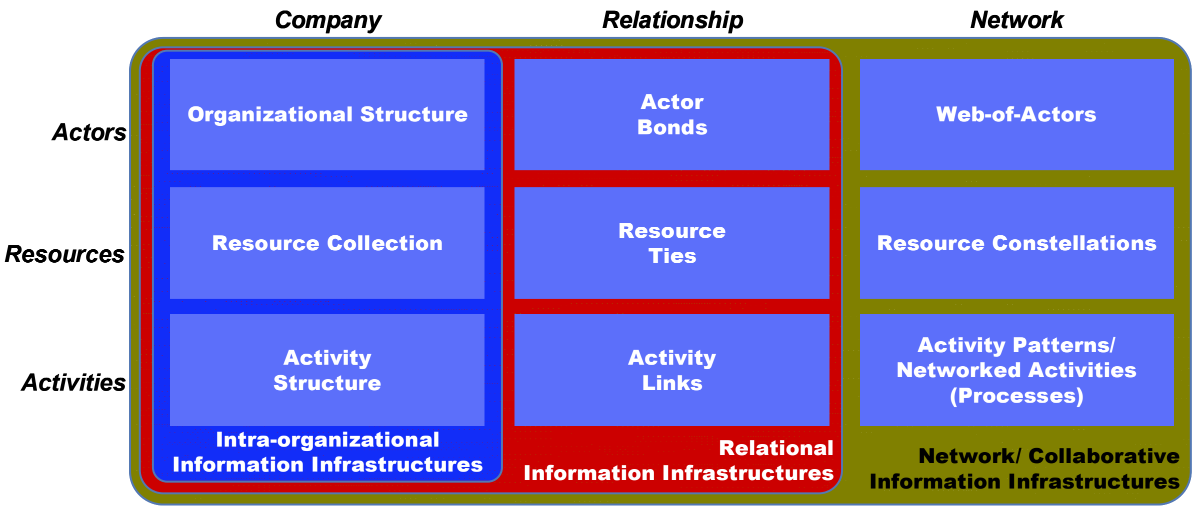


Figure 13: Identifying the Reach and Context of Information Infrastructures (Source: This is an extension of the ARA model by Håkansson and Snehota (1995); The II Layers have been added by the author)..

2.2.4 Transformational Behavior of Information Infrastructures

It would seem straightforward that a focal company ventures into developing such an information infrastructure aligned with its strategic demands in order to strengthen its position within its industrial network. Yet, as many studies indicate (Hanseth & Braa, 1996, 2001; De Burca & Fynes, 2001), deploying global Information Infrastructures leads into situations where strategic alignment does not fully explain the dynamics of implementation (Ciborra, 1997, 2001, 2002), and power struggles prevail over efficiency considerations (Hanseth et al., 2001).

As we explained earlier, Information Infrastructures are not only being the catalyst for purely inter-actor 'social' relations. Instead, they enable 'socio-technical' relations embedded in and performed by a whole range of different materials, human, technical, 'natural', and textual (Latour, 1982). Transformation of Information Infrastructures demand that we leverage the

[34] Typically we view *Resources* as assets that can be traded and sold; resources are characterized as *Fixed* (e.g. in plant and equipment, even skills of staff), *Shared* (e.g. jointly development of new products, processes or logistic functions), and *Collaborative Investments* (e.g. for tailoring products and services for particular customers). Grant (1995) views resources as *a)* Tangible resources include plants, equipment and cash reserves. b) *Intangible* resources include patents, copyrights, reputation, brands and trade secrets. Finally, c) *Human* resources are the people a firm needs in order to create value with tangible and intangible resources. Strategic resources leading to capabilities will have a great impact on achieved competitive advantage as they will affect the relationships between different actors in the business network (Baraldi, 2001, 2002). The ideas that a firm's critical resource may span firm boundaries and be embedded in interfirm resources and activities, hence constituting resource constellations, are present in the relational view of strategy (Dyer, 2000).

"hidden", yet potentially influential actors (e.g. IT vendors and service providers) that by cross-fertilizing best-practice processes and applications, may affect industrial dynamics.

Recent studies provide evidence that realization of Information Infrastructures represents a major transformational effort for organizations. Such efforts were found to be "coping" rather than "managing" or "controlling" transformation (Ciborra, 2002). It is a similar conclusion that many studies in industrial networks have shown throughout the years (Ford et al., 2002). Success of such efforts depends on a number of factors often ranging beyond the initial scope of such projects (Ciborra, 2001). During rollout, infrastructures become powerful agents of change (Johnston, 2002), forcing transformation beyond the focal company (Hanseth et al., 2001; Hartmann et al, 2002). In summary, Ciborra's (2002) research has shown that IIs are displaying a number of attributes that affect the dynamics of organizational transformation, thus also questioning the IMP Group's perception of technology as a mere resource.

2.3 Actor Network Theory – Technoscience of Transformation

In alignment with previous research (Walsham, 1997), we have also argued for the need of a more expansive methodology for inquiring into the real-world processes by which associations of humans and non-humans (among them information infrastructures) coalesce into persistent industrial networks or fail to do so (Sidorova & Sarker, 2000; Wagner & Scott, 2001). There seems to be a significant different view on the effect of transformation depending on what perspective (i.e. human or non-human) we take, yet both are becoming increasingly entangled as Information Infrastructures enable an increasing number of formal and non-formal business processes (i.e. human activities), and enrich job roles based on predefined / ad-hoc workflows hence changing inter-actor interaction patterns. Many transactions are subsequently executed between non-human actors, where their mirrored human counterparts are only involved in formalized activities in cases of exceptions (Nøkkentved and Hedaa, 2000). Hence, should we view Information Infrastructures as Actors too?

2.3.1 Actors in Business Network Theory and Actor Network Theory (ANT)

Even as the IMP Group is vocal about the need to consider both social and technical interdependencies, especially in relation to technological innovation (Ford et al. 2002), it is not at all as explicit how human and non-human actors are nomothetically or hermeneutically related and not clear about their *performative* aspects. Mattson (2003) believes there is some untapped potential for *Actor-Network Theory* (or ANT) in interaction and network studies. ANT provides a richer or more ”precise” methodology for studying dynamics of involvement of technical as well as social/organizational dimensions in boundary setting and also the involvement of actors in the network processes.

The last two decades have seen the emergence of what has come to be referred to as ANT, though its progenitors Latour (1996) and Callon (1997, 1991) disown this ‘naming’. The most pertinent aspects of ANT as a theory is its attempt to describe the interplay between science and technology via various elements (or actors) in networks where human and non-human elements (or nodes representing actors) are present. Adopting an ANT perspective can help highlight transformations involved in forming, transforming and maintaining heterogeneous networks (Law, 1999) before these activities become “black-boxed” (e.g. formalized and hidden from observation according to Walsham (1997)). These experiences of transformative successes and/or failures result in a particular mind-set or cognitive map, a repertoire of tools and preferred processes. ANT in correspondence to Evolutionary Economics propose that management behavior is a combination of *routines* embedded in the individual actor, which is often compared to the genes of an organism. The successful ones are selected and inherited from one period to the next, thereby ensuring transmission of knowledge (Nelson & Winter, 1982). Nelson and Winter’s routine-based *organizational memory* concept resembles ANT’s Black Boxes – or as they are described – “the way things work around here!”

Focusing on these processes foregrounds the emergent and progressive manner in which Information Infrastructures may enable or constrain business relationships (Monteiro, 2000). Actors in a particular topology influence each other through their links (or interactions according to the IMP Group). ANT suggests that a process of *translation* takes place, a process that explains how and why some actors take the attributes and properties of the actors they are connected too (Callon, 1991, Law, 1999). This translation process enables an actor/entity (simple or complex) to *inscribe* its properties and attributes onto other actors in the pertinent topologies. Certainly, in any given topology not all actors are able to *inscribe* their properties and attributes equality into other actors. These are described as *actants* (Walsham, 1997; Law & Hazard, 1999). An actant is an independent entity with the potential to become an actor in a given topology or in multiple topologies simultaneously, perhaps performing and behaving differently in various topologies depending on its relative position in these respective networks. While the actant does not directly affect changes in an actor-network, s/he/it may have to be considered in the translations (to perform and/or be performed). This terminology fits well to some of the observations made by Ciborra (2002), where information infrastructures seem to affect behavior, trajectory and outcomes of organizational transformation efforts.

2.3.2 Information Infrastructures as Actant Networks

Like any human actor, Information Infrastructures lead their human counterparts into coalitions that enter ever-shifting alliances with others. IIs might be used by top management, playing the role as a powerful *change agent*, while later lower levels of the organization might use the dissipating IT infrastructure to help them bring the change process under their influence and into the speed they preferred. Furthermore, global Information Infrastructures epitomized by ERP systems may after their painful integration into the corporate infrastructure turn out to be a constraining actor resisting most organizational change (Hanseth, 1996). Thus, in considering human or non-human actors' transformational ability, the concept of *actant* is a powerful departure from the view of technology as a "dumb" resource. Rather as depicted in Figure 14, it may be viewed as a "mirror" entity with the potential to become an influential actor in a given topology. In extension to the aforementioned attributes of Information Infrastructures:

- An *Actant* can become an actor in multiple topologies simultaneously, perhaps performing and behaving differently in various topologies depending on its relative position in the respective network.

- Information Infrastructures may mobilize large networks of other *actants* (i.e. software vendors, hardware vendors and service providers) plus actants delivering a constant stream of renewed and tested knowledge, e.g. companies collaborating closely with the software vendors (Walsham, 1997).

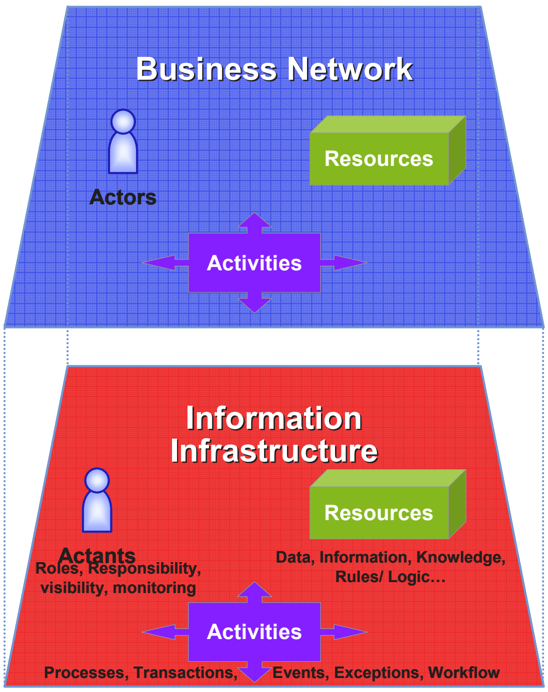


Figure 14: Parallel Universes - Information Infrastructures as Actant Networks mirroring a company's ARA-position in an Industrial Network
(Source: Nøkkentved, 2003).

Our viewpoint is that realizations of Information Infrastructures may be viewed as *actant networks* in that they contain modularized, interconnected best practice business processes, skills and business rules of diverse areas, most of them "translated" into an Enterprise or Inter-enterprise application. Upon introduction in the corporation, IIs mobilize a large network of internal and external actors plus other actants (i.e. vendors). All these participants are indirectly (and some directly) involved in a company's transformation efforts without being the direct decision-makers or instantiators of change. If we combine this perspective with the increased digitization of a company's material and immaterial assets it is evident that we need to shift our viewpoint or rather evaluation lens from an essentialist view of human actors driving transformation to a more multidimensional construct, which incorporates actants (Walsham, 1997).

To sum up, in order to better understand the drivers of change and the effect of Information Infrastructures, a more fine-grained socio-technical analysis of the adoption factors employed in shaping transformation is required. We need to advance our perspective of Information Infrastructures from static resources under the control of the focal firm or even the supply network, towards IIs as influential "actant-networks". The mobilization and transformation of human activities, resources and behaviors in relationships and networks, seems to be a prerequisite for the successful deployment of information infrastructures in organizations[35]. However, in contrast to "pure" ANT, we should avoid simple views that anthropomorphize technology but rather consider its effects on human actors interconnected within a network of relationships. We should strive to evolve our perspective of IT away from the technologically deterministic or social reductionistic (Hanseth, 1996), towards a balanced view of Information Infrastructures as a necessary utility (Sawhney, 2001), providing shared, intra- and inter-organizational infrastructure for the functioning of the firm. Such a perspective will typically need to take into consideration the trends forming industrial networks of firms and the underlying Information Infrastructures enabling them.

[35] This is a far cry from the typical Organizational Change literature, where traditional response to growing complexity has been to add management layers, administrative procedures, paperwork, and bureaucratic functions. However, the value of information decreases as it is passed up and down a hierarchy, since competitive decisions are delayed, and since vital details are lost in the efforts to distill and aggregate information and pass it on to top managers, who need to set limits to the size of proposals. The strength of IT is to introduce *simplicity*, and to replace the dichotomy of centralization or decentralization with *collaboration* and *direct communication*. IT makes it possible to have fewer layers, fewer people and fewer administrative steps. Hence, effective information infrastructures greatly enhance the possibility of making information available to the people who need it, when they need it, and in a format that facilitates its use. But to make them really effective, it is essential to move away from mere imitations of paper-based predecessors. One of the aims of designing information infrastructures should be to enable the processes of the corporation, enabling the corporation to function as one entity. Through the evolutionary deployment of IIs corporation may ultimately reside within broader collaborative infrastructures.

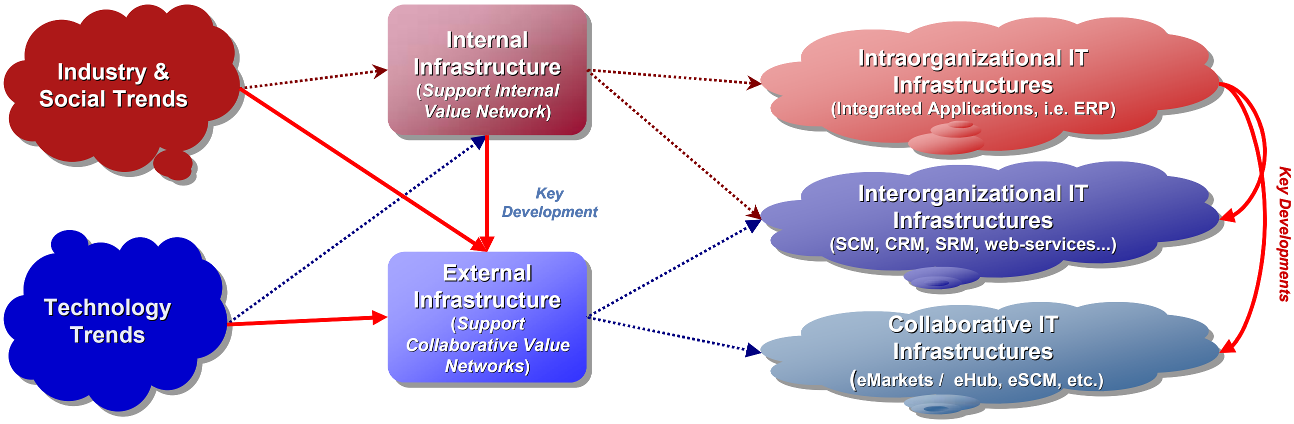


Figure 15: Towards *internal cohesion* and *external adaptiveness* as Information Infrastructures are increasingly evolving to represent the industrial network of the focal firm (Source: Nøkkentved, 2004).

2.3.3 Recent Deployment Trends of Information Infrastructures

Some of the Industrial Networks trends that drive deployment of IIs are based on the need for:

- *Intraorganizational optimization and homogeneity* (driven by development towards the single-instance, homogenous intraorganizational infrastructure services via ERP, while planning & collaboration activities are optimized via shared components utilizing fedrated models via SCM-, SRM, PLM and CRM infrastructures).
- *Interorganizational adaptation and flexibility* (strategic issues are driving industries towards a Networked, Collaborative Business Models, while recent advances in Data Standards like XML, Web services, SCA/SDO, etc., are accelerating this shift).

2.4 Information Infrastructure Synthesis – Towards a Domain Taxonomy

We have in this chapter argued that a more satisfactory account of the interwoven relationship between Information Infrastructures and organizational transformations is required. More specifically, we need to learn more about how this interplay works, not only that it exists. That implies that we should attempt to study in detail how a focal firm's Information Infrastructure shapes, enables and constrains organizational change. This approach will require a richer view of the role of information infrastructures beyond the well established process-centric perspective.[36] It seems vital to be concrete with respect to the specifics of the use of Information Infrastructures to be able to study their effect on transformation.

What also became apparent was that we need a different set of "ANT" lenses to evaluate the alignment between information infrastructures and Supply Networks. While the next chapter will delve into the context and IT-enablement of Supply Networks, during the process of developing our constructs we iterated back to this chapter in search of a better representation of how to scope or delimit our efforts that took into consideration the perspectives provide in this chapter. The Information Infrastructure (II) ontology[37] was further detailed as a taxonomy distinguishing various *II Domains*, which proved helpful in our delimitation and study. We propose this taxonomy as a means to structure our investigation of of Collaborative Supply Network Business Models[38].

The idea of "domains" classifying Information Systems is not new. Porter (2001) provided an overview of various Internet-enabled Collaborative IT applications retrofitted into his popular Value Chain construct to show their position and potential influence on competitive advantage (see Figure 16). Others within the Supply Chain Management research have also proposed IT-domains classified on "process domains" that could extend beyond a company's boundaries. For example, Cooper, Lambert, and Pagh (1997) have identified the following

---

[36] "The concept of processes really isn't that new. Effective managers have long known that you manage by processes - they're an essential tool for getting things done. What's different now is the enabling technology. Today's information systems allow you to do things that weren't possible in the past, such as accessing information simultaneously from multiple locations and diverse functional groups. With that ability, you can enjoy the efficiency of a process orientation with-out losing the responsiveness of a divisional orientation. The less developed information systems that supported command-and-control structures couldn't do that. In fact, those structures - which can probably be traced to the church and to the military as far back as Caesar - persisted precisely because for many years they were the only way to manage large, complex organizations." (from Paul Allaire, previous CEO and Chairman of Xerox in Goold & Campbell, 1987)

[37] An *ontology* essentially gives a common understanding of a specific domain by defining its elements and the relationships between these elements (Osterwalder et al, 2002). Taxonomy segments an ontology via attribute classification into cohesive groups (Osterwalder, 2004).

eight key SCM processes that define the company and permeate its boundaries: (1) customer relationship management, (2) customer service management, (3) demand management, (4) order fulfillment, (5) manufacturing flow management, (6) procurement, (7) product development and commercialization, and (8) returns/reverse logistics.[39]

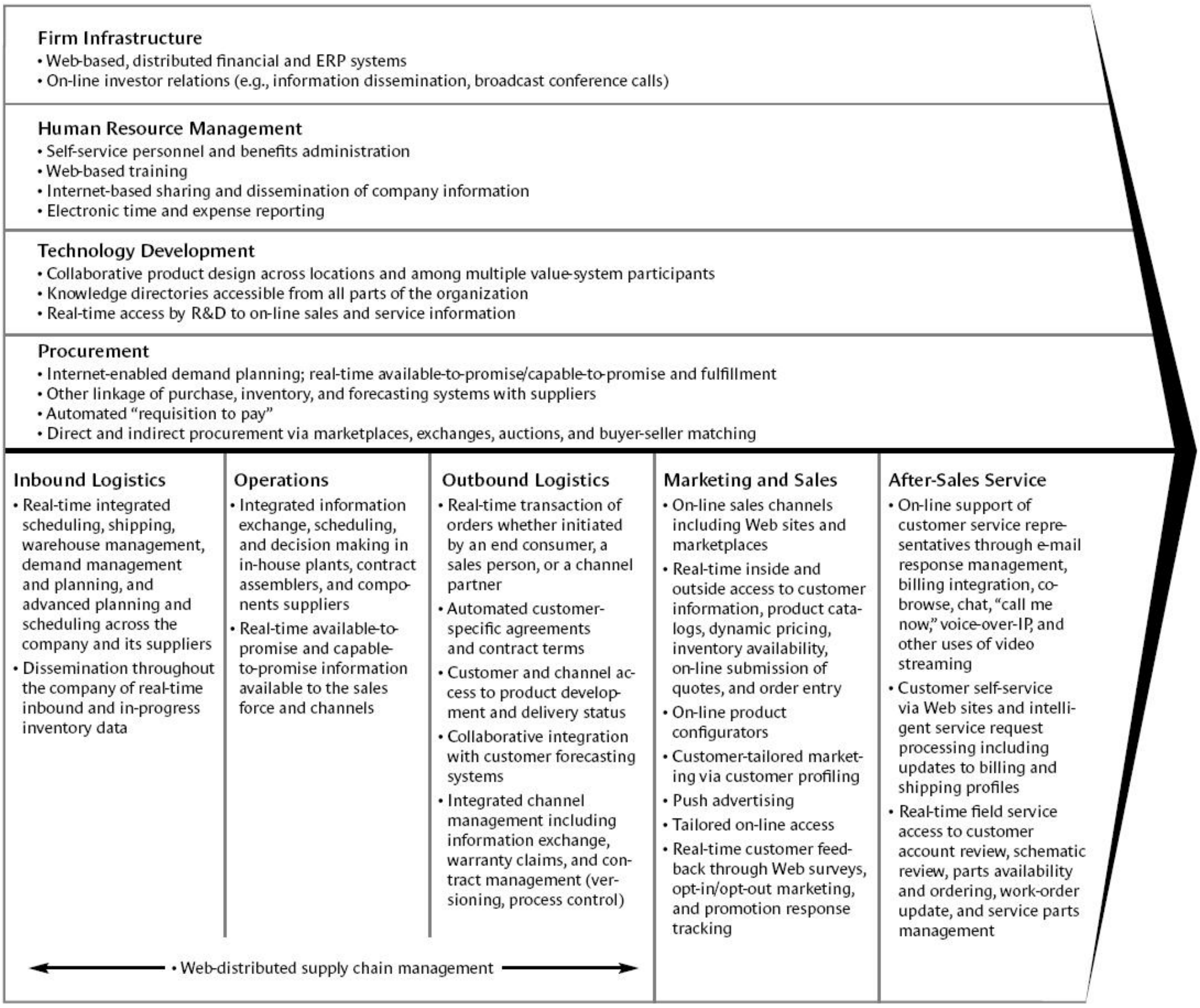


Figure 16: An overview of Internet-enabled IT solutions within the Value Chain (Source: Porter, 2001:75)

A recent contribution from IS Research on e-Commerce provided a rich typology of processes and enabling applications (Elie et al. 2004), hence showing how close collections of activities, actors' roles and resources are bundled in processes and enabled by an intraorganizational and collaborative information infrastructure.

---

[38] In alignment with current research (Osterwalder, 2004). we consider that a *business model* may be conceived as a mediating architectural construct between technology development/deployment and business value creation.

[39] Another noteworthy contribution was made recently by Chopra and Meindl (2004); their research distinguished between three "macro processes" that all companies participating in a supply chain have in common: (1) supplier relationship management, (2) supply chain management, and (3) customer relationship management. Moreover most IT-enablement follows these macro process or domains.

Our own quest to distinguish domains of Information Infrastructures resembling the descriptors of a business network, reached some conclusion during a series of detailed end-to-end event-driven information- and activities-based analyses together with a team supporting a large Nordic client (of IBM). The example depicted in the figure below, provides an case of how a Customer Complaint, ended up becoming quite intricate. What we documented were how Actors bonded via Activities to each other may relay Resources (Goods /Information). Events are processed by recipients who react by triggering own or other Actors' activities within or beyond their company boundaries. The complexity of real-world *Events, Actors, Activities and Resources* sequencing was substantial. Notwithstanding, one of the evident patterns was that information-processing and activity flows triggered by events were similar among actors with similar functional scope of responsibilities. For example, Supply Chain Planners in both companies were conducting nearly identical activities and handled similar information. This has been denoted in the figure below as actors with similar colors. Thus, an Information Infrastructure can be fragmented into similar Events-Actors-Activities-Resources taxa.

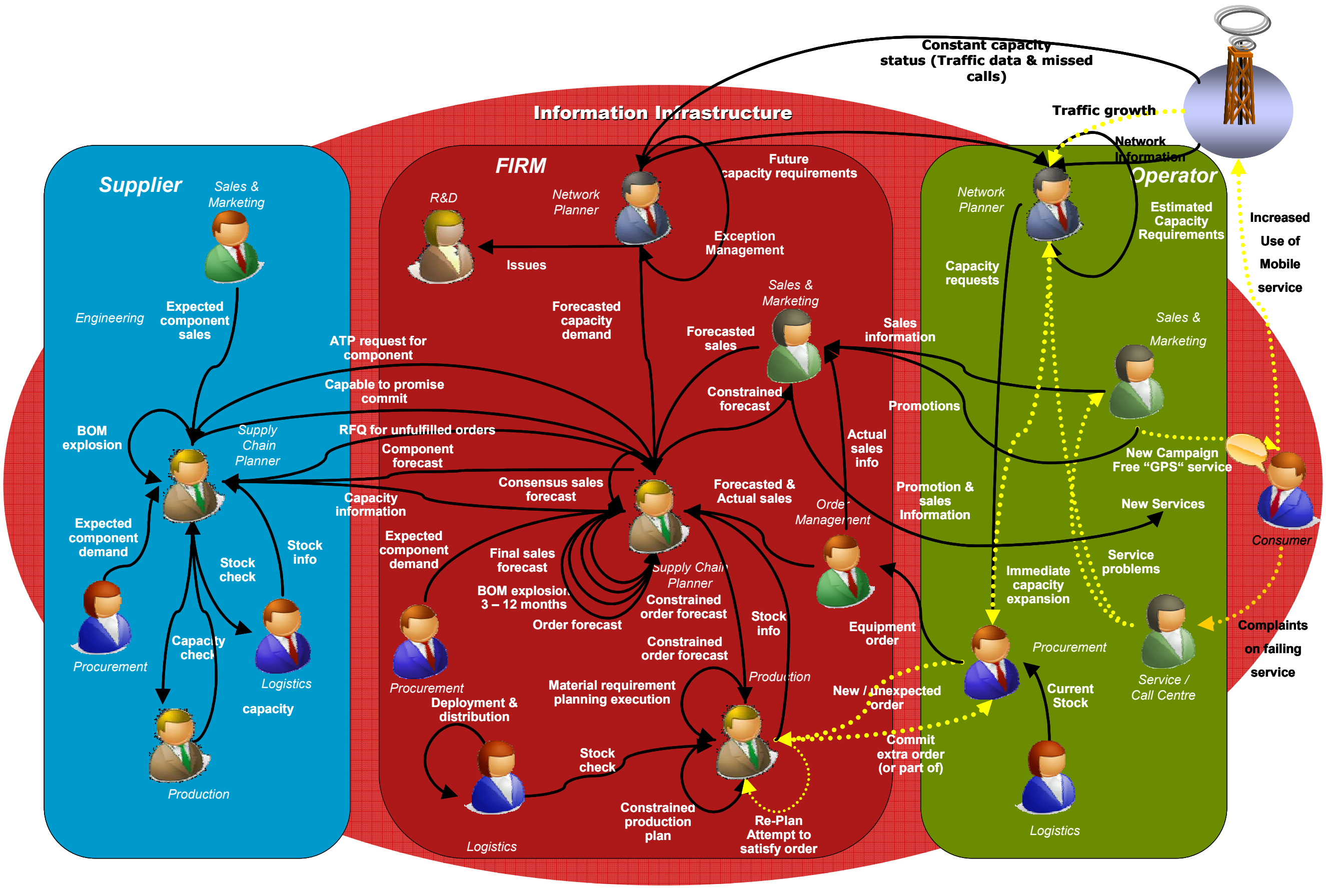


Figure 17: An Event-based Actor-Activity-Information Analysis across 3 collaborating companies in an Industry Network (Note: Figure made by the author in an case assignment; this is a highly simplified depiction what happens in case of a customer complaint, and how the various actors interact in the business network).

These domain clusters contain similar networked activities among actors with similar roles and demanding similar enablement from their IT systems. Thus, based on the above observations, we developed an *Information Infrastructure Taxonomy* based in the broad Business Model Domains (Nøkkentved, 2003). It was aligned with the perspective of different Business- and IT competencies, plus it had the opportunity to distinguish the "roles" of the various actors within an information infrastructure. Moreover, our taxonomy was easier to "map" into enabling applications developed by most Enterprise Application vendors (i.e. SAP, Oracle, etc.). It is concise enough to be the means through which Business Model Domains map into Information Infrastructures within and beyond the individual firm.

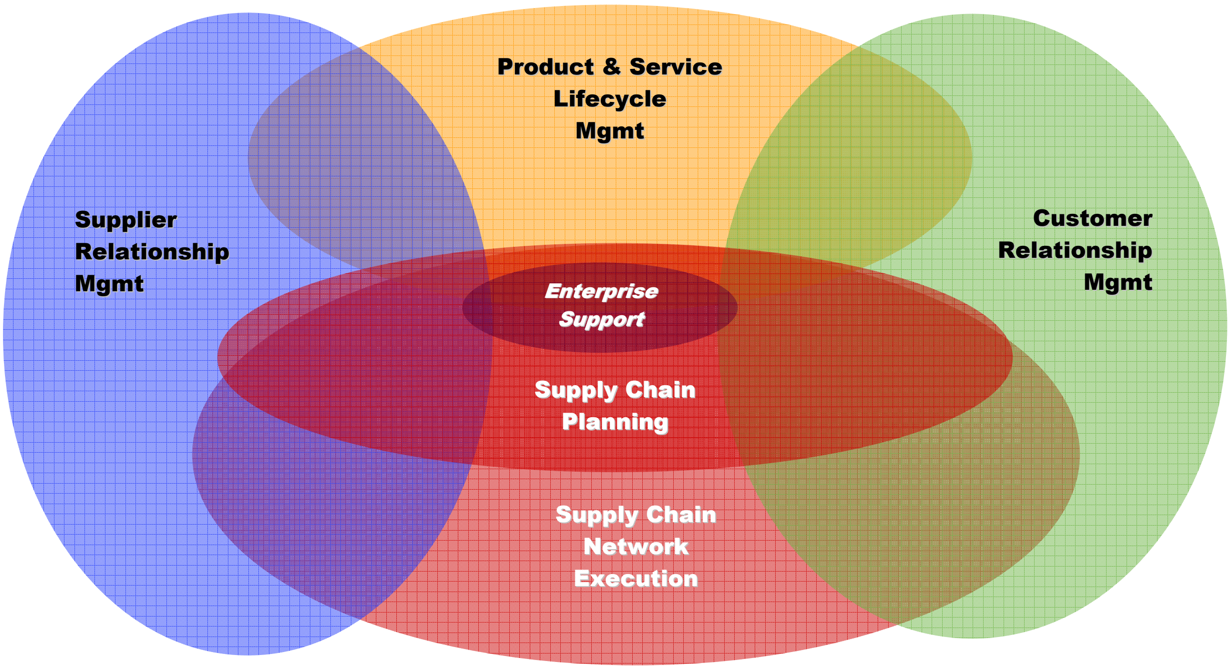


Figure 18: An Information Infrastructure Taxonomy of Business Model Domains within a Supply Network (Source: Nøkkentved, 2003).

Another important feature is the shared set between the various information infrastructure domains. These denote areas of internal and external collaboration and synchronization; moreover these are the areas where a lot of conflicts and tensions arise in collaborative processes as activities are shifting hands between actors with different views and competencies. For example, in the upstream domain of Supplier Relationship Management (SRM), a lot of the strategic value is delivered in the interface between Sourcing and Engineering & Development, whereas the operational efficiency of the function is achieved by the proper alignment between the operational actors (i.e. in Manufacturing, Logistics, Supply Chain Planners, Inventory) and the procurement officers. Below we provide an example of how a focal firm's domains are helping us to position partners in a Supply Network hence providing a view of on a Industrial Network (see Figure 19).

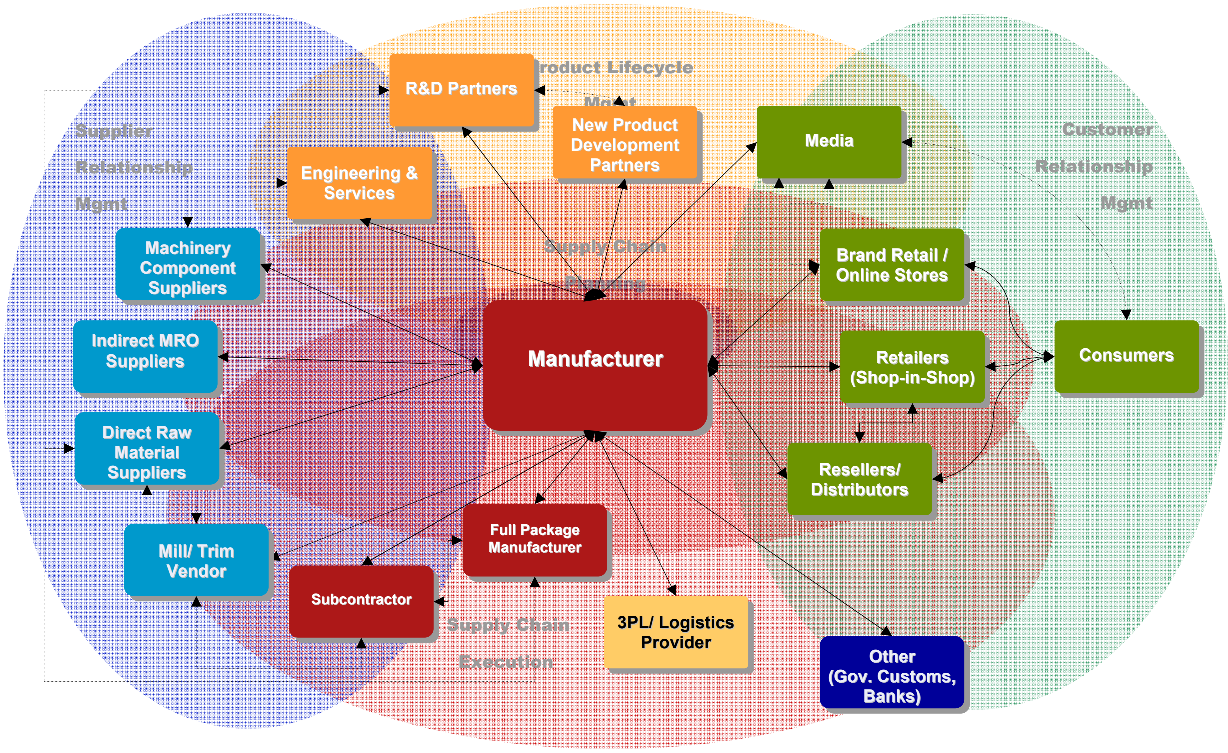


Figure 19: An example of a focal *Supply Network* and its partners aligned with the Business Model Domains (Source: Nøkkentved, 2003).

In summary, this *Information Infrastructure Taxonomy* has been used in this dissertation to guide our attention and helped us to delimit our scope. Furthermore, it exemplified the central artifacts of our construct and enabled us to depict the various collaborative processes in the Supply Network. If you are interested to view an example of such depictions, please refer to Figure 33, Figure 35 or Figure 42.

This foundational chapter sets the stage for our study; it defined the central concepts and theories behind our construct – *Industrial Networks* and *Information Infrastructures*. It provided a perspective into how information infrastructures are increasingly resembling the industrial networks they are supposed to enable – thus becoming Actants. We summarized this perspective with the help of our Information Infrastructure Taxonomy which mirrors the main domains of a Supply Network. Subsequent chapters will further elaborate on Collaborative Suppply Networks, and then expose enablement of supply-side networks – our study delimitation also labeled as *supply relationship management* (Roberts & Mackay, 1998).

3. COLLABORATIVE SUPPLY NETWORKS– BUSINESS MODELS

To study transformation of supply networks, this research project will pursue qualitative and subsequent qualitative empirical research in the realm of inter-enterprise collaborative processes. These processes are more dependent on multi-point alignment than other more structured/transactional operational business processes, thus providing a rich test bed to examine the opportunities and constraints of enabling them with IT applications in modern enterprises. SCM research draws on many research fields, but mostly upon organizational science (e.g., logistics, network theory, decision theory, administrative organization, and management science) and information systems (e.g., database systems, data communication, software process modeling, software engineering, programming). By residing at the intersection of both disciplines, this project will address enablement via adoption contingencies. We commence this chapter on Supply Networks from the vantage point of interactions in supply networks will be based on the SCM framework developed by Cooper, Lambert, and Pagh (1997).

3.1 Foundation – The Global Supply Chain Forum's SCM Framework

As we have previously mentioned, one of the most significant changes in the last decade is that individual businesses no longer compete as solely autonomous entities, but rather as business networks. In this era of inter-network competition, the ultimate success of a single business will depend on management's ability to integrate the company's intricate network of business interactions. Increasingly the management of multiple relationships across a network of multiple businesses and relationships is being referred to as supply chain management (SCM). In 1997, Cooper, Lambert, and Pagh offered a framework for understanding SCM, and raised a number of research questions. The definition of the SCM framework was developed in 1994 and modified in 1998 by members of The Global Supply Chain Forum. The framework tries to avoid a major weakness of previous SCM literature, which assumes that everyone knows who is a member of the supply chain. Instead it focuses on identifying specific supply chain members, key processes that require integration and what management must do to successfully manage the supply chain. Thus, the SCM framework encompasses the combination of three closely inter-related elements: the network structure of the supply chain, the supply chain business processes, and the supply chain management components (see figure).

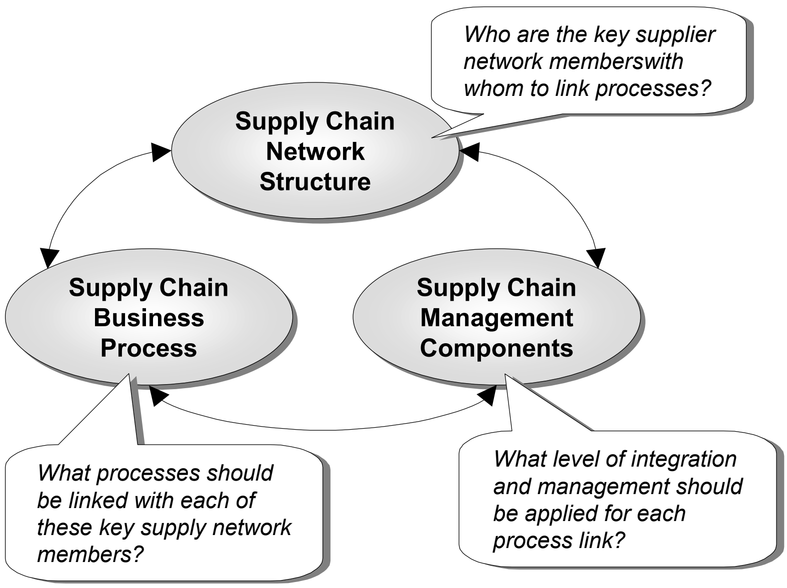


Figure 20: Interdependencies of SCM Design Domains.

3.1.1 Supply Network Structure

Three primary structural aspects can describe the supply chain network structure: members, structure and links. More specifically we can study the supply chain network structure by:

1. The *primary* and *supporting* members of the supply chain, where the primary members of a supply chain are all the autonomous companies (or SBUs) who actually perform operational and/or managerial activities in the business processes designed to produce a specific output for a particular customer or market.
2. The three *structural dimensions* of the network, which are the horizontal structure, the vertical structure, and the horizontal position of the focal company within the end points of the supply chain; while the horizontal structure refers to the number of tiers across the supply chain, the vertical structure refers to the number of suppliers/customers represented within each tier, and the horizontal position illustrates the company's closeness to the final consumer.
3. The different types of process links across the supply chain; these are managed business process links, monitored business process links, not managed business process links, and non-member' business process links.

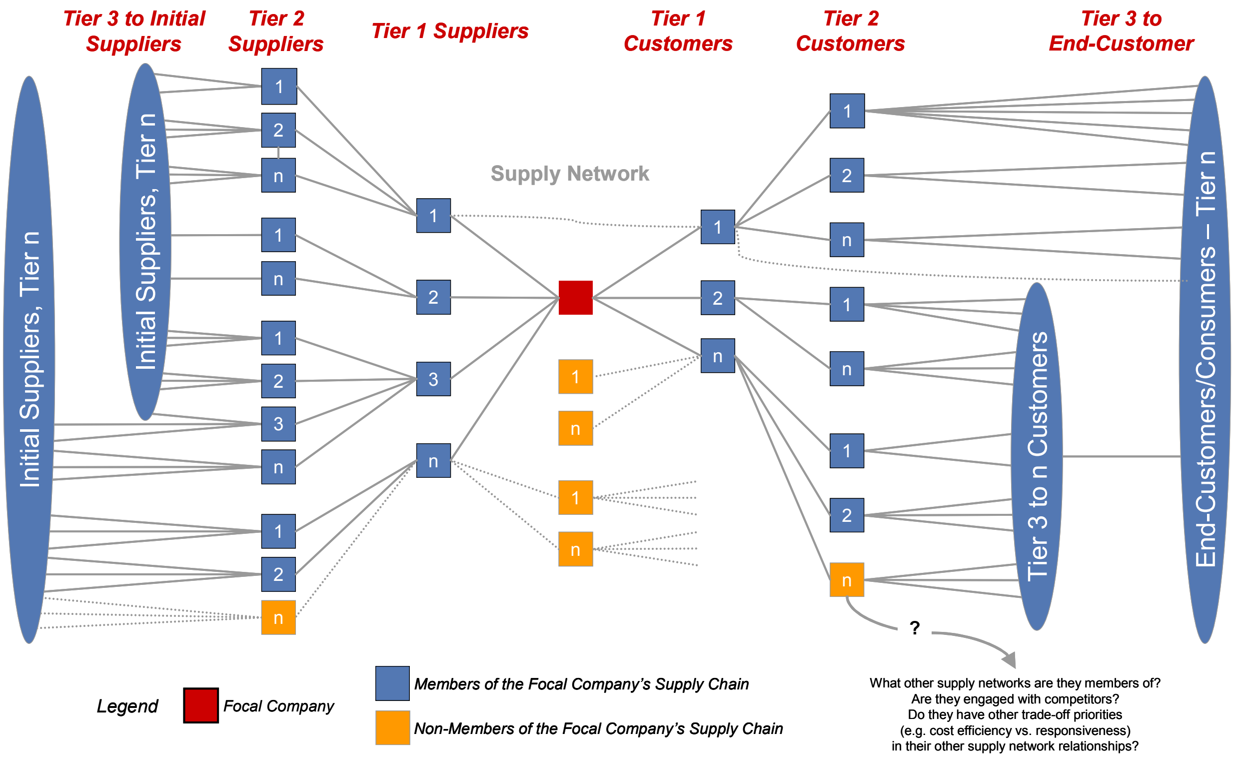


Figure 21: Supply Networks and Management Considerations (Source: Lambert, Cooper & Pagh, 1997)

Earlier research has shown that integrating and managing all business process links throughout the entire supply chain is likely neither appropriate nor necessary. Since some links are more critical than others, allocating scarce resources among the different process links becomes an essential management decision. Our research will focus on investigating network membership and structure, but it will also delve extensively into the nature of the various business links or interactions.

3.1.2 Supply Network Processes

According to Davenport (93), business processes are the activities that produce a specific output of value to particular customer or market. A process can be viewed as a structure of activities that manage the inter-organizational flows involving products, information, cash, knowledge and/or ideas. In supply networks these often extend and blend with processes of partners and competitors as shown by the figure below:

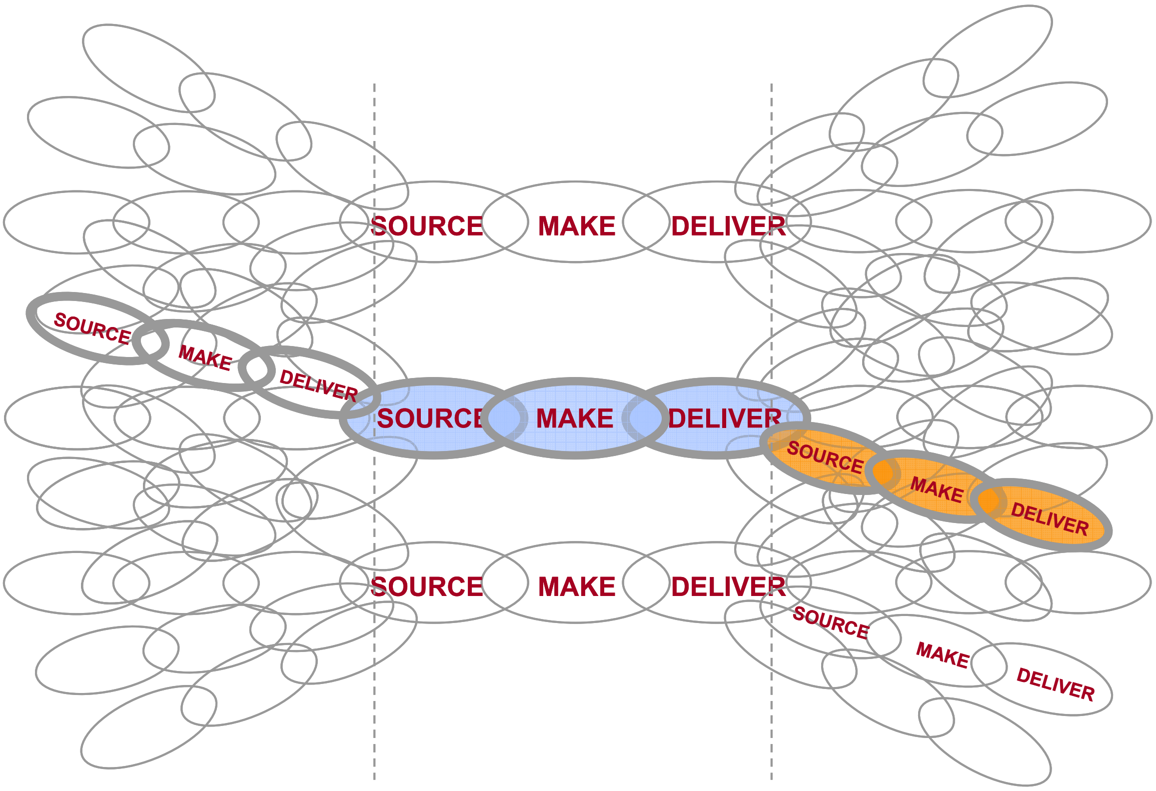


Figure 22: An externally focused Process-based view of a Supply Network (Source: SCOR, 1996)

.

The Global Supply Chain Forum have, identified the following seven key business processes that could be linked across a supply network:

1. customer relationship management,
2. customer service management,
3. demand management,
4. order fulfillment,
5. manufacturing flow management,
6. procurement, and
7. product development and commercialization.

The cash flow or returns process as well as the shared information flow has subsequently been added. The number of business processes that is critical and/or beneficial to integrate and manage in a business network will likely depend upon various contingencies. While some companies find it be appropriate to link just few key processes, others require tighter collaboration by linking multiple or all business processes. In the course of our research we intend to thoroughly analyze and discuss which key business processes to integrate and manage with the case-companies.

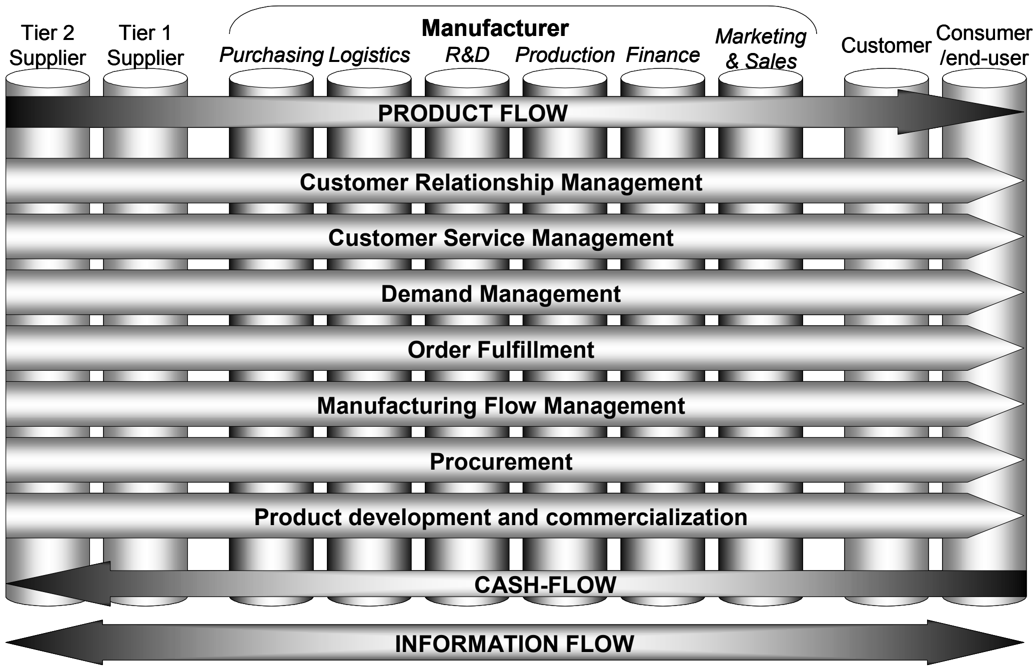


Figure 23: End-to-End Process Perspective (Source: Lambert, Cooper & Pagh, 1997)

3.1.3 The Management Components of SCM

The major components for integrating and managing process links in a supply chain network are the third element of the SCM framework. An essential underlying premise of the SCM framework is that there are certain management components that are common across all business processes and members of the supply chain. Cooper, Lambert and Pagh (1997) have identified nine management components divided into two groups that span the range of management decision-making within and across a firm:

1. The *physical and technical* group, which includes the most visible, measurable, and easy-to-change components like planning and control methods, work flow/activity structure, communication and information flow facility structure and product flow facility structure; it rather unfortunate that these tangible components receive most of the managerial attention.

2. The *managerial and behavioral* components that are less tangible and visible and are, therefore, often difficult to assess and alter; they include management methods, power and leadership structures, risk- and reward procedures, and culture and attitudes. They dictate organizational behavior and influence how the physical and technical management components can be implemented. Consequently, the groundwork for

successful SCM is established by understanding each of these SCM components and their interdependence. Research has indicated that the physical and technical components are better understood and applied across the supply chain.

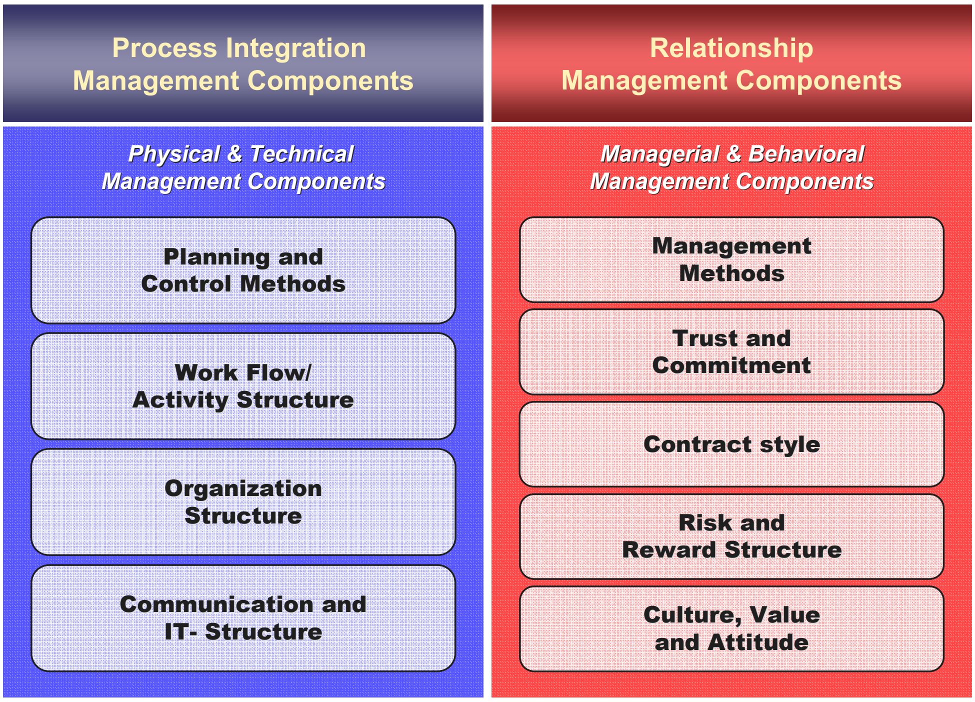


Figure 24: Fundamental Management Components Considerations (Source: Lambert, Cooper & Pagh, 1997).

An interesting issue pertains to the fragmentation of attention seen on many real-life implementations of SCM. In the SCM framework it is indeed possible that business processes are not linked across the same firms. In other words, different business processes can have different looking supply chain network structures. For example, a focal company can involve Supplier A, but not Supplier B in its product development process, whereas the demand management process may be linked with both suppliers. Thus, it is imperative that managers choose to integrate and manage different supply chain links for different business processes. Chopra and Meindl (2004), describe that successful SCM is based on determining:

1. who are the key supply chain members with whom to integrate processes,
2. what are the supply chain processes to link with these key members, and
3. what type/level of integration should be applied to each of these process links?

It is important to distinguish between primary and supporting supply chain members, and to identify the horizontal structure, the vertical structure, and the horizontal position of the focal company in the supply chain network. Beyond the need to further distinguish between managed to non-managed SCM business process links that we will study in detail via our Collaborative Process overview (see section 3.6), which in effect marries 3 of the Physical & Technical Mgmt components, one of the key transformational components identified by Cooper, Lambert and Pagh (1997), was the *Planning and Control Methods*. This was also verified by Nøkkentved and Rosenø, on their empirical investigation of Management Process Infrastructures among Scandinavian MNCs (1998), which also reported on the importance of Performance Measurement and supporting enablement of operational visibility. The table below summarizes the Contextual Parameters within this component.

Variables	*Low level*	*High level*
Style and frequency	Planning and Control of the process link is executed on a company individual, ad hoc and infrequent basis.	Planning and control of the process link is executed on a joint, systematic (both ad hoc and scheduled) and frequent basis.
Scope and Content	Focus is on short-term operational tasks, activities, and data. Some sharing of existing plans take place. Planning and control procedures, principles, and methods are developed and conducted individually.	Focus is on long-/short-term tasks, activities, data and the process integration. Emphasis is on meshing planning & control procedures/ principles/methods across firms, and continuously to improve the efficiency and effectiveness.
Performance measurement system (collecting/ evaluating/ displaying measures)	Performance measurement systems are not integrated. Measures are collected, evaluated and displayed independently. Responding actions are mainly decided and executed separately.	Perform. measure. sys. is integrated and jointly developed. Measures are collected/evaluated/displayed on a joint, shared and systematic basis. Responding actions are decided and executed together/simultaneously.
Objectives and performance measurement metrics	Objectives and performance metrics are focused on the transactional aspects (the operational and tactical level). Objectives and metrics are developed and determined independently.	Perform. metrics is focused on the process link and process output. Objectives/metrics are compatible, and developed/determined jointly. Metrics reflects performance of process on an operational, tactical and strategic level.
Ability to make changes	Operational changes of planning and control methods can be suggested to other's planning and control methods. However, tactical and strategic changes will often not be possible implement.	Parties may make some operational and tactical changes to other's planning and control methods within a predefined frame. Strategic changes can be suggested to other's planning and control methods.

Table 1: The "Planning and Control Methods" Physical Management Component in the SCM Framework (Source: Adapted from Lambert, Cooper & Pagh, 1997).

Supply networks should be properly understood, in order to be managed, streamlined and enabled. Our exploration of the perspectives presented in the SCM framework will guide our designation of contextual factors within the business domain hence provide additional validity to our conceptual construct. Now, after finishing this overview, we will start delving into the Collaborative aspects of Supply Networks.

3.2 Collaborative Supply Networks – An Introduction

Markets once favored competitors that could successfully integrate massive horizontal or vertical asset bases to create economies of scale (the "Fordist" model). The current global environment, marked by increased demand, decreased customer loyalty, shorter product life-cycles, and mass product customization, forces companies to lower costs while increasing the quality and variety of products and services.

The rise of Business-to-Business (B2B) Trading or Commerce Networks over the Internet enables companies to meet these challenges by extending their value-chains and cooperating with organizations whose complementary capabilities can give the whole business network a competitive edge. The ability to share, integrate and collaborate with other businesses provides an additional differentiation for companies competing with large asset-based competitors. The need to better integrate with customers and suppliers compels businesses to dramatically alter their processes in order to survive. As the cost and latency or friction is removed from B2B transactions, companies will be more willing to consider outsourcing what were once core business processes, thus finding themselves as participants in multicompany business processes. Consequently, many companies are currently disassembling their process infrastructures into independent processes and then reassembling them as parts of an extended supply network via outsourcing and collaborative partnerships, thus concentrating on their core competencies and process capabilities. This kind of partnering might also mean working collaboratively to share production, demand, capacity or product information in order to synchronize business behaviors across a supply network.

Industrial competition is therefore advancing from being between individual companies, to being between clusters of tightly-knit partners with the intent of delivering to the customer the desired product within a fitting time-frame at the right price. Hence, companies are progressing from the notion of the extended supply chain and supply networks into eSupply networks facilitated by electronic B2B marketplaces (Trade Exchanges or eMarkets). These support inter-organizational information sharing, transactional integration and collaborative, event-driven processes taking place in bilateral and multilateral relationships between partnering firms. By conducting Collaborative Planning within such a company's own Private eMarket or via Public eMarkets (e.g. consortiums), companies attempt to operate their value-added communities as though they were one seamless organization, synchronized to meet customer demand, in their pursue to achieve significant cost savings and service enhancements.

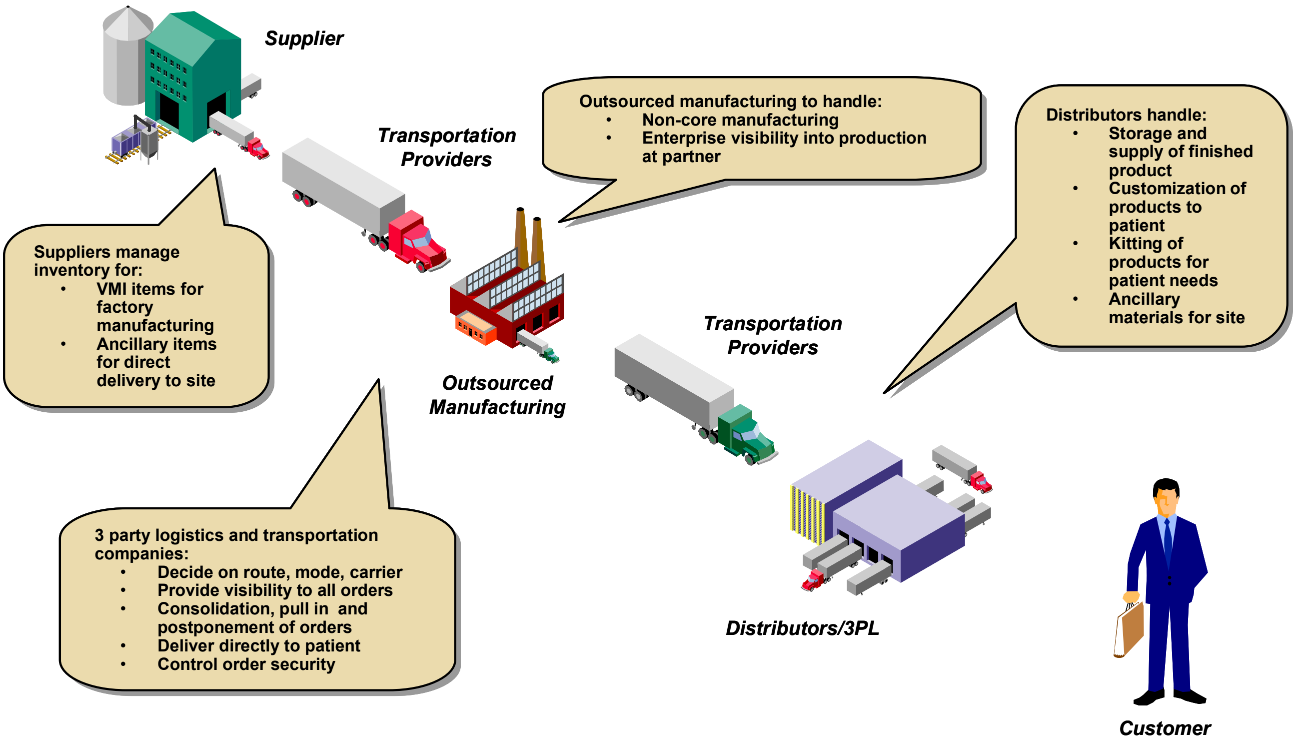


Figure 25: Examples of how Focal Firms may Leverage Partner Capabilities (Source: Nøkkentved, 2004)

This section will attempt to provide an overview of collaborative relationships and processes within eMarkets that utilize the Internet to facilitate co-ordination and enable collaboration among multiple trading partners. We will expose how eMarkets are currently deploying supply chain planning applications that bind firms through information-sharing, interdependent transactions and collaborative processes. Then we will delve into the various collaborative planning processes that may take place within an eMarket. Finally, we will present some of the benefits and implementation considerations of collaborative planning beyond the largely descriptive and anecdotal presentation of the advantages of eBusiness from popular literature and the press.

3.3 Collaborative Supply Networks – Emergent Business Models

The dawn of the new digital, networked economy[40], enables enterprises to transform themselves into *adaptable processes networks*[41]. The advent of the Internet as a universal communications platform extends even further a company's reach, and enables richer information exchange among collaborative networks of partners. In such an environment, companies must be *flexible* and *agile*—able to react quickly with minimal effort and expense. Agility can be greatly increased by improving the ability to detect problems, threats, and opportunities, giving the organization and its partners more time to react. Innovative companies are using current advances in information technology (like Collaborative SCM systems) and utilize common communication, security and process standards[42], to expand their networking capabilities and transform the nature of their operations[43].

The appearance of such ephemeral "plug-and-collaborate" supply networks and virtual B2B collaborative communities (e.g. E-Business/Trade exchanges), has been enabled by innovative advances in information technology and driven by the utilization of common communication, security and process standards. In the last decade a rising number of companies have been experimenting with process improvement, integration and automation. Most of these business engineering efforts were realized via enterprise resource planning - or ERP systems (from vendors like SAP, Baan, PeopleSoft, Oracle). The wider deployment of ERP systems and innovations in messaging and tracking technologies that allow real-time management of supply chain activities, has resulted in more compatible process and information infrastructures. Furthermore, the Internet has emerged as an ubiquitous communication platform on which companies can collaborate with their partners, reduce cycle times and enforce data and security protocols. These developments have led to the appearance of advanced planning, optimization and scheduling software (APS) that complements ERP/ MRP with an intelligent planning environment. APS/SCM systems implement supply network

[40] Among the most noteworthy proponents of the "digital economy" are Tapscott 1995, and Shapiro and Varian 1998

[41] The concept of adaptable process networks was presented by Chisholm, 1998.

[42] Examples of such Industry standards: Universal Descriptor Exchange (UDEX) in the Retail and Consumer Packaged Goods (CPG) industry, RosettaNet in High-Tech, and Chemical Industry Data Exchange (CIDX) in Chemicals.

[43] From an industrial network approach it is argued that the supply chain perspective contributes substantially to our understanding of efficient flows of materials but it fails to consider that relationships are not independent, but embedded (Gadde et al 2002). Hence, from an industrial network perspective, the supply chain concept is problematic. It is acknowledged that supply chains are important, but the network model suggests that there is risk in overemphasising the chain aspect. There are good reasons to include all the other branches of the network in the analysis, since a strong focus on the chain may lead to isolation from a wider network structure.

planning processes and act as a highly responsive nervous system of a supply network. Many software vendors are currently offering SCM systems (e.g. SAP, i2 Technologies, Manugistics, etc.) as supplementary systems to established transaction/ERP systems (SAP, 1998). Furthermore, these company-centric packages are currently being extended to provide collaborative planning via the Internet (i.e. SAP SCM‘s Collaborative Planning). Collaborative planning applications utilize Internet technology (with standardized data formats like XML) to synchronize demand signals and supply chain activities, by allowing supply network partners to view and share common information stored in B2B or even business-to-consumer web sites.

Hence companies are pursuing a more narrow control by reconfiguring their supply chains, focusing on core competencies that add value to their supply network, and leveraging skills and information technology to connect and coordinate processes among their trading partners in real time. Such seamless electronic connectivity enables companies to execute networked, cross-enterprise processes and integrate with trading partner operations.

3.3.1 From Mortar to Mortar & Click – the Rise of eBusiness

These developments are transforming sequential, enterprise-centric supply chains in which an enterprise drives multiple processes, into synchronized *electronically connected supply networks*, where one process drives more than a single enterprise. E-supply networks may be established either via direct B2B interfaces or via a new breed of Trade Exchanges, or *eMarkets*, which facilitate information sharing, transaction execution and collaborative processes. These predominantly industry-focused eMarkets are most often private, yet there are instances of public, horizontal or consortium-based, i.e. owned by a community of interdependent firms, or even consortiums of competing firms. Such cohesive business networks are confronted by immense challenges; e.g. they need constant communication with customers and suppliers to respond quickly to “pull/push signals” to manage low inventories, adapt quickly and economically to changes in demand/supply, by:

- Taking orders over the web, and provide immediate delivery information (e.g. ATP);
- Offering rich product selection and/or the ability to customize (e.g. we-customizable orders & products);
- Sourcing the order and commit to delivery, immediately, online (e.g. Capable to Promise);
- Service the order online, including changes and inquiries (e.g. order web-flow);
- Deliver product quickly, efficiently, and profitably (integration of logistics & freight information).

Table 2: Summary of objectives of contemporary e-Supply Networks

Upstream Objectives	Internal Objectives	Downstream Objectives
• Shorten time to market - through collaborative engineering, outsourcing, and contract manufacturing • Provide convenient purchasing via direct web-based sales, online catalogues • Enhance selection through customization or configurable products • Improve response by order promising, order tracking, event notification and fast delivery.	• Provide visibility of information – inventories, forecasts, orders, plans, engineering changes, KPIs. • Synchronize activities – optimized feasible plans, pull-based triggers • Promote responsiveness - reduce time to detect demand, commit, produce, fulfill • Achieve process simplification - by automating routine process steps • Leverage market mechanisms - Aggregate buying power, use auction-based buying/selling via trade exchanges.	• Replace inventory with information (inventory visibility, forecast end-of-chain demand, collaborate with channel / customer), • Shorter planning / replenishment cycles (automated planning process, collaboration with suppliers, rate based planning), • Reduce lead times (through supplier collaboration, "pull" replenishment / VMI and build to order/ postponement), • Improve synchronization (by generating feasible, optimized plans & schedules, replan when conditions change), • Provide order status and traceability • Use internal and external performance metrics.

These challenges require that partnering companies use *Collaborative Planning and Execution* to reach objectives within the core as well as the up- and downstream domains of the supply network. Application integration together with Internet connectivity enables such real-time communication and advanced planning functionality across multiple enterprises to optimize resource allocation and synchronize information and product flow.

3.3.2 Contemporary e-Supply Network Models

What we have presented so far is the substantial structural changes that are underway within the area of supply networks. The functionally driven stovepipes present in many contemporary supply chains are currently being transformed and replaced by more streamlined, electronically based processes[44]. Propelled by the accelerating permeation of information and communication technology into intra-organizational processes, which also enables inter-organizational collaboration, companies are *clustering* into private and collaborative exchanges to conduct their business. Even non-strategic sourcing can be facilitated by independent, commodity oriented exchanges. These marketplaces are entering in between the buyer-seller relationship and are bound to change the rules of the game[45].

---

[44] From Poirier (1999).

[45] The notion of the online exchange and its supporting technology are revolutionary in terms of their potential to bring trading communities together and enhance services, but ownership of the supply chain remains a very sensitive topic, with many companies unwilling to give up process ownership to a third party.

Instead of fewer intermediaries in contemporary supply networks, these last 5 years has shown a plethora of new intermediaries entering the buyer-seller relationship. It is evident that companies are able to connect with more partners in business communities, thus creating a multiplicity of network structures on top of each other! As shown in the figure below, complexity increases by additional intermediaries, while flow and ownership of product and information is decoupled. Actually, collaborative planning will take place via a collection of eMarkets, and dedicated B2B links. Some of the new intermediaries entering this interdependent network are shown in the table below.

Table 3: New e-Supply Networks Roles

Virtual Manufacturer	Virtual Distributor	Virtual Retailer	Virtual Service Provider
This type of organization does not manufacture anything, nor does it have any plants, but rather, controls product development, marketing, and sales as well as coordinate customer service for its products. It hires contract manufacturers and 3PLs and fulfillment service providers to make, assemble, and ship final products to its customers (e.g. NVIDIA, parts of Sony-Eriksson's production is outsourced to Flextronics).	This type of organization does not distribute anything and does not have any warehouses. It markets products, takes orders for multiple suppliers, controls marketing and sales, and coordinates order fulfillment. However, it relies on its suppliers to make, assemble, and ship final products directly to its customers (e.g. Ingram Micro).	This type of organization, better known as an Internet retailer, does not own any brick-and-mortar stores. It does, however, merchandise products in virtual stores, namely hosted Websites. The virtual retailer controls order fulfillment and can rely on its own distribution capability or suppliers to ship products directly to customers (e.g. Amazon).	This type of organization does not own any assets, but it does provide SCM services. This includes Lead Logistics Providers that perform logistics management for a company or a Logistics Exchange (LX), which is a trading exchange for procuring and monitoring shipping services (e.g. National Transportation Exchange). Many major 3PLs are developing such "plug-in" services for their customers' private eMarkets.

Thus, eMarkets are effectively functioning as a significant intermediary in the relationship between trading partners. An eMarket is a real-time, marketplace where a buyer can evaluate all the potential suppliers for a particular product or service. Within a supply network they can be classified as customer facing, e-commerce sites or business-to-consumer exchanges (B2C or eCommerce), and upstream or downstream, B2B trade exchanges or eMarkets (focusing on corporate customers).

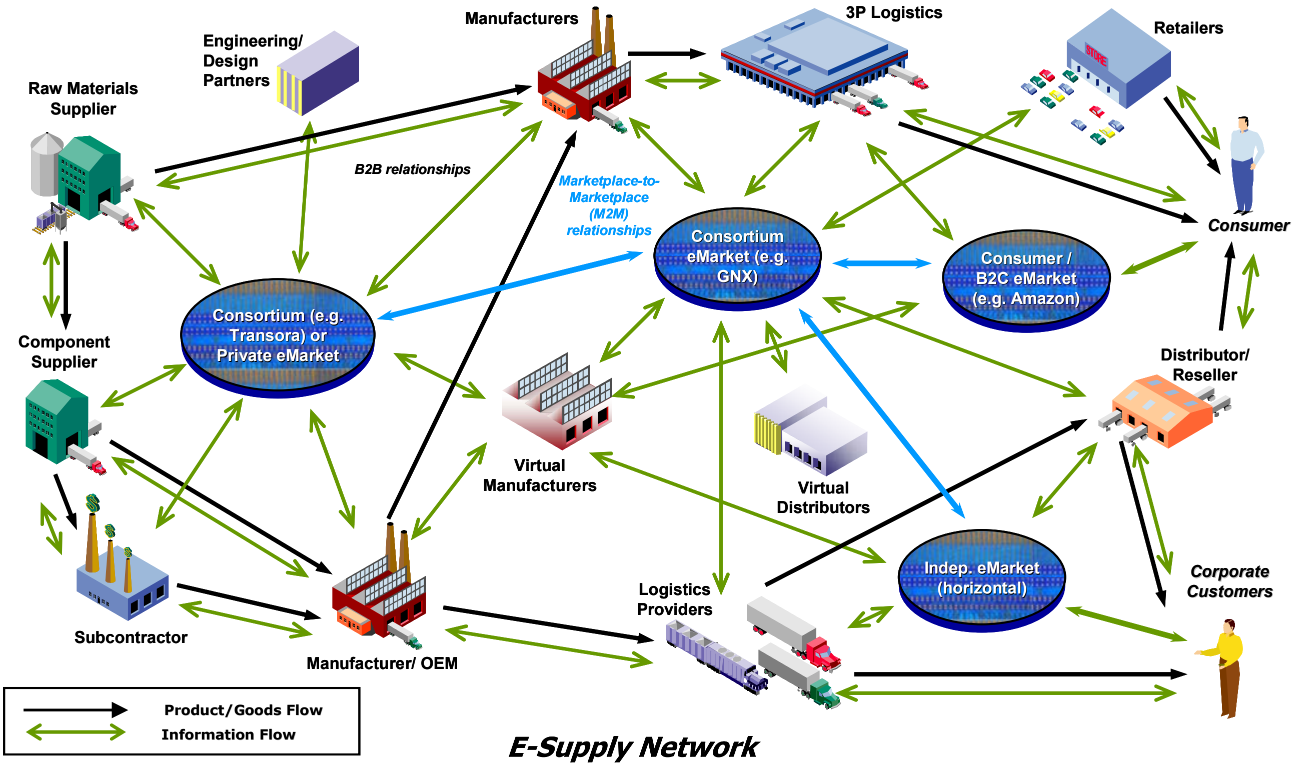


Figure 26: *Network Information Infrastructures* and intermediaries in a B2B Supply Network (Source: Nøkkentved, 2003)

3.3.2.1 *Extending Business Models with Network Structures*

Previously, research in business networks and supply chain management was focused on the issue of linkages (or relationships) between companies. With trade exchanges the issue becomes more the creation of *one* standardized process and data interface or relationship to an exchange, which then will function as a *hub* for the company's facilitation of information, business transactions and collaborative processes. So, instead of creating customized links to the company's strategic partners, the exchange becomes the central conduit of most business relationships.

A current tendency is that vertical exchanges are interconnecting with other vertical and horizontal exchanges (also called *Marketplace-to-Marketplace* or M2M – Cooper, 2006:245). This enables member companies to get access to a wider selection of services – from product development to financing. Thus, a multiplicity of network structures are evolving on top of each other, from B2B to M2M. The relative distances of a node from other nodes in a business network is changing by enabling a company to create relationships with distant suppliers and other small specialized firms[46]. The *network horizon*[47] becomes less opaque, as it extends the reach of the focal company further up- and downstream in the supply network. This has been enabled by the ubiquitous interconnectivity provided by the Internet and the resulting standardization of processes, based on communication and data protocols.

Companies are able to create more dense interactions, consisting of interrelationships between process activities, participating actors and applications. Consequently, the nature of relationships between actors in different companies is also altered as more intra-company processes are extended beyond the boundaries of the firm. Highly *reciprocal* or collaborative processes running via an exchange move the decision-making process from within the company to the relationship between companies, where decisions with partners are derived in a joint fashion.

3.3.2.2 Business Model Network Processes

All these trends reflect the evolution of business networks into streams of *network processes*[48], characterized by collaborative communities with high intra-cluster relationship density or *process density* (within B2B exchanges) and low degrees of inter-cluster interfaces (between M2Ms). In a network, *density* is defined as the number of exchange relationships, or ties, between managers relative to the amount of managers; i.e. the percentage of actual ties to potential ties (Nohria and Eccles, 1992). Since the network view focuses on exhibiting the ties between managers, or organizational units, it is a static picture that says little about the actual

---

[46] Small or midsize companies that cannot afford to incrementally invest in expensive infrastructure or supply chain management software (like SAP's APO) benefit the most by participating within an trade exchange. Benefits accrue from the selling, buying, and customer responsiveness aspects of their businesses. A trading exchange can overcome marketing and selling barriers in finding and serving markets. Through global connectivity, smaller suppliers get visibility and access to markets that they could not otherwise afford to access. Transaction fees paid to an exchange can present savings over hiring and maintaining permanent sales and marketing staff, providing a more positive economic model for joining. Utilizing a trading exchange presents further opportunities for smaller companies in managing internal resources and gaining efficiency. For the cost of an Internet connection, smaller companies can take advantage of leveraged buying negotiated by a trading community or customer host on behalf of its trading community members. By participating in a private or industry-focused exchange, smaller companies gain the benefits of reach and speed of transaction flow. The added capability of auctioning services to either sell or buy uncommitted inventory, or even post excess available capacity for other companies to use, are now open to smaller firms. Customer responsiveness benefits stem from visibility to end-customer and end-product demand and supply planning forecasts as well as transportation and logistics execution services. Prior to trading exchanges, the ability to leverage electronic connections to a larger customer supply chain had to be achieved through the adoption of EDI. The cost of building and maintaining EDI infrastructure prohibited many smaller companies from being able to leverage and effectively use these electronically-based processes. Trading exchanges, with their utilization of both XML- and EDI-based messaging and electronic alert capability, may overcome these economic hurdles.

[47] *Network horizon* is treated by Ford (1997:231).

[48] *Network processes* are discussed in Ford (1997:117); their definition is close to our perception of collaborative processes.

processes – i.e., whether communication is sporadic or frequent, and whether relationships are based on formalized processes or on personal relationships and informal communication. It seems that the thickness of the connecting relationships rather than ties, that exist between actors, determines the nature of a given network process.

3.3.2.2.1 INFORMATION-PROCESSING AS A NETWORK PROCESS DESIGN PARAMETER

Moreover, the capacity of *information processing* distinguishes processes (Egelhoff, 1991), e.g. while two firms may have the same relative amount of connections between actors, they can differ significantly in the frequency and amount of communication that takes place between them; e.g. collaborative activities requires more frequent and in-depth management meetings and on-going personal and electronic communication. Whereas informal communication can take place on a selective, case-by-case basis, formal communication (like business transactions) is more persistent over time and reflects a more determined and well-defined approach to collaboration. we note that processes differ, partly, in the amount of information, they process, and partly, in the formality of communication involved.

Collaborative processes also differ significantly with regard to the individual partner's involvement and the influence (or power distribution), exerted by managers across the supply network. Thus, we can say that the density of a process is partly determined by the volume of information-processing the formality of communication and the relative influence of the process members. Process density in management processes (coordination, planning, allocation and control) has been empirically investigated by Nøkkentved and Rosenø (1998).

Business networks are fragmented into sets of linked companies, or sets of connected relationships[49] distinguished by their *information-processing capacity*. A relationship exists between the traditional *types of information-processing* and the *volume of information-processing* in the processes. For example, collaborative processes that primarily handle routine information, are equipped to handle a larger volume of information.

Egelhoff (1991) distinguishes four types of *information-processing*, which require different levels of information-processing capacity of the processes used to handle them:

1. *Sequential information processing* typically takes place in vertically integrated manufacturing or long-linked technologies, where outputs of one unit become inputs of

---

[49] More about interorganizational links, see Snow et al (1992), or sets of connected relationships, see Ford (1997:.228)

another; operating units are linked to one another in a serial or sequential chain, which is not asymmetric.

2. *Reciprocal information processing* does not have the predetermined direction of decision making as in sequential processes. Rather, outputs of each part of the organization become inputs for the others; information flows back and forth between the parties of the information processing event, and decisions are often reached by mutual adjustment, e.g. transfer pricing, or joint product development.
3. *Routine information processing* takes place repetitively on a frequent basis. Inputs are in a standardized format and information is well-articulated. Managers are knowledgeable about the means-ends of the processes; i.e., they know what the goals are and they know how to achieve them.
4. *Nonroutine information processing* is the handling of unique or infrequent information. The systems used to manage this kind of information stress the use of analytical techniques for problem-solving as well as the heuristic search for alternatives. There is limited knowledge about means-ends of the processes; often managers do not know before-hand what exactly is to be obtained, and particularly not how to achieve it.

Egelhoff (1991) discusses the *information-processing capacity* of different types of management systems. For example, management systems that process nonroutine information in a reciprocal fashion are most often dedicated to handling horizontal coordination and conflict resolution and they include such systems as management committees, integrators, direct contact, task forces, project teams, and matrix designs. Informal communication systems are particularly well-adapted to this kind of information processing, i.e. corporate meetings and conferences, trips and visits, management transfers etc. Or, to process reciprocal and routine information, an administrative mechanism such as integrated databases is required; further, these databases have the capacity to process high volumes of information. Alternatively, nonroutine, sequential information-processing usually requires direct top-down involvement, or ‘hierarchical referral,’ which means a capacity to process only low volumes of information (limited by the narrowness of the hierarchy’s apex).

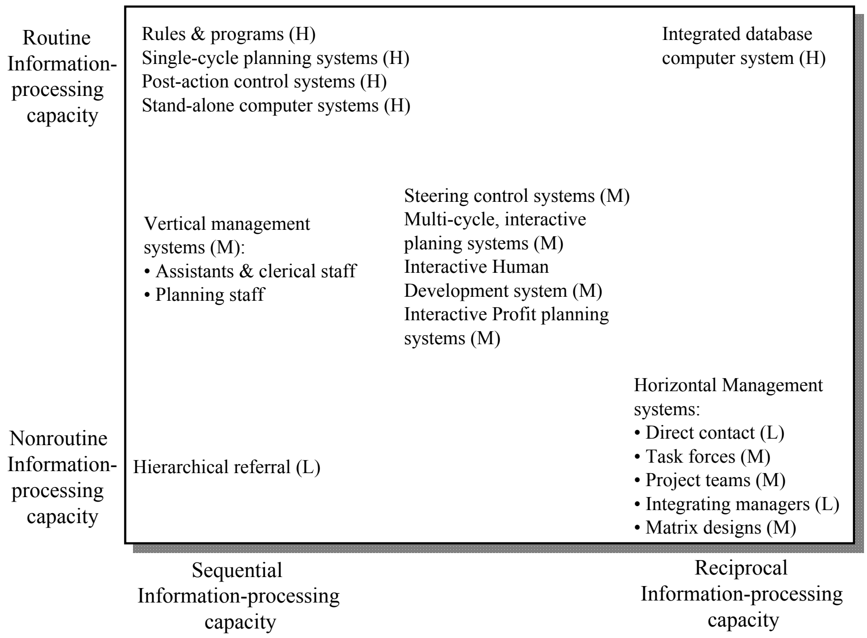


Figure 27: Process Matrix depicting routine versus non routine information processing and sequential versus reciprocal information processing (Source: Adapted from Egelhoff, 1991)

3.3.2.3 Evaluating B2B Networks via Industrial Networks

These new business models utilize internet-enabled relationships and are substantially challenging the ramifications of the current network models - like the Interaction Model (see section), and ARA (actors, resources and activities) model (Ford, 1997). For example, relationships running via an exchange are “polyadic” rather than “dyadic” (or *multilateral* rather than *bilateral*). The company doesn’t customize each dyadic relationship, but rather develops a wider pathway to the exchange, which then “publishes” the data and process formats to a multiplicity of exchange members. In order to comprehend the dynamics of these relationships, we need to enhance our view of business networks beyond ARA to include the network of interdependent *events* (Hedaa & Törnroos, 1997:18).

Beyond the need to better understand the structural and process aspects of change in “clustered” networks, one of the areas that we will concentrate our upcoming research upon is that of *exception handling* (or conflict resolution of inconsistent and disruptive events) within collaborative planning processes executed in trade exchanges[50]. One of the central tenets of the aforementioned CPFR model is the deduction, classification and handling of exceptions that

---

[50] According to Ford (1997:59), “inconsistency captures the dynamic nature of interaction” and adds that “inconsistency is an important but neglected aspect of interaction”. Finally, “inconsistency is an important key to change and development of interaction, and the management of inconsistency [or exception based management], is central to intercompany interaction.”

lead to inconsistencies within the collaborative processes. This process consumes according to the preliminary pilots more than 70% of the time spent to establish a close collaborative partnership (CPFR Roadmap, 1999). Exceptions often arise from changes in resources, organizational structure, company policy, task requirements or task priority. They can also include incorrectly or delayed performed tasks, resource contentions between two or more distinct processes, unanticipated opportunities to merge or eliminate tasks, conflicts between actions taken in different process steps and so on. Exceptions can be frequent and extremely disruptive[51]. They often are not detected until some task actually becomes obsolete, at which point they are typically rise up to higher management layers for clarification (Klein, 1997). Such events may generate cascading exceptions as normal work is shoved aside to handle the problem at hand (i.e. fire-fighting). Exceptions often do not have standardized preferred processes for handling them so they can be addressed inconsistently and with uneven effectiveness. If not detected and handled effectively, exceptions can thus result in severe impacts on the cost and schedule performance of process enactment systems (i.e., SCM applications like SAP's APO that support inter-organizational processes).

Thus, there is an increasing need for systematic exception-handling methodologies within collaborative processes. Such methodologies could assist process and application designers to anticipate potential exceptions and instrument their processes so that exceptions can be avoided or detected on time. Nevertheless, we won't delve further into this important issue as it is beyond the scope of our dissertation.

3.3.3 Classification of Collaborative Business Model – eMarkets

Thomas Malone (1987) predicted the rise of interorganizational Electronic Marketplaces or eMarkets nearly a decade before the first examples surfaced as the well known Amazon.com. eMarkets enable companies to efficiently trade and collaborate with their trading partners, and can be described as centralized portals that have either a **vertical** or **horizontal** orientation.

Vertical eMarkets, service a specific industry segment by delivering one location to transact business. They are "vertical" in the sense that they are channeled to serve specific industries, such as computing, chemicals, steel, and agriculture.

[51] More about the effects of disruptive events, see Saastamoinen (1995).

Another model is referred to as a *horizontal portal* where, for example, a given process such as procurement or transportation is transacted for several industry segments that share common traits.

Table 4: Types of eMarkets (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004).

Public eMarket or Horizontal Independent eMarket (IeM)	**Consortium eMarket (CeM),**	**Private eMarket of Hub (PeM)**
IeM is a many-to-many (m:n) business model, concentrates on the physical transaction – the buyer/seller process. This model pursues to maximize cross-industry or market-based efficiencies in order to achieve cost minimization and asset optimization. Each buyer and seller is but a click away and upon execution of the transaction; they can go their separate ways and may never meet again (i.e. no loyalty). This model is close to the neoclassic characterization of "perfect competition", in that it supports transparent exchange of information such as pricing and availability of all alternative products so that buyers will always be able to make rational decisions. IEs are the natural extension of the Auction model in a B2C or B2B commodity world (e.g. eBay, Freemarkets).	The most potent variant of Public eMarkets has proved to be Consortium eMarket (CeM), which in many respects resembles an electronic version of an industry cartel. Various members of an industry provide the liquidity and momentum in order to achieve industry-specific efficiencies. CeMs concentrate on vertical sourcing and provide a framework for more intense intra-consortium coordination and co-operation (examples: e2open, Covisint, GNX, Transora, Pantellos, etc). While CeMs won't realize the unrealistic return on equity that prompted founder members to invest during the financial bubble, they provide cost and process efficiencies that are not attainable by building and running in-house Private eMarkets. These advantages exist on several levels: infrastructure economies of scale, expanded access to e-business skills, reintegration to efficient trading communities (role- and domain-based), and efficient development and propagation of process and data standards	A Private eMarket or eHub, also called Private eMarket (PeM), is a marketplace established by an entrepreneurial or influential member of a supply network – typically a brand or competence owner. Participation is ensured via cooperative coercion, a new, but very powerful phenomenon that attempts to achieve process and cost efficiencies for a certain subset or segments of an Industry – in some cases it enforces membership (like Daimler-Chrysler's, or WallMart's PeM entry-requirements). In fact, cooperative coercion leads to a tightly-nit, contractual, long-term partnership that pursues collaboration between trading partners. So, PeMs are consolidating pre-established relationships between well-known partners. PTEs are often structured as one-to-many hubs hosted by the supply network host. The initial motivation is procurement cost savings through collaboration, process control, dynamic pricing, plus cycle time and efficiency improvements.

Horizontal eMarkets are web sites where buyers and sellers can come together to communicate, share ideas, advertise, bid in auctions, conduct transactions, and manage inventory and fulfillment. They are "horizontal" in the sense that they serve a wide range of diverse industries or address horizontal applications across industries (examples: VerticalNet and TradeOut.com). Another horizontal variant connects customers to a set of suppliers that specialize in a functional supply chain area (e.g. logistics and transportation services).

Based on current praxis and research undertaken, we can classify these developments into various types of eMarkets. The real opportunity in eMarkets is the development of collaboration throughout a company's relationship portfolio. Given the ever-increasing need to ensure customer responsiveness and drive industry competitiveness, many companies are currently establishing their own Private eMarkets, or coerced into Consortium eMarkets.

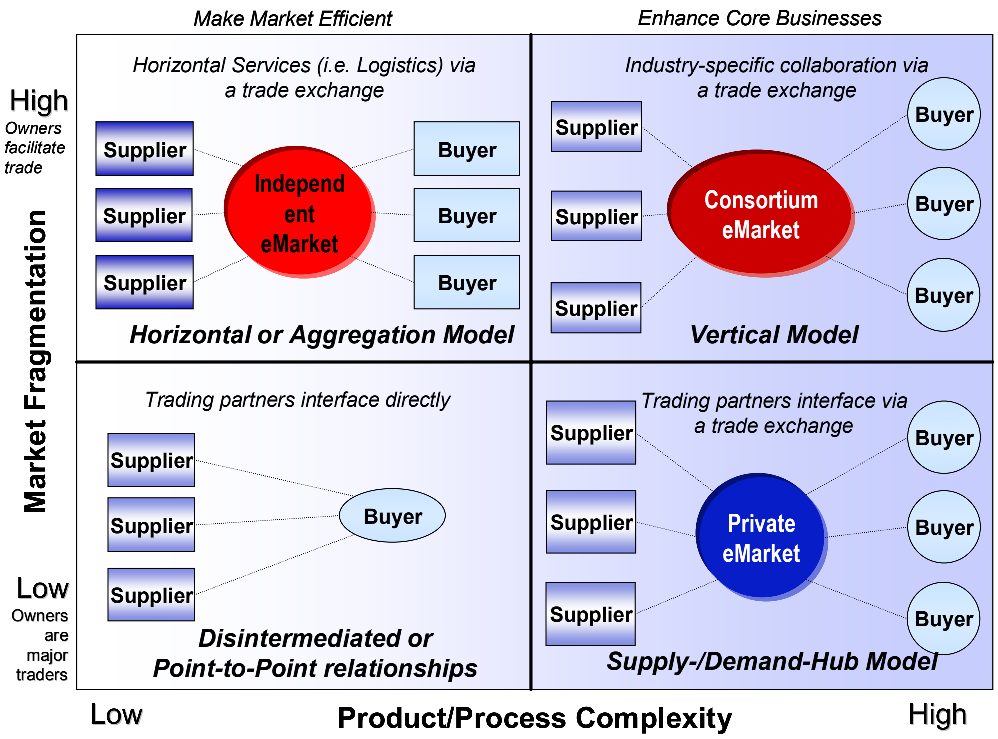


Figure 28: Industry Contingencies and Types of eMarkets (Source: Nøkkentved & Hedaa, 2001).

3.3.3.1 Private or Public eMarkets - Business Models

After the initial euphoria, the dot-com collapse and the structural changes of the industries (increased ERP penetration), eMarkets are entering a period when technology finally lives up to its promise by creating considerable productivity gains across all industries. The increasing adoption of the Private eMarket model and the progressive adoption of loosely coupled business services made available on demand, lay a renewed foundation for eMarket services, driven by: a) commoditized functionality in supplier and customer self-service portals available as packaged applications; b) improved internal (or A2A) integration with ERP and hosted transaction services; and c) the advent of Business Process Management and Web-services that allow dynamic configuration of loosely coupled services across fragmented industry supply networks (i.e. contract manufacturing and 3rd-party logistics).

These steady, though slow evolutionary developments towards *Collaborative eMarkets* increasingly enable collaborative relationships that share and "jointly derive" planning data, integrate back-end enterprise systems (e.g. ERP), and coordinate supply network activities and resources in real-time among their members. In this context, *collaboration* is the negotiated cooperation between independent companies, exchanging capabilities and constraints to improve collective responsiveness & profitability. Specifically, inter-organizational collaboration is defined as a:

> "process in which organizations exchange information, alter activities, share resources and enhance each others capacity for mutual benefit and a common purpose by sharing risks, responsibilities and rewards" (Huxham, C. ed., 1996).

On the other hand, Consortium eMarkets that have survived the dot.com bust (e.g. E2Eopen, Elemica, Transora, Trade-ranger, GNX, WWRE), have been developing in a different path than original anticipated, and are currently thriving by offering:

- industry-specific content and collaboration services (via hosted applications), but collaborate on shared business processes, such as settlement and logistics (e.g. Transora has focused on the data synchronization problem for CPG, while GNX offers a broader range of services, some of which stem from partnerships with other service providers).
- eMarkets interconnections (M2M), that enables member companies to get access to a wider selection of services – from product development to financing.
- supplier- and product content and synchronization/translation services (Cross-industry data and process mappings).
- End-to-end supply network collaboration—With broad standardization of basic B2B processes, multi-tier collaborative processes that require Vendor-Managed Inventory (VMI) / Collaborative Planning, Forecasting, & Replenishment (CPFR) are finally getting ready for prime time.

3.3.3.2 Public or Private or Both!

One further clarification that is currently taking place is the division of labor between the Private and Public eMarkets, in other words, what functionality should be developed in the private domain and what should be subscribed via the public offerings (in e.g. Consortium eMarkets). While this is not an easy question to resolve, most companies have been adopting a portfolio approach to e-market participation, using different models for different business requirements. As depicted in the figure below, horizontal eMarkets are best for settlement and payment (e.g., Swift.com, transactional financial exchange), Consortium eMarkets are best in hosting supplier catalogs (with vertical community content), running integration hubs[52], and supporting creation of harmonized Product and Supplier Registries (e.g. UCCnet, DUNS). Few CeMs host supply chain event and procurement applications, while Supply Chain Collaboration and Product Development are easiest to deploy within a private eMarket given competitive/sensitivity issues.

Value Added Services	Application Domains	Functionality	Public: Horizontal eMarket	Public: Consortium eMarket	Private: Private eMarket
	SCEM & Logistics	Supply Chain Event Management	★★	★★★	★★
		Logistics & Transportation Services	★★★	★★	★
	Financials	Settlement, Payment & Clearinghouse	★★★	★★	★
	SRM	Sourcing & RFx/Auctions (Non-strategic)	★★	★★★	★
		Procurement (Indirect / Non-strategic)	★★	★★★	★
		Sourcing & RFx Services (Direct / Strategic)	★	★★	★★★
		Procurement (Direct / Strategic)	★	★★	★★★
Business Applications	PLM	Asset Maintainance & Management	★	★	★★★
		Collaborative Design & Engineering	★	★★	★★★
		Collaborative Project Management	★	★★	★★★
	SCM	Supply Chain Collaboration (e.g. CPFR)	★	★★	★★★
		Order Fulfilment	★	★★	★★★
	Content Mgmt	Catalogs & Content Services (Non-strategic)	★★★	★★	★
Content & Data Management		Catalogs & Content Services (Strategic)	★	★★★	★★
		Community Content & Industry Registry	★★	★★★	★
	CRM	Customer Service and Support	★★	★★	★★★
	BI	eAnalytics (Performance Monitoring+Reporting)	★	★★	★★★
	Middle-ware	B2B Transactional Integration/Mapping Services	★★	★★★	★
IT Integration		B2B Document Routing & Security Services	★	★★★	★★
		B2B EDI VAN Replacement & Registry Services	★★	★★★	★

Figure 29: Creating eMarkets Functionality Portfolios — Optimizing Utility, Value and Deployment (Source: adapted from own SRM presentation, Nøkkentved, 2004. The number of Stars denote potential fit.)

Distinguishing between eMarket *value-added services* require that companies evaluate the three major interorganizational issues:

1. **IT Integration** – the common logic here is to avoid setup and operational cost of a private eMarket infrastructure for non-core/-strategic processes, which will enable the company to link to business partners more cost-efficiently to exchange business documents.
2. **Content & Data Management** – there is a clear trend towards increasing use of Punch-out Catalogs (roundtrips) rather than Local Catalogs. Many companies realize the difficulty of

[52] Integration Hubs use different data formats and protocols like EDI and XML (xCBL, CiDX, CPFR, RosettaNet) to map and translates

enabling and maintaining local supplier content (e.g. Shell), while few suppliers have created advanced sales catalogs. Use CeMs to reduce costs of Supplier Activation and Content Management for non-core/-strategic content compared to pure in-house deployment. Further companies should exploit economies of scale in information provisioning (e.g. non-sensitive supply chain and Industry information) for enablement of collaborative processes via CeMs.

3. **Hosted Business Applications** – running multifirm applications is cumbersome! CeMs can enable collaborative multi-firm capabilities by linking information and processes (i.e. supply chain visibility, notifications, and information pooling) via Web services.

One of the most potent development in the wake of the Private and public eMarkets was the creation of standardized process definitions and data interfaces or relationships. All that enables individual companies (or communities) to create a transactional *hub* for the facilitation of information, business transactions and collaborative processes. So, instead of creating customized links to the company's strategic partners, the marketplace becomes the central conduit of most business relationships.

3.3.3.3 Enabling Integration - From EDI to B2B XML

On the pre-Internet era most business focused exclusively on internal optimization; interorganizational, B2B relationships were handled on a one-on-one buyer-seller basis without any benefits or synergy being derived from pooling any processes or transactions across the supply network. In this "Old World" each individual connection or link to a business partner needed integration (via EDI, Edifact, FAX, etc.), and customization of back-end systems that in turn required constant maintenance. Prohibitive costs related to the setup of such *one-to-one* (1:1) relationships, left many companies out of the integration loop, thus technology did not lead to any significant benefits.

With the emergence of e-Commence and e-Business, numerous eMarkets sprouted, which promoted the realization of e-Supply Networks, characterized by a virtual number of potential trading partners coming together to share information, transact business, and collaborate. While EDI-based interconnections have proved too costly and inflexible to be the

protocols, standards,and data formats between multiple firms' systems (current examples are Transora & Elemica).

integrating vehicle for the Digital Economy, eMarkets enhanced by new developments in process and data-standards (e.g. XML, Java) are squeezing transaction costs further down. Collaborative planning & execution can take place via B2B or B2M2B scenarios. In *Point-to-Point*, *bilateral* (1:1) relationships imply that focal company have to establish formalized relationships with each partner (either via EDI or Internet), where as *Marketplace* (B2B or B2M2B), or *multilateral* relationships, imply the creation of one, broadband interface to an eMarket (public or private), where partners interact in a one-to-many or a many-to-many collaborative planning environment.

Hence, companies are able to create more dense interactions, consisting of interrelationships between process activities, participating actors and applications. Consequently, the nature of relationships between actors in different companies is also altered as more intra-company processes are extended beyond the boundaries of the firm. Collaborative processes running via an eMarket shift the decision-making process from within the company to the relationship between companies, where decisions are derived in a *joint fashion*.

3.3.4 Stuck in the Middle – The State of Public eMarkets?

When the author started investigating and working with eMarkets in the period between 1999 and 2002[53], industry eMarkets were created out of equal parts fear and greed with a flood of press coverage and billions of dollars in investment:

- Fear of the emergence of an eBay-like eMarket in each industry. Standing as the intermediary between corporate buyers and suppliers, such an eMarket, due to network ejects, would become a natural monopoly in which all buying and selling took place. The operator of such an industry eBay would be able to charge monopoly rents to match buyers with sellers, and it would own the asset of a total picture of transaction flow in the industry. To protect their own interests from outside forces, the leading corporate buyers in about two dozen industries decided to invest in and own these vertical industry exchanges.

[53] This chapter consolidates an IBM report the author completed for the further invstments in the aras of eMarkets or Trade Exchanges (2004).

- Greed in the hopes of making dot-com-like financial killings. Many CEOs, seeing the outrageous stock valuations that were being given to Internet startups, saw investments in industry exchanges as a way to realize similar gains.

The result was the creation of two dozen major industry eMarkets or Consortiums. Among the more prominent were: Covisint and Supply On in the auto industry; Transora and CPGMarkets in consumer packaged goods; Quadrem and Metal Spectrum in mining and metals; WorldWide Retailers Exchange and Global NetXchange in retailing; Petrocosm and Trade-Ranger in oil; ChemConnect, Envera, and Elemica in chemicals; Enporion, Pantellos, and (later) Eutilia in utilities; Forest Express in pulp and paper; Rubber Network in rubber; eHITEX and E2Open in high-tech; MyAircraft and Aeroxchange in airlines; Rooster.com and Novopoint in agriculture; and Exostar in aerospace. We predicted at the time that half of these eMarkets would fail. Interestingly, all five of the eMarkets that we said had a high likelihood of success — Quadrem, Pantellos, Rubber Network, Trade-Ranger, and WorldWide Retailers Exchange — have survived, though Trade-Ranger and Pantellos are now merging with geographical exchanges.

However, when the Internet bubble burst in 2001, all of the greed and much of the fear evaporated, as did CEO and press interest in these industry exchanges. Yet the eMarkets themselves still existed, with their own management teams, technology, and investor capital to be turned into some form of return. While some eMarkets like Covisint, London Metal Exchange, Petrocosm, and Rooster.com burned through their cash without creating a viable business, more than a dozen quietly identified roles that allowed them to generate revenues, grow, and even become profitable. This modest success has set the stage for the next phase of eMarket activity — that of consolidation and conversion of industry-owned consortia into privately owned enterprises (Cooper et al, 2006).

No industry eMarket has become the main venue for buying and selling in its industry – there has been no B2B equivalent of eBay. In line with our earlier arguments on Private Exchanges or eHubs, most current B2B eCommerce is done directly between large buyers and large sellers with no intermediaries (Elie et al. 2004). Those of the Public eMarkets that have survived and grown have done so by focusing on smaller problem areas. Some have carved out a role as venues for large buyers to conduct sourcing events with smaller and midsize suppliers, for midsize buyers seeking a hosted procurement and/or sourcing solution, or by connecting large buyers with midsize and small suppliers for electronic order flow. For example, US-based utilities exchange Pantellos reported 27% revenue growth in 2003 and EBITDA profitability; European-based Supply On had transaction volume double in 2003 and is profitable; mining industry exchange Quadrem achieved 44% revenue growth in 2003; retail exchange GlobalNetXchange (GNX) had 42% growth in revenues in 2003 and is reportedly nearing profitability; and European utility exchange Eutilia has seen transaction volume double since its inception. Other leading industry exchanges such as Elemica, Exostar, Transora and WorldWide Retail Exchange (WWRE) have concentrated on standardizing data synchronization between buyers and suppliers. Forest Express has gone so far in this direction that it has changed its name to Liaison Technologies to emphasize this connectivity role.

Provider	Number of suppliers	Number of customized catalog suppliers
Ariba	140,000	25,000
Perfect	14,000	4,500
Quadrem	46,500	1,000
Ketera	30,000	5,000
cc-hubwoo	12,000	1,800
IBX Nordic	10,000	2,500
ePlus	25,000	1,000
SciQuest	30,000	1,000
BasWare	12,400	1,000

Table 5: Buy-side/ ePurchasing eMarkets providing Supply Network Services (Source: IBM 2006).

On the Horizontal eMarkets, they were initially conceived to provide two functions: 1) offer hosted procurement and/or sourcing tools to corporations, and 2) provide data exchange and connectivity between B2B buyers and sellers in an industry. While most eMarkets still offer both services, the more successful have tended to specialize in one or the other. eMarkets that are focused on ePurchasing have posted the best revenue growth and profits; those that concentrate on data synchronization are being accepted as important industry utilities. It seems that this concentration will continue for the next 5 years. Nevertheless, the logic of industry-specific, consortium ePurchasing exchanges like is starting to decline, as companies realize that their purchasing and sourcing needs extend beyond industry-based suppliers. As a result, cross-industry or Horizontal Public eMarkets like cc-hubwoo (the merger of Germany-based cc-chemplorer and France-based Hubwoo-Avisium) and Perfect Commerce (formerly eScout), which allow buyers to reach suppliers that serve multiple industries (and vice versa), have enjoyed more success than have most industry-owned exchanges. These horizontal eMarkets are starting to merge with or acquire industry eMarkets — or at least those that have enjoyed a modicum of success. cc-hubwoo recently offered to acquire oil industry exchange Trade-Ranger, and in late October 2004, Perfect Commerce announced its merger with Pantellos, in which Pantellos' utility owners receive Perfect stock. This trend will accelerate in the following years as the industry owners of ePurchasing-focused exchanges seize the opportunity to cash in on their investments.

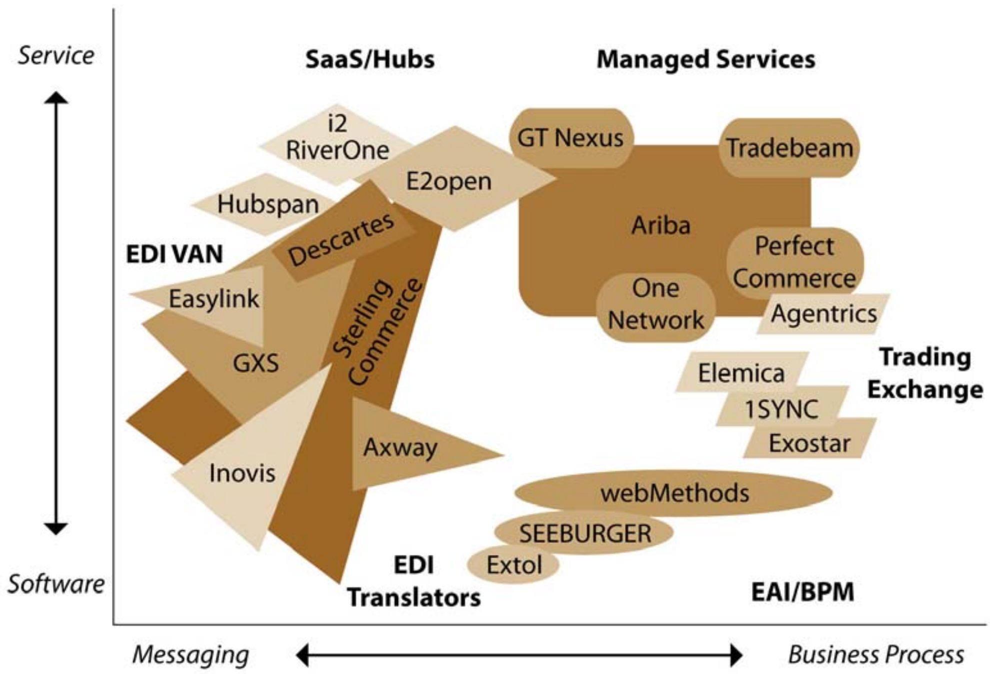


Figure 30: State of the B2B eMarkets in 2006 (Source: AMR Research, 2006, reproduced with permission)

While industry-specific data synchronization has value today, the need for cross-industry data synchronization will become more urgent as intra-industry synchronization is solved. In recognition of this trend, Transora in the CPG industry and WWRE in the retail industry have begun coordinating their efforts, setting the stage for a likely merger. Because data synchronization and integration is similar to the services being offered by EDI network operators like GXS, Innovis, and Sterling Commerce, either the industry exchanges will consolidate among themselves to provide an alternative to EDI networks or they will be acquired by these companies.

There seems to be differences in the way eMarkets are faring in the various geographical regions. For example, European companies have proved to be much more willing to use B2B exchanges than their North American counterparts, and as a result European exchanges have been doing better than those on the other side of the Atlantic. Whether this is due to persistent cultural factors like greater comfort with using shared marketplaces or that smaller domestic markets force companies in Europe to cooperate earlier than their US competitors is unclear. What is clear is that European exchanges have higher adoption and usage metrics than do US exchanges. Cross-industry exchanges like cc-hubwoo in Europe have larger client and supplier counts and higher revenues than their US counterparts like Perfect Commerce. European-specific industry exchanges like Supply On and CPGMarkets have had stronger transactional activity and achieved better financial results than US-based counterparts like Covisint in the automotive industry (since folded) or Transora in consumer packaged goods. Heavy use of GNX by European retailers has contributed to its $8 billion transaction volume in 2003 and the 42% increase in its revenues, while the more US-focused WWRE has shifted more in the direction of data synchronization and away from procurement and sourcing.

Thus, the story of electronic marketplaces as described by Malone (1997) is not fully undone. New concepts like SaaS (Software as a Service) and SOA (Service-oriented Architectures), will once again provide disruptive trajectories where companies will question once again the boundaries and scope of their operations. As outsourcing is becoming more sophisticated given these standards (Hanseth, 1996), and the continuous rise of the eProcurement marketplaces (now renamed “Supply Networks”!), it seems that the concept of eMarkets or Trade Exchanges or eHubs is soon to be repackaged and resold to the highest bidder!

Yet, in our storyline the interesting point is not ephemeral business models, but rather the glue and binding agents that do exist with or without them – the relationships (Gadde & Håkansson, 2001). Hence, we will look into the details and provide our own preliminary classification of relationships in a Collaborative Supply Network.

3.4 Relationships in Collaborative Supply Networks

eMarket-enabled business relationships often involve the automation of various aspects within a buyer/seller or trading relationship. Contemporary implementations of inter-organizational partnerships focus on enabling B2B planning (especially via Consortium or Private eMarkets). Remark that collaborative relationships involve some sort of synchronized planning plan execution. While there are myriad aspects within a collaborative planning relationship among trading partners in a eSupply Network, three broad eMarket-enabled relationship categories have been identified: a) *Information-Sharing*, b) *Integrative*, and c) *Collaborative*.

Table 6: Summary of objectives and challenges facing a company in eSupply Networks (Source: Nøkkentved, 2004).

Information-Sharing	Integrative or Transactional	Collaborative
Information-Sharing relationships mean that partners are given access to an area of an eMarket that has the shared information in it, or one partner transmits shared information to the other partner	Integrative relationships support information-sharing and Computer-to-Computer transmission of fixed structure transactional information.	Collaborative planning relationships facilitate collaborative relationships, where many-to-many information is not just exchanged and transmitted, but is jointly developed by the buyer and seller.
• Most B2B transactions are taking place outside the marketplace (via email, fax and mail) • Supports synchronized, but independent planning and forecasting (one-to-many, many-to-many) • Minimum support of integrated execution – such eMarkets function as middleware and message brokers • Information sharing relationships differ from collaborative relationships primarily in that information is sent on an FYI basis	• Rich information exchange and event notification (one-to-many, many-to-many) • Most transactions between backend systems (ERP) are transmitted via the marketplace • No support of synchronized planning – planning is still completed within each partner • Supports synchronized execution of routine transactions (i.e. Order fulfillment, Replenishment) • These activities involve information notifying the buyer and seller that a purchase is taking place and that funds need to be exchanged	• All collaborative relationships involve some sort of joint planning and plan execution. • Rich information exchange and exceptions/alert notification • Most transactions between backend systems (ERP) are transmitted via the marketplace (one-to-many, many-to-many) • Supports joint synchronized planning and synchronized execution of routine transactions (i.e. Order fulfillment, Replenishment) • Most routing processes are driven by real time exception handling

3.4.1 Information-Sharing Relationships in Supply Networks

Historically, little information has been electronically shared among trading partners. The first collaborative planning relationship follows the automation of buyer-seller EDI-based transactions (mostly procurement or replenishment), and involves *information sharing* or data exchange. This involves at least one of the following arrangements: a) The partners are given access to an area of an eMarket that has the shared information in it, or b) One partner transmits shared information to the other partner. For example, Web-based collaborative planning books allow buyers to electronically view planning information (e.g. demand forecasts). From a buyer-side, automation has focused on electronically providing forecast needs. In this type of relationship, information ancillary to actual plans is shared only on an FYI basis.

Buyer or seller can share various types of information, either before or after a purchase is made. This information may involve the seller's offerings or the buyer's future needs. Information-sharing relationships differ from collaborative relationships primarily in that information is sent on an FYI basis. The recipient is using the data as-is and is not providing feedback. An important exception is that this may differ in Private eMarkets or eHubs. Here a partner's internal SCM system may publish information and expect feedback. Nonetheless, this information is helpful in improving supply chain performance. Information-sharing arrangements electronically support both supply chain planning and execution, thereby presenting the potential to improve overall network performance. Relative to planning, these arrangements only support independent planning done by each participant, rather than joint planning. Forecasts developed independently from trading partners, and pushed to upstream. However, sharing helps to ensure that trading partners' plans are as synchronized as possible, which in turn effectively reduces uncertainty in their supply and demand situation. Rather than having to predict or forecast a partner's activities, information sharing ensures that the parties are knowledgeable about each other's activities.

Automation of transactions is not taking place within an Information-Sharing eMarket. They may involve activities conducted to execute the buyer's purchase of a commodity. These activities involve information notifying the buyer and seller that a purchase is taking place and that funds need to be exchanged. Thus automation focuses on using EDI to electronically send purchase orders and invoices, and to transfer funds. The only information that can be transmitted in this type of relationship is that needed to execute a purchase. So, to summarize, this relationship supports synchronized, but independent planning and forecasting (one-to-many, many-to-many), provides minimum support of integrated execution, while most B2B transactions are taking place outside the marketplace (via email, fax and mail).

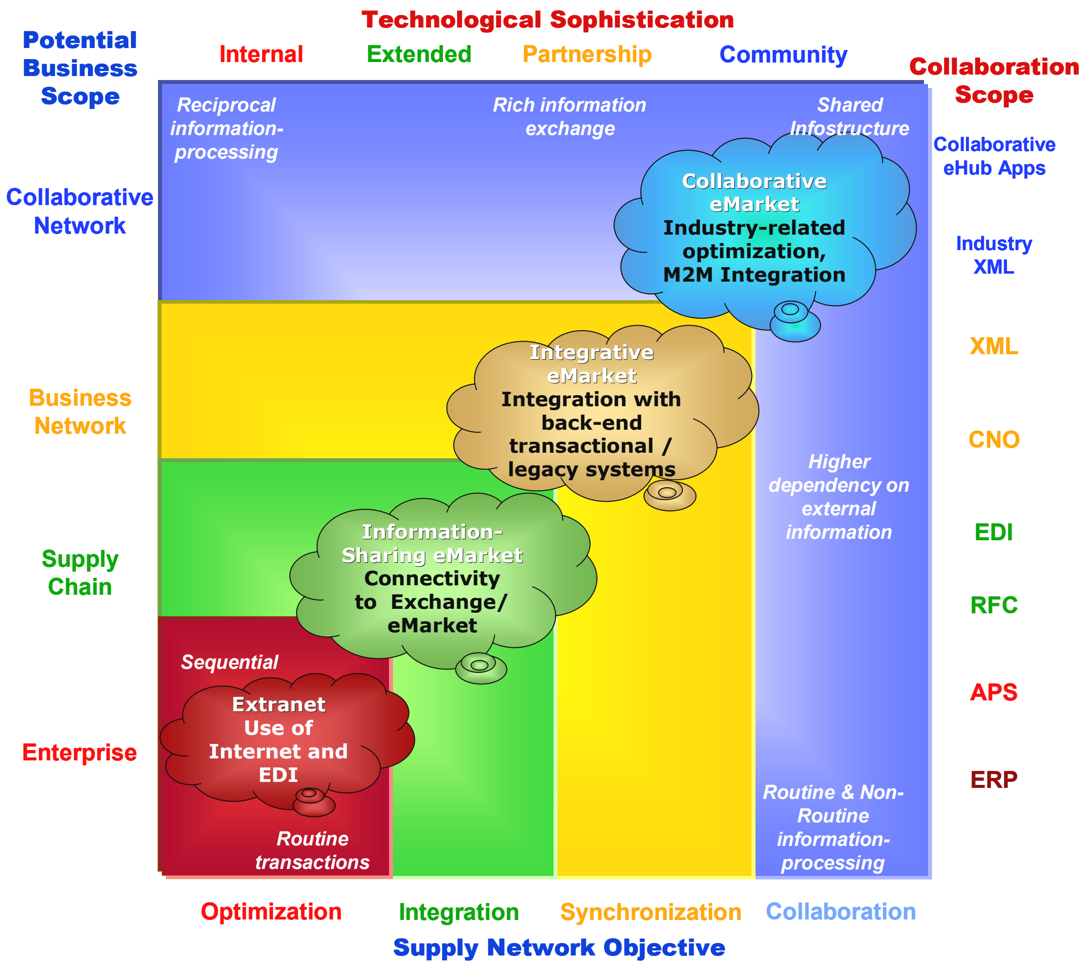


Figure 31: eMarket types based on Collaborative Relationships defined on Scope and Objectives (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004).

3.4.2 *Integrative Relationships in Supply Networks*

While information-sharing relationships enable supply chain synchronization, they do little to reduce the uncertainty faced by trading partners in determining future demand, and do not grant the opportunity for the other partner to provide his or her own insight and knowledge of customer needs or other market opportunities. In addition, there is little opportunity to work together on matching supply with anticipated customer demand. To further enhance a buyer-seller relationship some progressive companies are moving toward *collaborative relationships*, in which they are "working jointly with others, especially in an intellectual endeavor." Collaborative efforts enable trading partners to work together to better understand future demand and to put plans in place to satisfy it profitably.

An integrative eMarket facilitates collaborative relationships, where many-to-many information is not just exchanged and transmitted, but is also jointly developed by the buyer with the seller. For example, in the case of working collaboratively on customer requirements, trading partners might work together on new product designs and customer demand forecasts. Generally this information deals with future product plans and needs. Much like an information-sharing relationship, related information to an actual transaction is shared in a collaborative environment. Yet, either party may alter joint plans. A trading partnership between a particular buyer and seller could be based on various exchange modes. That is, some information may be exchanged on a transactional basis, some on an information-sharing basis, and some on a collaborative basis. These type collaborative planning relationships require that transactions are transmitted via the eMarket. That means that a shared repository exists that facilitates and integrates both data and transactions between people and systems. To summarize, this eMarket type facilitates rich information exchange and event notification (in one-to-many, many-to-many scenarios), it integrates most transactions between backend systems (ERP), and supports synchronized execution of routine transactions (i.e. Order fulfillment, Replenishment), and Computer-to-Computer transmission of fixed structure transactional information. These activities involve information notifying the buyer and seller that a purchase is taking place and that funds need to be exchanged. However, Integrative eMarkets still do not support synchronized planning via the shared marketplace – final planning is still completed within each partner's planning system (e.g. APS).

3.4.3 Collaborative Relationships in Supply Networks

The two previous types of collaborative planning relationships are nothing more than facilitators of communication, though probably the first to be implemented. Lacking well-defined business processes and industry wide product standards, many vertical eMarkets will provide just the basic infrastructure for linking companies together. How? By establishing XML-based standards and aggregating data across participants. Rather than building a proprietary B2B infrastructures, participants expect these shared collaboration environments to:

1. *Reduce supplier integration costs* by allowing firms to integrate to multiple customers through a single eMarket, substantially cutting down on the slew of integration projects.
2. *Minimize investment expense* by allowing firms to share the development and ongoing maintenance costs, rather than creating redundant systems and capabilities.
3. *Optimize industry wide capacity* by pulling together supply chain information from many firms, and offering a consolidated picture of industry capacity and market demand in order to optimize interenterprise production.

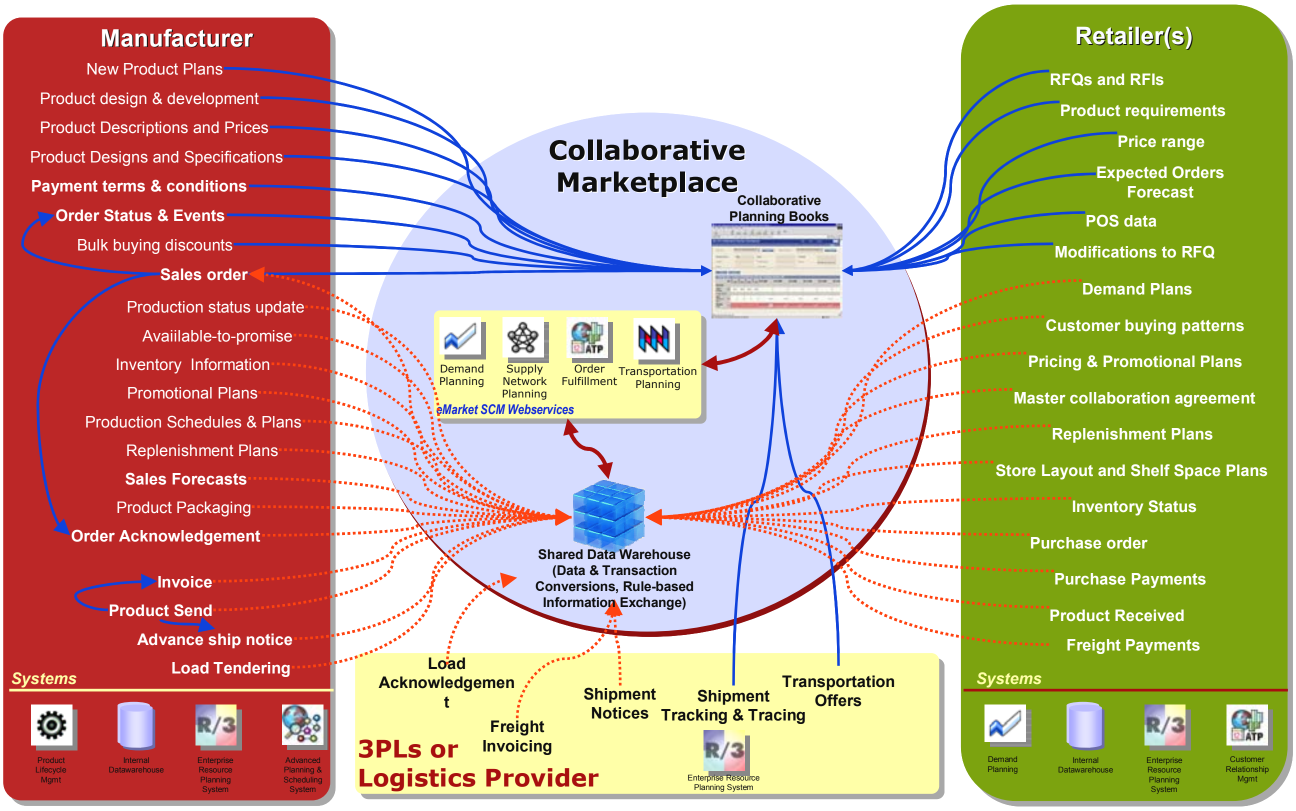


Figure 32: Collaborative eMarket – Enabling Joint SCM Execution via hosted SCM applications and web services; these quasi-organization may be realized as private/owned by the firm, or consortium-based (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004).

Thus, *information-sharing* and *integrative collaborative eMarkets* simplify buyer/seller integration through a single communication & coordination venue. Nevertheless, both models require that most members still own and maintain elaborate internal SCM systems. Another model is slowly emerging that will probably in some industries overtake the other two flavors. The *Collaborative eMarket* will play the part of *industry optimizers*, by actively coordinating entire supply networks. These full-featured sites will monitor cross-enterprise demand and capacity to fulfill manufacturers' needs with optimal supplier capacity. Participants will directly own them through Private-, Public, or Consortium-oriented constellations, manage these venues and support them primarily through membership and service fees. Manufacturers and suppliers that connect into these hubs will pay for SCM system and Event-/Exception Management System services through an ASP-like model of subscription fees along with à la carte payments for additional services. That makes this model a favorite Private eMarket/ eHub configuration among large, dominating players (like Dell, IBM) that want to consolidate their relationship portfolio, but it will also be appropriate among fragmented industries, where many small partners will join forces to create Collaborative Communities.

These complex eMarkets aggregate demand & supply, match buyers & sellers, consolidate capacity, monitor multi-level performance and notify changes real-time based on internal exception management rule-engines. They are able to share data between ERP systems, reserve or route ATP requests, and conduct N-tier mapping (multi-company BOM explosions and dependent requirements). Supply network optimization will take place via Collaborative SCM/SRM/PLM tools executing from within the eMarket, which will then transmit rich planning information and exceptions/alert notification to the members.

Most transactions between back-end systems (ERP) will be transmitted via the eMarket (in both one-to-many, many-to-many modes). Collaborative eMarkets support joint synchronized planning and synchronized execution of routine transactions (i.e. Order fulfillment, Sourcing, Replenishment), while more advanced versions will deliver a full range of transactional relationships, like collaborative production scheduling, and collaborative product development. To summarize, these eMarkets deliver an extensive collaborative platform to jointly plan & execute a wide range of activities (i.e. Design & Engineering, Sourcing, Manufacturing, Sales, Distribution & Transportation). Such collaboration will ensure a) visibility by real-time communication in the supply network, b) performance transparency, and c) responsiveness, by reducing time to detect demand, commit, produce, and fulfill buyer demands. It may sound like rocket science, but many companies (e.g. Wallmart, Cisco) are currently evolving their Private eMarket to support such collaborative relationships.

3.5 Processes in Collaborative Supply Networks

3.5.1 Defining Collaborative Processes

Collaborative Processes use Internet connectivity and standards to enable real-time communication and planning functionality across multiple enterprises to synchronize information and product flow, in order to optimize resource allocation and minimize costs.

It may help to reduce inventory across enterprises, maximize network capacity utilization, improve service levels, shorten planning cycles, *pull* rather than *push* products, identify critical supply issues, and introduce sophistication and clarity into the process (Skjoett-Larsen et al, 2003). Collaboration with upstream and downstream partners can take many forms, including mass customization to joint product development, shared forecasts, and co-location or other managed inventory practices, yet it requires that the internal processes are in place (see figure below).

As can be seen, this changes the nature of the relationship and hence the transaction between trading partners. Instead of buyer/seller relationships we have a range of relationships. Collaborative Planning may take place either via *B2B* or *B2M2B collaborative scenarios*.

3.5.2 From Internal to External Collaboration

Companies may view collaboration as a means to synchronize supply chain operations, particularly with regard to strategic, tactical, and operational planning activities. Collaboration may involve optimizing and integrating various planning processes in the supply network, like: Sales & Ops-, Demand-, Capacity- Supply-, Production-, Product Lifecycle-, Category-, Transport-, and Merchandise Planning. Many companies are currently experimenting with systems technology to speed up operational and financial transactions with trading partners by using EDI and more recently, eMarkets. This coincides with the increasing automation of internal processes, which is necessary to conduct B2B commerce. Furthermore, many internal production and distribution processes like MPS, MRP, DRP are moving outside the boundaries of the firm (e.g. Vendor Managed Inventory is changing towards Dynamic Replenishment process based on Demand Signals from multiple customers) – see Figure 33.

The goal of these optimization and integration efforts, is to provide functionality, such as:

- Real time communication, including business logic, where each event is monitored by alerting systems for real time transactional data and decision support information about customers and orders.
- Shared resource allocation, document generation, and profitability monitoring.
- Deliver to promise, where rates and routes are chosen accurately and dynamically, giving delivery time in hours & minutes.

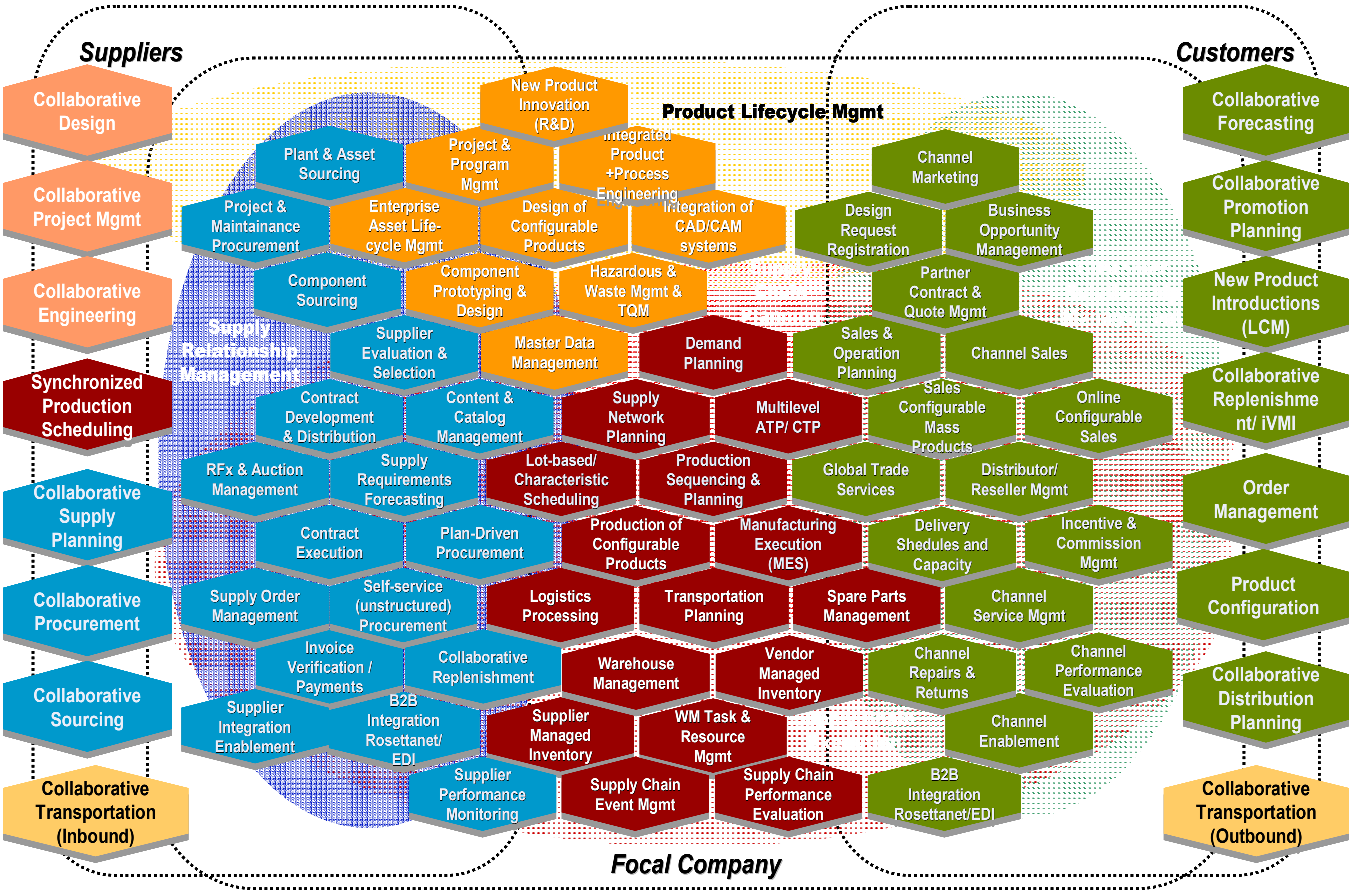


Figure 33: A simplified mosaic of Collaborative Processes within the Information Infrastructure Domains of a Manufacturing Enterprise; The hexaconal symbols depict Collaborative Processes, while their relative position indicate their Interdependencies and most typical Interfaces (Source: Nøkkentved, 2003).

3.6 Collaborative Processes Frameworks in Supply Networks

Within an *eMarket* that delivers/supports collaborative planning, the standard supply chain processes – *plan, source, make, deliver* – are similar to the ones defines the Supply Chain Operations Reference-model (*SCOR*). There are a number of standard process reference models developed in the area of SCM most prominent is the aforementioned SCOR and CPFR.

A *process reference framework* describes, characterizes and evaluates a complex management process. Such a model builds on the concepts of BPR, benchmarking and process measurement, by integrating these techniques into a cross-functional framework. Once a complex management process has been "captured" in a process reference model, it can be described unambiguously, communicated consistently, and redesigned to achieve competitive advantage. In addition, given the use of standard measurements for process elements and activities, the process itself can be measured, managed and controlled, and it may be refined to meet a specific purpose. Process Reference Models accommodate a number of constructs by providing a balanced horizontal (cross-process) and vertical (hierarchical) view, they are designed to be (re)configurable, and are most often used to represent many different configurations of a similar process as an aggregate of a series of hierarchical process models

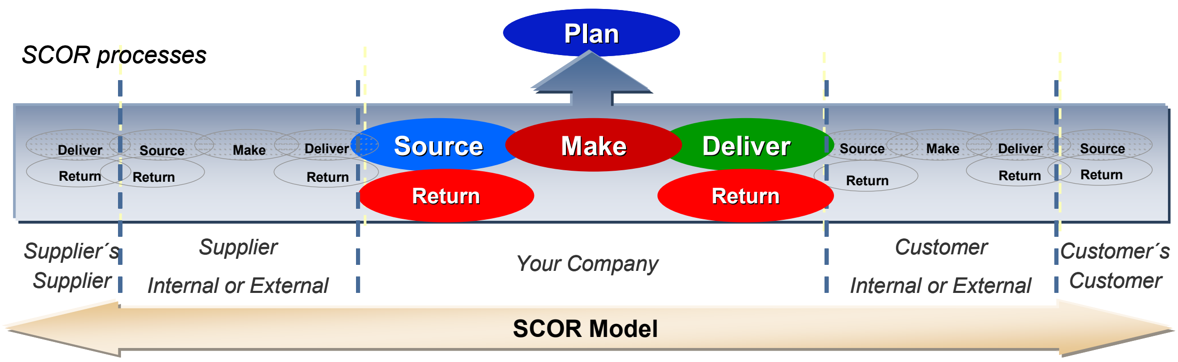


Figure 34: The Supply Chain Council's Supply Chain Reference process model (Source: SCOR rel. 5.0)

SCOR has been developed and endorsed by the Supply-Chain Council[54], are transformed into their collaborative counterparts. SCOR outlines the key inter-linked supply chain processes and

[54] The Supply Chain Council (SCC) was organized in 1996 by Pittiglio Rabin Todd & McGrath (PRTM) and Advanced Manufacturing Research (AMR), and initially included 69 voluntary member companies (today over 450).

their component sub processes, which may assist companies in evaluating their supply chain performance, identifying weak areas, and developing improvement solutions.

Rather than the chain oriented metaphor used to depict the 4 processes, eMarkets do not require bilateral or point-to-point relationships, but support multilateral interfaces between its members. From a process and applications support perspective, the requirement for front facing customer processes to be integrated with back-end transactional processes becomes cross-company in scope. Companies will have to bridge or supplant information from their internal Enterprise Resource Planning (ERP), APS, CRM, and legacy applications to one or many eMarkets, either initially via a Web browser, or eventually via system-to-system integration. The building blocks of such communication are a) common business documents and transactions, and b) common semantics, taxonomies and standards (both data and process).

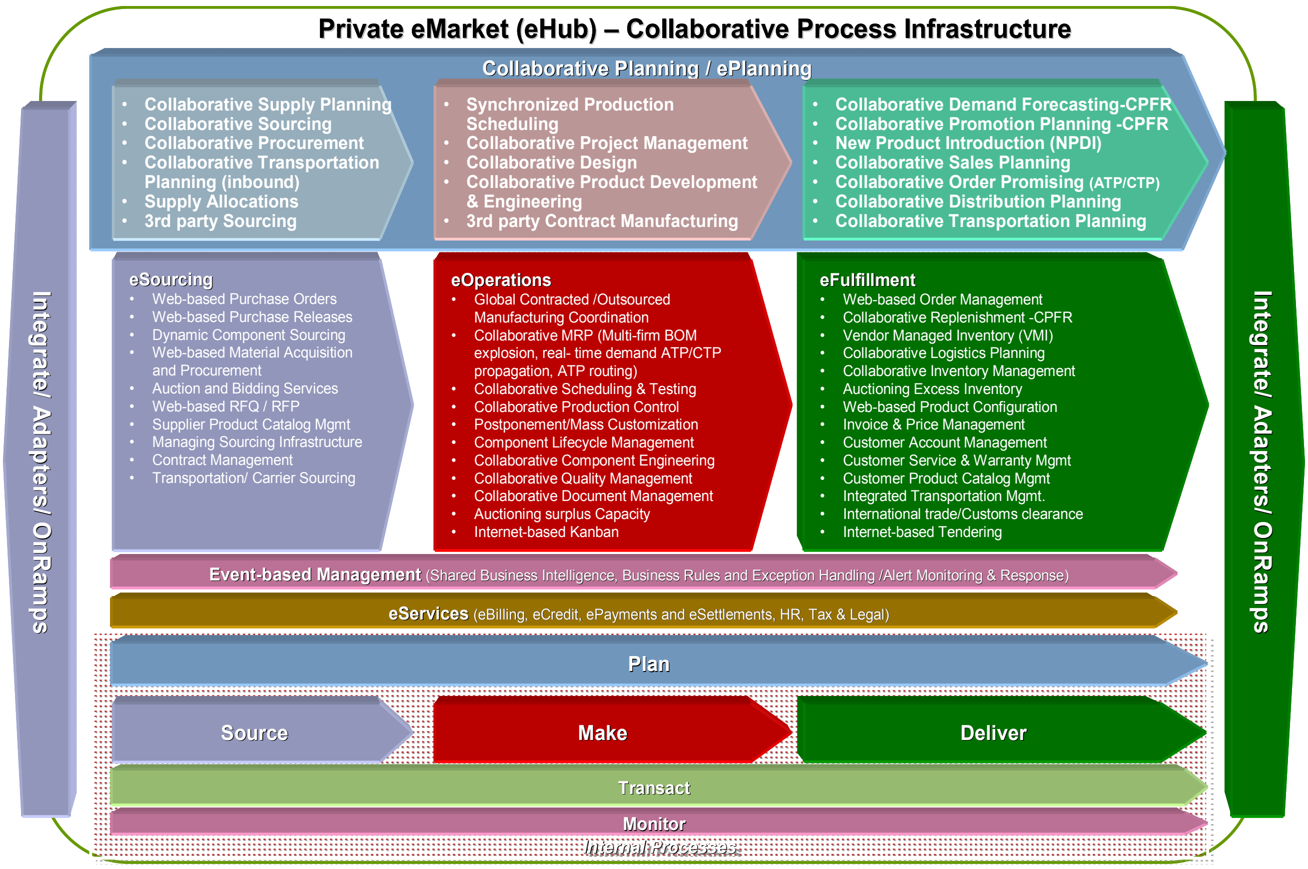


Figure 35: *Collaborative Processes* in Supply Networks classified based on the SCOR Process Domains; such processes encapsulate & extend internal ones (Source: Nøkkentved & Hedaa, 2001, Nøkkentved, 2004).

In the figure above we have documented some of the collaborative processes that may take place within a *Collaborative Information Infrastructure* enabling a Supply Network. As noted by the SCOR framework, the planning process spans all other processes, making it the fundamental linkage of manufacturing execution, sourcing, delivery, monitoring, and control.

We have categorized most collaborative planning processes under these headings. Also, operational processes taking place either outside or through an eHub/eMarket, triggering, feeding or requesting information from/to collaborative processes. Collaborative planning may then take place in either external fashion - meaning within each company in information-sharing and integrative eMarkets, or within the actual eMarket (in a Collaborative eMarket).

3.6.1 An overview of the Supply Chain Operations Reference (SCOR) Model

The Supply Chain Operations Reference-model (SCOR) has been developed and endorsed by the Supply-Chain Council (SCC), an independent not-for-profit corporation, as the cross-industry standard for supply-chain management (SCM). SCOR is freely available to all who wish to use the standard reference model. The SCC was organized in 1996 by Pittiglio Rabin Todd & McGrath (PRTM) and Advanced Manufacturing Research (AMR), and initially included 69 voluntary member companies (today over 450).

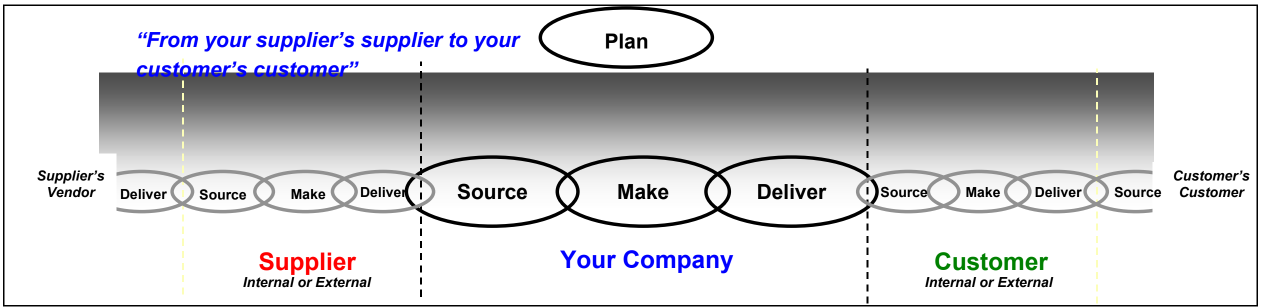
A process reference model describes, characterizes and evaluates a complex management process. Such a model builds on the concepts of BPR, benchmarking and process measurement, by integrating these techniques into a cross-functional framework. Once a complex management process has been “captured” in a process reference model, it can be described unambiguously, communicated consistently, and redesigned to achieve competitive advantage. In addition, given the use of standard measurements for process elements and activities, the process itself can be measured, managed and controlled, and it may be refined to meet a specific purpose. Process Reference Models accommodate a number of constructs by providing a balanced horizontal (cross-process) and vertical (hierarchical) view, they are designed to be (re)configurable, and are most often used to represent many different configurations of a similar process as an aggregate of a series of hierarchical process models. A process reference model allows companies to:

1. Communicate, using common terminology and standard descriptions of the process elements
2. Leverage metrics and benchmarking to determine performance goals, set priorities, and quantify the benefits of process changes
3. Understand the best practices that yield the best performance
4. Understand the overall SCM process and evaluate overall performance

5. Identify the software tools best suited for their process requirements.

SCOR describes	SCOR spans
Standard descriptions of management processes	All customer interactions, from order entry through paid invoice.
A framework of relationships among the standard processes	All market interactions, from the understanding of aggregate demand to the fulfillment of each order.
Standard metrics to measure process performance	All physical material transactions, from the supplier's supplier to the customer's customer, including field service logistics
Management practices that produce best-in-class performance	
Software tools that enable best practices	

The four basic processes – *plan, source, make, deliver* – define at level 1 the processes that encompass the supply chain, and extend across all parts of the manufacturing and delivery process vendor payment. Scope is generally from immediate supplier's supplier to immediate customer's customer, in a "chain of chains".



PLAN	SOURCE
Demand/supply planning	*Sourcing/material acquisition*
Assess supply resources; aggregate and prioritize demand requirements; conduct inventory planning; assess distribution requirements; determine production, material, and rough-cut capacity for all products and all channels	Obtain, receive, inspect, hold and issue material
Plan infrastructure	*Source infrastructure*
Make/buy decisions; supply-chain configuration; long-term capacity and resource planning; business planning; product phase-in/phase-out; manufacturing ramp-up; end-of-life management; product line management.	Vendor certification and feedback; sourcing quality; inbound freight; component engineering; vendor contracts; initiation of vendor payment
MAKE	**DELIVER**
Production execution	*Demand management*
Request and receive material; manufacture and test product; package; hold and/or release product.	Conduct forecasting; plan promotions; plan projects; plan sales campaigns; collect and analyze point of sale (POS) data and actual customer orders; promote products; price products; measure customer satisfaction; execute efficient customer response (ECR)
Make infrastructure	*Order management*
Engineering changes; facilities and equipment; production status; production quality; shop	Enter and maintain orders; generate quotations; configure product; create and maintain customer

scheduling/sequencing; short-term capacity	database; manage allocations; maintain product/price database; manage accounts receivables, credits, collections and invoicing
	Warehouse management
	Receive and stock finished goods; pick and pack; configure products; ship products; create customer specific package labeling; consolidate orders
	Transportation management
	Manage traffic; manage freight; manage product import/export; Installation management: Schedule installation activities; perform installation; verify performance
	Deliver infrastructure
	Channel business rules; order rules; management of deliver inventories; management of deliver quantity.

Table 7: Overview of SCOR's Main Process Typology (Source: SCOR, rel. 5.0)

SCOR becomes the starting point for improved supply-chain management. Focused on key process terms and measurement tools, the model is not a step-by-step guide on how to improve supply-chain management. Rather, it is designed to be used in a change management process of configure, compare and implement. The plan, source, make, deliver model provides manufacturers with information on how to create goals and measures against industry best practices, and how to determine the financial costs and return on specific improvements. In this research project we will use SCOR as a supplementary reference tool to evaluate SCM improvement opportunities, identify gaps in current processes, quantify the potential benefits of specific process improvements and provide data for project financial justifications.

Furthermore, by using SCOR we will be able to better understand the business problem from management's viewpoint (Level 1 metric performance), map supply-chain processes using SCOR's templates, determine the strategic elements requiring change and associated performance targets, and help define the new supply-chain configuration. We see SCOR as a support tool for our more comprehensive approach detailed earlier under the SCM framework.

3.6.2 An overview of the CPFR process model

As we have seen, SCOR is an excellent model to provide the necessary overview and classification of collaborative arrangements. The next vexing question is "how" are we going to initiate and establish such collaborative processes. This is the realm of the CPFR model (*Collaborative Planning, Forecasting, and Replenishment*), which according to the Voluntary Inter-industry Commerce Standards, "*... is a business process model for value chain partners to coordinate plans in order to reduce variance between supply and demand"* (www.cpfr.org).

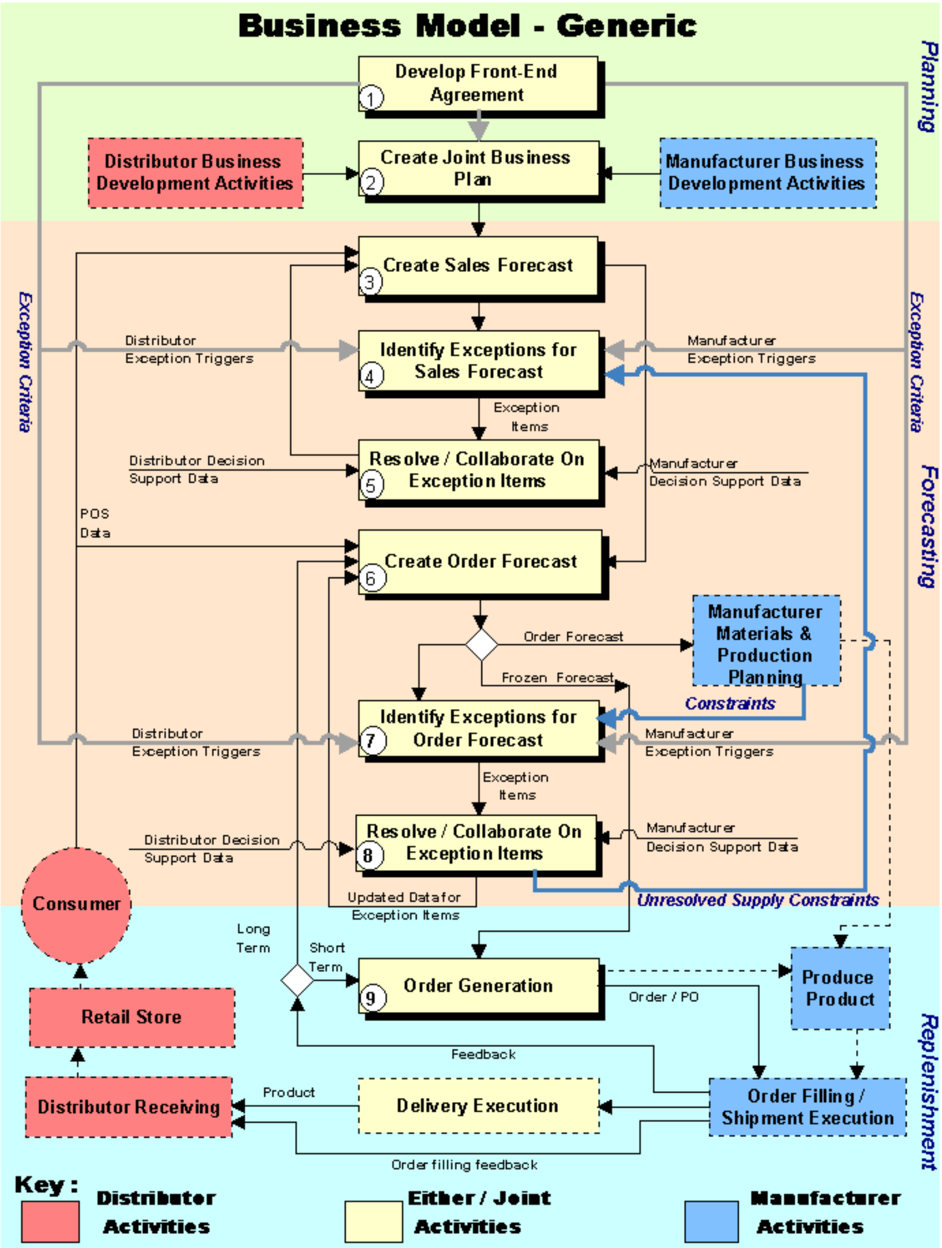


Figure 36: Setting up collaborative partnerships with CPFR's 9 process steps (Source: www.cpfr.org).

CPFR is a business process model that companies use to optimize supply chain activities such as Vendor Managed Inventory (VMI) by leveraging the Internet and EDI to radically reduce inventories and expenses while improving customer service. Historically, CPFR grew out of the retail consumer goods industry. We focus on this model because it is the most widespread accepted, piloted, studied and enabled (by SCM software).

CPFR provides a set of guidelines on *how* companies can establish dense, collaborative partnerships within a supply network[55]. From a business process standpoint, CPFR defines how retailers and suppliers can synchronize their different planning functions. Retailers are focused on predicting customer reaction to promotions, competitors, and product category changes, while suppliers usually concentrate on managing the level of inventory at distribution centers. While the retailer's objective is to keep products in stock in stores, the supplier's objective is to create the most efficient production and replenishment process possible. These differences are reflected in each party's sales and order forecasting processes. For example,

- Sales (Consumer Demand) Forecast Comparisons Retailers produce very detailed sales forecasts, often including weekly (or even daily) store-level demand per SKU.
- Suppliers may also gather a great deal of intelligence about what sold from a syndicated data source (typically IRI or Nielsen), but they usually create only market- or account-level forecasts. The CPFR solution aggregates the more detailed sales forecasts from the retailer and compares the total with the supplier's number.
- In Order Forecast (Replenishment Plan) Comparisons, retailers often do not produce an order forecast at all. When retailers do produce an order forecast, it may include only base demand. Many handle promotional orders through a totally different process, tools, and personnel. Suppliers, therefore, don't often get an integrated view of the retailer's demand. A CPFR solution can improve this situation by providing a forum where replenishment order forecasts and promotional orders can be brought together and compared in full. It can also give the retailer better visibility to how the supplier makes changes to their order forecasts to meet demand.

The guiding principles developed for CPFR out of the VMI best practices are:

[55] Today, more than 30 US companies are part of the CPFR commitee, amongst then Wal-Mart, Kmart, Schmuck, Wegmanns, SuperValue, Butt, Target on the retail side as well as manufacturers such as Procter& Gamble, Sara Lee, Levis, Nabisco, Kimberly Clark, Kodak Heineken.

- The trading partner framework and operating process definition focus on customers[56].
- Trading partners manage the development of a single shared forecast of customer demand that drives planning across the value chain[57].
- Trading partners jointly commit to the shared forecast through risk sharing in the removal of supply process constraints[58].

From the IT side partners include Sun, Hewlett Packard, IBM and SAP. The concept is also extending to Europe and currently Procter & Gamble is running pilots in 4 countries with 4 leading retailers.

[56] One key finding that has come out of the programs is that no single business process fits all trading partners or all situations between trading partners. Trading partners have different competencies based on their strategies and investments. They also have different sources of information and different views of the market place. CPFR is structured as a set of scenarios or CPFR process alternatives for trading partners to use. Depending on the scenario, the retailer or the manufacturer may be responsible for specific parts of the collaboration process.

[57] A single shared forecast is developed which is then shared across the entire supply chain, to ensure that both retailers, wholesalers, manufacturers and suppliers work towards a common goal. Retailers and manufacturers have different views of the marketplace. Retailers see and interact with the end consumer in person and infer consumer behavior using POS data. They also see a range of manufacturers, their product offerings, and their plans for marketing those products. Manufacturers see a range of retailers and their merchandising plans. They can also monitor consumer activity, with some delays, through syndicated data. Given these different views, the trading partners can improve their demand planning capabilities through an interactive exchange of data and business intelligence without breaching confidences. The end result is a single shared forecast of consumer demand at the point of sale. This single shared-demand plan can then become the foundation for all internal planning activities related to that product for the retailer and the manufacturer, all the way to the manufacturers suppliers. In other words, this single shared forecast is the basis for the synchronization of the extended supply chain.

[58] The value of having a single demand plan, if nothing else changes, would be to better co-ordinate value-chain process activities. This co-ordination would yield significant, but not dramatic benefits. Dramatic benefits come from using the demand plan to affect the significant constraints inhibiting supply-process performance. An example of a significant constraint would be manufacturing flexibility. Most manufacturers hold finished goods inventory in sufficient quantities to meet retail demand. Manufacturing capacity is not used because the retailers' normally short order-cycle times are inconsistent with longer manufacturing cycle times. By extending the retailers' order cycle and thus making it consistent with the manufacturing cycle, production could move to a "make-to-order" process for some products.

3.7 A Synthesis – Collaborative Supply Network Process Domains

According to experiences gained by the case companies that have already implemented CPFR based collaborative processes, CPFR does not itself fit all B2B collaborative needs. Products that are commodity-based, have many alternative sources of supply, are undifferentiated, or where price is the primary driver for acquisition, a many-to-many eMarket model makes more sense. This is because a generally public/consortium eMarket that focuses on transaction cost reduction works. Buyer and seller are both motivated to reduce the cost of doing business – with any buyer or seller. CPFR better fits any need where these characteristics are not apparent. CPFR is more applicable where customer service and buyer and seller agree to forgo the benefits of a short-term (i.e. price deal) for the greater mutual benefit of a longer-term relationship. Thus, electronically driven CPFR processes are most appropriate where service and product, not price differentiation, is the factor in the buying decision. CPFR works best where the focus is on long-term relationships for highly differentiated products with limited sources of supply (see *CPFR Roadmap*, 1999; and Seifert, 2003).

In accordance with CPFR pilot results the major collaboration opportunity areas are in demand planning and inventory replenishment. Yet, this is only the beginning. Upcoming eMarkets, whether being information sharing, integrative or even collaborative, will implement standardized data and process models that will support a range of processes as depicted in the figure below. In the figure below we have depicted the major initiatives within each process domain (e.g. CPFR).

Multilateral relationships among trading partners within an eMarket often differ depending on the companies involved. In general, collaborative relationships dependent upon the specific buyer and seller involved. It is highly unlikely that all trading partners will have the same relationships with the buyer or seller. There will always be favored suppliers and customers with different collaborating capabilities. Additionally, electronic collaboration will differ substantially by a trading partner's role within the supply network, depending on whether it is a manufacturer, distributor-wholesaler, retailer, or 3PL provider. The most important collaboration opportunity areas will vary along a supply network and are likely to result in three major, clusters of buyer-seller collaborative planning processes:

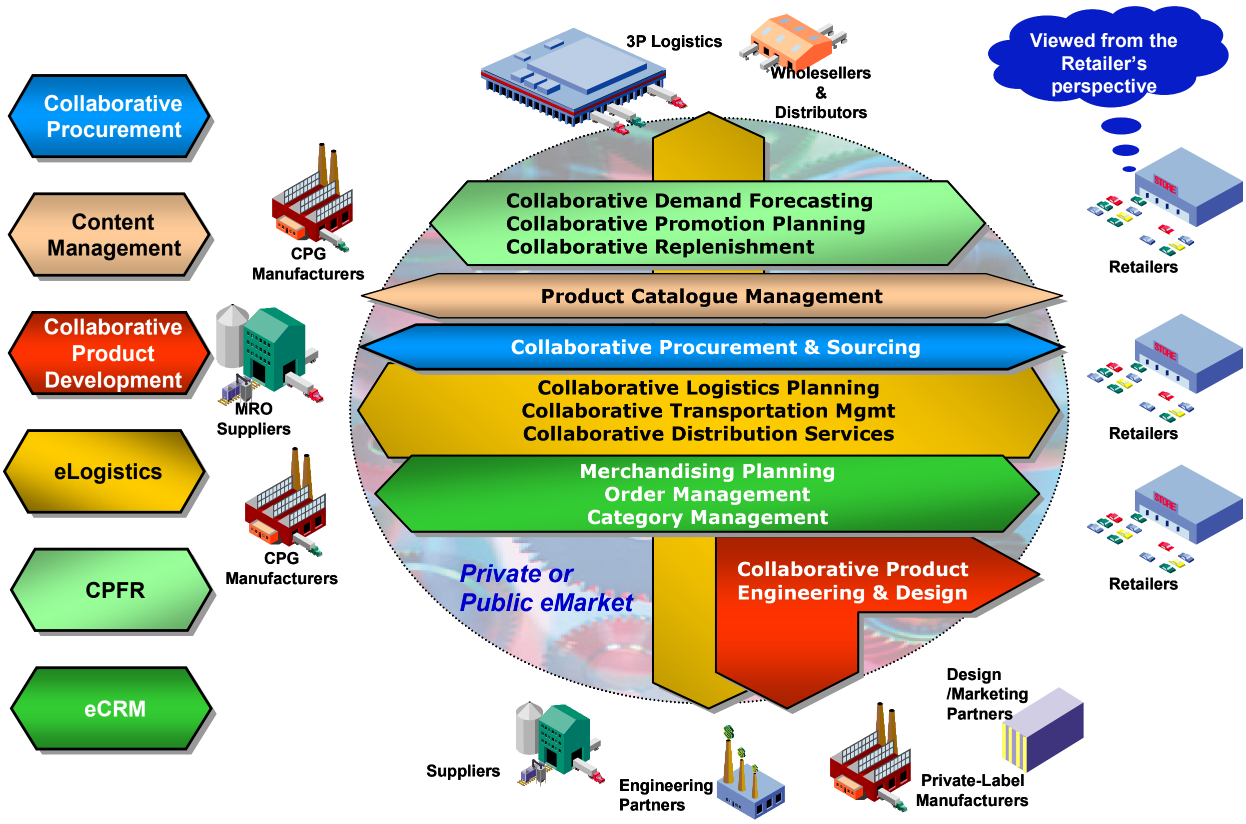


Figure 37: An example of Collaborative Processes required by the Retail Industry that can be executed via a Consortium eMarket (i.e. WWRE) or Private eHub/ eMarket, e.g. Wallmart (Source: and Nøkkentved, 2004).

1. Manufacturer with its suppliers (including tier supplier with its suppliers)
2. Manufacturer with its customers (e.g., wholesale-distributors and retailers)
3. Companies with their 3rd Party Logistics (3PL) providers

3.7.1 Downstream Supply Networks – Manufacturer-Customer Collaborative Processes

For finished-/brand goods manufacturers and their customers (such as wholesale-distributors and retailers) the major collaboration opportunities lie in demand planning and inventory replenishment. By collaborating and synchronizing sales forecasts these supply networks attempt to jointly evaluate customer demand at the point of consumption, i.e. retail store shelves. Once established, a replenishment plan that meets the anticipated demand will be mutually agreed upon. Coordinating both the demand and replenishment plans will help ensure that customer requirements are met in an optimized fashion. Such collaboration requires that the partners cooperate electronically to share and modify each other's demand plans and forecasts. Each trading partner will need to understand the other's promotional plans and the plan's impact on customer demand. Within this context, it will be important to electronically share promotional calendars that include anticipated marketing actions designed to stimulate customer demand pricing actions, customer promotions (e.g., coupons), advertising plans, new product introductions, assortment plans, etc. In addition to demand forecasts and replenishment plans, a manufacturer and retailer may collaboratively manage a category of products, possibly at store level. This will require that they electronically collaborate on store layout and shelf space plans. In addition, POS (point-of-sales) data involving store-level demographic information must also be shared, to jointly assess the proper assortment of products to be placed within each store. In the following we will shortly present the 3 processes of demand-, promotion- and replenishment planning.

3.7.1.1 Collaborative Demand Planning

Collaborative Demand Forecasting coordinates demand and replenishment plans to ensure that consumer requirements are met in an optimized fashion, by jointly developing forecasts and promotional calendars. While traditional planning/APS, uses historical data for statistical modeling, and incorporates market intelligence, collaborative forecasting uses POS data - store level consumer demand rather than DC replenishment, agreed consensus-based forecasts and joint promotional plans to reach and optimal forecast and replenishment plan. Thus, relevant input from business partners can be taken into account to synchronize planning across the network to generate optimized plans based on data from the eMarket. Collaborative forecasting may be undertaken by an eMarket designed to:

- Enable the exchange of appropriate up-to-date planning information with partners
- Allow easy access using the Internet to read and change data (via planning books)
- Restrict user access to authorized data and activities (via a Data Warehouse)
- Support consensus planning process (through shared planning books)
- Support exception-based management (though alert notification via email)
- Generate 'one number' for forecast across the supply network.

The most widespread collaborative process currently, *Collaborative Demand Planning* between manufacturers and their distributors/customers, allows both partners to streamline their work processes and ultimately benefit from a more accurate forecast, better market transparency, greater stability, reduced inventory and better communication. Buyer and seller develop a single forecast and update it regularly based on information shared over the eMarket. It is a B2B workflow, with data exchanged dynamically, designed to increase in-stock customer stock while cutting inventory.

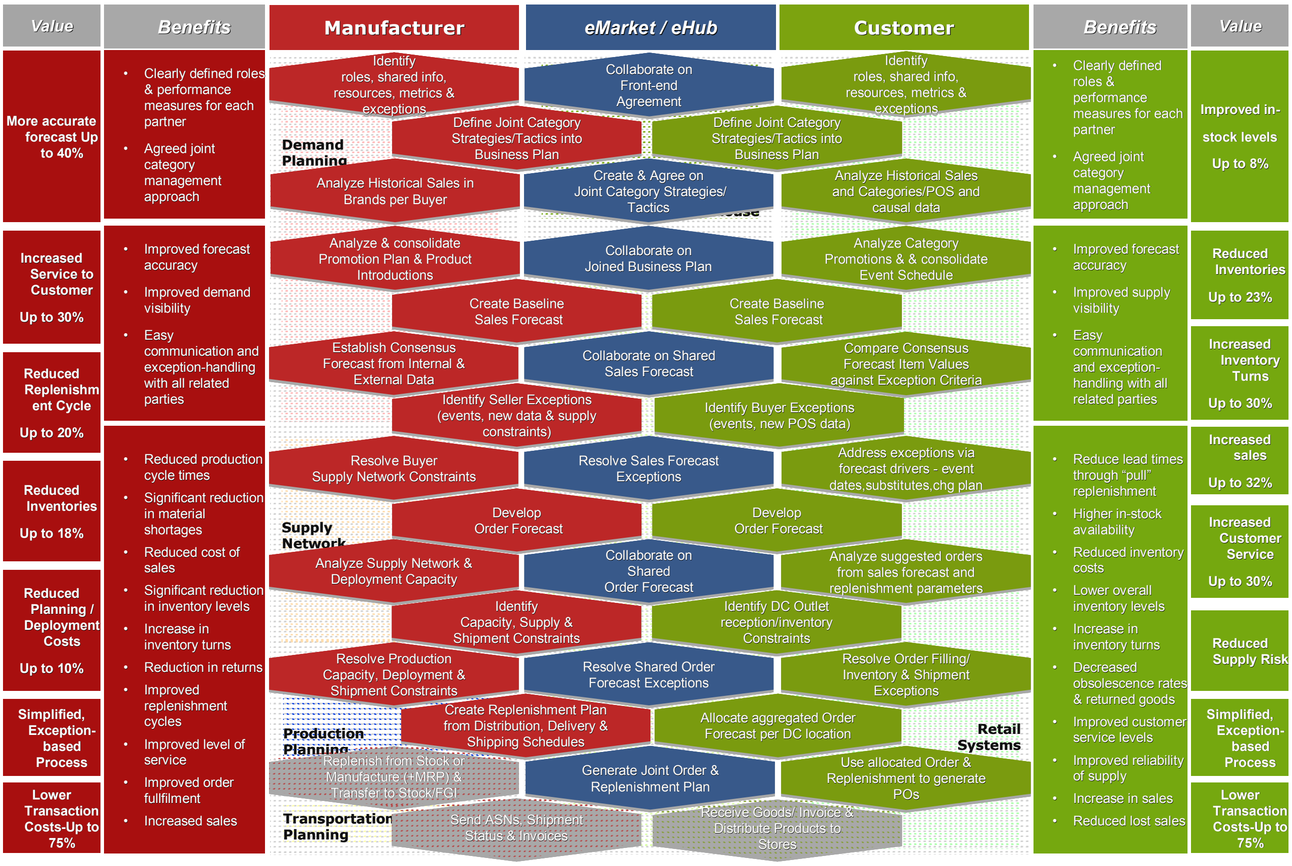


Figure 38: CPFR – From Collaborative Demand Planning to Collaborative Replenishment, Enabling Applications and Benefits (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004; Benefits from CPFR Pilots).

The basic process of the CPFR model consists of 9 steps defined by (see detailed view in the figure):

- Step 1 - *Front-end agreement*: Participating companies identify executive sponsors, agree to confidentiality and dispute resolution processes, develop a scorecard to track key supply chain metrics relative to success criteria, and establish any financial incentives or penalties.
- Step 2 - *Joint business plan*: The project teams develop plans for promotions, inventory policy changes, store openings/closings, and product changes for each product category.
- Steps 3-5 - *Sales forecast collaboration*: Buyers/Retailers and suppliers share customer demand forecasts, and identify exceptions that occur when partners' plans do not match, or change dramatically. They resolve exceptions by determining causal factors, adjusting plans where necessary. This is achieved by comparing current measured values such as stock levels in each store adjusted for changes such as promotions against the agreed-upon exception criteria (in-stock level, forecast accuracy targets).
- Steps 6-8 *Order forecast collaboration*: Develop a single order forecast that time-phases the sales forecast while meeting the business plans inventory and service objectives, and

accommodating capacity constraints for manufacturing, shipping, and more. Identify and resolve exceptions to the forecast, particularly those involving the manufacturers constraints in delivering specified volumes, creating an interactive loop for revising orders.

- Step 9 - *Order generation/delivery execution*: Generate orders based on the constrained order forecast. The near-term orders are fixed while the long-term ones are used for planning. Results data (POS, orders, shipments, on-hand inventory) is shared, and forecast accuracy problems, overstock/understock conditions, and execution issues are identified and resolved.

3.7.1.2 Collaborative Promotion Planning

Collaborative Promotion Planning between distributors and their customers allows these supply network partners to streamline their work processes and create a more accurate plan; e.g. the distributor's promotion planning data created in Collaborative Forecasting is accessible to external partners via the eMarket, who can then decide to participate in a planned promotion. In Promotion Planning via an eMarket, the external partner in the collaborative planning process accepts or rejects a promotion offered by the distributor or manufacturer. By accessing the shared planning books or data warehouse of the eMarket, the external partner can: display a list of promotions, display detailed information such as periods and quantities, accept or deny the offer, attach a note to a promotion plan.

The brand manager initiating the scenario shown in the figure above identifies an area that requires incremental promotional activity. Once the target and the area have been identified, the promotion is established and passed on to the field organization. The account manager receives notification and is instructed to develop promotion plans for the company's accounts. Having set the objectives of the promotion, initial volume lift factors, and promotion elements such as media and trade support, together with the allowances and funds, the account manager is able to develop the events. These events are then are presented to the retailer for approval and, if they are accepted, the two parties work together to agree on the details of the promotion and volume estimates. When the final promotion plan is in place, the account manager orders additional promotional materials, such as display pieces, and passes the promotion details on to the supply chain manager. The supply chain manager integrates the details into the plan and the promotion is run. To complete the cycle, both the retailer and manufacturer are able to evaluate the effectiveness of the promotion and use what they have learned for future planning. By combining promotions and demand forecasting plus information regarding new product introductions, partners are able to streamline the demand signal and achieve substantial benefits.

3.7.1.3 Collaborative Replenishment

Collaborative Replenishment takes over after completion of the aforementioned processes - collaborative forecasting and collaborative promotion planning. Via eMarkets partners have the opportunity of automating large parts of the replenishment transactions via Internet-based Vendor Managed Inventory (iVMI), which utilizes XML formatting to exchange information between systems. VMI is a service provided by a supplier for its customers whereby the supplier takes on the task of requirements planning for its own products within the retail company. For VMI to work, the supplier not only must be able to track the amount of its products stocked at the customer site, it must also take into account the customers sales forecasts. Making VMI possible via Internet provides small retailers with an economical alternative to participating in supply chain planning. It also allows the retailer to maintain control over the data it is sending to the supplier and change it if necessary. To achieve their goals, participants will be able to access the Supply Network Planning data through Internet planning books residing in the eMarket. To summarize, automated replenishment or iVMI is a strategy aimed at enhancing the efficiency of a partnership. VMI is only possible if the manufacturer has information on sales figures/current stock levels -> retailer needs to transfer them. Typically, the result is that the manufacturer can forecast future sales and replenish retailer inventory more efficiently, which also means that it is easier for him to plan production.

3.7.2 Upstream Supply Networks – Manufacturer-Supplier Collaborative Processes

The major benefits that a manufacturer will get from collaborating with its suppliers include new *product development* and *synchronized production scheduling*. The latter can be segmented into *collaborative supplier planning* (for strategic & tactical decisions), *collaborative procurement* (for operational day-to-day requirements), and *collaborative production execution* (primarily for outsourced production, or subcontracted production). Collaborative product development will yield benefits by helping the manufacturer to develop stronger products more efficiently. There are several major opportunity areas within collaborative product development:

- *Design Collaboration* - Product/packaging designs will need to be electronically shared and modified--possibly using CAD files.
- *Product-Costing Information* - Costing data will need to be shared and mutually established to help ensure that target product costs are achieved.
- *Subcontracting Relationships* - Contract terms and conditions will need to be jointly established and contracts electronically passed back and forth for modification and approval.

In a similar fashion, coordinating or synchronizing all tier-supplier production schedules will help ensure that future material needs are satisfied, resulting in improved order fulfillment. This is often realized by electronically sharing schedules with suppliers, allowing them to provide feedback and make changes based on whether or not material needs can be met. This type of collaboration also includes visibility into the raw material, WIP, and FG inventories of all suppliers to help ensure synchronized realistic production schedules.

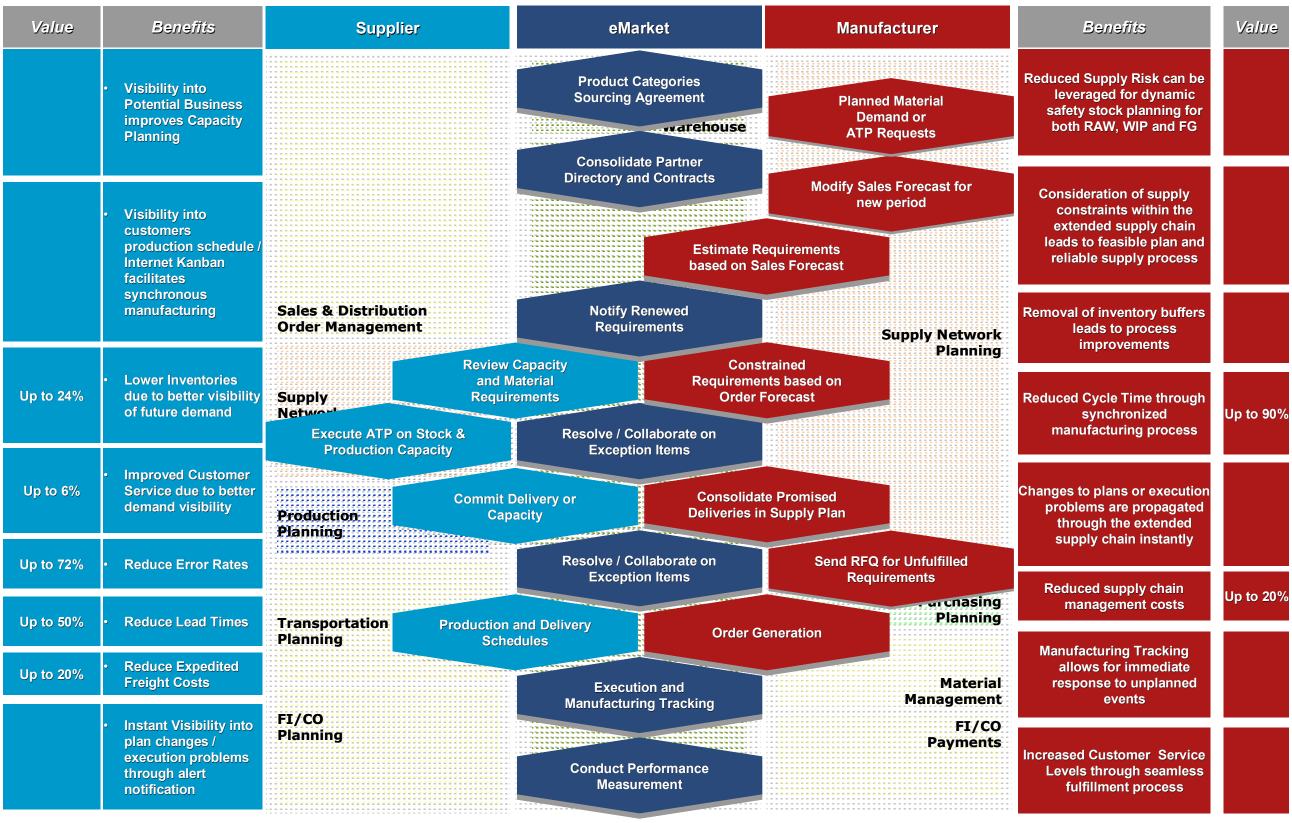


Figure 39: Collaborative Supply Planning Process Scenario with detailed processes, Enabling Applications and Benefits (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004).

3.7.2.1 Collaborative Supplier Planning

Collaborative Supplier Planning, enables suppliers to access to production plans as well as dependent requirements, which enables them to use consumer demand customer inventory levels to fine-tune replenishment; materials requirements are shared at an early stage between manufacturers and suppliers so that all parties involved can adjust their supply and production plans; e.g., if the delivery of the dependent requirements can't be made in time, an alternative date can be suggested. The goal of this process is to help enterprises carry out collaborative supply chain planning activities with their business partners. Thus, relevant input from business partners can be taken into account to synchronize planning across the network, in order to generate optimized plans based on data from the supply network. Enterprises can now focus on enhancing customer value by enabling true business collaboration among business partners in their networks. Collaborative supplier planning may be conducted or executed by an eMarket designed to:

- Enable the exchange of appropriate and up-to-date required planning information with business partners
- Restrict user access to authorized data and activities
- Support a consensus planning process and exception-based management
- Generate 'one number' for supply chain planning across networks

During the course of Collaborative Supply Planning the manufacturer and supplier exchange information on the material requirements of the manufacturer, and they collaborate on exceptions. This type of collaboration enables both the manufacturer and supplier to create more accurate supply network and production plans. The plans can be updated regularly based on information shared over the Internet. This is a business-to-business workflow, with data exchanged dynamically, which is designed to decrease inventory. The basic process consists of seven steps:

1. Both partners agree on the process: define the role of each partner, establish confidentiality of shared information, commit resources, and agree on exception handling and performance measurement.
2. The partners create a joint business plan and establish products to be managed jointly including category role, strategy, and tactics.

3. The manufacturer creates a supply/production plan, based on a single forecast of consumer demand.
4. The manufacturer and supplier exchange information on the component requirements and create a joint forecast.
5. The supplier creates a supply/production plan based on the joint forecast.
6. Both partners identify and resolve exceptions particularly those involving the supplier's constraints in delivering specified volumes, creating an interactive loop for revising orders.
7. Both partners continue with succeeding planning steps.

3.7.2.2 Collaborative Production Execution

Collaborative Production Execution ensures that future material needs are satisfied, resulting in improved order fulfillment. Manufacturers get visibility into suppliers' material availability, schedule and constraints. By calculating dynamic material availability and lead-time using constraints across network, suppliers and subcontractors may optimize their own production schedules resulting in more timely deliveries and minimal delays.

3.7.2.3 Collaborative Engineering or Product Design

Collaborative Engineering or Product Design, improves the development cycle time for new products and helps develops better products more efficiently. Multinational companies operating globally across multiple time zones characterize the current engineering marketplace. These conglomerates typically outsource many of their standard operations to subcontractors. Collaborative Engineering and Design facilitates the cooperative effort essential for coordinating the engineering and project management tasks of dispersed groups and for involving development partners, contractors, suppliers and customers directly in the product development process. The result is a collaborative environment in which the company responsible collects project-relevant information, publishing it for access by business partners who may or may not be members of an eMarket. The only thing that the partners need on site is a Web browser. All participants in a collaborative scenario receive notification of changes or new project assignments. The collaborative communication is carefully monitored throughout the process, ensuring the right people get the right information at the right time.

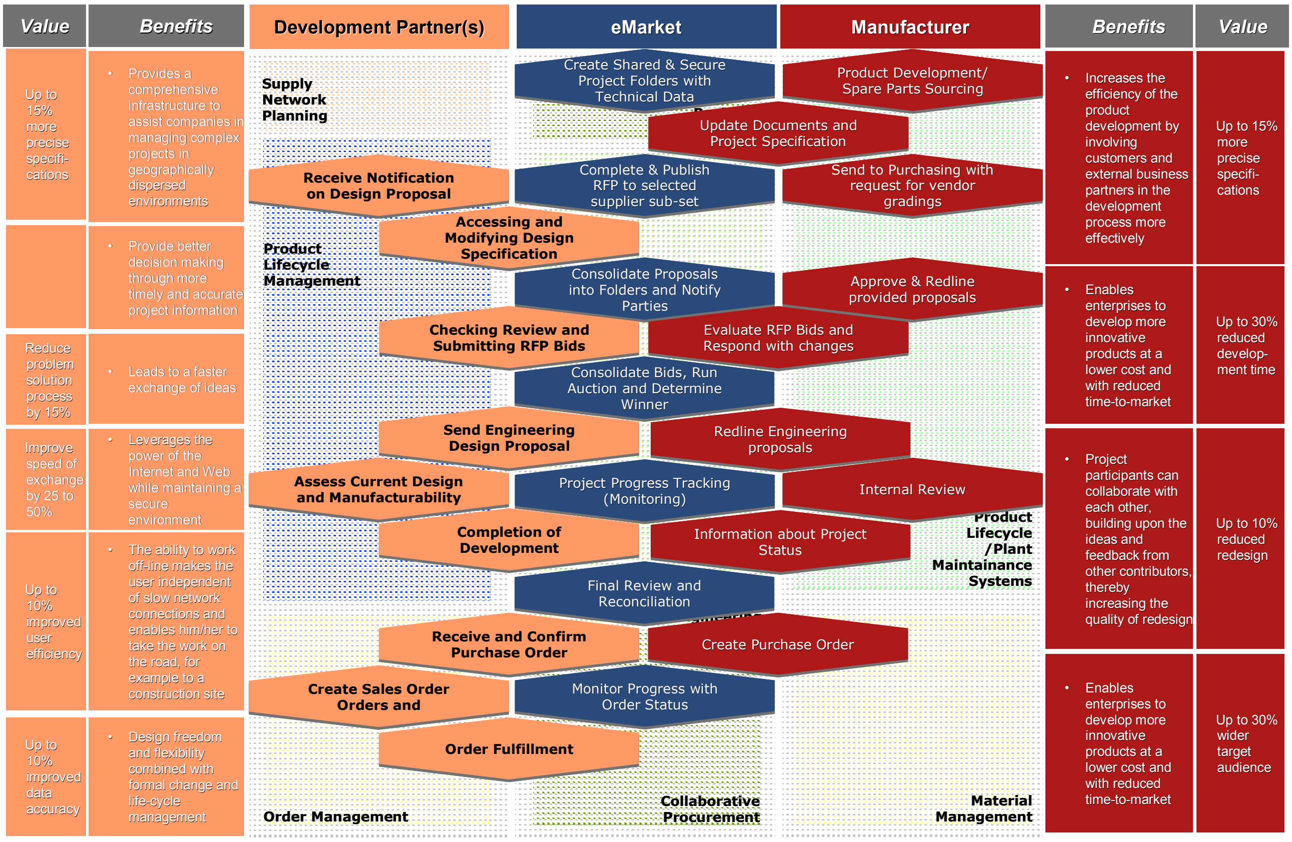


Figure 40: Collaborative Engineering, Tendering and Project Management – Processes, Enabling Applications and Benefits (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004).

3.7.3 Horizontal Supply Networks – Manufacturer-3PL Collaborative Processes

Collaboration among companies and their 3PL providers will focus on joint logistics planning. 3PLs provide transportation shipper services in order to make better use of their transportation equipment and warehousing and distribution center facilities. This might involve collaborative planning to help ensure vehicles are fully loaded by the following:

- Consolidating a shipper's inbound, inter-facility, and outbound shipments
- Combining the shipper's goods with those of another trading partner

These activities involve a shipper electronically sharing the shipment plan with a carrier and comparing it to the availability of equipment, labor, and other transportation resources. Trading partners can support this through joint electronic visibility of transportation resources. Collaboration between a company and 3PLs providing distribution center (DC) services will focus on the productive use of facilities, labor, and equipment. This might involve electronic sharing of DC inventory replenishment plans with analysis to ensure that planned receipts do not overload the receiving function. Plans may also need to be shared to ensure that each DC has enough space to store planned inventories. In addition, 3PL providers can provide insight into the potential for co-sharing of space among trading partners. For example, around the Christmas holidays some of the manufacturer's DCs may be overloaded, providing an opportunity to use a 3PL facility on a temporary basis to correct the problem. This type of collaboration would be further supported by electronic visibility into the availability of DC space and other resources.

3.7.3.1 Collaborative Transportation Planning

Collaborative Transportation Planning between manufacturers and their carriers allows both partners to streamline their work processes and ultimately benefit from reduced handling costs, greater transparency and greater efficiency. Members of an eMarket may share DC inventory replenishment plans with logistics providers, and inform their carriers about their shipment plans, and the carriers can accept, reject or change shipment requests. Based on current developments within the APS systems sphere, eMarkets are enabling a more full view of the opportunities for transportation by facilitating *Tendering for Bids*[59] and *Advanced Shipping Notification*[60]. Recently the CPFR model itself has been extended to include Transportation Carriers and 3PLs in a more rounded "3-way" business model. This allows buyer, seller and carrier to come together to exchange key information, provides visibility to status data and conformance to plan, and then provides processes to jointly derive the plan itself.

This new initiative is called *Collaborative Transportation Management*, or CTM. The CTM model can be executed as stand-alone or in parallel with CPFR. CTM progresses through the following activity steps:

---

[59] With this function, planners can offer shipments to carriers through the eMarket. A planner can react to the offers made by the carrier and also supervise the status of the tenders. The planner receives tendering statistics and can also judge the service quality of a service agent. The possibility to call for tenders for shipments directly through the eMarket is an additional planning function. The interaction between the planner and the service agent may run completely through the system. Planners can also include carriers who are not members of the current eHub in the decision-making process - the carriers process the data through their own systems. System access is monitored using user safety profiles and authorization objects that are assigned specially for the tender status tasks. The service agents can then call up only those shipments that were offered personally to them.

[60] Vendors can use inbound-delivery processing through the Internet to create and process shipping notifications for the customer. The system ensures that a vendor can only select purchase orders that belong to him/her. The user can create and change shipping notifications, which are reflected in the customer's system as inbound deliveries and contain basic data such as the delivery date or delivery quantity of these inbound deliveries. At the point of shipping notification entry, a list appears to the vendor that displays all purchase orders and scheduling agreements that are relevant to that vendor. After the delivery date and the unique identification number have been entered, an inbound delivery for the customer is generated. The customer and the vendor can also modify these deliveries at a later stage, and all parties can view any changes in real time. This process is an alternative to the previous order notification method through EDI and produces the same result.

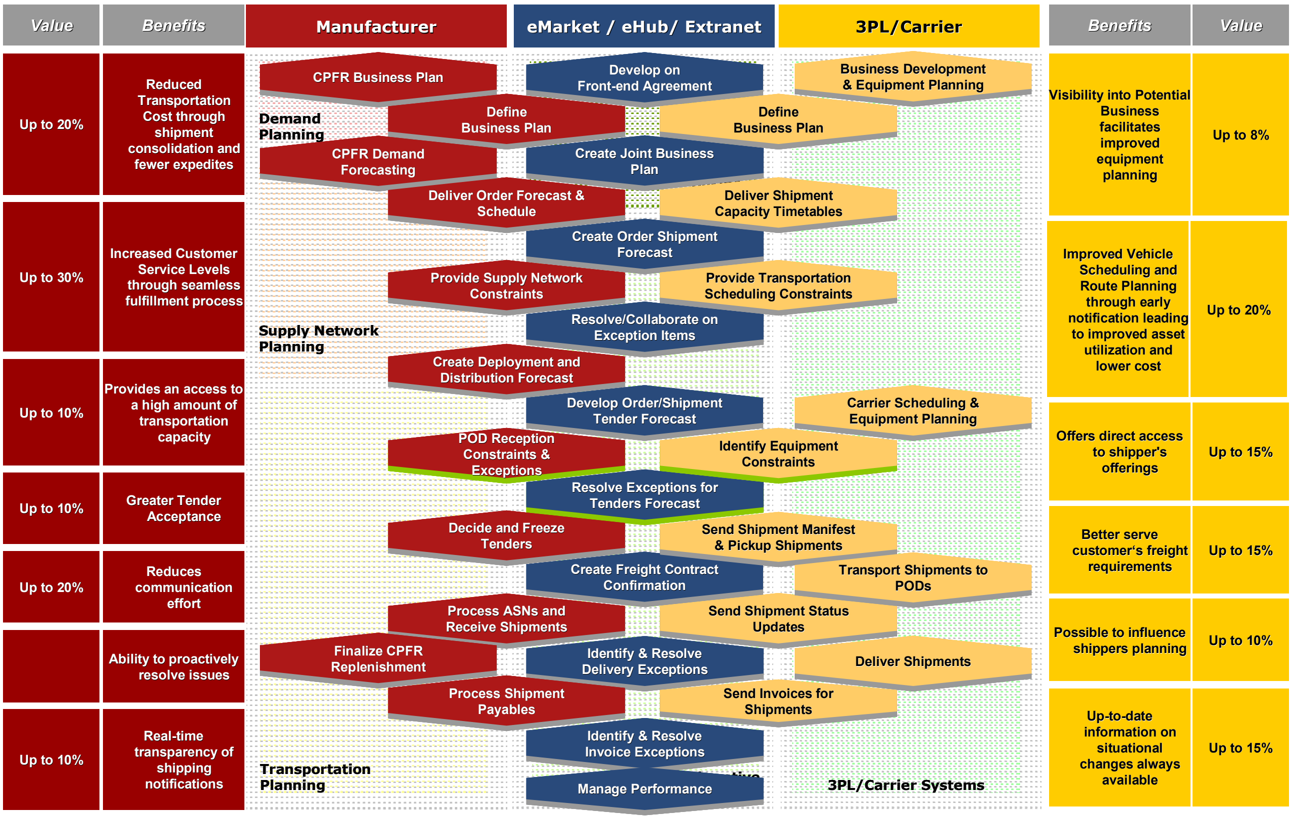


Figure 41: CPFR-related Collaborative Transportation Planning Processes, Enabling Applications and Benefits (Source: Nøkkentved & Hedaa, 2001; and Nøkkentved, 2004).

- In Step 1, the trading partners establish an agreement to collaborate. This agreement defines the relationship in terms of freight terms (who pays for and controls the carrier relationship) which products will be included, the locations that will be involved, the types of shipments that will be included and the strategies for managing exceptions (this is equal to step 1 of CPFR). This also includes a summary of Key Performance Indicators (KPIs) that will be used to measure the relationship to ensure that satisfaction is being achieved all-around, which may or may not align with CPFR.

- Step 2 of CTM involves the aggregate planning phase where planned shipment volume is matched to equipment asset plans (this is integrated to step 5 of CPFR).

- Next in Step 3, *Create Order Shipment Forecast*, the carrier gains insight to increases or decreases in planned volumes reflected in the order forecast - expressed in terms of shipments. The carrier then has the ability to review equipment requirements to handle the shipments forecasted.

- Exceptions to the plan are created in Step 4 and resolved collaboratively in step 5, resulting in the carrier's commitment of equipment to accept the resolved volume (this is synonymous to Step 8 of CPFR).
- Step 6 of CTM is the creation of order/shipment tenders based on the resolved order forecast. The tenders (part of step 9 of CPFR) are made earlier in the process, in order to facilitate the highest level of acceptance by the carrier.
- Step 7 is the identification of exceptions based on latest equipment availability, pickup requirements and delivery requirements. Collaboration will eliminate unnecessary wait time and subsequent charges, and will improve overall efficiencies.
- Step 8 is the acceptance of a tender.
- Step 9 is creation of the final shipment contracts for specific freight orders. This signifies the results of collaborative tender acceptance and specifies the terms of the agreement, today represented as manifests and BOL's. Steps 9 through 11 involve the execution of the plan and visibility of the shipment status. Buyers and sellers gain significant efficiencies by planning shipment acceptance and anticipating inventory moves beyond carrier delivery, such as receiving, put-away or cross docking.
- Step 10 involves the communication of shipment attributes (such as weight, line items, freight classes and assessorials) and shipment status.
- In Step 11, shipment status is continually updated as to progress and projected delivery, creating delivery exceptions and changes to be resolved interactively between the parties.
- Steps 12 and 13 involve the traditional payment process. Typically, there are differences between carriers and shippers as to shipment attributes such as weight, freight class and assessorials. The information for these exceptions is provided in Step 10 and collaboratively resolved through messaging in steps 12 and 13.
- Finally, the partners' measure and report performance in Step 14 against KPIs included in the CTM agreement from Step 1.

With this process we finalized our guided tour of some central collaborative planning processes that may be executed between various partners through an Collaborative Supply Network - below we provide a final overview of the Collaborative Processes in such a Business Model:

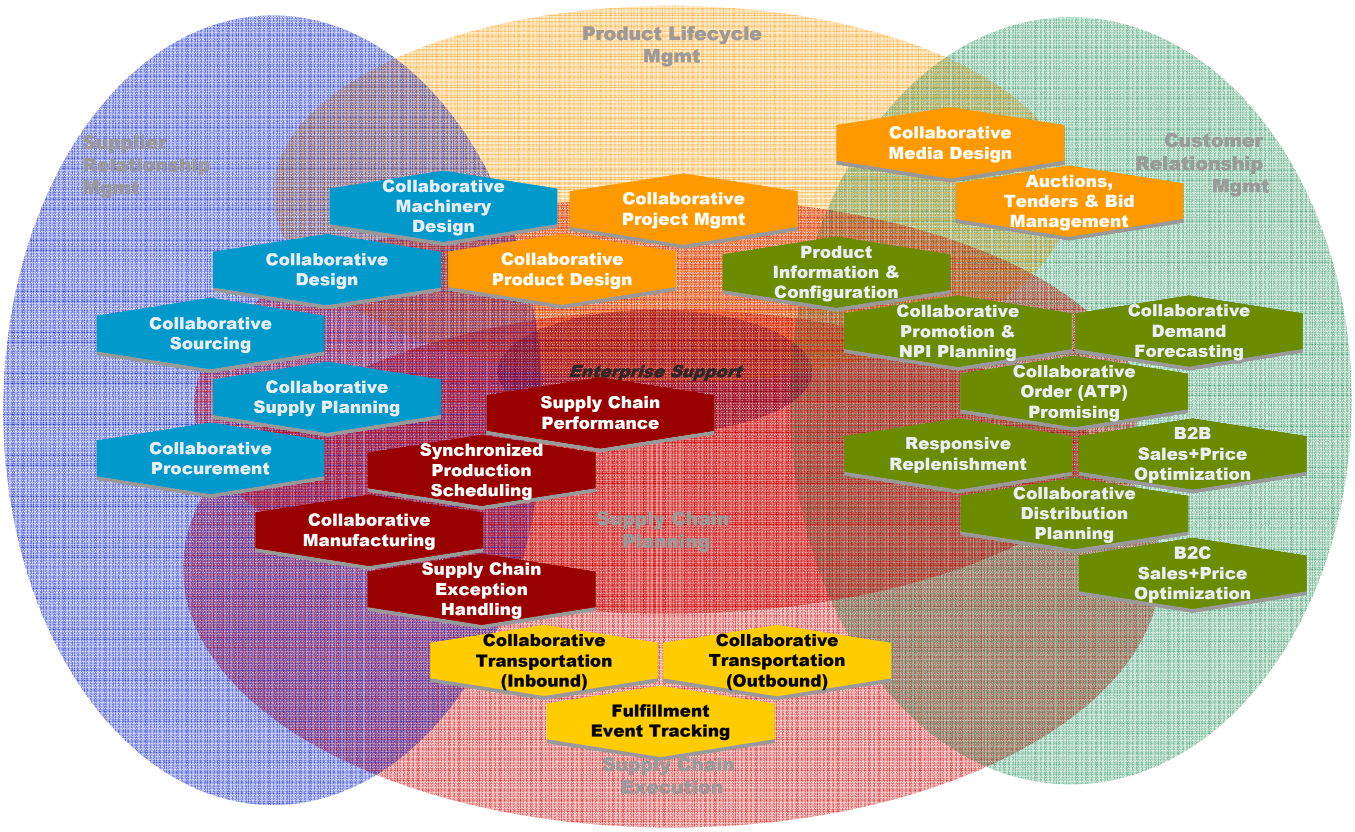


Figure 42: Externally oriented Collaborative Processes in a Supply Network positioned within the II Taxonomy Domains(Source: Nøkkentved, 2003).

In the next section, we will present what are the tangible benefits achieved by implementing collaborative planning. CPFR has been a major instigator of collaboration pilot projects around the world.

3.8 Benefits and Realization of Collaborative Supply Network Processes

While popular literature and business press has touted the benefits of collaborative planning, recent pilots have shown that the actual benefits far exceed expectations (Seifert, 2003). During the last section we attempted to show benefits (both qualitative and quantitative) linked to the various processes. In this section we will summarize the KPIs and benefits documented in cases so far. For example, manufacturers that implemented collaborative planning achieved: reduced inventory levels (18-40%), increased inventory turns (20-70%), reduced production cycle times (up 67% reduction), reduced returns (5-20%), improved forecast accuracy (7-20%), reduced freight cost (18-20%), and lower overall distribution costs (10-30%).

Table 8: Summary of benefits from the various CPFR pilots (Source: Nøkkentved & Hedaa, 2001)..

Process	Operational / Financial Impact	Benefit to Buyer	Benefit to Seller	Driver / Enabler
Collaborative Planning	Clearly defined performance metrics			Define roles & responsibilities for each partner
	Agreed joint category strategies			Develop joint business plans
Collaborative Forecasting	Improved Forecast Accuracy And Timeliness	Up to 20%		Increase forecast accuracy via shared downstream/ upstream information
	Improved Supply Visibility			Improve supply information
	Improved Demand Visibility			Improve demand information
	Improved Exception-Handling			Enhance Communication between trading partners
Collaborative Replenishment	Reduced Lead Times Through “Pull” Replenishment		50% reduction	Increase downstream demand visibility
	Higher In-Stock Availability	5-8%		Reduce order cycle times, Improve in-stock position
	Reduced Production Cycle Times		Up 67% reduction	Improve procurement co-ordination, Supply contracts for new products
	Reduced Transaction Costs	50-75%	50-75%	Flexible aggregate planning
	Reduced Inventory Costs		13%	Increase pipeline visibility to eliminate buffer inventory
	Lower Overall Inventory Levels	10-30% reduction	18-40% reduction	Improve match of supply w/ demand
	Increased Inventory Turns	10-30%	20-70%	Improve sell through and cycle times
	Reduction In Returns		5-20%	Improve downstream demand visibility
	Decreased Obsolescence Rates		5-10%	Improve downstream demand visibility
	Reduced Transportation Costs		2-10%	Improve fulfillment and procurement co-ordination
	Improved Replenishment Cycles			Improve manufacturing planning and efficiencies
	Improved Customer Service Levels	10-30%		Improve demand information
	Improved Reliability Of Supply			Improve procurement co-ordination
	Increased Sales	20-70%		Improve order fill rates via pipeline visibility & reduce lead times
	Reduced Lost Sales			Improve demand information
	Improved Order Fulfillment			Improve fulfillment co-ordination

On the other hand, downstream partners achieved: Increased sales (12-40%), increased buyer productivity (40%), improved customer service levels (up to 22%) and in-stock availability (as much as 8%), reduced overall inventory levels (18-40%), and increased inventory turns (10-

30%). These are significant results reached only for subsets of various product categories traded between partners. Another still not fully understood benefit is that improvement of partner communications, release enormous amounts of time, which partners can spend improving customer relationships and handling exceptions.

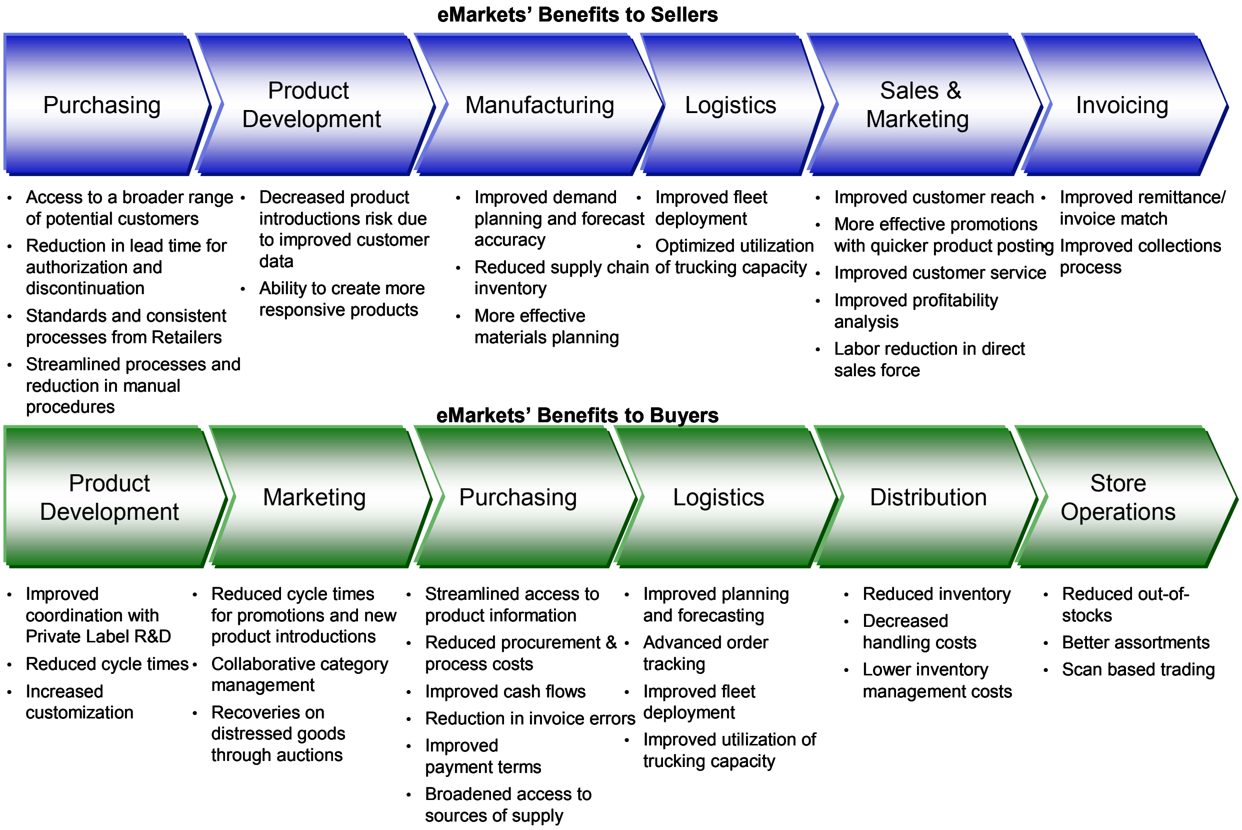


Figure 43: Summary of eMarket Benefits. As we described earlier, companies use eMarkets or eHubs to realize their Collaborative Supply Network processes (Source: Nøkkentved & Hedaa, 2001).

CPFR is fast becoming the most explored model of downstream collaborative planning. In comparison with Vendor Managed Inventory or other initiatives that has gone before, pilot implementations of collaborative processes with the CPFR methodology (in Wall-Mart, Kimberly Clarke, HP, P&G, Nabisco and others – see CPFR Roadmap, 2000) have shown significant benefits, to both buyer (retailer, manufacturer etc.) and seller – manufacturer, suppler etc.[61] (Seifert, 2003; Gelinas & Markus, 2005).

[61] A survey by Industry Directions (April 2000), found that over two-thirds of those surveyed (130 Fortune-500 corporations) are actively involved in CPFR activities or pilot research. About one-quarter of the respondents have a CPFR pilot underway or plan to start a pilot within the next 6 months.

3.8.1 Transforming the Supply Network –Practical Considerations from CPFR & SCOR

In order to implement Collaborative Planning, companies have to realize that they are part of a broader business network or ecosystem, which is per definition collaborative. Beyond an in-depth understanding of their core competences, members of such communities have to standardize their information and process infrastructures. Most companies need to overcome a number of barriers in order to successfully implement or participate in such Collaborative eMarkets: Variability[62], Scalability[63], Uncertainty[64] and Change Management[65]. Finally, collaboration requires some semantic synchronization (e.g. Master data, units of measure). Business partners have to agree on standards to be used for routine collaborative processes - *who is doing what, when and where, plus who is responsible*?

3.8.1.1 Organizational Implementation Considerations

CPFR pilots have identified a number of recurring challenges that have to be resolved in order to make collaboration a success. These are a) *Mutual trust*, b) *Sharing of savings and risks*, c) *Common performance metrics*, d) *Adoption of inter-enterprise business processes*, and e) Striving to reach *critical mass* ASAP. Case companies that have already implemented the CPFR business model, have identified some critical cross-functional issues, that need to be understood and addressed by potential partners pursuing closer collaborative arrangements:

- Building *trust* and *collaboration* among trading partners
- Reducing channel *conflict* (by mapping and handling potential exceptions)
- Enhancing channel services
- Pricing based on market conditions and value versus standard pricing
- Responding to customer needs and demands versus the pushing of products from the supply chain to customers.

---

[62] Since there is no single business process that fits CPFR for all consumer goods and retail firms, there is a set of CPFR alternatives that needs to be mixed and matched by trading partners to fit their needs.

[63] Most early pilots have been managed with sheer labor. According to Wegmans' D'Arezzo: "We achieved CPFR with Nabisco using paper and pencil and hard work. To do with a lot of suppliers in a lot of product categories, we need technology to automate it."

[64] Many trading and consumer goods firms are naturally reluctant to share the plans in advance, fearing that they will somehow fall into the hands of competitors. While CPFR eliminates significant uncertainties and inventories across the entire supply/demand chain, but a preliminary top-level agreement on how savings are shared is critical. According to Jim Uchneat: "Vision does not create success as much as writing down, such as who gets what dollars of savings".

[65] The real key to successful CPFR implementation is forging cultural alliances rather than traditional adversial relationships. Benchmarking Partners: "A company must itself have an culture of openness, and it must have a leader at an upper level who makes a jump over the hurdle of "we can't let them have that information."

- Adopting standard business documents, terms, and processes.

Collaborative eMarkets help companies do more work with fewer people by automating routine communication and offloading simple services to customers. Collaborative processes transform organizations in that they allow customers and suppliers to serve themselves[66], reach new customers without adding staff[67], and automate common business processes[68].

3.8.1.2 Technological Implementation Considerations

Deployment of collaboration in an eMarkets environment offers tremendous benefits, as described above. At the same time, the increased level of aggregation that *Collaborative eMarkets* provide results in challenges for the traditional hub-and-spoke-based collaboration planning processes (Gelinas & Markus, 2005). Some of these challenges are described below:

1. **Data normalization** - Exchange participants need to agree on:
    - Conventions for representing time buckets. The greatest challenge of a Collaborative Planning in an eMarket is managing the diversity of time buckets used by different trading partners[69].
    - Product codes. Capability to utilize Global Trading Item Numbers (GTIN) that incorporate U.P.C. codes, EAN codes, and new identifiers. (See the Global Commerce Initiative guidelines)
    - Location codes. Ability to support Global Location Numbers (GLN) instead of DUNS.

---

[66] When customers can use services provided by collaborative processes to embed your product configurator or order status service inside their operations, they can answer questions on their own time rather than waiting for you to help. Customers get faster, cheaper responses, and you get to keep call center staff to a minimum. Moreover, such interactions allow companies to get feedback on what customers need ("Organic Business" by Ted Schadle, Charles Rutstein, Carey E. Schwaber, Forrster Research, April 2004).

[67] Since eMarket services use standards to project a company's data down the wire, they can reach new customers at minimal marginal cost. ("Organic Business" by Ted Schadle, Charles Rutstein, Carey E. Schwaber, Forrster Research, April 2004).

[68] Firms are stuck maintaining — and training every new employee on — scads of standalone applications. The swivel-chair integration required to tap all those systems will disappear as firms like Pfizer replace redundant manual approval processes with a single approval engine. The results? Faster training, higher productivity, and more lights-out operations ("Organic Business" by Ted Schadle, Charles Rutstein, Carey E. Schwaber, Forrster Research, April 2004).

[69] Here there are many alternatives: A) Standardize on common weekly and monthly calendars on the exchange (for example, normalizing week boundaries on the exchange to Sunday to Saturday). Weekly and monthly data is mapped from enterprise-specific calendars as it is sent or received. B) Disaggregate weekly and monthly data to daily buckets as it is received, using allocation rules. The CPFR solution then provides enterprise-specific calendar views of this data on the exchange. C) Bring data onto the exchange in as-is form. Use allocation rules to present aggregate views, and allow exception messages to diverge between the buyer and the seller.

- Score carding criteria that will be used to rank trading partners.

2. **Internationalization** - Ability to simultaneously handle different: Languages, Currencies, Date formats, and Time zones.
3. **Interfaces** with Global Commerce Initiative (GCI) approved processes for item alignment, party alignment, and purchase order.
4. **Security** at the enterprise, user and exchange layer. The security model and management of the exchange must meet the highest security standards because data is represented from many buyers and sellers.
5. **Interoperability** - CPFR XML schema support to guarantee consistent hub-to-hub and advanced peer-to-hub-to-peer messaging.

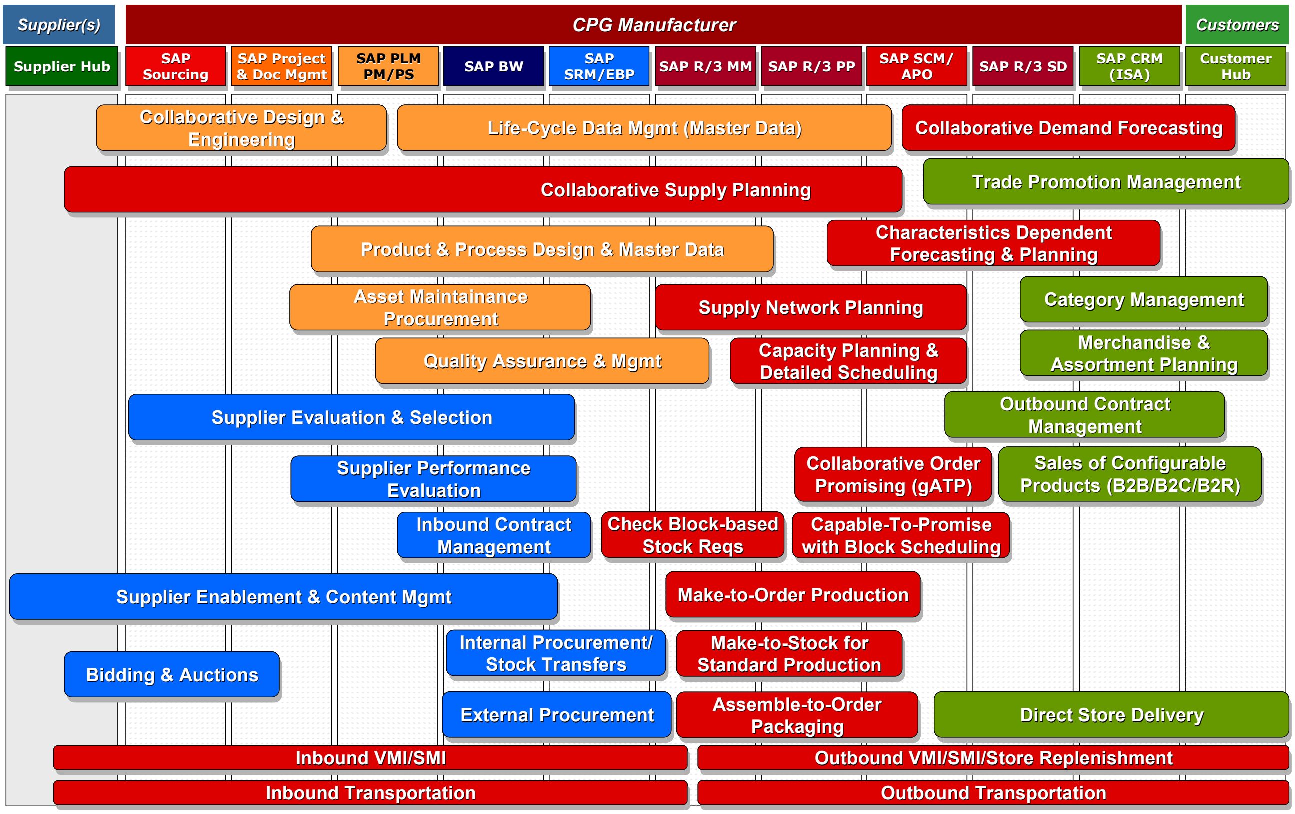


Figure 44: End-to-end Value Streams (coloered based on their domain) and IT- enablement with Applications, E.g. Blue processes belong to the SRM II domain, while Green ones to CRM, Orange ones to PLM and Red ones to SCM (Source: Nøkkentved, 2003).

3.8.1.3 Process Implementation Considerations

Companies have to bridge information from their internal Enterprise Resource Planning (ERP), Advanced Planning and Scheduling (APS/SCM), Customer Relationship Management (CRM), and legacy applications to one or many eMarkets, either initially via a Web browser, or eventually via system-to-system integration. Thus, the building blocks of such integration is a) *common business documents and transactions*, and b) *common semantics, taxonomies and standards* (both data and process). This enables multiple IT applications to work in unison to enable end-to-end processes triggered either internally or externally. Such IT-enabled process orientation is a prerequisite for enabling collaboration across internal departments and external partners. The benefits of Collaborative Planning in eSupply Networks may be clear, but there are 3 key interdependent questions that need to be addressed:

1. Who should one collaborate with?
2. How should one go about collaboration?
3. What are the requirements for and the implications of collaboration?

3.8.1.3.1 Who should one collaborate with?

Collaboration requires significant investment in time and resource for both partners in order to achieve significant benefits, so the selection of partners should be carefully considered. New technology and the introduction of eMarkets and ASPs may have reduced some of the technical risk and cost, but for collaborative planning to be effective it needs the alignment of people, processes and resources between partners. As with any other critical business decision the cost and benefits should be carefully assessed, and in this case this is for at least 2 partners. The result is that collaboration should be targeted at your long term trading partners, for key products, where the product and service are primary buying factors.

3.8.1.3.2 How should one go about collaboration?

There are several possible strategies for collaboration. Historically implementation of collaborative process frameworks like CPFR can be seen as partnership, process or technology lead. Close trading partners have recognized the mutual benefits of collaborative planning, and have evolved the processes for this. This has had the benefit of building on the trust and working knowledge, which are key to success; however, the processes and any technical solutions may be inefficient and not easily transferable to other partners.

Alternatively, companies have designed CPFR processes into their ways of working, and rolled these out to their key partners, for example, motor manufacturers and their suppliers.

However, this may be dependent on a dominant player, and be less than fully collaborative. Latterly Advanced Planning Systems (APS), and the internet have provided the tools that have driven many CPFR implementations (Seifert, 2003).

The ideal strategy combines the right balance of partnership, appropriate process design and use of enabling technology. One feature of many successful CPFR implementations, and inherent in a partnership lead approach, is the use of pilots. This allows the evolution of the right process, and the understanding of the changes needed to organization, roles, and performance measures, as well as technology.

3.8.1.3.3 WHAT ARE THE REQUIREMENTS FOR AND IMPLICATIONS OF IMPLEMENTATION?

Case companies that have already implemented the CPFR business model, have identified some critical cross-functional issues, that need to be understood and addressed by potential partners pursuing closer collaborative arrangements:

- Building trust and collaboration among trading partners
- Reducing channel conflict (by mapping and handling potential exceptions)
- Enhancing channel services
- Pricing based on market conditions and value, versus standard pricing
- Responding to customer needs and demands, versus the pushing of products from the supply chain to customers.
- Adopting standard business documents, terms, and processes.

This section on implementation considerations concludes our study of the state and context of Collaborative Supply Networks. Before moving into our delimited domain of SRM, we will briefly summarize.

3.9 Summary on Collaborative Supply Networks

Enablement of complex, Collaborative Supply networks with information infrastructures may lead to a highly-probable, though slow Lamarckian evolutionary process, rather than a revolutionary inflexion point of current business practices among Industrial Organizations. Collaborative Business Models are transforming the Industrial Age models of customer acquisition, procurement, pricing, and customer satisfaction as well as how we measure the performance of a corporation. Focus on the customer is all consuming; customers want to buy products anytime, anywhere, cheap and fast, and fulfillment processes must be structured to meet these demanding requirements. Companies are simply recognizing that the old rules will not give them the continued success that they had enjoyed, but instead, new ways and protocols are emerging (this is exposed in detail in the cases presented by Dyer, 2000). Notwithstanding, the value of using the Internet-based IT - or any supply chain/relationship management tool - may not significantly improve until the company re-invents itself to embrace internal and external transformation – not an easy undertaking process (Skjoett-Larsen et al, 2003)!

What we have presented so far is the substantial structural changes that are underway within the area of Supply Networks and their catalysts, private and public eMarkets. The functionally-driven silos present in many contemporary supply chains are being transformed and often replaced by more streamlined, electronically based processes. Internet and associated standards like XML have revolutionized inter-enterprise business processes by enabling seamless information exchange between business partners process (Gelinas & Markus, 2005). High volumes of data can be transferred at low cost, and even minor business partners can exchange information in at low cost. Interactive on-line access to each others' systems can be achieved easily via a conventional internet browser.

In summary, propelled by the accelerating permeation of information and communication technologies into intra-organizational processes that also enables inter-organizational collaboration, companies have been rejuvenating their business models by developing private eHubs and participating in public marketplaces to accelerate their business. After the dust of the dot.com crash settled, these eMarkets are entering more forcefully between the buyer-seller relationship and are bound to change the rules of the competitive game. In short, we believe that the development, promotion, and adoption of these networked business models, will maximize the impact of eBusiness in most industries, and enable companies and customers to begin reaping the benefits of the new digital economy.

We have so far attempted to present the overall picture of the processes, frameworks that help us define a company's supply network. Studying contextual factors across a multitude of collaborative interfaces across all fronts is too extensive an undertaking. Therefore, in the next chapter we have delimited ourselves into the upstream domain of a company's business model. A detailed overview of the Supplier Relationship Management domain will thus be pursued, in order to set the agenda for our research themes and subsequent analysis.

4. SRM – SUPPLY-SIDE COLLABORATIVE BUSINESS MODEL

In the upstream supply networks, enabling information infrastructures requires the adoption of information and communication technologies as Materials Management, e-Procurement- and eSourcing. Recently, the major Enterprise Application vendors (i.e. SAP and Oracle) have clustered these under the Supply Relationship Management (or SRM[70]) umbrella term. While eProcurement focuses on enablement of indirect purchasing focused on the buying side, SRM takes on a broader relationship perspective that encompass all sorts of planned/structured and/or unplanned, strategic and operational purchasing and sourcing activities within the company (Corsten & Hofstetter, 2001). As depicted below, these trends have been especially acute among enterprises where SRM expenditures exceeding 45 percent of revenue (Gadde & Håkansson, 2001).

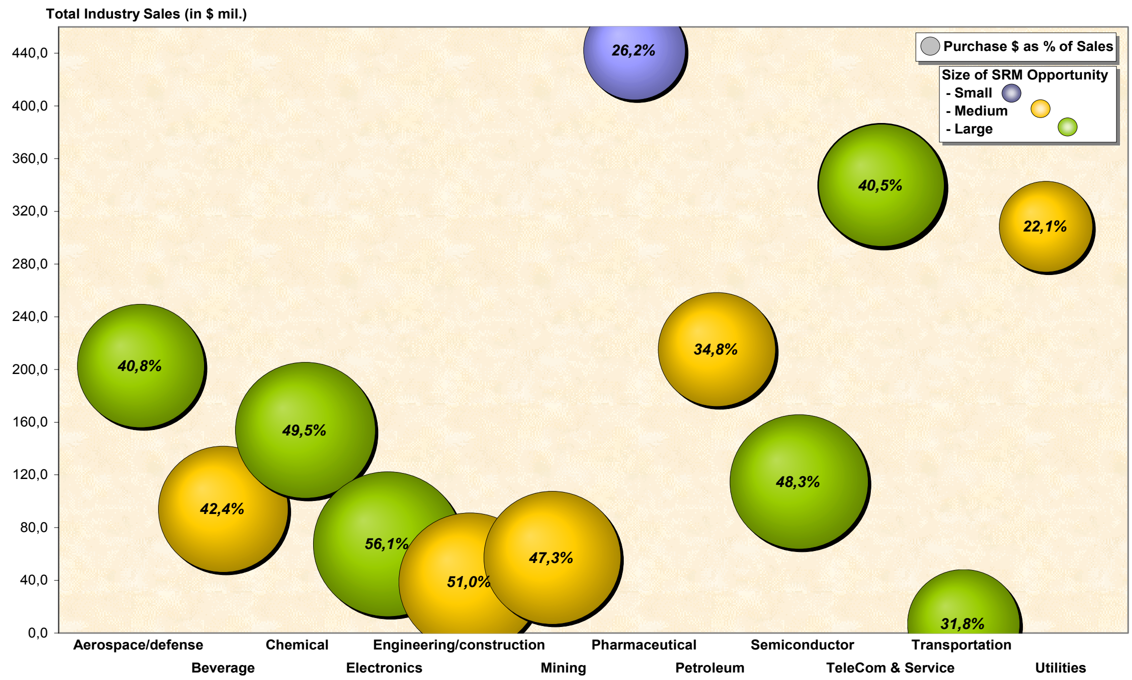


Figure 45: Purchase Volume per Industry – Estimated from Industry Benchmarks from APQC´04.

70 Supply Relationship Management (SRM) seek to unite engineering, design, sourcing, specification of services and the physical logistics, as well as the management and administration of suppliers needed to optimize enterprise profitability. SRM practices attempt to drive maximum value from the entire supply base at acceptable risk on a sustained basis.

Such growth has been driven by increased focus towards "core competences" leading to the purchase of "components" rather than raw materials and the increased usage of contract manufacturing. Naturally, when these expenditures grow, suppliers' ability to directly affect corporate performance increase. To improve or sustain financial performance, many companies are currently looking at better ways to manage the supply base and optimize all transactions and total costs. In an economic environment with slow top-line growth, companies can pursue an immediate opportunity to boost profits through the cost management of supply-side expenditures. However, suppliers represent more than just a cost center. They can also be a source of expertise, capable of delivering more-innovative products, faster and cheaper (Ellram & Carr, 1994; Gadde & Håkansson, 2001). As an interorganizational system (IOS), SRM information infrastructures are typically deployed to enable supplier networks involving internal functional and external supplier relationships (Easton & Araujo, 2003; Müller et al., 2003; Gadde & Håkansson, 2000, 2001), and meso-level market structures (like eMarkets delivering application, integration and content services – see Nøkkentved & Hedaa, 2001).

4.1 Defining Supply Relationship Management (SRM)

Supply Relationship Management (or SRM), is an umbrella term that includes a broad range of many-to-many processes that manage inbound goods and services in support of their transformation into outbound goods and services (Corsten & Hofstetter, 2001). As an emerging discipline, SRM seeks to bundle sourcing and procurement (of services and materials) with related areas as engineering, design, production, logistics, as well as the management and administration of suppliers, into a collaborative and integrated framework, enabled by technology in order to optimize enterprise profitability at acceptable risk on a sustained basis.

SRM can be characterized as a broad, multidiscipline and proactive approach in managing supplier relationships and create a full life cycle view of supply decisions[71]. Its objective is to engage a larger part of the supply base, streamline the communication process leading to more informed, timely decisions and cost-effective execution. While the vision is not new (see Gadde & Håkansson, 2001), recent enablement of SRM practices with information infrastructures support companies in their efforts to:

---

[71] "SRM is the proactive management of a company's entire relationships with suppliers across all business areas with the goal to deliver, procure... SRM differs from e-procurement because it does not only look at the operative business processes but also supports such strategic sourcing tasks as strategy development, outsourcing decisions, integration of suppliers, and materials group management." (Dr. Daniel Corsten, Joerg Hofstetter, University St. Gallen)

- Effectively manage large part of their supply base;
- Extend visibility into current and potential supply base;
- Determine the right relationship strategies for each category and supplier;
- Implement processes that support the selected category and relationship strategies across the corporation;
- Enable procurement and sourcing processes and integrate interdependent processes;
- Continuously monitor & measure performance across all relationships, and,
- Empower people by transforming roles, responsibilities, skills and mindsets…

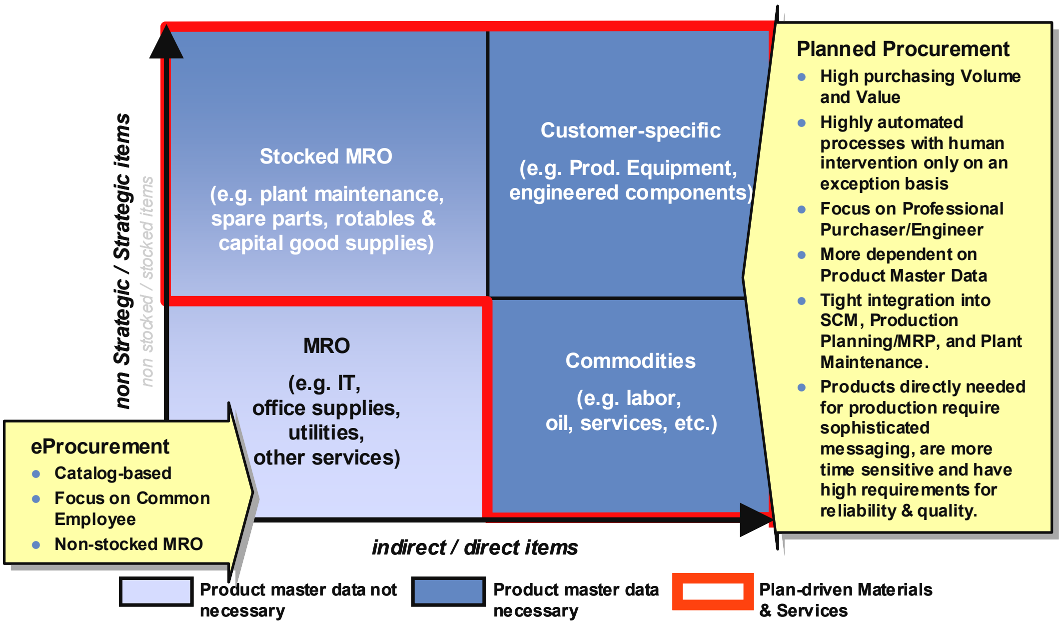


Figure 46: Defining the Procurement Domain (Source: Nøkkentved, 2003).

SRM extends corporate-wide procurement processes, with sourcing analytics (e.g. spend analysis) , sourcing execution, contract management, invoice payment and settlement, and - closing the feedback loop - supplier score carding and performance monitoring. From a procurement perspective, SRM extends the previous eProcurement practices biased toward improving purchase requisitioning, ordering, into Plan-driven (/Scheduled) procurement of stocked-products, also characterized as structured procurement (Subramanian and Shaw, 2001). SRM is linking traditional Supply Chain Management, Product Development and Asset Maintenance with Operational Procurement and Strategic Sourcing. It bundles all procurement and sourcing activities, establishing sourcing policies and contracts, and supporting all sorts of transactions from simple, unstructured to complex or structured (contract-/scheduling agreement-based or call-off).

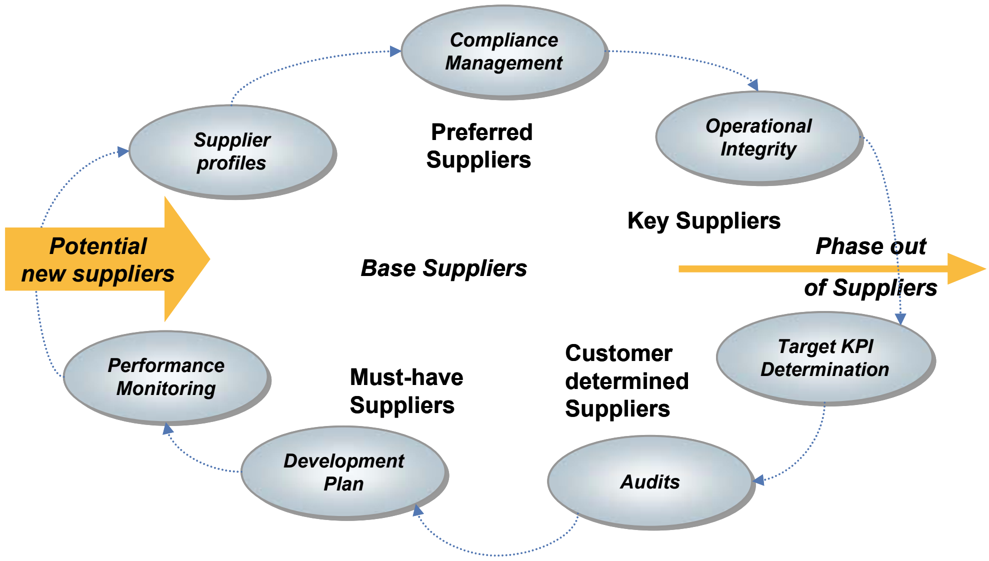


Figure 47: SRM Lifecycle – Continuous Management of the Supply Base (Source: Nøkkentved, 2003).

Hence, it enables from simple episodes, to real-time, collaborative relationships triggered by real-time exchanges between companies.

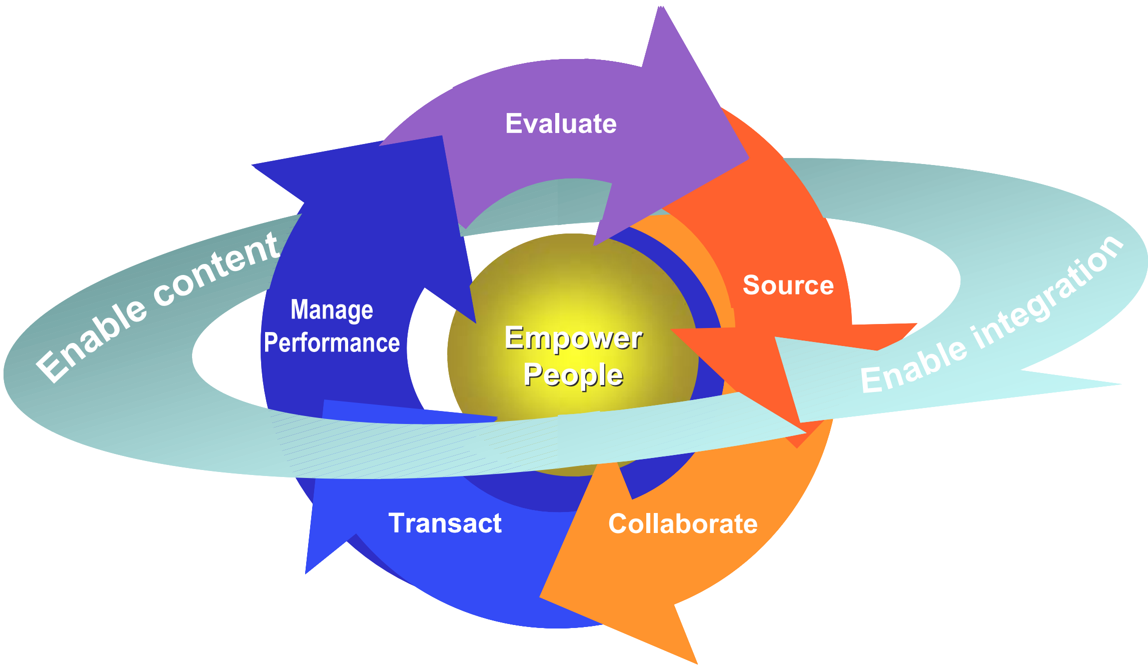


Figure 48: SRM Overview – Uniting the SRM Processes into an overall framework depicting the overall event and activity sequence in SRM (Source: Nøkkentved, 2003).

4.2 Position and Interdependencies of an SRM Information Infrastructure

The SRM domain is an extension of "traditional" supply chain management (SCM) and enriches the business practices associated with SCM. With the exception of the intraorganizational infrastructure realized via ERP (i.e. enterprise resource planning) systems, the remaining domains (like SRM), as depicted below) constitute the firm's interorganizational information infrastructure in that it extends beyond the focal firm, incorporates its surrounding business network, and provides information sharing, transactional and collaborative process enablement (Nøkkentved, 2001).

In coherence with Gadde & Snehota's (2000) views, the idea of offering different levels of support for different supplier sizes and relationships is fundamental to the success of SRM. These infrastructures have to support all sorts of relationships, e.g. by providing a portal for simple transactions with small suppliers, or through end-to-end integration with larger, more strategic suppliers (e.g. sourcing of collaborative engineering & design).

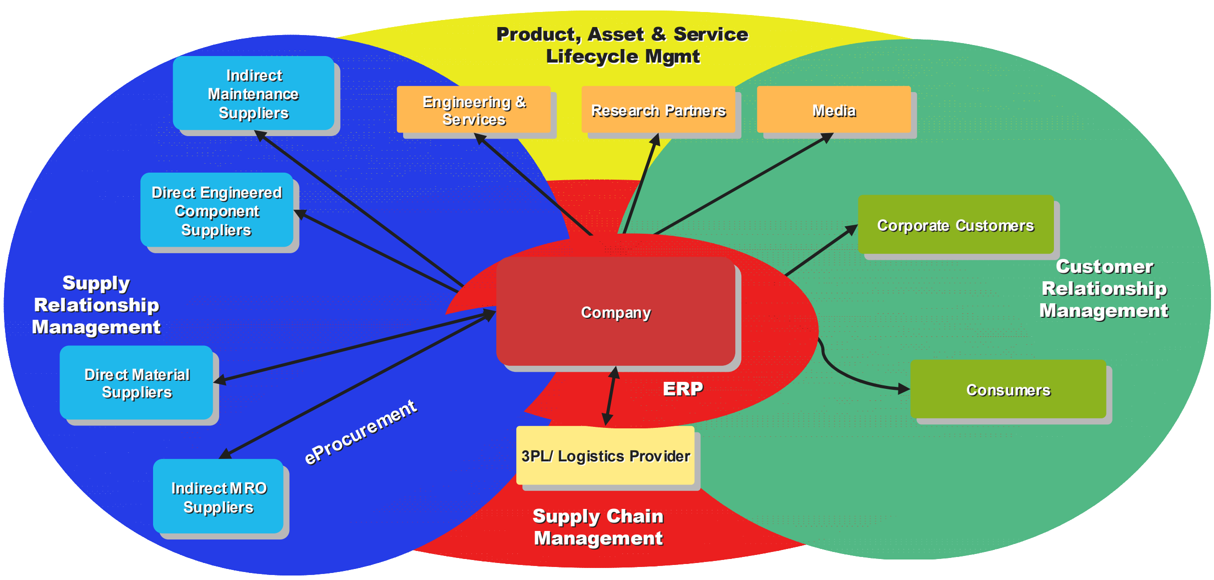


Figure 49: The Collaborative Business Network and the various II Domains – SRM covers the upstream part of the Supply Network and typically interfaces with PLM, SCM and ERP domains (Source: Nøkkentved, 2003).

Moreover, the domains represented above highlight another attribute of the various II domains – their close interdependency. As IIs increasingly enable and support process activities within the focal firm and across the business network, it is apparent that a multitude of activities are handed over in between the various domains. For example, SRM is supporting the area of Product Lifecycle Management (PLM) by providing sourcing and purchasing support in areas like Enterprise Asset Management, Maintenance and Project-based procurement.

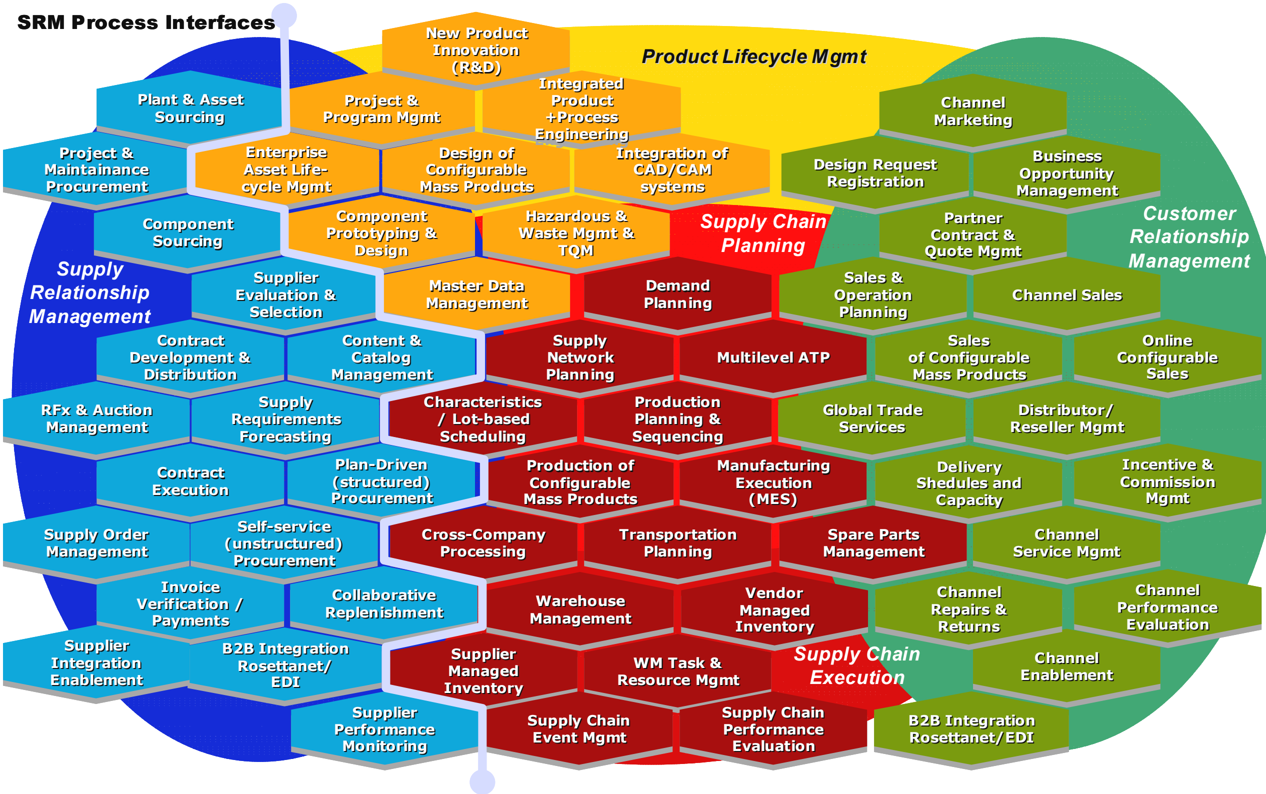


Figure 50: An overview of the Collaborative Processes and their interdependencies within the II domains; SRM processes and their interfaces to the other II Domains are shown too (Source: Nøkkentved, 2003).

Similarly, the SRM process might start with the design phase in product life-cycle management (PLM) and extend to processes that typically fall under the supply chain planning (SCP) and supply chain execution (SCE) categories, such as manufacturing, fulfillment, and replenishment. In fully integrated mode, SRM would also have touch points into an organization's enterprise resource planning (ERP) applications, and from a demand perspective, even into customer management applications (e.g. supporting forward auctions of excess inventory, sourcing and procuring advertising and media, etc.).

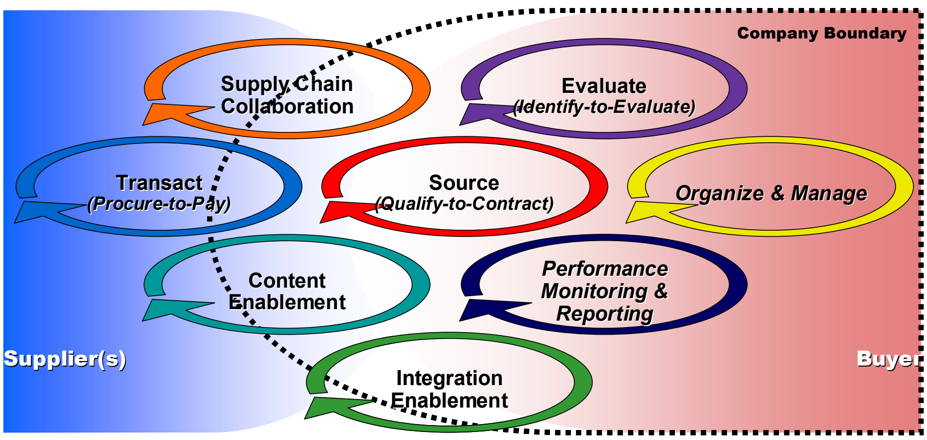


Figure 51: An end-to-end recurring or iterative SRM Processes superimposed on Buyers Sphere of Influence; e.g. Procusre to Pay demands a lot of collaboration with the Supplier(s) involved (Source: Nøkkentved, 2003).

To take advantage of this holistic view, all these processes must be first integrated internally and then externally. At a basic level, this is about giving suppliers a self-service view of the information they need to see - for example, order status, payment remittance information, demand forecasts, supplier scorecard information, and the like - to take costs out of managing the supply chain by speeding up processes and improving the accuracy of information. At a more sophisticated level, this is about creating real-time integration between buyers' and suppliers' processes. However, to understand how infrastructures may enable SRM processes we need to move from the meso- to the macro level.

4.3 Overview of Best-Practice SRM Processes

From the vantage point of a number of studies conducted by the Center of Advanced Purchasing Studies (CAPS) and the Supply Chain Council's SCOR model (Nøkkentved, 2000) a number of best practice end-to-end SRM processes have been identified. As seen in the figure above, these interdependent process cycles are extending beyond the boundaries of the focal firm, thus in coherence with IMP's axioms, these processes are not always "controlled" or "managed", but are rather seen as "shared" and interdependent with the firm's suppliers.

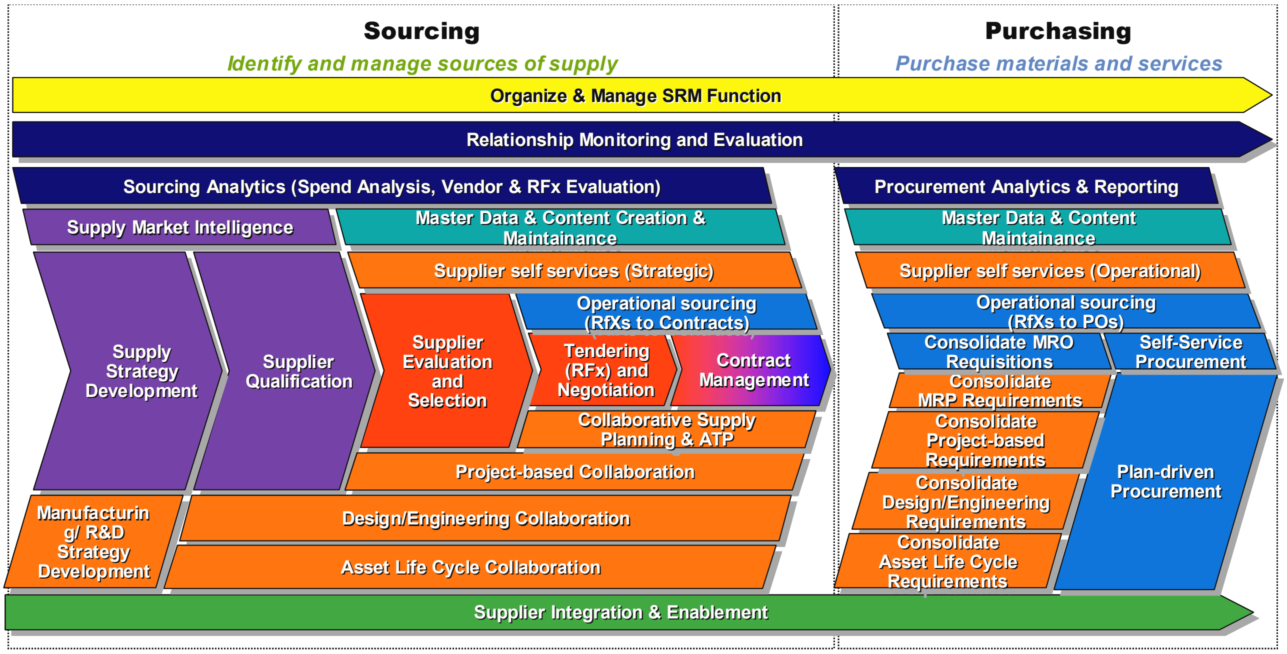


Figure 52: SRM Best-practice Operational & Strategic Process Framework (Source: Nøkkentved, 2003).

Thus, firms implementing infrastructures to support SRM processes need to take a more outward look and involve the key suppliers in the design and setting of such a collaborative supply network. Moving again towards the micro-level, these processes can then be disaggregated into a mosaic of potential process activities that enable transactions and relationships within and across the business network (see SRM Processes below).

4.4 Enabling SRM with IT Technology – Typical Architectural Views

Successful implementation of SRM practices will require information infrastructures that reflect buying processes and the complexion of relationships that an enterprise maintains with its trading partners (Hartmann et al. 2002, Rosson, 2000). Building fine-grained relationship models requires moving well beyond the simple tier of suppliers as "preferred."

As a result, enterprises should require that suppliers and associated agreements be accessible to multiple parties and applications within the enterprise. Moreover, complex services need to be enabled like exposure of contractual commitments, decrements against master contracts, penalties and incentives for buyer and supplier performance, multichannel interaction management, and supplier development and enablement. We have tried to depict below the types of functionality/services that current infrastructures may enable. Although customer data models have been built and maintained for many years, the business world at large is only at the beginning in terms addressing the need to model supplier relationships (Barua et al. 2002). In summary, an SRM need to fulfill following objectives:

1. *Automation* - at a most basic level, support the automation of transactional SRM process between an organization and its supply-side trading partners. For example, purchase order routing, invoice presentment, payment, and so on.
2. *Optimization* - support the optimization of processes and decision-making through enhanced dynamic, real-time analytical tools (e.g. supported via data warehouses and online analytical processing tools,
3. *Visibility* - provide trading partners with visibility of information and process flows in and between organizations. It is also necessary to differentiate how suppliers may view such information; some information would be aggregated a single view for self-service users, or made available for application-to-application integration.
4. *Integration* - provide a single view of the supply chain that spans multiple departments, by integrating processes, transactions and software applications for internal users and specified external trading partners.

5. *Collaboration* - provide mechanisms for collaboration through the sharing of information, both internally and externally, and provide bi-directional, real-time, yet event/exception-based communication capabilities (Nøkkentved, 2000).
6. *Flexibility* – provide a flexible platform thus minimizing relationship specific II adaptations and investments to be able to change suppliers with low switching costs.
7. *Adaptability* – practices reflected in business processes, business rules which constitute the organizational routines (Nelson & Winther, 1982), are often undergoing major changes. Moreover, there is a increasing rate of technological enablement, which implies that IIs need to continuously improve or enhance their embedded processes with evolving SRM practices and technologies (e.g. mobile services),

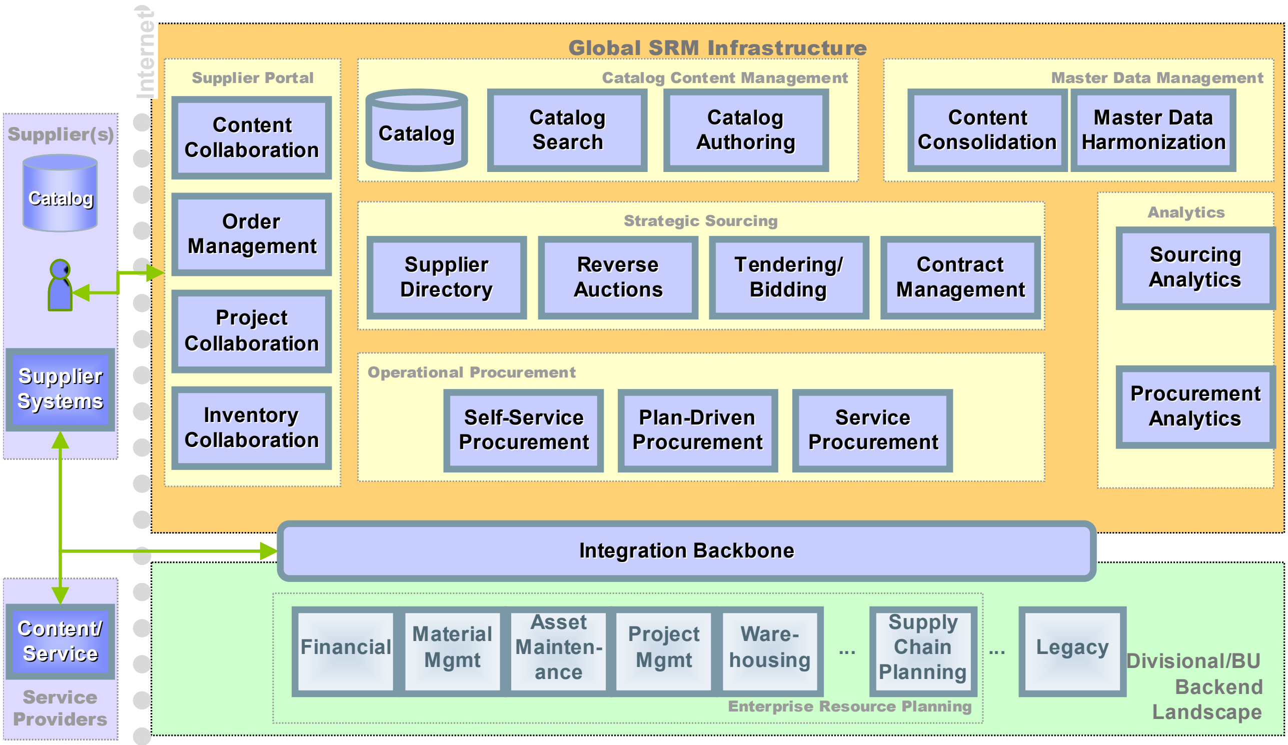


Figure 53: Application Architecture example of an SRM Information Infrastructure (Source: Nøkkentved, 2003).

Current trends in the IS community testifies that applications are increasingly realizing such goals via open standards (for information and process exchange), open source, and integration, in other words, the end to siloed enterprise applications, and the advent of applications that can talk to each other, ultimately in real-time. Many software vendors proclaim full support of core source-to-settle processes, yet we believe that the technology will continue to mature and add support for things that we might not have even considered.

4.5 Enabling SRM – Composite Views of Roles, Processes, and IT

The aforementioned SRM Architecture enable vendors and companies to enable their SRM processes with application and infrastructural software. The author has worked extensively within IBM and with SAP AG. to define the detailed processes in best-practice SRM practices. From these co-operative exercises and a number of implementation efforts the following portfolio of Process-to-Application aligned scenarios were created. All these representations were developed by the author, within the context of the Event-Actor-Process/Activity-Resource framework that defines the Information Infrastructure Domains.

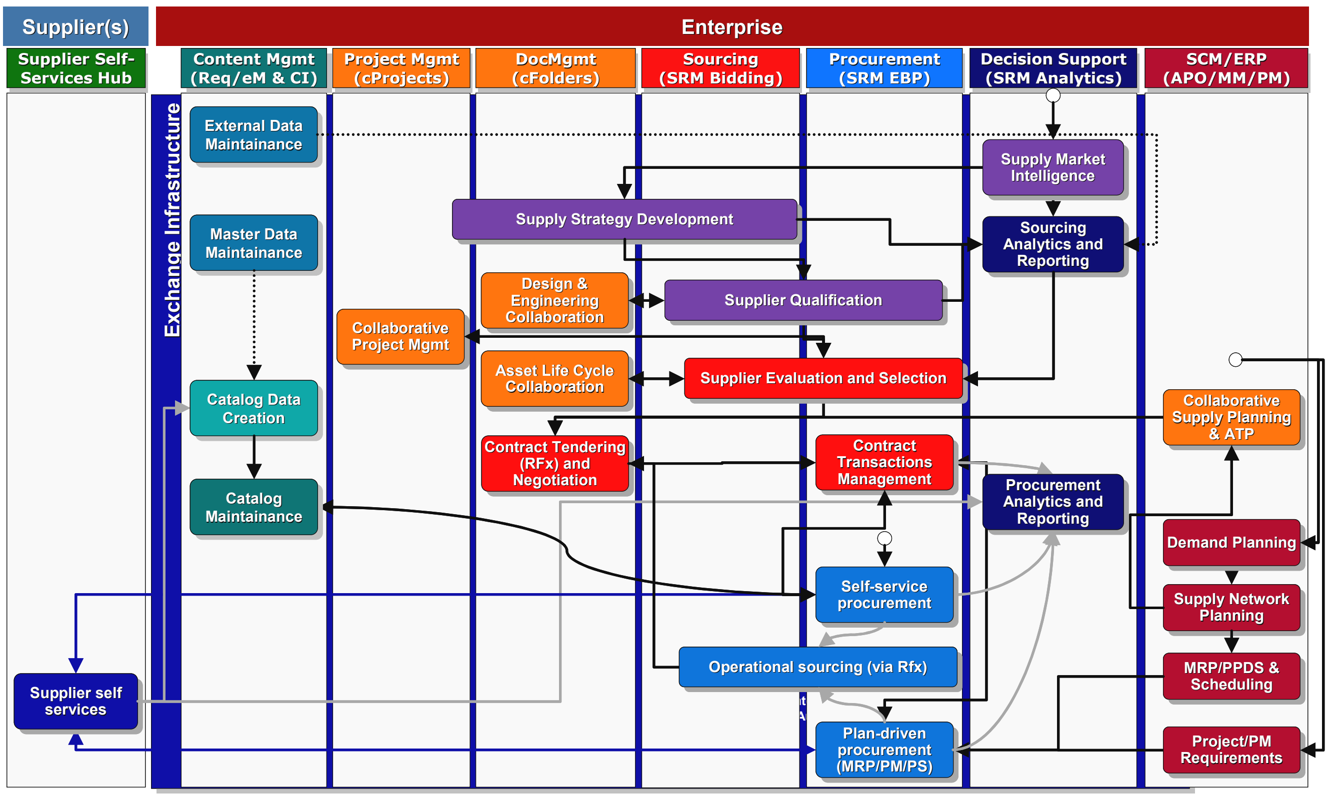


Figure 54: Implementing SRM – Primary Processes, Interactions & Application Enablement (via e.g. SAP SRM).

We have subsequently within a number of client engagements elaborated some of the depicted processes in greater detail. These were used in later stages of our qualitative research as guidelines on Actor Roles & Responsibilities, Process Activities performed and Resources required, in that these process descriptions linked an SRM Information Infrastructure and the IMP Group's ARA model enabling us to move beyond the typical process-flow centric perspective. This took our analysis one step further than the one depicted in section 3.7.2, to a more fine-grained view of how technology can be aligned with users, processes and resources.

We also had the opportunity to investigate in more detail the KPIs/ metrics driving the various processes, which was a major input into our value-driven initiatives. These scenarios were:

1. Self-Service Procurement (this is the typical eProcurement process)
2. Plan-Driven Procurement
3. Supply Market Intelligence & Strategy Development
4. Supplier Qualification & Rationalization
5. Supplier Evaluation and Selection (this is the typical eSourcing process)
6. Design & Engineering Collaboration Process
7. Contract Development
8. Supplier Self Services (Order Management)
9. Supplier Self Services (Content Management)

Self-service procurement enables employees to create and manage their own requisitions. This relieves purchasing departments of a huge administrative burden while making procurement both faster and more responsive.

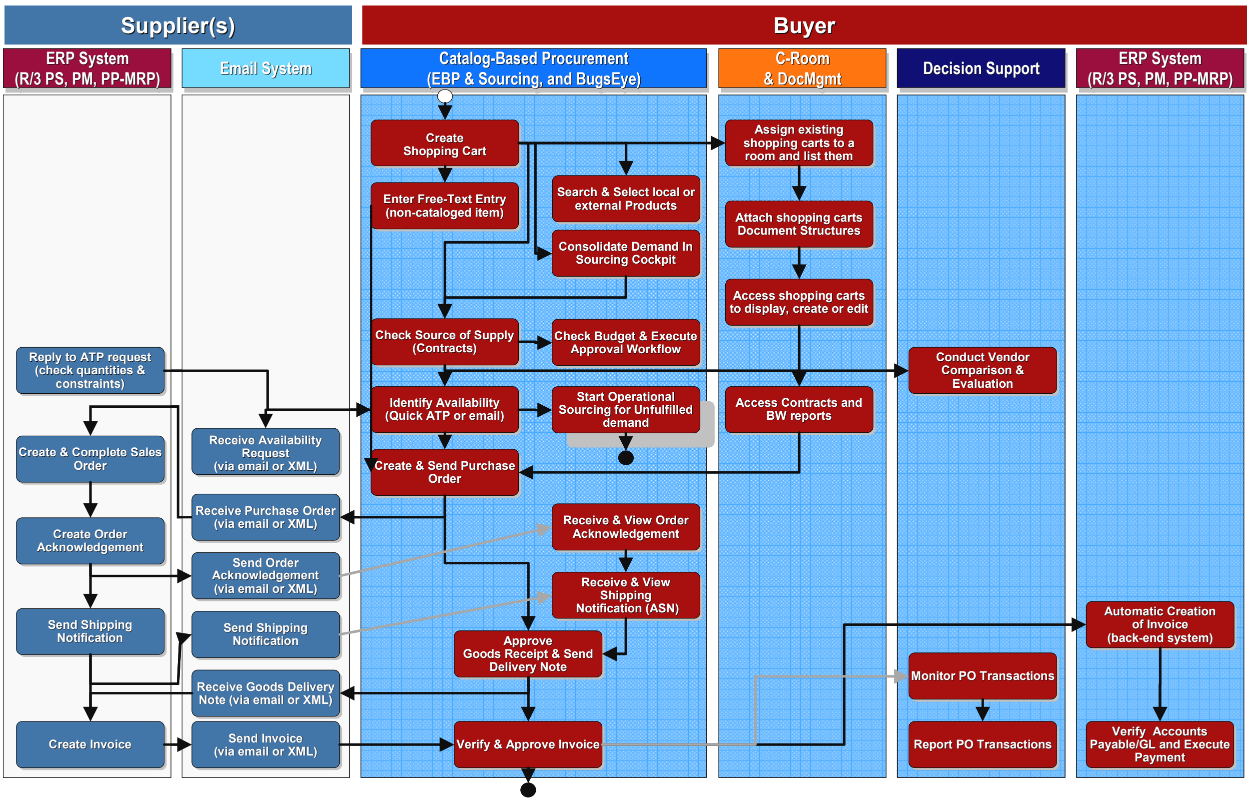


Figure 55: SRM Information Infrastructure practice - Self-service Procurement

The *Plan-driven Procurement* scenario automates and streamlines ordering processes for regularly needed core materials in alignment with plans (i.e. MRP). This scenario demands extensive integration with a company's planning, design, and order-processing systems. It enables the company to link procurement processes to a plan-driven strategy that gets the materials/services needed for core business processes. Plan-Driven Procurement typically integrates with backend systems such as ERP and production systems. This scenario enables the integration of operational procurement with the company's existing supply chain management solution.

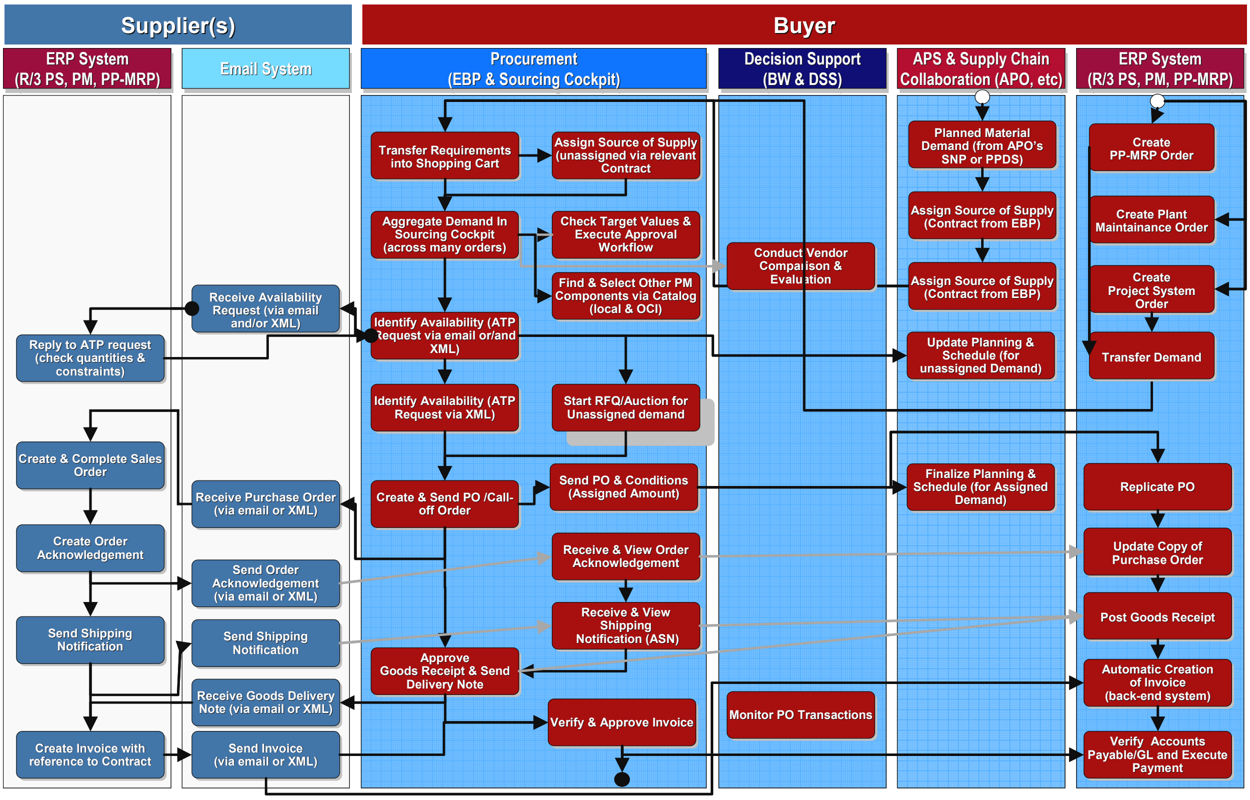


Figure 56: SRM Information Infrastructure practice - Plan-driven Procurement

The *Supply Market Intelligence & Strategy Development* scenario focuses on optimization of Supplier Base by analyzing the purchasing expenditures. Global spend analysis is the foundation for strategic sourcing initiatives in that it enables the discovery of sourcing opportunities with substantial savings potential for different product categories and suppliers. It serves as the starting point to develop, execute, and monitor corporate sourcing strategies. It is estimated that sourcing accounts for up to 75% of the total opportunity for procurement savings within an enterprise. But to capitalize on such opportunities, companies must carefully weigh cost-reduction goals against issues of quality, risk, and innovation. The scenario describes in detail how Procurement Executive officers deploy application to activate typical standard product and other development collaborative processes .

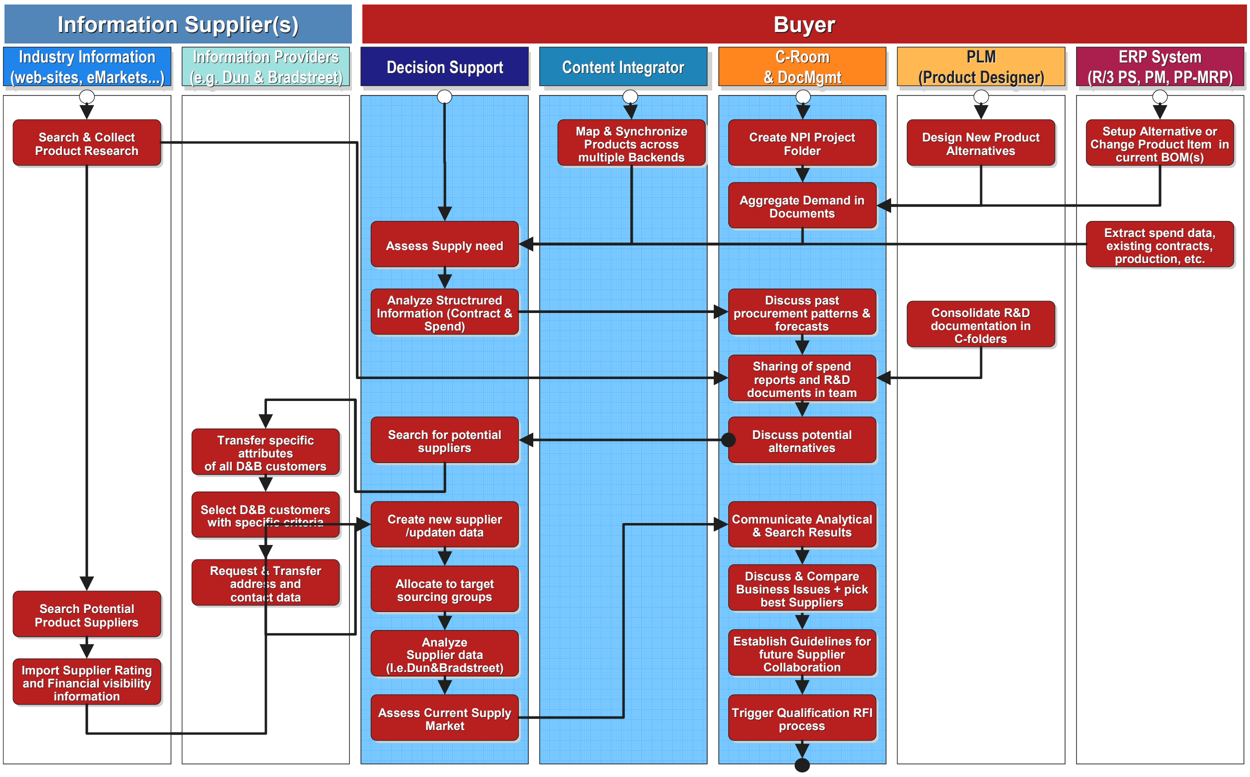


Figure 57: SRM Information Infrastructure practice - Supply Market Intelligence & Strategy Development

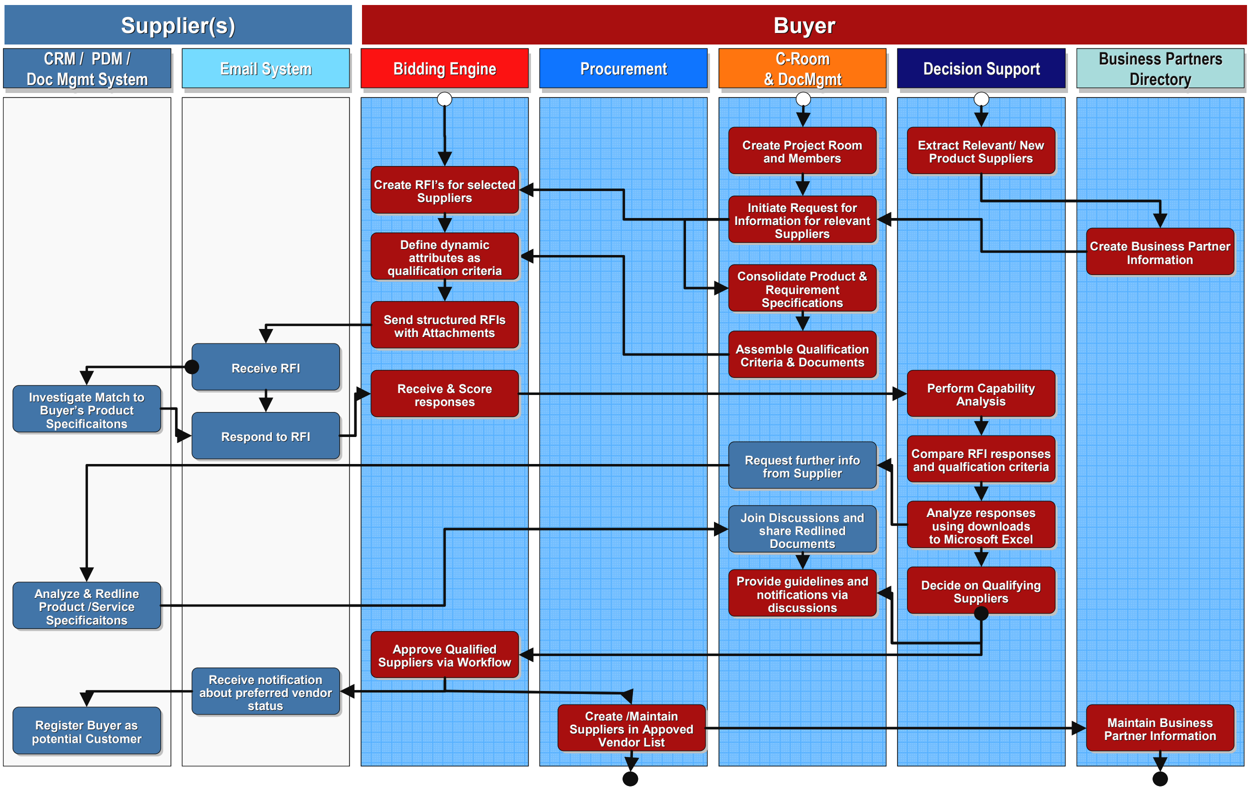


Figure 58: SRM Information Infrastructural practice - Supplier Qualification

The *Supplier Qualification* scenario covers the entire process of identifying and qualifying new suppliers and on-boarding them. Ongoing evaluation including nominating preferred suppliers related with special products and categories is also covered.

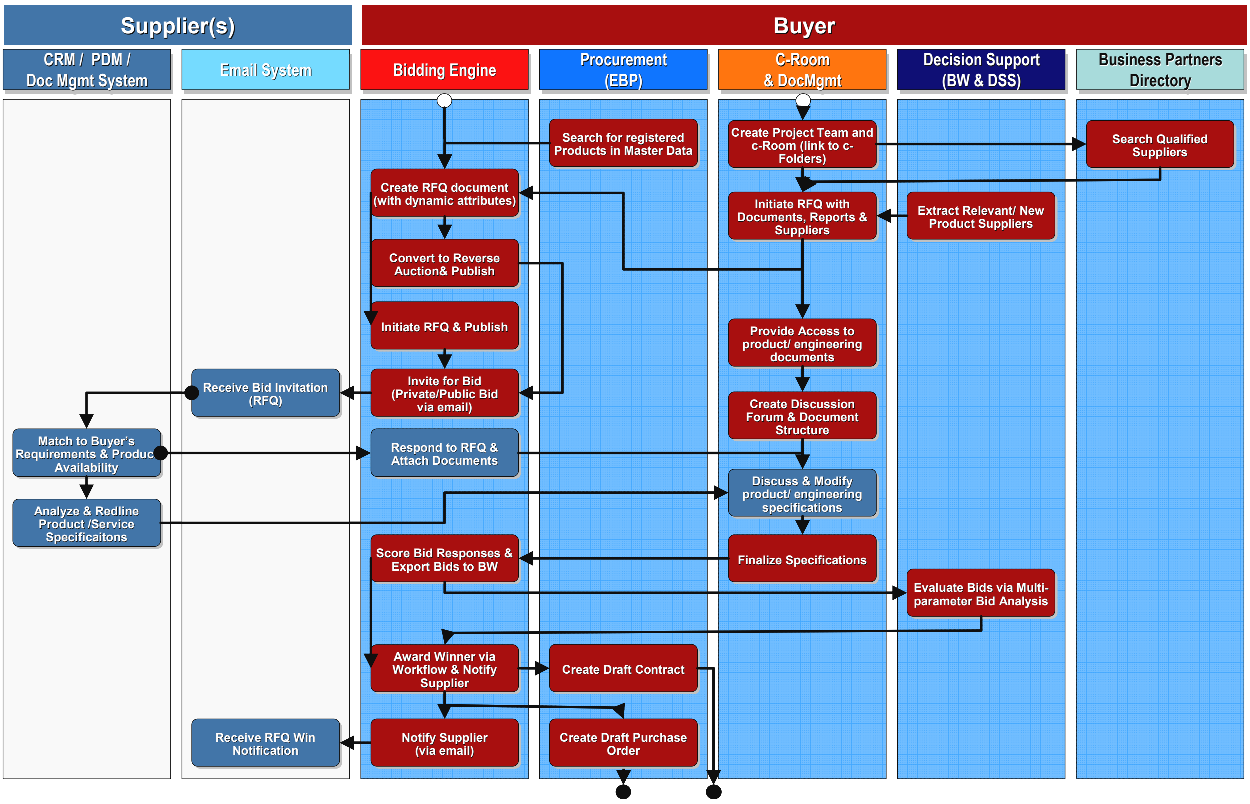


Figure 59: SRM Information Infrastructure practice - Supplier Evaluation and Selection.

The *Supplier Evaluation and Selection* scenario enables purchasing professionals to identify evaluate and select qualified suppliers. This can be done via an RFI cycle or if available suppliers exist via an RFQ process (that many lead into an auction). This often leads into a supplier negotiation –the process of choosing the right supplier for a certain product or material group. The scenario depicts how companies can use various auction and bidding techniques that enables purchasing professionals to negotiate the best possible terms and conditions. The above scenario might be different if we are dealing with complex products, which require extended internal preparation, such as gathering information from the engineering department leading into a *specification* roundtrip with the suppliers. This *Collaborative Tendering for Design & Engineering* scenario describes how companies optimize a cross-enterprise product development with internal and external teams including the sourcing of complex product components. This is reached among other things by a consistent central storage of all relevant data during the entire collaboration process and a secure integration of external partners and suppliers.

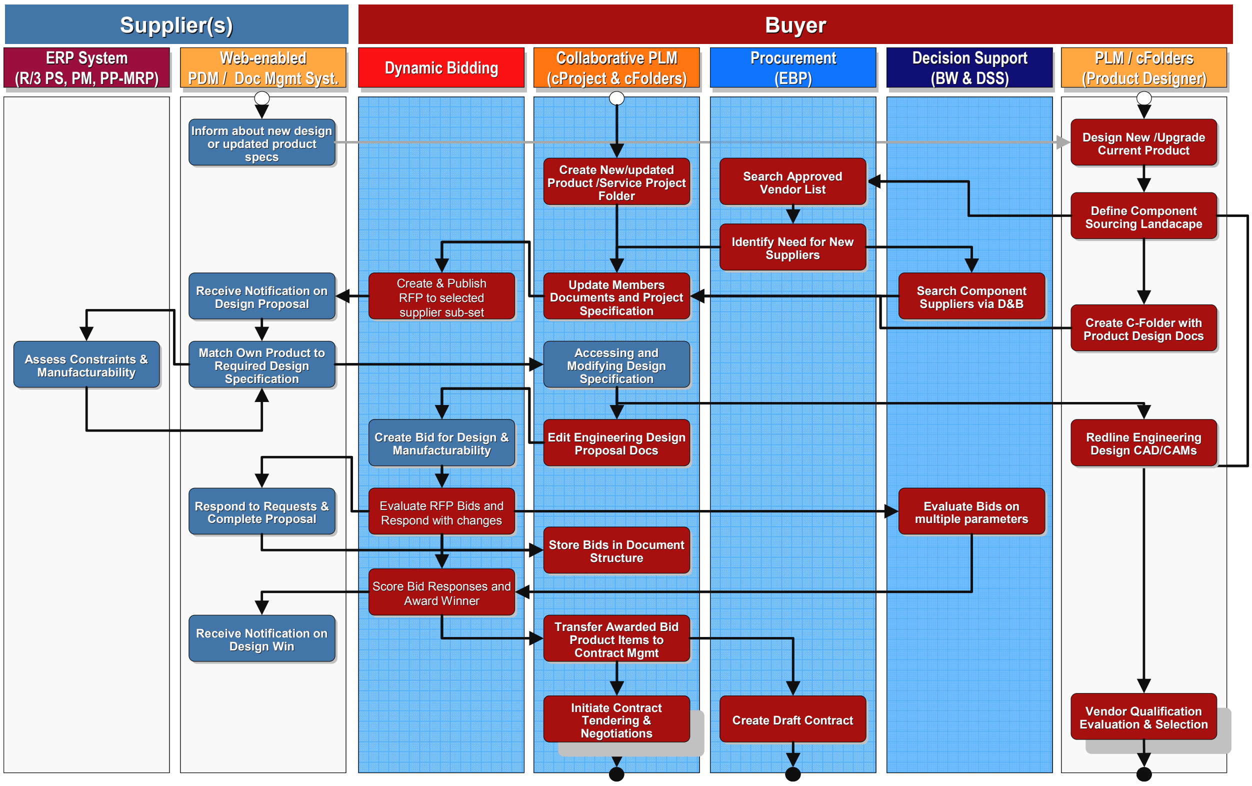


Figure 60: SRM Information Infrastructure practice - Collaborative Tendering for Design & Engineering

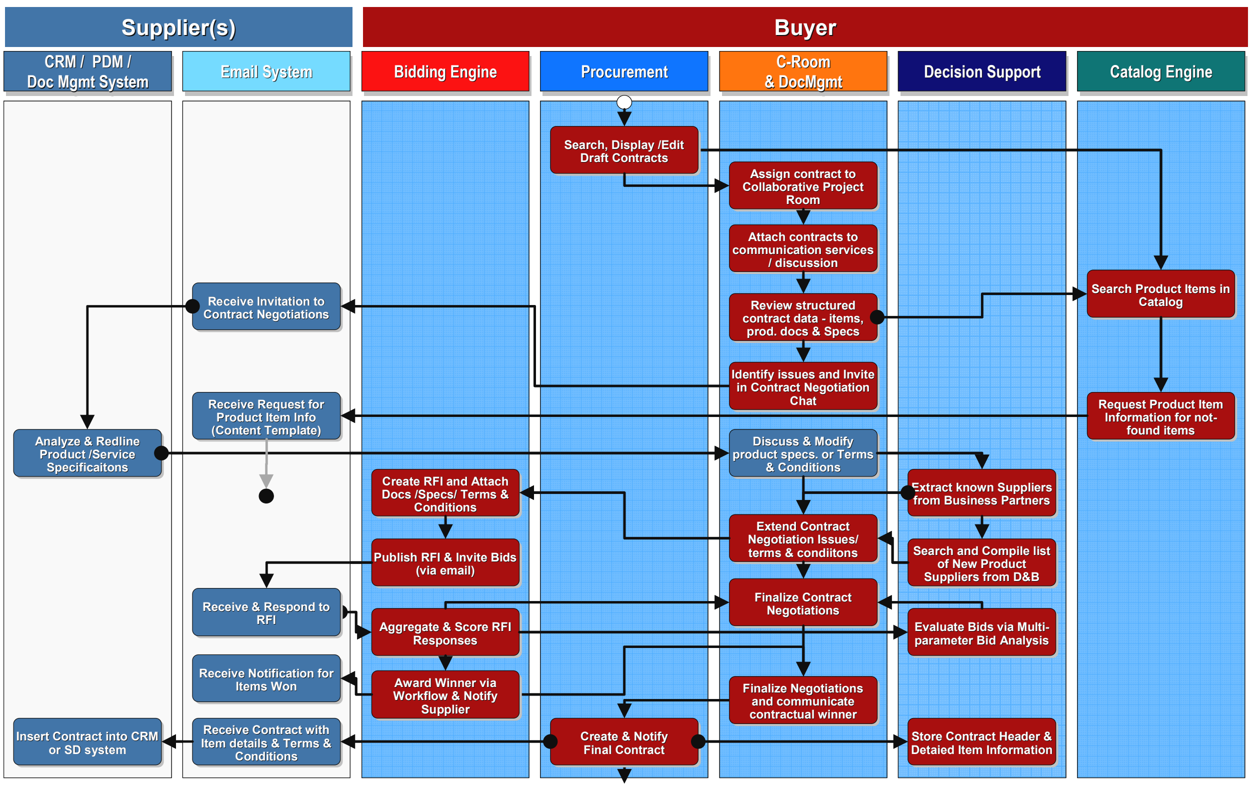


Figure 61: SRM Information Infrastructure practice - Contract Development incl. Tendering+Negotiation.

This scenario is often continuation in the *Contract Development* one. Contract development supports the process to create a new contract or to renegotiate an existing contract. It is a collaborative and workflow-driven process typically involving multiple different stakeholders (e.g. Purchasing, Engineering, Legal, Management etc.) within an organization prepare a first draft version of a contract. It is also a document-centric process as previous RFx items and prenegotiated clauses are often used in compliance to corporate standards.

So far most of the scenarios involve the Suppliers in a reactive mode. In the next two practices identified, the suppliers are "driving" the processes – these are Supplier-driven order management and content management. Both of these scenarios are part of a broader scenario that enables suppliers to handle the buying organizations' purchasing processes – via a company's eHub or Supplier Network consortium-based (i.e. eMarket). The first one of the Supplier Self-Services, the Web-based *order collaboration* process providing suppliers with a streamlined order management system, where suppliers can view, change, and respond the orders. All subsequent communications relating to a purchase order are exchanged electronically.

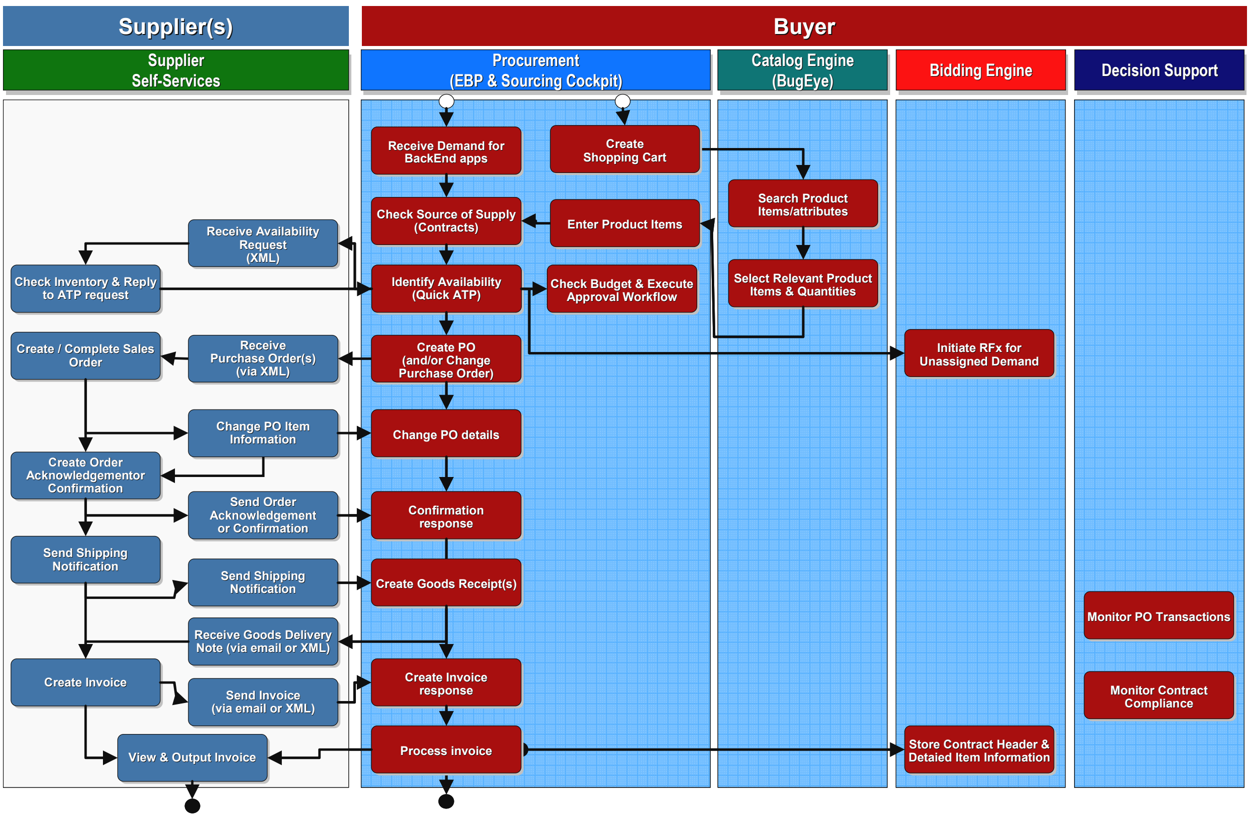


Figure 62: SRM Information Infrastructure practice – Supplier Self service Order collaboration management

The second process scenario in Supplier self-services is *Content Management*, which allows partners to handle the processing, creation and layout of the supplier data that constitutes the different catalogs: import of supplier catalogs, verification, clean up and format the data, classification and mapping, and enrichment of the data. Moreover this best practice process describes how suppliers maintain their own electronic supplier catalogs.

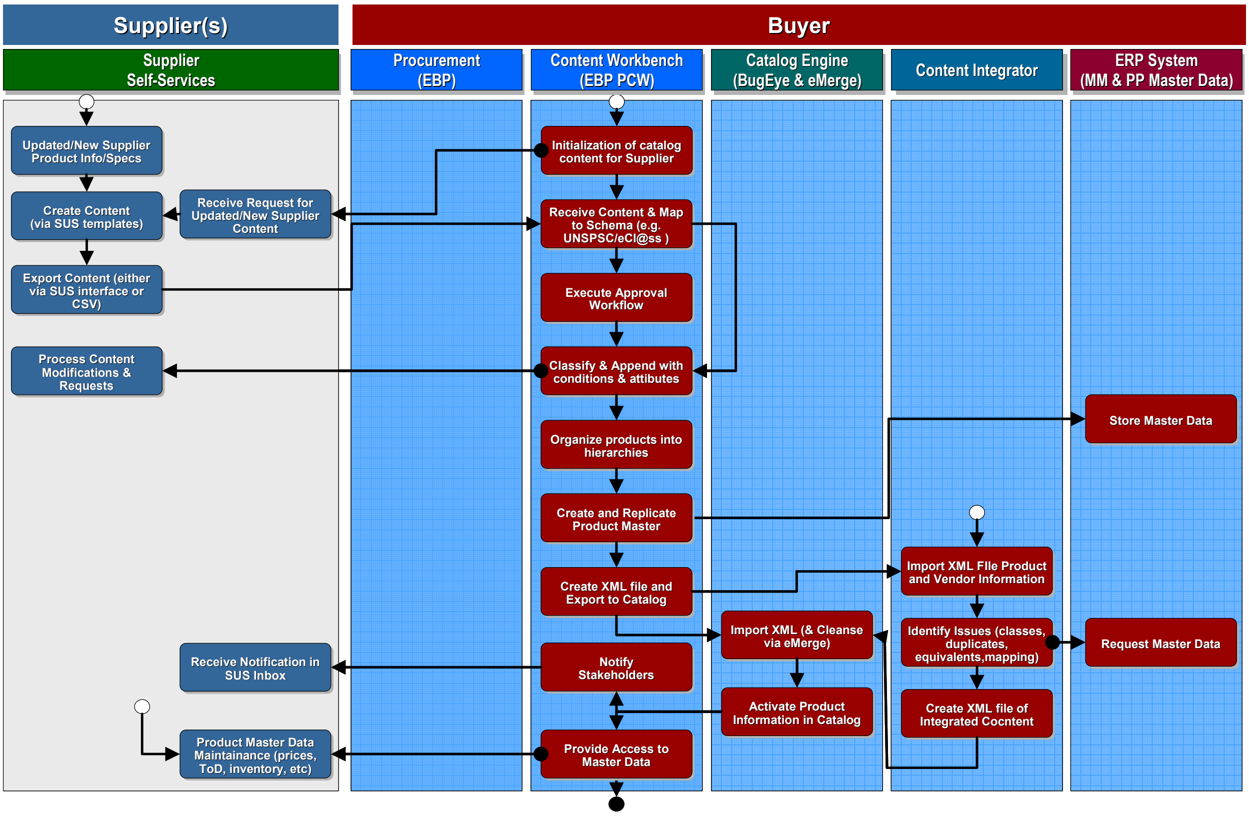


Figure 63: SRM Information Infrastructure practice – Supplier Self service Content Management

This scenario completes our current journey. We have shown only some of the most central of the maps developed so far and described in their entirety in Figure 52. As mentioned, this was an appropriate level of analysis, as we were searching for the competence-driven initiatives that help companies transform their SRM operations and enable them with IT. Also, we hope that this brief best practices overview has provided a more tangible picture of what we mean by a collaborative supply network. As seen in the figures above, most processes are transcending the borders of the enterprise by interacting in a synchronous or asynchronous manner with a multitude of suppliers.

4.6 Enabling SRM – Deep Dive into the Performance Metrics of SRM

These IT-enabled process activity, role-based and enabling application views helped us to create a substantive framework that incorporated performance and collaboration metrics used in our subsequent analysis. The table below summarizes our findings so far:

1. Total # of active suppliers
2. # of Suppliers per 80% Spent
3. % of Suppliers per 80% Spent
4. Total # of schedule deliveries
5. Average # of Deliveries per Supplier
6. # of On-time deliveries
7. # of late deliveries
8. # of early deliveries
9. # of complete deliveries
10. # of deliveries received without any queries due to quality, quantity or paperwork
11. # of rejected shipments/deliveries
12. # of deliveries proper unloading equipment provided
13. # of deliveries with accurate shipping documents provided
14. # of deliveries with Certificate of Analysis (COA) are used and accompany shipment
15. # of zero defect deliveries
16. # of stock-out occurrences
17. % of raw material written off in the last 12 months
18. Total Acquisition Costs
19. Total # of Invoices
20. # Invoices with right first time matching
21. # of Incorrect Invoices
22. Outstanding Payables ($)
23. Average invoice value
24. Total $ Purchase
25. Total Purchase $ within purchase organization
26. Total # of PO issued
27. Total Purchase $ under long term contract
28. Total PO under long term contracts
29. % $ in Blanket Orders vs. Total $ Purchased
30. % $ under contracts vs. Total $ Purchased
31. % $ in Spot Orders vs. Total $ Purchased
32. Total # of rush orders
33. % of items purchased through JIT
34. $ spent using differing payment terms
35. Total Inventory Turns
36. Raw material Inventory Turns
37. Total # of orders transacted via EDI
38. Total purchasing $ issued by EC
39. Total # of paperless transactions
40. Total # of paperless transactions
41. Average supplier lead time (from PO issue to delivery)
42. Average minutes required for supplier to acknowledge PO
43. % Spent on Qualified Suppliers
44. # of suppliers certified by quality department
45. # of suppliers with productivity improvement initiatives
46. # of long term contacts/agreements
47. # of new active suppliers in last two years
48. # of suppliers audited by Purchasing last year
49. # of suppliers involved in Idea generation of new product development
50. # of suppliers involved in Idea/concept generation of new product development
51. # of suppliers involved in Design of new product development
52. # suppliers involved in Tests of new product development
53. # of suppliers that are EDI capable
54. # and frequency of meetings with qualified suppliers
55. Total # of corrective action reports
56. Number of VA/VE initiatives launched in the past year
57. % cost savings from VA/VE initiatives versus total savings
58. Total # of key commodity categories
59. # of categories with standard specifications
60. # of specification reduction initiatives launched in the past year
61. # of RFP issued in the last 12 months
62. number of supplier with an active cost reduction program
63. Purchasing organization's time spent on transaction processing
64. Purchasing organization's time spent on value-added activities
65. Number of activities undertaken to reduce total requisition cycle time
66. $ Value of contracts identified not visible to procurement personnel
67. $ Value of contracts which have used Total Cost of Ownership perspective
68. Human resource budget for purchasing
69. Overhead allocation for AP
70. Total cost of AP process
71. Total number of transactions completed
72. Purchasing and Receiving budgets
73. Minimum order quantity for key suppliers
74. Number of orders incorrectly fulfilled

Table 9: Potential KPIs for performance improvement that might result from SRM implementation

In extension to our section on the SCOR Process framework, we also evaluated the SCM metrics or Level 1 KPIs tracked by the Supply Chain Council (the SCOR owner), with the process metrics that we documented during the development of the best-practice maps.

SCOR Level 1 SCM KPIs / SCOR Process Metrics	Delivery Performance	Fill Rates	Perfect Order Fulfillment	Order Fulfill-ment Lead Time	SC Respo-nse Time	Production Flexibility	Total SCM Cost	Value Added Produ-ctivity	Warranty Cost	Inventory Days of Supply	Cash-to-Cash Cycle Time	Asset Turns
Plan												
Demand Forecast Accuracy	✓✓		✓✓	✓✓	✓	✓	✓			✓✓	✓✓	
Finance, Planning and MIS Cost							✓✓					
Inventory Carrying Costs							✓✓					
Excess and Obsolete Inventory DOS					✓✓	✓	✓	✓		✓✓	✓✓	✓
Spare/Service Inventory DOS					✓✓	✓	✓	✓		✓✓	✓✓	✓
Source												
Material Acquisition Costs					✓	✓	✓✓	✓✓	✓			✓✓
Source Cycle Time	✓		✓	✓	✓✓	✓✓	✓			✓	✓	
Raw Material Days-Of-Supply										✓✓	✓✓	✓
Cost of Raw Material												✓✓
Incoming Material Quality	✓		✓✓				✓	✓	✓✓	✓✓	✓✓	

SCOR Level 1 SCM KPIs / SCOR Process Metrics	Delivery Performance	Fill Rates	Perfect Order Fulfillment	Order Fulfill-ment Lead Time	SC Respo-nse Time	Production Flexibility	Total SCM Cost	Value Added Produ-ctivity	Warranty Cost	Inventory Days of Supply	Cash-to-Cash Cycle Time	Asset Turns
Make												
Master Schedule Achievement		✓✓		✓✓						✓✓	✓✓	
Make Cycle Time				✓	✓✓	✓✓					✓✓	
Labor and Overhead Costs							✓✓	✓				
Scrap expense							✓✓		✓✓			
WIP Days-Of-Supply					✓✓	✓				✓✓	✓✓	
Capacity Utilization					✓✓	✓✓						✓✓
Cost per Process								✓✓				✓
First Pass Yield per Process	✓		✓✓		✓	✓		✓	✓			✓✓
Deliver												
Order Management Costs							✓✓	✓				
Delivery to Schedule	✓✓		✓✓	✓						✓	✓✓	
Finish Goods Inventory Days-Of-Supply	✓	✓✓	✓		✓	✓		✓✓		✓✓	✓✓	✓

✓✓ *"high and direct influence"* ✓ *"soft or indirect influence"*

Table 10: Evaluation of SCOR Level 1 SCM KPIs and their relationship to typical Process Metrics.

An additional area we documented during our investigations was the *critical success factors* for realizing these same processes. What we found is reported in the following section.

4.7 Realizing SRM – Some Critical Success Factors or Inhibitors

Despite the compelling nature of the benefits of B2B infrastructures (Hartmann, et al, 2002), enterprises hoping for similar results face an uphill battle (Easton & Araujo, 2003). Because of the variety of goods and services purchased by the enterprise, the complexity of consumption, and hence complexity of cost structure, changes wrought in pursuit of business improvements will necessitate the transformation of the purchasing organization itself. Fundamentally enterprises will require different skill types to attain cost advantages through SRM. The movement to open sourcing as well as the need for more-efficient operations will necessitate re-engineering of purchasing processes. Re-engineering efforts — and ongoing purchasing operations — will require expertise beyond the purchasing department and involve other departments, business units and even trading partners. This suggests that reorganization will also be a theme of increasing recurrence. Yet, there is also a “mindset” barrier to such efforts. Most enterprises do not view suppliers as a source of competitive advantage, and enterprises are certainly not in the habit of looking to their internal procurement managers as the key to supporting internal customers through SRM. Thus, there are ingrained buying cultures and inappropriate incentive structures, that inhibit implementation of information infrastructures enabling the supply network. Some examples of inhibitors that often derail SRM efforts are often related to lack of:

1. appropriate global sourcing practices - Supplier selection is still often regional and based on finding the lowest cost,
2. strong, multi-criteria competitive bidding practices that take a TCO perspective.
3. cooperation among business units and across functional areas.
4. enterprise cross-functional cooperation during the design/engineering and sourcing cycles
5. trust in or procedures to ensure suppliers' capabilities and commitments.
6. clarity on the roles of strategic sourcing and operational procurement (In some categories (e.g., capital goods, spot-buys and certain types of services) sourcing and procurement are one and the same.).
7. appropriate incentive systems - managers who are compensated based on behaviors that would preclude "trusting" their suppliers to support their enterprise business goals.
8. flexibility in supplier contracts and relationships that seem "cast in concrete"
9. relevant information architectures that obscure visibility into enterprise spending and SRM best practices
10. a set of metrics to measure non-price-related supplier qualifications[72].

In the end, the potential for value generated by such a information infrastructure is that it interconnects the symbiotic business network surrounding the firm. To summarize, such efforts are often hampered by current practices, relationships and business processes established within the firm and between its partners.

[72] Such metrics might be: on-time delivery; quality of product; quality of service; category coverage; production lead times; bar coding, electronic data exchange (EDI), Web or XML; updated manufacturing technologies and R&D commitments; fulfillment costs; payment terms and electronic funds transfer (EFT) capabilities; the cost and business value (e.g., marketability of new features) vs. the cost efficiency of standardization

4.8 Supply Networks and SRM Summary – Completing the Circle

Thus far, little substantiated guidance has been provided to companies and managers on how to configure and deploy supply networks. There is a need to better understand exactly “how” and “why” collaborative processes are created, what do they depend upon, and how can they be designed and enabled to ensure proper management attention, resource and time allocation. We need to understand just how different network structures demand differing degrees of enablement. Finally, we believe that it is imperative to expose the opportunities and deficiencies of the current applications and supporting methodologies in order to ensure exactly how comprehensive a collaborative supply network solutions may be deployed. We believe, that such supply network configuration is necessary, in order to extract the often elusive benefits of B2B.

These hopefully not too antagonistic messages brings us to the end of this chapter and the end of this part of the dissertation where we presented the theories, definitions, background and preliminary syntheses leading to the definition and evaluation of our construct of research themes.

5. RESEARCH THEMES, METHODOLOGY AND DESIGN

We have taken the reader through an journey on the latest collaborative business models available in the area of Supply Networks and delved into the Supply Relationship Management business domain. We have attempted to expose the deployment complexity of such models, which evidently will benefit from more normative guidance assisting companies and managers on how to design supply networks and enable them with collaborative, interorganizational information infrastructures. Such methodologies and tools are needed by practitioners to successfully deal with the complexity of the transformation task. There is a need to better understand exactly "what" are the preconditions of successful transformation of such business models based on collaborative or integrative processes, and how they should be designed to ensure proper management attention, resource and time allocation. Implicitly, we believe that it is imperative to expose the deficiencies of exclusively company-centric Enterprise Architecture methodologies (like e.g. TOGAF[73]). Additionally, as mentioned in Chapter 2, we need to move beyond the simplistic views of Management Research & practice of IT as a "resource"!

Still, there seems to be limited research pertaining to the transformation factors afflicted by intermediate, network entities, structures and processes on contemporary business networks. Large parts of the evidence supporting the above developments is qualitative with few exceptions (Subramanian & Shaw, 2002). While we could pursue similar approaches as in earlier studies (e.g. Management Process Infrastructures, Nøkkentved & Rosenø, 1998), and utilize generic conceptual contributions from research in business networks[74], we have chosen to follow Easton and Araujo's (2003) recommendations to develop "contextual factors" or contingencies intermediating between the firm's capabilities, transformation initiatives and the outcomes of IT-enablement and Operational Efficiency. We hope that that our contribution may provide the outlines of a "toolbox" to study the critical success factors attached to the *business model innovation* phenomenon.

---

[73] The Open Group Architecture Framework (TOGAF) is a framework - a detailed method and a set of supporting tools - for developing an enterprise architecture. Read more about TGAF in http://www.opengroup.org/architecture/togaf8-doc/arch/

[74] For example, we could study collaborative supply networks with Ford's (1997:69-71) dimensions of of interorganizational relationships (i.e. *formalization, intensity, reciprocity, standardization* and *conflict*). Furthermore, we could use Ford's (1997:58-59) aspects of interaction to study the effects of interaction (*capability* and *mutuality*), and the implementation of interaction (*particularity* and *inconsistency*).

5.1 Research Themes – Understanding Enablement of Supply Networks

The objective of this dissertation is to assess how companies can commence with transforming their collaborative supply networks. To make it within a reasonable amount of pages and time we have delimited our study to the upstream part of collaborative supply networks – the Supplier Relationship Management (SRM) business domain. We have in the previous chapters provided amble information constituting the backdrop of a transformation methodology as we have exposed: a) which are the prevailing Collaborative Supply Network models; b) what are the most common Collaborative Processes and their Benefits, and c) what level of SRM Enablement is currently available. In the remainder of this chapter, after a reformulation of our research themes, we will immerse ourselves in a discourse on methodologies that we will apply, and then bring the chapter to a close with a brief overview of the research design.

5.1.1 An Overview of our Research Themes from the SRM perspective

In the introductory section we presented our list of research themes that would be driving this research. Below we depict a view of our main conceptual constructs, their interdependencies, and research themes that we will pursue within the SRM domain.

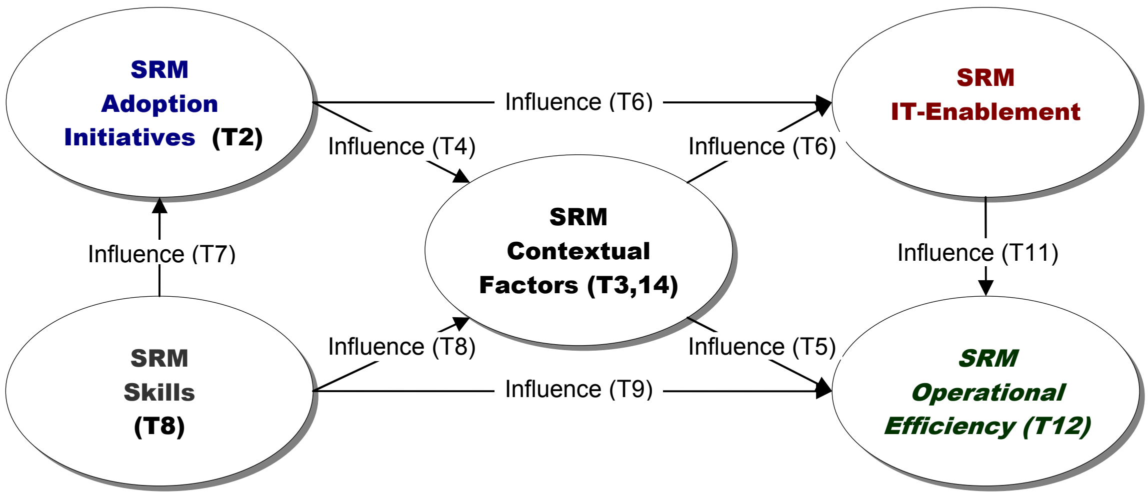


Figure 64: Overview of the *SRM Transformation Constructs* and *Interdependencies* in this research.

Our effort in the next chapters will be to navigate and evaluate our research themes. Let us reformulate them as we have selected SRM as our Business Domain:

T1. What *Business Models* exist that sufficiently describe Collaborative Supply Networks?

T2. What are the *SRM Adoption Initiatives* that typically drive change in this Domain?

T3. What are the *SRM Contextual Factors* that sufficiently characterize the SRM Domain?

T4. Which Contextual factors are influenced by the *SRM Adoption Initiatives* driving transformation?

T5. Which SRM Contextual factors influence *SRM Efficiency*?

T6. How does SRM Contextual factors and Initiatives influence *SRM IT-enablement*?

T7. How does SRM Capabilities or Skills influence the *SRM Initiatives*?

T8. Which SRM Skills influence the *SRM Contextual factors*?

T9. Are SRM Skills influencing the *SRM Efficiency*?

T10. How does Other Contingencies as Industry, Geography and Size affect our Construct?

T11. Does the state of SRM IT-Enablement influence *SRM Efficiency*?

T12. What are the Value-related Metrics that help us measure *SRM Efficiency*?

T13. What is the Role of Actors in defining the state, outcomes and priorities of *SRM IT-Enablement*?

T14. Are SRM Efficient Companies pursuing a broader set of *SRM Contextual Factors*?

5.1.2 An Amended view on our Business Model Innovation Construct

So far, from the above 14 themes we have only elaborated on the initial one, T1, in these last 3 chapters. Yet, what happened was that we actually enriched our view of what are some of the constituent and explanatory parameters within each of the main constructs. Actually only recently we discussed the performance parameters within SRM, thus shedding some light on our theme T12. Moreover we are clear that within the transformation initiatives there might be a distinction between long-term/ strategic and more operational ones as shown in Figure 52. The core of our argument, our intermediate construct *SRM Contextual Factors*, were explored in these last 2 chapters. For example, the role of the industry was discussed in the SRM introduction, while the area of emergent business models (on eMarkets and eHubs), provided some insights into how companies use external parties for various outsourcing efforts. Moreover, during our detailed exposition of the main SRM business process scenarios we described in detail the Actor-Activity-Applications bundles. In there we did distinguish some differences pertaining to their focus, predisposition and orientation. They may be either running the operations, deciding on sourcing, or setting the priorities or monitoring execution.

With these process attributes and perspectives in mind we iteratively enhanced our original construct view to incorporate the a number of subconstructs. Based on our earlier research (Nøkkentved & Rosenø, 1998) and Supply Networks relevant indicators from Gadde and Håkansson (2001), we decided on a number of conceptual context factors that we would evaluate in our analysis – these were: a) Company *Business Context* (i.e. Industry, Size, Location, etc.), b) *Outsourcing Context* (i.e. state, type, etc), c) *Operational Context* (or State of Resource Allocations), d) *Operational Priorities* (i.e. Objective-setting driving planning, operations and change), and e) *Operational Visibility* (i.e. Control processes like measurements and monitoring). We were still uncertain about the nature and direction of interdependencies among these concepts. All of these conceptual factors are depicted below with the most reasonable linkages. As will be discussed later, we were unable to justify them or even propose any sequencing or causality, thus we choose to evaluate the framework during our quantitative analysis with a Structural Equation Model (SEM).

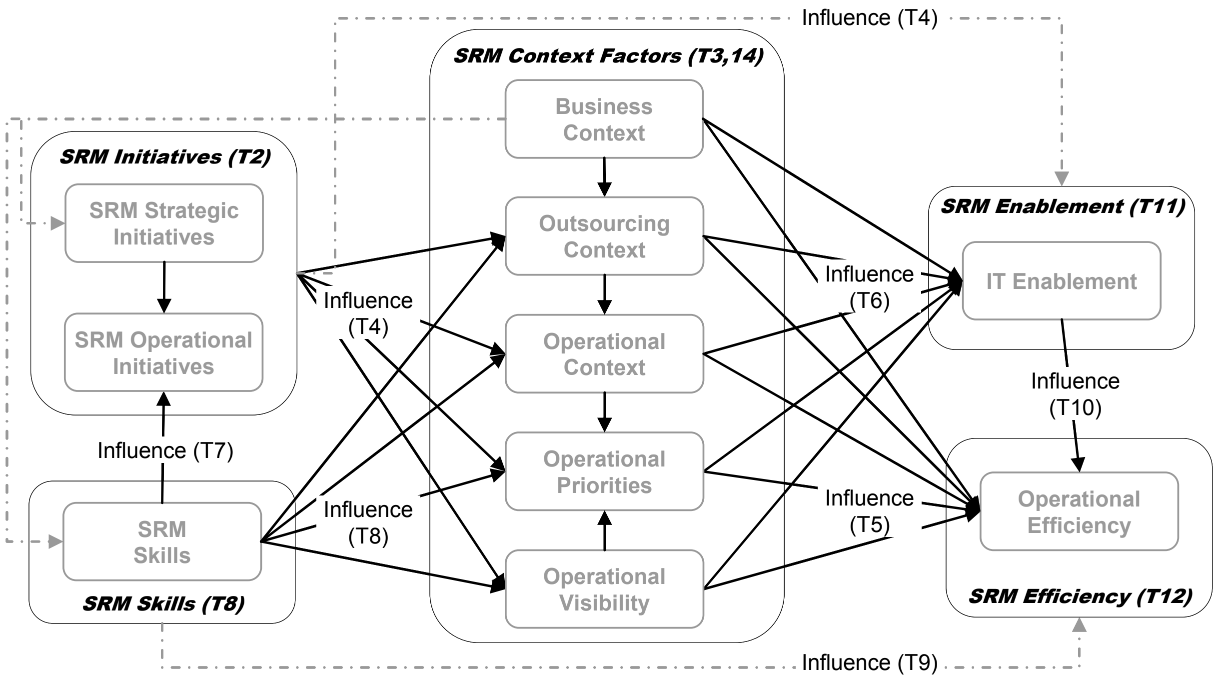


Figure 65: SRM Transformation Constructs with Subconstructs and Causal Interdependencies.

5.1.3 *Identifying Transformation/Adoption Factors in Collaborative Supply Networks*

Even if the company does deploy best-practice processes, it is expected that development of such information infrastructures lead to major change management and transformation efforts. These as well as other factors contributing to the *successful project implementation* like executive support, project and change management, project communications, business cases and technical skills and continuous application maintenance and operations skills, were assumed as given in that most organizations either develop these skill sets or insource them from external partners[75]. Hence, from a practical perspective we will construct a framework that may assist companies in exposing current and/or lacking procurement and sourcing capabilities and their alignment to the objectives of transformation prior to commencing with such an effort.

Our main thrust and argument is that *successful capability-driven IT-enablement initiatives lead to performance improvements* (Subramanian and Shaw, 2001). However, these initiatives are not having a direct effect on performance in that they may be constrained by a set of intermediate contingencies. Our focus is on overall contingencies (enablers and constraints) of the successful deployment of collaborative supply network supporting the SRM business model domain. We have supplemented and studied some of the factors identified and assessed by a recent research effort conducted by Hartmann et al. (2002), and we will use them to build our measurement model.

While our dissertation presents a smooth, linear and evolutionary progression towards our construct, in fact this has been an iterative process that circled between qualitative and quantitative research. Thus, we made a conscious decision to present a more detailed account of our research design where it made most sense – within some of the chapters. For example, on the qualitative, council approach, we will do a more detailed introduction outlining the approach and background in the relevant chapter. Similarly with the quantitative construct design. The importance of this chapter is hinged mainly on our retrospect of what we will investigate with our themes, and then with what method.

---

[75] Other systems development practices which contribute to project success are effective project planning, effective change control, business justification, compatibility of skills with the skill set needed for project requirements, and leadership by a “champion” who markets the project internally. These are well researched areas and plenty of external and intenal documentation exist (e.g. IBM’s 7-Key of Success in the Ascendant Methodology), thus we choose not to investigate them in detail. We presumed that successful implementation implied them.

5.2 Research Methodology – Background and Choices…

Research into highly complex socio-technical systems like (inter-)organizational networks should preferably utilize eclectic approaches that often demands inclusion of a multiplicity of perspectives and theory-building paradigms (Brown et al. 1999). The selection of a best methodology for any particular research project is critical to the resulting quality and value of that project. The selection of the best research methodology should be determined within the context of research objectives (Barua et al, 2001).

Given that our own study has been primarily seeded by the central question of deployment of best practices in IT-enabled transformation in the upstream domain of supplier relationship management, the most appealing epistemological method was the grounded theory approach within the Interpretivist tradition (Walsham, 1995; Orlikowski 1992). This philosophical perspective helps to encompass and categorize the interpretive flexibility of information systems (Orlikowski 1992) which focuses on the mutual influence of information and communication systems, organizations and human actors.

Subsequently, and after iterations and refinements we were able to transition into a more normative, inference-prone statistical analysis via a survey-based sample. It was the marriage of methods rather than rhetorical side-taking that led to the our final construct. In this section we will provide a brief overview over the methods we have employed during the course of our investigation.

5.2.1 Interpretative research in IS – Making use of the main principles

Information Systems research can be classified as positivistic, interpretive or critical. Klein and Myers (1999:69) have attempted to classify various IS research methods, as:

1. *positivistic,* when there is evidence of formal propositions, quantifiable measures of variables, hypothesis testing, and the drawing of inferences about a phenomenon from a representative sample to a stated population.
2. *critical,* if the main task is seen as being one of social critique, whereby the restrictive and alienating conditions of the status quo are brought to light. Critical research seeks to be emancipatory in that it aims to help eliminate the causes of unwarranted alienation and domination and thereby enhance the opportunities for realizing human potential;

3. *interpretive,* if it is assumed that our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings documents, tools, and other artifacts. Interpretive research does not predefine dependent and independent variables but focuses on the complexity of human sense making as the situation emerges (Klein & Myers, 1999:69).

In our case, interpretative research seemed to be an appealing approach as the intention was to study the practices of IS practitioners within a particular, yet multi-theoretical field. Within this philosophical and research tradition, Klein and Myers (1999:69) defined 7 *Principles of Interpretive Field Research*[76]. Of these the 3rd "principle of interaction between the researchers and the subjects", seemed relevant to our study format, in that the initial, interactive, qualitative part of our research (i.e. the qualitative survey and council work), where the author participated and interacted with a team of subject matter experts to "interpret" and identify a set of constructs describing transformation initiatives. According Klein and Myers (1999:74):

> "interpretive researchers must recognize that the participants, just as much as the researcher, can be seen as interpreters and analysts. Participants are interpreters as they alter their horizons by the appropriation of concepts used by IS researchers, consultants, vendors, and other parties interacting with them, and they are analysts in so far as their actions are altered by their changed horizons. "

The other principle at play in our study has been the 4th one, the "principle of abstraction and generalization", where we attempt to abstract, test and then partially generalize our initial qualitative construct with a survey. Klein and Myers (1999:75) quote Walsham (1995) on the

[76] Klein and Myers (1999:72) described these principles as the following:
1) The fundamental principle of the hermeneutic circle - this principle suggests that all human understanding is achieved by iteration between the interdependent meaning of parts and the whole they form. This principle of human understanding is fundamental to all the other principles.
2) The principle of contextualisation - requires critical reflection on the social and historical background of the research setting, so that the indented audience can see how the current situation under investigation emerged.
3) The principle of interaction between the researchers and the subjects, which equires a critical reflection on how the research materials (or 'data') were socially constructed through the interaction between the researchers and the participants.
4) The principle of abstraction and generalization, pertains to the idiographic details revealed by the data interpretation trough the application of principles one and two to the theoretical, general concepts that describe the nature of human understanding and social action.
5) The principle of dialogical reasoning, denoted the sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings (' the story which the data tell') with subsequent cycles of revision.
6) The principle of multiple interpretations, requires sensitivity to possible differences in interpretations among the participants as are typically expressed in multiple narratives or stories of the sequence of events under study. Similar to multiple witness account even if all tell it as they saw it. The final one mentioned by the authors was;
7) the principle of suspicion, which requires sensitivity to possible 'biases' and systematic 'distortions' in the narratives collected from the participants.

various types of generalizations from interpretive case studies – the development of concepts, the generation of theory, the drawing of specific implications, and the contribution of rich insight. Undoubtedly, our initial qualitative study was focusing on the development of concepts (e.g. our SRM transformation initiatives). The second part of our study, attempts to generalize identified the contextual factors affecting performance within a domain, yet we were early on in agreement with the viewpoints of researchers in the Actor-Network Theory approach like Tatnall & Gilding (1999: 963), stating that:

> "*Actor-network theory* extends ethnography to allow an analysis of both humans and technology by using a single register to analyze both, so avoiding the need to consider one as context for the other. It helps the researcher not to think in terms of human/non-human binaries and the different discourse with which each may be aligned. An actor-network analysis of information systems innovation may well be described as an ethnography but one that develops themes that conceptualize people and artifacts in terms of socio-technical networks, thus employing concepts such as networks, enrolments and actors."

Our early focus on understanding and documenting the Business Processes of Collaborative Business Models available to contemporary companies was ethnographical in nature, while the increased digitization of these same business processes erased the binary view of the human actor versus their avatars implemented as roles (or actants) in the latest iterations of enterprise applications. Our effort to generalize the interpreted concepts derived in unison with "analysts" (e.g. our SMEs in SRM), was a natural next step in using theory to make "sense" of the "contextual factors" leading to success of Information Infrastructures. Yet, it would be difficult to follow Actor Network Theory to its fruition in that we had difficulties discerning the method of "translation"(Callon, 1993), and Walsham's (1997) description of irreversibility and "black boxes" into a guided procedure of our quest to "sensitize" the transformation needed and its effects (Latour, 1999).

In comparison to pure case-study based Interpretivist research, we were embedded in a context of a large consulting company that was in a quest to better understand the field of study in order to be able to deliver more client matching solutions with this domain. Hence, we had the opportunity to mobilize the broader organization and utilize both qualitative and quantitative techniques, enabling us to improve the rigor and explanation of the results achieved. Hence the latest tenets of grounded theory and described by Charmaz (2000), who advocates varied forms of data collection, made a lot of sense, even under the essentialist criticism of Tatnall & Gilding (1999: 963)[77]. Our concern was more on the "interpretation" of the abstract construct we initially posed, hence we turned to the study of grounded theory to gain a better foothold on whether we should abandon Interpretivism for Positivism, as we were transitioning into inferential statistics via methods like Partial least squares (Gefen et al. 2000).

5.2.2 Grounded Theory – Making Sense of Theory building

Grounded Theory (GT) is a general methodology for building theories that are grounded in data, systematically gathered and analyzed, with the purpose of developing theoretically comprehensive explanations about a particular phenomenon. Strauss and Corbin (1990:23) explain the GT approach as:

> "one that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systematic data collection, analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, and then prove it. Rather, one begins with an area of study and what is relevant to that area is allowed to emerge".

The GT method proponents acknowledge that there might be several views of reality, which should be represented as accurately as possible. In this way, the imperfect and probabilistic nature of reality apprehension - a specific assumption of post-positivism - is recognized. The techniques and analytical procedures enable investigators to develop a substantive theory that is significant, theory-observation compatible, generalizable, reproducible and rigorous such as other qualitative research methods.

While this is the traditional way of understanding the GT method, recently, some researchers proposed using the GT method in conjunction with the constructivist paradigm, wherein it can be used as a flexible, heuristic strategy rather than a formal method (Charmaz 2000). A focus on meaning while using GT method furthers interpretative understanding. In this case, all developed theories would be contextual, formed by the conditions guiding action of actors embedded in specific socio-technical settings. The developed theory will serve, then to highlight beliefs, meanings, yet also expose contradictions, paradoxes related to concepts guiding action in specific contexts. In our study context, the idea was to help question reality

[77] They state that: "Methodologies such a grounded theory lend themselves to essentialist descriptions of phenomena arising out of the coding process. Open, closed, axial and systematic coding with their reliance on the concepts of categories, properties and dimensions lead us to think about innate properties rather than properties arising out of negotiation."

created by the practitioners' actions and interactions, and finding useful new ways of thinking and acting. No matter which approach we pursue, the results should provide an idea where the data came from, how the data were rendered and how concepts were integrated. According to Haig (1995), a good *grounded theory* is one that is (1) inductively derived from data; (2) subjected to theoretical elaboration, and (3) judged adequate to its domain with respect to a number of evaluation criteria.

One of the appealing guidelines provided by the GT method pertains to *coding* enabling the transformation of data to a theory. Coding is defined as the analytic process through which data are fractured, conceptualized, and integrated to form theory (Strauss & Corbin, 1998:3). Its aim is to identify, develop and relate the concepts that are the building blocks of theory. The authors identify three different types of coding to transform data into a theory that is grounded in reality: open coding, axial coding and selective coding, where:

1. *Open coding*: means labeling concepts that represent discrete happenings and other instances of the phenomena.
2. *Axial coding*: denotes the procedures by which data are put back together in new ways after open coding, by making connections between categories, and finally,
3. *Selective coding* is the process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development.

During *open coding*, sampling should be done as wide as possible to enable researchers to be open to discover concepts in the situation (Haig, 1995). Although sampling should be done systematically, the researcher must be flexible to code any event that he/she finds interesting for the study (Strauss & Corbin, 1998:210). During the study the researcher should question and compare the data continuously. The answers to the researcher's questions will lead to further sampling and the coding of more incidents. During *axial coding*, sampling is done to define the dimensions and properties of the categories as well as to define the sub categories and their relationships to the categories. During *selection coding*, sampling is used to strengthen the theory, while dependencies are tested between proposed concepts. This means that more coding does not alter the description of the categories, but rather their positioning vis-à-vis each other. Hence, in GT, the concepts that result in categories emerge from the data and iterations of interactions. In the proposed study the grounded theory should link the realities of SRM practitioners[78] to concepts of transformation initiatives – our initial qualitative part of the study. By taking the ANT criticism of GT being too essentialist, we then had a clear method of generating categories of initiatives resulting from open and axial coding reflecting both theoretical recommendations (Gadde & Håkansson, 2001) and SRM best practices. Coding commenced from a deducting extract of proven theoretical statements or perceptions from field research in this well-defined area of Supply Networks (Harland, 1996) – not just open ended exploration. We then evaluated with the council team members and detailed further via axial coding. Further, a central thread of our method was to find the realization schedule of such initiates. Here we utilized the participant's deep practical insights to conduct selective coding via interdependency mapping which was subsequently analyzed via Social Network Analysis (SNA) techniques.

To summarize, our perceptions were stipulated as preliminary categories, while refinement, inclusion or even exclusion of categories was done systematically against the stated perceptions or qualifications of each – in line with the Charmaz's (2000) recommendations. The marrying of approaches enabled us to use deductive approaches with the more interpretive, inductive perspective of GT that let's a theoretical concept emerge from observational data, while we then could attempt to better grounded them based on incidents in the data assembled via a quantitative survey. Naturally, the transition of these same categories after the first round was an additional iteration, where consensus drove the final ones to be investigated normatively.

5.2.3 What about Action Research?

According to Brown et al. (1999), in an *action research* perspective the role of the researcher is not only to observe but also to influence the system once context, problem area and status quo of current projects and solutions are sufficiently understood. As the author was actually in the period between 2001-2004 involved in managing large SRM projects, it was more appropriate to characterize the consequences of the Council Team's qualitative, GT-driven definition of SRM initiatives as emancipating among project of the time, as it changed and intervened in the practices of IS professionals - hence in line with the above definition of action research. If the study concluded in that period this would have been the main methodological underpinning,

[78] We have viewed this studu as a synergistic marriage of hands-on consulting practitioners with rigorous academic IS and Business Networks research. This line of thinking is supported by Davenport and Markus (1999), who argue about the mutial benefits of consulting practices and academic research.

yet as we continued with the subsequent, much broader, in terms of concepts, quantitative evaluation of our construct, we moved away from the influencing role[79].

Moreover, we remind that the main purpose of this study should be to develop a framework for improving IS-related adoption practices. While we did test the acceptance of the SRM initiatives framework in various industries and IS professionals of IBM, this was only part of the proposed framework. Our approach differs from typical Action Research project where the researcher advocates a course of action to be taken and tests the success of that action. Grounded theory coding methods were used prior and after that qualitative phase, so just like Baskerville and Pries-Heje (1999) we used GT coding methods to enrich the theoretical underpinning of an action research study.

5.2.4 Method Summary - Towards Iterative Grounded theory

As Orton (1997) refers to, our methodological approach can be characterized as a constructivist-variant of an *iterative grounded theory*. In retrospect and given the aforementioned, we do contend that, while research based upon a profound literature study has its merits we still believe that a combination of quantitative and qualitative research is better suited for exploratory, theory-building endeavors like ours. Theory building is after all the result of a spiraling process from open, unsubstantiated views to practice to existing literature and back. Theoretical frames used here are the IMP Group's Industrial Networks and Interaction Approach (Ford, 1997), transformation of Information Infrastructures (Weil & Broadbent, 1998, Ciborra, 1999, 2001), domain specific theories and conceptualization (Pagh et al, 1998; Gadde and Håkansson 2001) and internationalization theories from international business theory (Weisfelder 2001). The concept of key success factors form strategic management and supplier networks theory (Harland, 1996; Snehota & Håkansson, 1995), while global sourcing challenges and issues as presented in the purchasing literature (e.g. Monczka and Trent 1991. Concepts of co-evolution and network interdependence was primarily derived from the IMP literature (Ford 1998; Gadde and Håkansson 2001), given that our focus was on transforming the business model. The following section will therefore provide a brief overview of how we designed our research consisting of 2 qualitative rounds followed by a quantitative study, while the subsequent chapters will elaborate these in detail.

---

[79] For a period of 2 years, the author was actually the manager of the SAP SRM Community of Practice of PriceWaterhouseCoopers Consulting and then IBM in Europe, thus partially influencing not only the consultants, but also clients and vendors alike.

5.3 Research Design – Iterative Construct Development

The research method we pursued combined findings derived from an *iterative grounded-theory* driven by multiple a*ction-research* iterations leading to a qualitative construct development phase. This phase then seeded the design of the measures and subconstructs that was investigated via the global CPO survey which opened the door to our quantitative phase –that is in brief how the research effort led to our e*mpirical results*..

5.3.1 Initial Construct Exploration - The Qualitative PwCC Survey 2001

This was the initial stage of the qualitative research. Based on a consolidation of experiences from numerous client assignments a questionnaire was developed by the author, which was then reviewed and approved by the team assigned to conduct the survey. The initial objective was to identify and report back to the consulting practice on CSFs of eProcurement projects conducted in the period between 1999 and 2001 (by PwCC – subsequently acquired by IBM). A clear objective of these efforts were to enhance our understanding of value creation via the alignment of organizational (process, structure, strategy) and technological factors. The results of this survey were published in summer 2001 in internal publications, which relayed current practices and potential pitfalls of procurement initiatives.

The survey consisted of over 100 questions and was administered to 50 project managers responsible for North American procurement projects selected for this survey and drawn from manufacturing and non-manufacturing industries, varying in size from the world's largest organizations to moderately sized companies. The sample concentrated on companies pursuing the creation of extensive supplier relationships enabled by information and communication technologies, especially via eProcurement, eSourcing and ERP systems. Of all the completed questionnaires, 30 projects were qualified as being either in the process of implementing an eProcurement solution, or were in process of extending an operational eProcurement solution for a client. In order to elaborate on the answers provided, and with the consent of the original respondents, additional questions were emailed. After reviewing the answers, telephone interviews were conducted by the author and the team focusing on the issues highlighted.

While the sample was not sufficiently large to draw statistical inferences, it did consolidate many project managers' experiences not only from their current projects, but also previous ones, thus enabling us to identify issues and challenges facing such efforts. Hence, this effort provided a lot of valuable information to commence with the creation of best-practices for SRM. Actually, there was too much information reported back, as the original questionnaire was too open ended (e.g. open-coding in GT) as we were interested to learn in a field that at that time was not well-defined. Consequently we needed to identify and extract the conceptual categories in more detail (i.e. Axial Coding process of GT). Hence we sampled some of the most knowledgeable of the project managers and asked them to join us in a series of workshops – the council sessions.

5.3.2 Qualitative Construct Creation via Council

This group of project managers or subject matter experts (SMEs) – the " Council of Judges", were invited to discuss and exploratively refine the categories /concepts and statements highlighted by the survey in order to define relationships between value creation factors and their underlying contingencies. The objective of these sessions was to get agreement on the exact definition of the initiatives as postulated in our theme T2. At that stage we also collaborated and exchanged a lot of ideas on concepts and realization potential with a group of 3 SMEs from SAP, who functioned as referees regarding the realization potential of the transformations explored.

The initial workshop of this *Council of Judges* took place in May of 2003. The author participated as a Catalyst, Facilitator and Scribe in these discussions (in true action research settings). We first detailed the experiences to date, presented the previous survey and the best practices assembled by IBM and SAP. Then we started reviewing the open-ended material from the survey. A qualitative clustering process (using 3M's Post-It) was used to group concepts like KPIs, processes, competencies, actions and "how-to's" on a whiteboard. In the second day of the workshop, we labeled the SRM Value drivers and started outlining the Transformation initiatives. We used both processes and CSFs from the first survey that did not relate to project execution related CSFs. We also used a map of competencies derived from the best practices and then the list of metrics proposed from SCOR and the survey.

The initial grouping on the whiteboards were made as to represent interdependent clusters of actions labeled as *SRM initiatives*. Each of them was evaluated for consistency by asking the judges to assess whether they represented a well-defined project or a subproject. The latter ones were subsumed within higher level descriptions. Each of the SRM Initiatives did in the end represent the consensus of the group on what represented individual projects often initiated by companies during the course of a broader SRM project. We evaluated their structure and preconditions and individual templates per initiative were constructed. Within each of them we disaggregated the issues, actions, KPIs and objectives identified by the previous survey and defined basic, distinguishable and actionable elements affecting their successful realization. In a subsequent session with SAP we evaluate the actual IT-enablement given their EBP and SRM applications.

One major and final undertaking that took a bit longer than expected was the assessment of the interdependencies between the various SRM Initiatives in order to enable us to sequence them in threads of realization. The proximities among these initiatives were evaluated leading to qualitative indications of the direction and strength of their mutual interdependencies. Thus a structured, exploratory framework emerged which combined the following elements: Value Drivers of information infrastructures enabling SRM practices and SRM Initiatives or contingent actions companies may undertake. One of the surprising results of this axial and selective coding of the concepts that we followed was that we did reach a consensus across the team and across the companies (IBM and SAP), given that the details per identified transformation initiative were substantial (in ANT terms the inscriptions and translations resulted in “black boxes”).

After the workshops the author continued for a longer period with a detailed analysis of the results via SNA (Social Network Analysis) methods and tools (e.g. UCINET and NETDRAW). These were reported to the team via phone and presentations, the materials were published in IBM’s internal knowledge infrastructure and disseminated via a multitude of internal and external events plus academic conferences. The actual construct was tested and refined with success in a couple of clients and the method was shared with SAP which used it as input for their solution development process for their 3rd release of their SRM application.

The research design in this phase followed guidelines provided by GT - data collection and analysis were highly iterative in nature. Theory building was a result of a spiraling process form cross-case analytic results to existing literature and back (Goedde and De Villiers, 1997) We did follow the *grounded theory* approach to obtain data about a phenomenon and allowed the construct of SRM initiatives to emerges from the discussions on the data. These categories (e.g. themes, concepts represented as initiatives) were grounded on data and experience.

5.3.3 The Quantitative Survey of 2004 and PLS Analysis of 2006-7.

The Council sessions led to a major iteration in this study back to theory and then forward to the overall construct as presented in our Research Themes. We understood early on that the transformation initiatives identified do not affect operating performance directly, but rather via a number of intermediaries. While we did identify these as contextual parameters they were not materialized into concrete questions before 2004. That year IBM launched an initiative to survey CPOs across the world on the state of their domain. The author shared the Council materials with IBM's Institute of Business Value (IBV) and reviewed the initial questions in a series of calls and meetings. The initial interview-based survey was conducted by IBV in Europe, which the author did not participate – thus these results are not reported in this dissertation. Nevertheless, the author reviewed the resulting amendments to the original questions made after the interviews, and provided input before the global web-based survey was executed by IBM in conjunction with the Economist Intelligence Unit. The measurement instrument was defined defined by the author as depicted in the figure below with a set of parameters per subconstruct and options that will be described in detail in Chapter 7.

Figure 66: Final Construct Measurement Design with Subconstructs' Parameters that were surveyed.

The IBV team did make the initial report and summarized the descriptive statistics in a series of internal presentations and web seminars. The author received the initial raw Data-set ultimo-2004 and an amended, final and consolidated version by Marc Bourde from IBV in mid-2005.

From the end of that year a new process commenced where the author started analyzing the results. One of the immediate issues faced was that the data set of 344 companies only included 127 answers on eProcurement, which unfortunately invalidated our idea of using LISREL – a co-variance based Structural Equation Model (SEM) technique – to study our causal model . After a review of recent literature in early 2006, another alternative SEM technique was identified (i.e. Partial Least Squares or PLS). However, analysis did not commence before the end of 2006 and was completed in spring of 2007.

The final dataset was thus subjected to an extensive barrage of statistical techniques to evaluate our hypotheses and evaluate the construct. We used SAS' JMP rel. 3.0 and 7.0 (in 2007) as we had amble experiences of using the tool in the ´90s. JMP is the de-facto software tool for statistical visualization, yet just as comprehensive as SAS. JMP was used to conduct and report on a number of multivariate analyses, while for the PLS analyses we used the excellent free-tool SmartPLS rel.2M3 (Ringle, Wende & Will, 2005). The analytical process went through the following steps:

1. For Descriptive analysis we used univariate statistics and means comparisons.
2. For the first round of hypotheses testing we used Cluster Analysis to identify significantly Performance clusters using Ward's and SOM.
3. Used Discriminant analysis to evaluate which Clustering technique led to then most differentiating result.
4. Then we subjected the surveyed parameters into a substantial Nonparametric Analysis of Variance (no-par ANOVA), to identify significant relationships between the Performance Level groups
5. Given that analysis, we then used PLS (the variance-based Structural Equation Modeling technique), to investigate our SRM Adoption Construct
6. Finally, we conducted a number of statistical validation analysis for the construct produced above.

This overview completes the description of our Research Design phase. We deemed that our method departed from our previous normative, hypotheses-driven research experiences in the 1990s (see Nøkkentved & Rosenø, 1998). It was refreshing to use an iterative Grounded Theory approach to create the measurement tool, by combining theory with practice in such a great environment as IBM's Business Consulting division. From now on we will attempt to report on the results.

6. Research Analysis – Building the Qualitative SRM Transformation Construct

In this chapter we will report on the first of the two-stage qualitative investigation pursued to create the SRM transformation construct. As explained in the final section on Research design the focus of the initial survey was to take the temperature of the experiences made with implementation of eProcurement projects. The initial survey will be presented in summary form while the Council round will be greatly elaborated.

6.1 eProcurement Qualitative Survey 2001 – Getting the Initial Overview

In June 2001, the leaders of the PwCC Procurement Value Chain Group commissioned a comprehensive procurement survey. The survey that the author helped to develop consisted of over 100 questions and was administered to 50 North American procurement clients.

The results of this survey were published in July 2001 in procurement studies released by AMR Research and PricewaterhouseCoopers. The 50 North American procurement clients selected for this survey were drawn from manufacturing and non-manufacturing industries, and vary in size from the world's largest organizations to moderately sized companies not appearing on this year's Fortune 500 listing. Client selection was primarily based on the appropriateness of the survey data. The project overview section identifies key characteristics of the selected clients.

Survey questions were designed to report the state of procurement in leading organizations touching on a number of areas reported below. The resulting analyses conducted by the author together with the team focused on the practices and potential pitfalls of procurement initiatives, in an attempt to provide procurement and information technology executives a view of the state of procurement. The areas investigated were Procurement Project Management, Business Case / ROI Development, Content / Catalog Management, Supplier Adoption, Advanced Commodities, Sourcing, Change Management, Technical Services including Software Maturity and Integration.

6.1.1 Overview of the Functionality used

In summary, the survey of the sample of companies that had implemented an indirect e-procurement application provided the following overall findings. On the utilized functionality delivered by such systems the following table highlights what the respondents answered. On the Benefits achieved the respondents provided us with the following:

- Cost savings average 10%.
- Inflated expectations and poor planning have caused project cutbacks and a lack of documented Return on Investment (ROI).
- Reductions in price via demand aggregation and maverick spending deliver benefits.
- Initial projects have been successful, but future phases were uncertain.
- Content management, process enforcement, and supplier enablement are the top three implementation barriers.

Table 11: SRM Survey 2001 - Overview of the System Functionality used by Respondents.

Functionality	Answers
Receive goods at user desktop	70%
Reconcile POs, receipts and invoices	60%
Receive goods at centralized location	56%
Integration to a procurement card or P-Card	56%
Receive purchase acknowledgements and ASNs	50%
International company sites	47%
International suppliers	45%
Settlement/electronic funds transfer	18%

6.1.2 Evaluating Project success

Of the buying organizations surveyed, the key drivers for their eProcurement implementations were based upon reaching project ROI based on savings and improved contract compliance. Finally some even mentioned the need to establish B2B presence. Most projects conducted ROI studies (82%), prior to an eProcurement Implementation. The median payback period was approximately 18 months. Efforts to improve compliance to supplier agreements were measured by companies via reduction in maverick buying (where with a technology solution, maverick buying was expected to decrease), enforced purchasing restrictions to catalogued items, and optimized and enabled approval rules and processes (improved process efficiency).

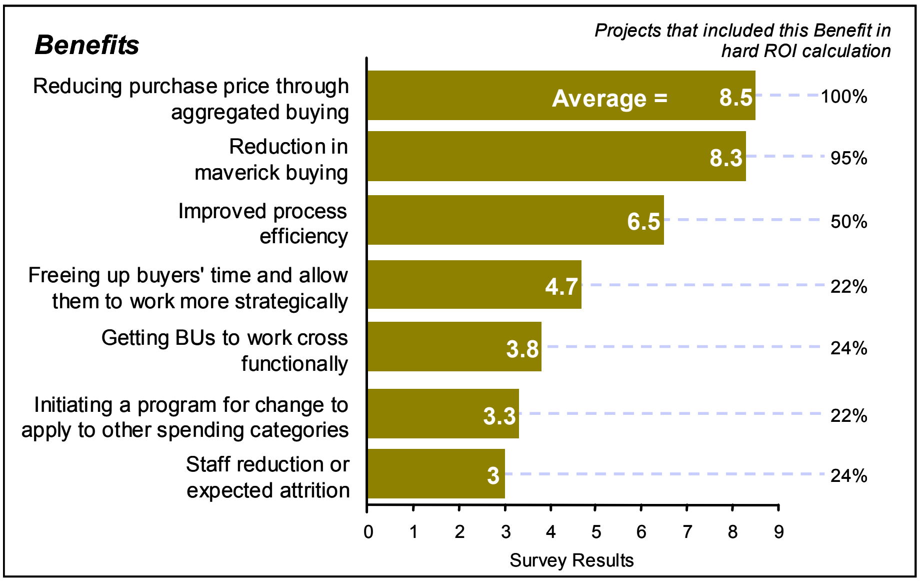


Figure 67: SRM Survey 2001 - Summarized Benefits by eProcurement implementations.

Moreover most companies highlighted that spend aggregation across multiple Business Units, and increased compliance and greater volume of spend per contract, led to increased buyer leverage for price reduction and/or volume discounts.

In the two graphs below the averages expected cost savings and the expected ROI of the e-procurement project are shown. The median range for the expected ROI was 25%-50%, with a low of less than 25% and a high greater or equal to 200%, while the median expected cost savings were less than 10%.

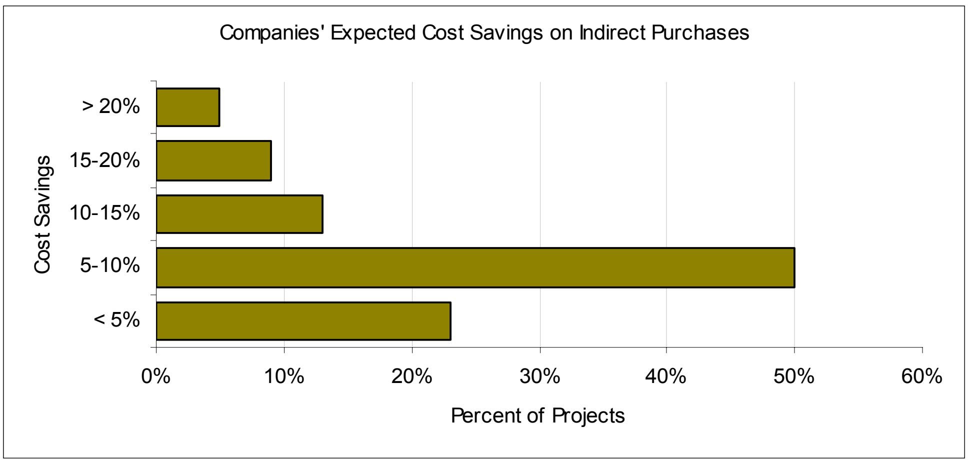


Figure 68: SRM Survey 2001 - Expected Cost Savings on Indirect Procurement

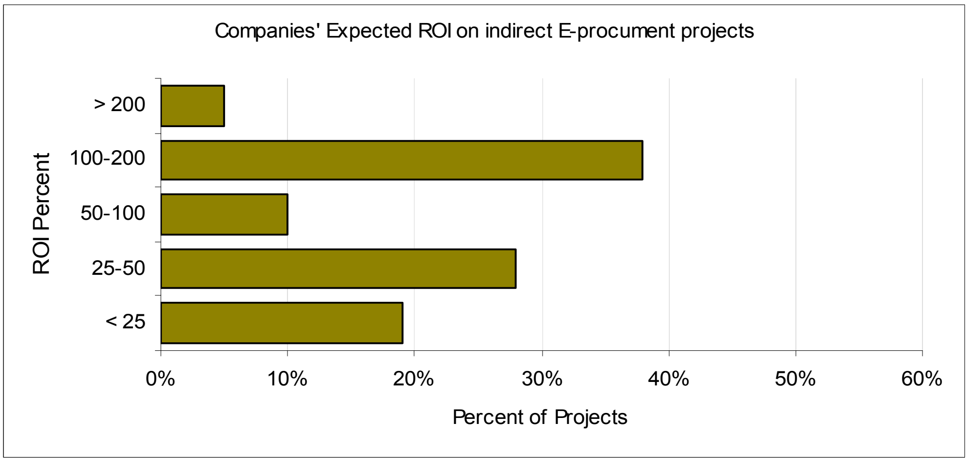


Figure 69: SRM Survey 2001 - Expected ROI from eProcurement Projects

6.1.3 *Obstacles in the Road of an eProcurement Implementation*

The majority of respondents (78%) claimed that they were on track to achieve their ROI, while those not on track cited Catalog Management, Supplier Adoption, Organizational Problems (lack of management support, employee commitment to change, lack of allocated resources) and Business Process issues (User Adoption and Change management) as the main reasons.

Table 12: SRM Survey 2001 - Inhibitors of Success in Deploying eProcurement.

Issues	*Rating(Avg)*
Content / Catalog Management (includes the creation, distribution, presentation, syndication, and management of content and electronic catalog	**6.5**
Getting chosen suppliers enabled	**5.6**
Changing/enforcing internal business processes	**5.5**
Obtaining accurate baseline spending data	**5.3**
Backoffice integration	**5.2**
Getting resources from Business Units	**5.2**
Building internal consensus around project scope	**4.7**
Building internal consensus around which suppliers to select	**4.2**
Building internal consensus around spending categories to target	**3.8**
Lack of good international suppliers	**3.7**
Finding qualified domestic suppliers	**3.2**

Scale: 1 = Not at all problematic, 10 = Extremely problematic

These reasons were consistent with how projects typically decreased their original scope. These results were controlled by asking what were the main obstacles in implementing more advanced commodities (e.g. direct materials, stocked-MRO, etc.).

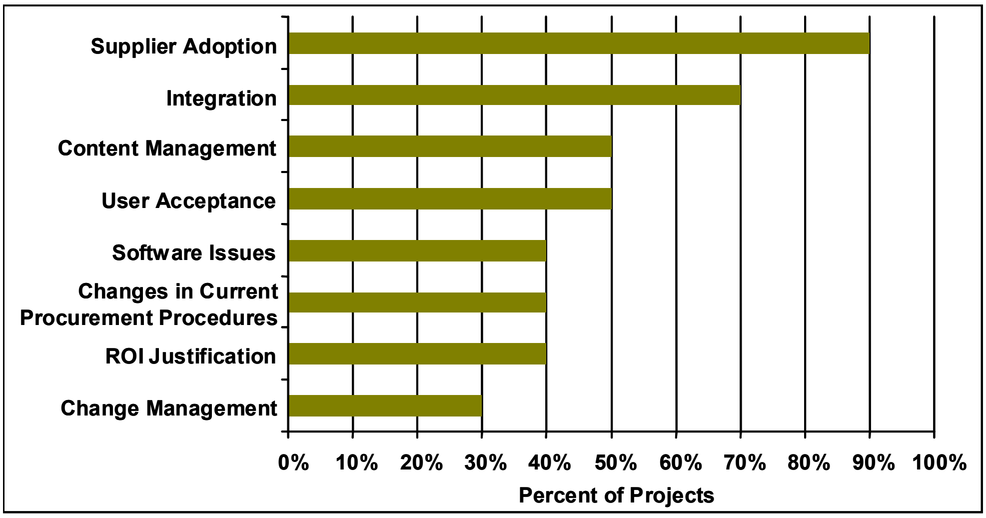


Figure 70: SRM Survey 2001 - Areas that were typically removed from the project scope.

6.1.4 Elaboration on the Main Problems related to eProcurement Implementations

As mentioned, we did conduct subsequent interviews with the various project managers in order to elaborate the survey findings and provide a richer picture of the trends identified. The interviews focused on the four major areas of supplier adoption, content management, and change management. Most of the major statements from the interviews were sampled and consolidated into the tables. In the following we will shortly sketch the findings of these interviews.

6.1.4.1 Why is Catalog & Content Management (CCM) Important?

Almost half of all projects surveyed scaled back suppliers, users, and categories from the original design because of issues with receiving and creating content from suppliers. CCM was listed as a major barrier to supplier adoption citing cost, value, communication, and technical issues. On the other hand, active users will only embrace an eProcurement system if relevant and frequently updated content is present. As projects progress from simple to strategic product & service categories, CCM becomes even more important as it requires duplicate master data within the firm's transactional systems (i.e. ERP). Catalog & Content Management was identified by project managers as one of the most problematic of all eProcurement issues. The issues highlighted by the answers were:

- Consistency / Quality of content (50% respondents) - 70% of projects do not use a content service provider (CSP) citing high costs and eProcurement vendor content, however, good content and searches are mandatory for user adoption and ROI realization.

- Time / Cost (35% respondents) - content costs \$3-\$4 per SKU for creation and \$1-\$2 for maintenance by 3rd party vendors; buyers need to have dedicated team for CCM; maintenance frequency also affects cost in that over half of suppliers update content less than six times a year.
- Technical (25% respondents) – most eProcurement software vendors were not providing adequate CCM services.
- Non-Catalog purchases - 25% of eProcurement purchases are non-catalog, 18% (14%) of suppliers are roundtrip / punch-out enabled (have buyers using roundtrip / punch-out)
- Supplier Problems (20% respondents) - almost half of suppliers did not have eCatalogs in place at the project start date, while few suppliers support on-line inventory and configurable products on their web sites. This leads to buyer-centric content strategies.

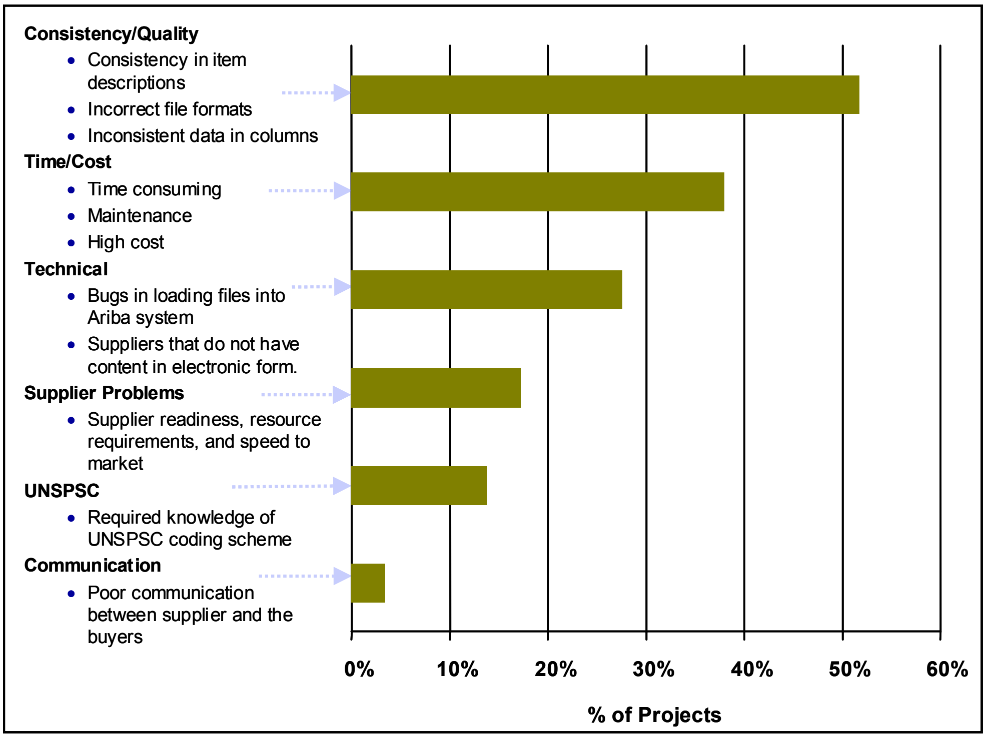


Figure 71: SRM Survey 2001 - The Major Barriers to Supplier Adoption (remark some of the parameters were formulated in reverse to control validity; in the technical section systems presenting issues were requested) .

6.1.4.2 Issues with Supplier Adoption

Supplier Adoption was identified as a reason for stalling project progress in six of the 15 stall responses. The successful projects seemed to have a phased approach to implementation and a manageable scope. The most frequent Supplier Adoption problems cited were:

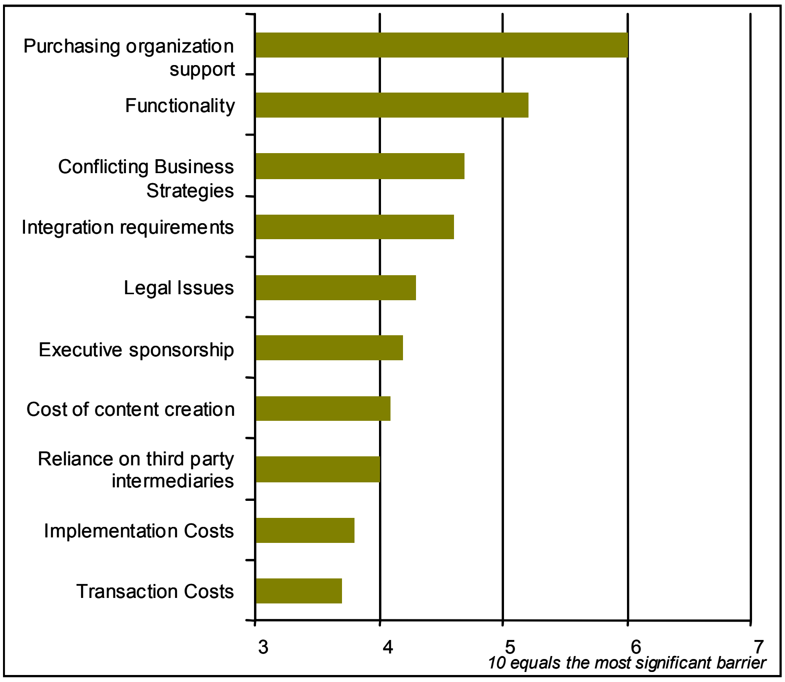


Figure 72: SRM Survey 2001 - Typical Responses on the Issues with Supplier Adoption.

- Change Management – denoting that strategies/expectations are inconsistent between supplier and buyer, leading to low commitment by supplier and buyer, and limited resources being allocated for the tasks. All this leads to increased reliance on 3rd party providers to create, maintain, and house content which is costly.
- Integration & Technical – lack of technical resources with adequate skills; lacking supplier enablement in terms of content and transactions.
- Legal & Security – Supplier concerns about security of data available to suppliers and marketplaces.
- Cost & Benefit – Suppliers do not see the value of making the changes necessary to conduct business with buyers and marketplaces.
- High transaction costs – although the most common PO format for buyers is XML, buyers used the more expensive EDI format with 28% of suppliers. Suppliers still prefer email and fax more often than any other PO format.

6.1.4.3 Issues with organizational inertia – the need for change management

Organizational and process issues were identified by 80% of respondents as another significant challenge they faced. The barriers to change that managers face in procurement projects include:

1. Organizational Scope – 44 %of projects state that change management was the reason for the failure of organizational adoption of new business processes (meaning getting users to standardize around common processes, and change their modus operandi), which leads to Political resistance – 44% of projects state change management failed in gaining management support and sponsorship
2. Change Complexity – eProcurement implementations were viewed as extraordinarily complex because the changes occur between several organizations as well as within organizations; 60% of projects cite change management as the reason for failure to move into complex commodities.
3. Lack of Skills – Existing buyer skill set falls short of those needed by a strategic sourcing analyst.

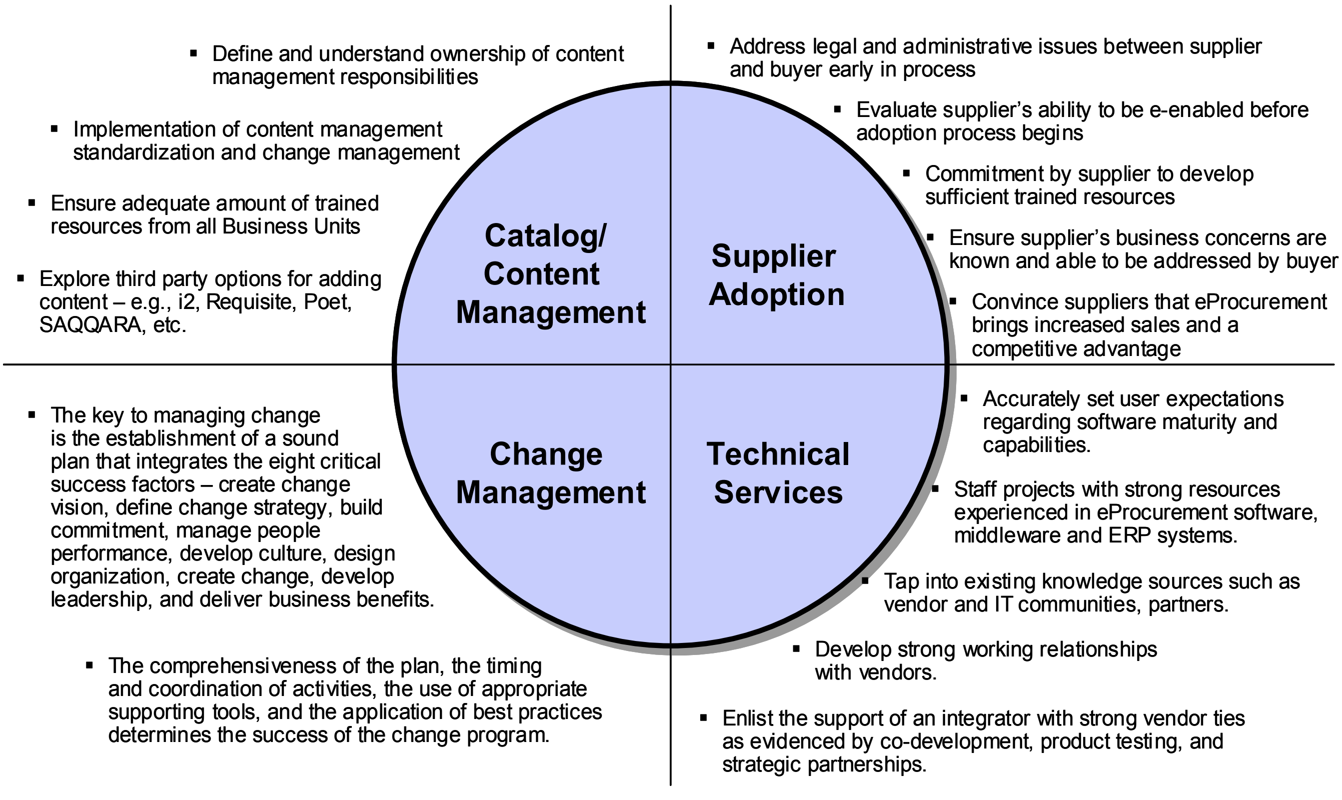


Figure 73: SRM Survey 2001 - Summary of Critical Success Factors (CSFs) in large eProcurement Transformation Projects

After describing the various obstacles and inhibitors of such implementations, most of the identified critical success factors or competencies required to adopt IT applications within the eProcurement Domain, were summarized under the four areas identified as key.

6.1.5 Practical Implications of the eProcurement Survey in 2001

The following recommendations[80] can be drawn from the survey. Even 6 years later, most of them are still an excellent advice for any SRM project:

- Define a rigorous and aligned procurement and e-procurement strategies before commencing with any realization effort. Perform a thoughtful diagnostic to anticipate all technical and organizational barriers.
- Spend a lot of time on design – make sure an overall organizational governance structure exists for any e-procurement improvement effort as one has to link the business units, departments, and sites up through commodity teams to a global procurement council and/or the senior executive team. Without this integration most eProcurement transformation efforts fail!
- Craft your project phases to be self-funding! Eliminate obstacles that will block each phase by thorough project planning and sequencing. Let your addressed spending categories drive your strategy for process redesign, sourcing, content management, supplier enablement, integration, communications, and training.
- Reengineer your processes and decouple your applications for maximum flexibility – take the final requirements and hold the vendors contractually responsible for all capabilities stated during evaluation.
- Don't execute such projects on hype, yet rather based them on a solid, defensible ROI and take the money on the table. Most importantly, don't discount the option value of this type of project to build organizational momentum around ongoing procurement improvement and commodity management.

These recommendations and study literally professionalized the eProcurement practice in PwCC and IBM and was a major provider of data that needed further treatment. They were subsequently used as an input to the next phase of the investigation which looked at the initiatives necessary to prepare an organization for such projects and enable value creation.

---

[80] The following recommendation were authored in collaboration with AMR Research.

6.2 Qualitative SRM Adoption Council 2003 – Construct Development

In this part of the analysis, we will present the results of the detailed, qualitative investigation facilitated by the author in unearthing the concrete actions, business objectives and performance metrics that will be the outcome of a set of SRM Initiatives typically launched by companies to adopt new practices and enable the SRM II domain with IT applications.

6.2.1 Introduction to the Council meetings

In order to develop the SRM initiatives framework we assembled in the Summer of 2003 a group of experienced Procurement & Sourcing subject matter experts, which had at least 3 years project management and implementation experience within the area of Procurement and Sourcing applications among multinational clients of IBM. A three-day workshop was conducted which assembled these experienced managers with the clear purpose of developing a preliminary construct of SRM initiatives. This group of Judges/evaluators of the framework was labeled the "Council" as this group continued to review the results and contributed to the ongoing development of the typology undertaken by the author.

The council meetings had the objective of defining the objectives and enablers of such transformation efforts supporting SRM practices in organizations. The presentations initiating the workshops were based on the previous section's pilot study results. The council members were introduced to the holistic approach to SRM domain, CSFs and the necessary competencies necessary to initiate such transformation. Then, various terms and typologies were defined, discussed and refined. Later, the members were asked to study one typology at a time, and evaluate each relative to others in the same typology, in preparation for group discussion. A structured form of maximum-minimum 5-point Likert scales were used initially to cluster the actions, competencies, objectives and KPIs within each initiative.

The aforementioned survey results were used as input and the participants ranked the various statements into Enablers or SRM initiatives that companies have to pursue. Based on existing literature and practice, 6 value clusters were identified encompassing 19 SRM transformation initiatives that drive IT enablement.

6.2.2 Realizing SRM Enablement – A Value-creation Approach

One of the areas we received interesting input from the participants were the KPIs and value of the value of SRM adoption, which is justified only when the perceived benefit is large enough to cover the costs. Benefits of using an IT-enabled SRM Collaborative Enterprise Architecture include enhancing effectiveness and improving efficiency when costs comprises of initial investment and on-going expenses of implementing them.

SRM supports companies to reduce the time, effort and costs of buyer company associated with requesting, sourcing, negotiating and, ultimately, purchasing from suppliers. It further enables purchasing staff to extend the speed, quantity, and quality of information processing that has more long-term effects (i.e. on revenue). It is found that the higher the value they perceive from e-procurement adoption, the higher level of e-procurement utilization sophistication (Subramanian & Shaw, 2002). The participants were ask to provide examples of the KPIs used by the companies to calculate the ROI of adoption (see previous section). Below we provide an overview of the SRM-specific factors linked to value creation.

Table 13: Initial set of Value Creation drivers and Enablers defined by the author (Source: Nøkkentved, 2003).

Impact	Enabler	Value creation
		DECREASE COSTS
Reduce Material Costs	Demand aggregation Better external and internal information tools Enhance supplier engineering collaboration Parts content integrator	Volume Discount Better and flawless line of arguments during negotiations Reduce unit price of new parts Reduction of parts base maintainance
Lower process costs	Compress sourcing cycle time Simplified processes Automation Supplier rationalization Ensure global compliance Supplier self-service Reduce risk of quality reduction and price increase	Inventory level Execution costs Purchasing administrative costs Supplier management (less suppliers) Less Maverick buying Part of relationship costs externalized Supplier performance monitoring
		INCREASE REVENUES
Increased revenues	Better cost price Better market share Collaboration & Compress sourcing cycle time	Better FP price position Better finished product margin Accelerated Time to Market
		INTANGIBLE BENEFITS
Intangibles - Brand Image	Better brand image for corporation	Easier market penetration - less sales effort Better company gross margin
Intangibles - Allocations	Demand allocation	Quality improvement Product innovation
Intangibles -Risk Reduction	Ensure global compliance	Corporate guided contract's conditions

6.2.2.1 Identifying the SRM Value Themes and Realization Initiatives

As mentioned, the value proposition of SRM extends previous eProcurement solutions by enabling strategic sourcing, and integrating the supply chain and product life-cycle functions of a business. Moving beyond the simplistic eProcurement focus on minimization of transaction costs and cost savings(Gadde & Håkansson, 2001), and utilizing the aforementioned objectives of an collaborative architecture, the group reached consensus on 6 interdependent value clusters for the business (see table below).

Table 14: Identified Value Creation Clusters or Value Themes of an Collaborative Information Infrastructure in the SRM domain (Source: Nøkkentved, 2003).

Value Themes	**Description**	**Process Domains**	**Affected KPIs**
Value Optimization	Getting the optimal total cost of purchased materials and services by consolidating demand, getting the right price and enforcing appropriate purchasing behaviors	Source & Monitor	Spend within (out) contract per commodity Price variance per commodity Average order quantity per supplier per year Average number of parts per category
Sourcing Optimization	Ensuring security of supply through intelligent sourcing, robust procedures and flexible purchasing	Evaluate	Average spend volume per supplier ABC distribution of purchasing spend by supplier Process cost (number of suppliers, number of RFPs / RFQs, number of contracts negotiated, cycle time
Process Efficiency	Reduce transaction and operational costs by automating and enforcing selection and procurement processes	Transact + Enable	Number of errors per purchase order Contract compliance Contract handling cost Cost per transaction for "procurement to delivery" cycle time
Complexity Reduction	Reducing types of demand, rationalize procurement requirements and harmonizing master data to support procurement activity	Monitor + Collaborate	Average cost of content preparation & maintenance Number of PO refusals due to incorrect data Number of wrong shipments Number of parts per product per material group
Supplier Collaboration	Working with suppliers on joint process improvement and capability development	Collaborate	Product development process costs Warehousing cost and Inventory levels Number of reportable production and assembly problems for typical product
Organizational Empowerment	Defining the organizational structure and processes for optimized purchasing and supplier management	Organize	Turnover Percentage of purchasing staff with job roles linked to purchasing strategy Annual performance against job goals

The above categorizations helped the team identify what companies need to do to enable SRM. These initiatives represent concrete interdependent set of actions that companies may pursue in their attempts to reach a number of objectives within collaborative procurement and sourcing.

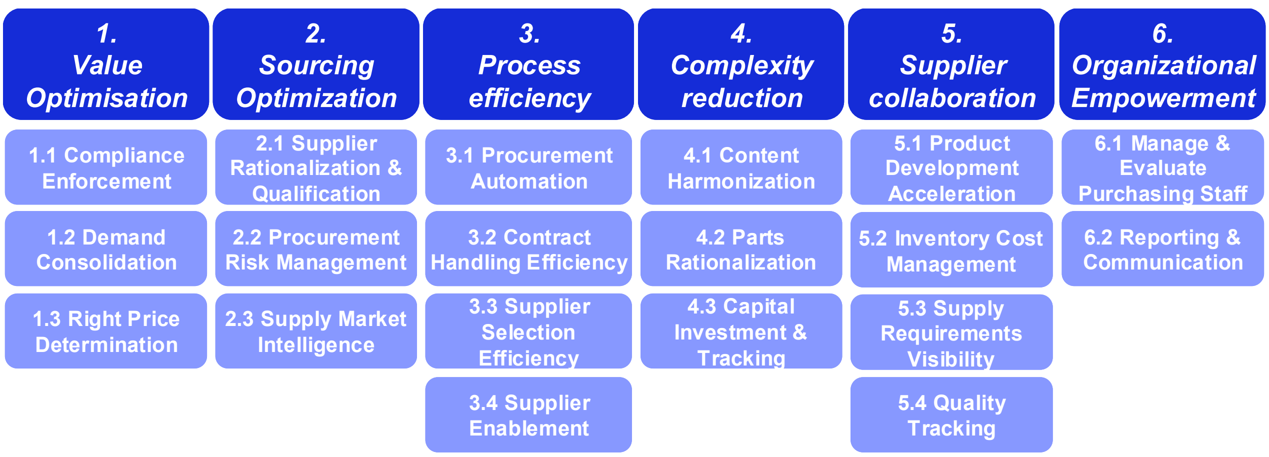


Figure 74: Overview of the *SRM Value Themes* and their underlying Realization Initiatives (Source: Nøkkentved, 2003).

These meso-level SRM enablers represent both actions that need to be undertaken at the network, relationship and company level, incorporating both actor deployments, resource investments and activity transformations. The following table summarizes the council's work on defining each initiative's objectives, typical actions, impacts and KPIs used to track them.

Table 15: Overview of the Results of the 1st Council Meeting - SRM Value Themes, Transformation Initiatives, Actions, typical Impacts and KPIs used to track and measure progress (Source: Nøkkentved, 2003).

Value Themes	SRM Initiatives	Initiative Objective	Typical Capability-driven Actions	Business Impacts	KPIs
Value Optimization	Compliance enforcement	Reduction in total cost of purchase by ensuring the compliance of disparate business units in handling and adhering to centralized approvals / contracts and the control of company-wide procurement processes.	Higher predictability and higher committed volume decreases supplier's costs (e.g. safety stock, stock outs). Implement Spend Reporting to make Spend transparent (per Supplier, per Commodity, per Contract). Implement central groups per commodity group responsible for compliance. Define company-wide interaction processes with central compliance groups. Define company-wide approval rules (take geographical situation into account) change management and training Implement transportation cost reporting Set up procurement services via intranet and do not allow other procurement channels	Automating checks of existing contracts during approval processes, Decentralization of approval across different business units More consolidation of volume per contract More effective supplier contract management due to better reporting Reporting on contract compliance and actions that can follow .	Spend per commodity under contract (Contract compliance) Ratio of spend per supplier under contract and not under contract of the same commodity Price variance per commodity Number of contracts / commodity Delta prices
	Demand consolidation	Improved contracted item prices by consolidating demand from multiple BUs within a company, also leading to reduced procurement process costs. Demand aggregation increases purchase volume with the selected vendors.	As a Buyer, leverage higher purchasing power and get higher price discounts Suppliers can decrease costs with higher committed volume from the buyer Refine material and vendor master coding. Make purchasing behavior transparent (Spend (contracted, not contracted), Supplier, Commodity, PO). Define cooperation guidelines for different facilities to consolidate demand. Align processes to aggregate orders and route them consolidated to the supplier.	Visibility of expenditure per supplier at group level will improve application of rebates, volume consolidation, inventory management and central reconciliation/ visibility of contracts under negotiation Supplier rationalization will be possible through greater awareness of supplier competencies Demand aggregation Enhanced supplier relationships	Ratio of number of products produced and number of products ordered by customer Inventory level of finished (or ready to sell) goods Inventory turn level for materials Obsolete inventory on total inventory Number of supplier per commodity
	Right price determination	Achieve higher cost transparency & price determination by involving qualified vendors in best price evaluation (bids & reverse auctions), which further clarify the suppliers' price structure & contingencies.	Use of supplier portfolio and coordinated qualification and selection of suppliers across business units (process definition, selection criteria) Use efficient, electronic access and visibility to supplier performance, to evaluate significantly more responses to RFQs and identify best prices based on multiple criteria (quality, etc.) Leveraging technology (i.e., auctions, support for RFx development and evaluation) extends traditional sourcing capabilities and results in compressing the sourcing process timeline. Make visible historical data of negotiations for several years (Supplier history) and conduct price arbitrage across divisions)	Manual qualification and selection process will be improved through automation Reduction in qualification process through the reduction of the same supplier being qualified numerous times across business units Supplier selection process costs Price discount % eAuction over traditional auction Price discount moving non- compliant spend to eAuction	Ratio on number of actual delivering Suppliers per set of commodity Number of involvements of individual suppliers in quotation process per set of commodity Sourcing cycle time Process Cost (# of suppliers, # of RFP/RFQ, # of contracts negotiated, throughput time) Price Variance / commodity
Sourcing Optimization	Supplier rationalization & qualification	Rationalize or deproliferate Supplier-base to determine how many and which suppliers to maintain for a given commodity or specific part commodities, and manage associated risks.	As each Supplier has specific value added, the buying organization needs to pre qualify a portfolio of suppliers and understand their interdependencies. Make spend transparent (Supplier, Commodity). Define Supply Strategy per commodity group. Align processes for implementation of Supply-base strategy. Select value adding suppliers. Align/Concentrate spend per supplier group (strategic, non-strategic) per commodity group.	Visibility of total expenditure per supplier per commodity will enable better deals to be structured and ongoing performance monitored through greater focus Less effort will be required to brief suppliers on how to deal with the organization Lower Supplier selection & maintenance costs	Average spend Volume per Supplier ABC distribution of purchasing spend over supplier-base Average supplier selection & maintaining costs Price per unit / commodity
	Procurement risk management	Manage trade-off between procurement cost (unit price, process cost) and procurement risk (e. g. Lead Time, Quality, Delivery Reliability) by enabling the buyer to determine tactically the optimal order quantities to be allocated to suppliers.	Notion of risk management is linked with supplier follow up, either logistic agility, potential capacity, financial health, or potential ability to change. Identify and prioritize the risk factors per commodity group Make the single supplier relationship transparent towards the risk factors (as-is) Group the suppliers by the risk factors Define per relationship and per risk factors the to-be status and the required measure to achieve the status	A clear strategy can be developed for key and fall back suppliers Monitoring of supplier performance will lead to greater risk mitigation evidence and associated strategies Less reliance may evolve through dependence on bottleneck suppliers Average Spend Distribution per Supplier Group (strategic, non-strategic) per commodity group Reduced risk – increased supply stability; increased availability to promise Lower Unit Prices and improved Quality of material & services Inventory stock outs (pos. effect)	Spend per supplier per commodity group Supplier rating Score Card Elements (Quality, Lead Time, Financials Key Figures, etc.) Number of unplanned stock-outs Max price differences between suppliers for same commodities

Value Themes	SRM Initiatives	Initiative Objective	Typical Capability-driven Actions	Business Impacts	KPIs
	Supply Market Intelligence	Understand the upstream market, and know what kind of changes have to be done in the near future. Match product enhancements to new suppliers. Prepare for strategic sourcing and negotiations - Search for potential sourcing risks for strategic suppliers (bankruptcy, excessive demand, etc)	Supply market intelligence enables purchasers to effectively analyze upstream markets to improve sourcing decisions. Classify supplier relationship types. Determine performance monitoring strategy for given relationship densities. Identify the supplier performance measures. Create a supplier scorecard Purchasing info base construction Purchasing reports and surveys Proposition of new components, technology and alternatives to design office and engineering	Improved procedures for registration and acquisition of alternative suppliers Databases can be created on information on key suppliers for future improvement initiatives Harmonisation of supplier records vis-à-vis external supplier bases (e.g. Dun&Bradstreet's DUNS classification) Lower Information search, qualification & risk mgmt cost	Supplier life-span per commodity Number of design changes originated in the purchasing department Number of supplier files complete with external information
Process Efficiency	Procurement automation	Reduce cost and increase speed of procurement processes by automation and elimination of unnecessary steps. Reduce rework (e. g. due to incomplete orders by improving data quality).	Procurement automation provides purchasers with effective tools to reduce time spent in the purchasing process Make number of POs transparent (Supplier, Commodity, departments). Redesign and automate process for procurement and supplier interaction. Adapt supplier selection criteria or e-enable suppliers. Reorganize work of purchasing department (Staff redeployment into more value adding areas).	Some inefficient manually operated procurement processes with suppliers and within the company may be removed through workflow approvals and risk mitigation strategies Inconsistent procurement processes may be removed through control, standardization and then automation Lower Procurement Process Cost and Error rates Less Maverick buying – more consolidation and reduction of spend	Procurement cost per PO Procurement throughput Time Number of Errors/ per PO Number of contracts/ BU, scheduling lines/BU Number of incomplete or false purchase order
	Contract handling efficiency	Cost efficient management and re-negotiation of existing contracts in handling of suppliers, contracts, and purchase information on a consolidated basis.	Global visibility of contracts and ability of reusing contracts improves contract handling process costs. Define contract handling standards per commodity group. Implement cross-unit coordination processes. Implement central contract management and monitoring.	Through greater awareness of contracts under management and recording, application of standard leading practices may be improved Contract Handling Process Cost Supplier Selection Process Cost Perform outsourced sourcing service for other business units / organizations	Spend per commodity under contract Spend per commodity not under contract Number of Suppliers per commodity under contract Contract Handling Cost
	Supplier selection efficiency	Accelerate the selection process of pre-qualified suppliers through RFx automation, supplier self-entry, weighted criteria evaluation and collaboration on the content of the RFx proposal.	Better information, a defined supply strategy per commodity group and insight into the evaluation criteria lead accelerates selection of suppliers across business units Make spend transparent (per supplier, per commodity, per contract) Align processes for implementation of supply base strategy Select value adding suppliers Align/ concentrate spend per supplier group	Industry metrics may be applied to lead to better contract formation and allocation of expenditure Greater focus may be applied with key suppliers through considering total expenditure and development of suppliers leveraging their talents for core competency development Lower Supplier Selection Process Cost Perform outsourced sourcing service for other BUs/ organizations Lower Selection Process Cost (# of suppliers, # of RFP/RFQ, # of contracts negotiated, throughput time)	Average spend Volume per Supplier ABC distribution of purchasing spend over supplier-base Average supplier maintaining costs Average supplier selection cost ABC distribution of supplier disputes & suits and ABC distribution of quality
	Supplier enablement	Reduce supplier adoption and content mgt process costs by integrating suppliers into procurement processes and content management processes. Provide web-access to non-enabled suppliers to reach efficiency in more supplier relationships.	Evaluate supplier's ability to be e-enabled before adoption process begins Make the cycle times (PO approval and supplier confirmation) transparent Address legal and administrative issues between supplier and buyer early in process Ensure supplier's business concerns are known and able to be addressed by buyer Implement supplier adoption (communication, incentives, training, ramp up) Define strategy to IT enable more suppliers along the procurement process Define and understand ownership of content management responsibilities	As many suppliers have limited IT capability to operate the sales order process electronically, opportunities will be able to be created by scaling processes to supplier types using past experience Increase supplier adoption rate, Increase of e-business exchanges Lower Procurement Process Cost – catalogue update cost Real time information, Reduction of data entering costs and mistakes, Reduction of interfaces maintaining costs Increase of visibility across Supply chain	Cost per transaction for procurement-to-delivery cycle Share of suppliers interacting electronically Time passed between final PO approval and supplier confirmation PO through-put time/cycle time Number of planning changes & delays
Complexity Reduction	Content harmonization	Synchronize and harmonize supplier product content, supplier info, and internal master data to ensure the quality and efficiency of the enterprise-wide procurement activities by reducing additional effort in catalogue maintenance and increasing visibility of group-wide activities per supplier.	Investigate capabilities of suppliers to support a harmonized content supply chain Investigate industry standards (UNSPSC) Implementation of content management standardization and change management Explore 3rd-party content providers Define global content strategy to target the individual needs of the business units and the capabilities / possibilities of the suppliers Select and/or enable suppliers to participate in the defined content creation and maintenance processes	Lower Material Handling Costs Reduction of error rate (due to manual entries and lack of cost information) Lower Supplier Selection Process Cost (improved Selection Efficiency) Increase of catalogue and contract driven procurement (decrease of spend and administrative costs) Reduction of Maverick buying and quality of the information for the end user Content Preparation/Maintaining Cost	Average content preparation/maintenance cost per supplier and commodity groups Number of PO refusals due to in correct data Number of wrong shipment

Value Themes	SRM Initiatives	Initiative Objective	Typical Capability-driven Actions	Business Impacts	KPIs
	Parts rationalization	Reduce the number of different materials and consolidate # of parts purchased for similar uses to streamline material handling for production, inventory management and supplier selection.	The same part/ item with multiple codes throughout information systems may be rationalized to reduce duplication, excess inventory, evidence of unnecessary parts complexity in the product portfolio Create parts database and define parts groups in the Procurement department responsible for limiting complexity Identify duplicates in the parts database Define and implement parts rationalization strategy	Material Handling Process Costs Inventory Carrying Cost Inventory Capital Cost Joint product design # of parts	Number of parts per product per material group Number of new parts per commodity group/ per time unit (to be judged against the breadth of the product line) Inventory Level per commodity group Material Handling Process Costs
	Capital investment & tracking	Follow up of investment and tools made for and kept by the suppliers is one main driver for negotiation. The quality is almost always dependant on the degree of investment made in this field.	Better return on investment may be achieved by recognizing what is available and plans put in place to leverage assets e.g. reduction of software licenses which can be shown to be non performing, reduction of communication devices which are hired and not used Code assets as part of delegation of workflow approvals Track assets using fields	Unit cost Level of investment in cost structure Impact of depreciation on ROI and stock exchange share value	Ratio of investment in cost structure Follow up of quantities made by a given tool
Supplier Collaboration	Product development acceleration	Streamlining Product Development Process from a cost and time perspective by reducing the iteration steps in sourcing a product design or engineering specification with an external design or engineering partner.	An accelerated product development process increases revenue through shortened time to market, and reduced costs through reduced process time Make number of products developed, supplier involved and documents revised transparent by enabling a collaborative design & development process Define strategy on partner enablement and involvement in the development cycles(technical needs, document handling) Implement / align processes along strategy – work on project base (document standards, handling rules, document indexing, retrieval)	Collaboration with suppliers will be able to be improved through transfer of documents electronically thereby reducing errors ensuring version control and discussions conducted in real time by looking at editable documents Product cost follow up during development phase Time to market /Throughput-time Product Development Process Cost Pricing /configuration	Number of iterations and number of days for typical design change or release Number of reportable production and assembly problems for typical product Fit of manufactured product to original specification Number of purchasing problems during production
	Inventory cost management	Reducing inventory levels through shorter supplier lead times, reduce inventory holding costs via cycle time reduction, and streamline inventory mgmt to handle demand fluctuation across several facilities.	Inventory levels are highly dependent on cycle/lead times – reducing cycle/lead times lowers inventory requirements and holding costs Make stock level and costs per commodity transparent Evaluate per commodity group the company wide required stock levels and demand Centralize the planning of demand and the monitoring of inventory levels across several facilities	Safety stock of inventory will be able to be reduced through enterprise wide awareness of availability Large hidden inventories will be exposed and expenditure budgets cut to reflect real need rather than perceived need Inventory Carrying cost Inventory Capital Cost Inventory Management Process Cost Improved supply chain performance	Average Stock Level per commodity group Warehousing cost per average value of stock Number of people in inventory mgmt per average value of stock Inventory Mgmt Process Cost
	Quality tracking	Improve quality of inbound deliveries, in order to take appropriate measures without delay. Use quality information in supplier evaluation and further contract negotiations	Improved quality tracking will enhance the purchasing organization's ability to follow up supplier performance and thereby increase adherence to quality demands Classify supplier relationship types and identify quality standards/commodity Determine performance monitoring strategy for given relationship densities Identify the supplier performance measures Create a supplier scorecard	Supplier performance can be improved by targeting areas of weakness highlighted through record capture and monitoring for trends Information may be manipulated to produce trends and report by exception Improved Customer Service Levels	Customer satisfaction index Ratio of Defects versus Received (return index)
	Demand / Supply Requirements visibility	Improve supplier collaboration, improve the supplier's inventory turns & costs, by providing more accurate production plans and visibility into future end-product customer demand.	Improved collaboration across the production process provides suppliers with increased visibility into raw material inventories and future demand, which allows them to better plan and adjust their own inventories and manufacturing requirements Make number of products under contract transparent Install ongoing forecasting capabilities of customer demand and establish close linkage to commodity purchasing Establish cross functional team on demand management process and validation	Customer demand may be met through better demand communication Document management, certificates and audit needs may be improved Improved Forecast Accuracy leads to lower Unit Price and Increased Inventory Turns, plus improved Throughput Time	Ratio of number of products produced and number of products ordered by customer Inventory level per product Inventory turn level for materials
Organizational Empowerment	Reporting & Communication	Bring transparency to purchasing activities by defining appropriate KPIs and reporting formats, and making them available in a real-time (web-) reporting environment..	Having effective reporting and communication in place is mainly a pre-requisite for other business initiatives to reach their full potential. Diffusion of information on processes, contracts, selections, suppliers, price deviations, enables internal & external communication and ensures support of top management to supply activities. Identify reporting capability required and incorporate into reporting set Establish a communication part on the supplier portal Create change management information internal bound and external bound on the extranet Collaborate with top management to get efficient reporting	Improved performance visibility and monitoring Better reporting information throughout the corporation More efficient communication (lower process costs) Faster response due to better information-/ event-flow.	Brand image of corporation Number of world class suppliers proactive to sell Satisfaction index of other departments

Value Themes	SRM Initiatives	Initiative Objective	Typical Capability-driven Actions	Business Impacts	KPIs
	Manage purchasing staff	Report and communicate purchasing activity to senior management and other departments. Continuously empower and evaluate the purchasing & sourcing staff.	Translate company strategy in the evaluation indicators for purchasing staff , balance workload, keep people trained on the right areas Define the Purchasing and Sourcing organization Identify and improve roles and responsibilities. Use procurement process analytics to identify opportunities for improvements Constantly report information relevant to purchasing actions or problem	Efficiency of Purchasing budgets Better Role allocation Improved employee satisfaction Efficiency of purchasing staff	Allocation of purchasing staff to purchasing actions Price deviation per product category, per design project, Ratio of purchasing cost per sales unit

Let's illustrate our initial conceptual classification – for example the SRM Initiative, ***Demand Consolidation*** attempts to reduce costs by consolidating the procurement demand from multiple business units within a corporation to enable aggregated contracts and aggregated volume leading to fewer suppliers; such consolidation often leads into bigger spend volumes/contract and earning higher discounts from the suppliers. This initiative was hence classified under the "*Value Optimization*" value cluster. For each of these initiatives a detailed template was created incorporating business context, objectives, business levers, KPIs, measures/metrics, and related SRM processes.

This classificatory exercise completed the initial investigation of identifying what are the initiatives a typical company utilize to IT-enable the SRM domain. A lot of detail was documented and a much more clear view was reached which was not found in any comparable level of detail in the literature. In the subsequent sessions of the council refined the classification and provided a detailed view of the sequencing of realization based on the SRM Initiative interdependencies.

6.2.3 Classifying the SRM Initiatives and Staging Considerations

An additional classificatory perspective explored by the council group was the placement and relative alignment of the various SRM initiatives or enablers within an overall Supply Network Strategy of a firm. The team classified the various initiatives under the various SRM objectives and then categorized them as shown in the matrix below, which covered the two subdomains of SRM – Procurement and Sourcing, plus the levels of operationalization – Strategic and Operational. The resulting cells of the typology represented the typical competencies most companies strive for. This was compared and affirmed by our previous survey.

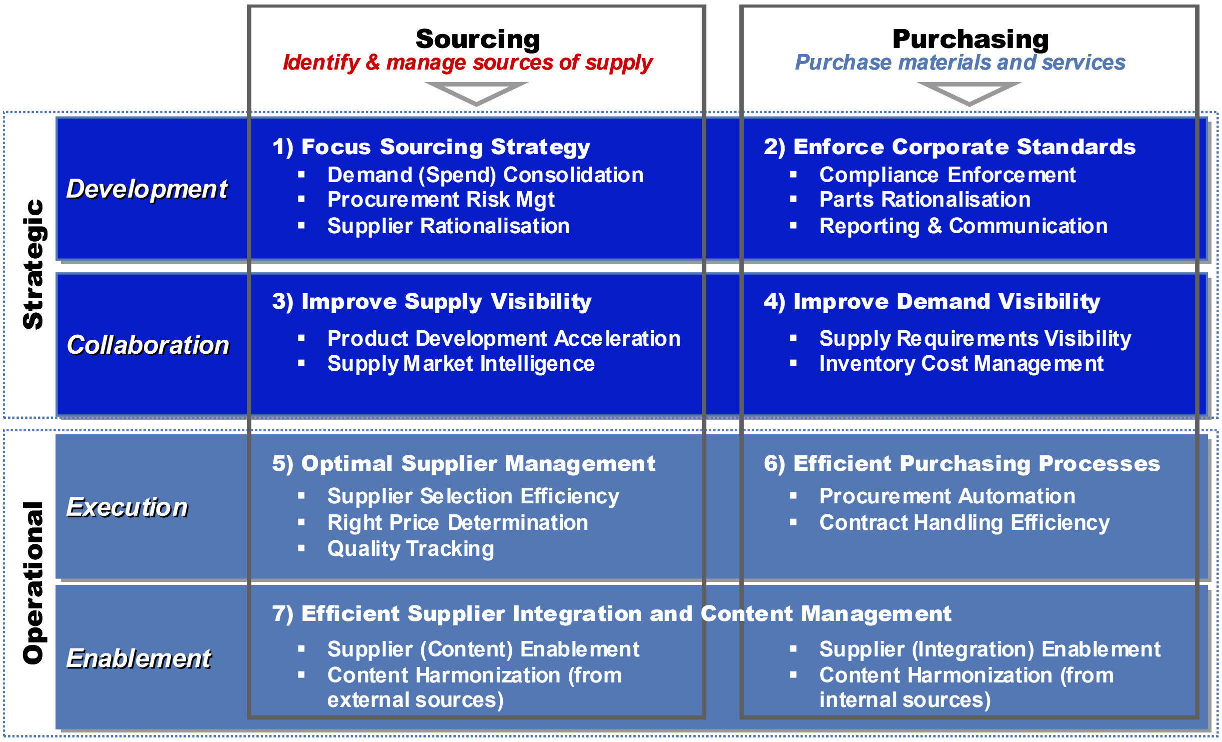


Figure 75: Initial Classification of SRM Subdomains, Capability Themes, Levels and Initiatives (Source: Nøkkentved, 2003).

6.2.3.1 Classification of the SRM Initiatives into Realization Streams

In order to understand the role of infrastructure in value generation, the respondents were asked to grade the fulfillment of each of the major value creation KPIs identified in the previous phase vis-à-vis the identified, descriptive SRM initiatives on a 0-5 Likert scale (from 0: "no influence" to 5: "high influence". Employing a confirmatory factor analysis in SAS' JMP and using a non-parametric (Kendal-T) correlation matrix (in that there were 15 ranking judges), seven factors (with eigenvalues>1) explained 81,66% of the variance in the ratings

(Cronbach's α>.7). Based on this analysis a number of SRM realization streams were identified. Based on the varimax-rotated factor pattern, the first dimension describes *Optimization* efforts that an II can support (primarily process automation & reengineering). The second dimension supports the *Consolidation* efforts. The third dimension consists of indicators for *Enablement*, where the fourth dimension, *Rationalization* supports efforts to improve management of staff and risk. The fifth dimension supports *Evaluation* activities, the sixth *Aggregates* internal demand based on ongoing product sales and asset maintenance, while the final dimension helps companies *Harmonize* their internal content. This exploratory conceptual construct seems coherent with the objectives we outlined, yet it certainly provides another perspective of the nature of the SRM value clusters originally identified.

SRM Initiative	Optimize	Consolidate	Enable	Rationalize	Evaluate	Aggregate	Harmonize
Expl. Variance %	21,65	36,90	49,41	59,11	67,92	75,66	81,66
Product_development_acceleration	-0,85						
Supply_market_intelligence	-0,84						
Procurement_automation	0,80						
Contract_handling_efficiency	0,80						
Compliance_enforcement	0,50						
Demand_consolidation		-0,88					
Parts_rationalization		-0,73					
Inventory_cost_management		-0,78					
Supplier_enablement_			-0,92				
Quality_tracking			0,63				
Manage_Purchasing_staff				-0,85			
Procurement_risk_management				-0,68			
Supplier_rationalization_&_preq				-0,56			-0,55
Supplier_selection_efficiency_					0,85		
Right_Price_determination					0,77		
Reporting_and_communication					0,71		
Capital_investment_tracking						0,88	
Supply_requirements_visibility						-0,70	
Content_harmonisation							-0,78

Figure 76: Initial Classification of SRM Initiatives Realization Streams (Source: Nøkkentved, 2003).

6.2.3.2 Classification of the SRM Initiatives into Realization Streams

One the major tasks of the council was to link the various SRM Initiatives into the contemporary list of SRM-related business processes that are typically enabled by best-of-breed applications. We used the latest list of processes from SAP's SRM and Ariba's solutions and asked 7 council members to judge and grade (they received 10 votes each) the interdependencies between SRM initiatives and enabling processes. Below we show a *Ternary* Plot[81] of the 3 Factors extracted via Correspondence Analysis[82] we conducted based on the

[81] Ternary plots are a way of displaying the distribution and variability of three-part compositional data in a triangle with sides scaled from 0 to 1, where each side represents one of the three components. A point is plotted so that a line drawn perpendicular from the point to each leg of the triangle intersect at the component values of the point. We used the Canonical Scores on 3-axes from Correspondence Analysis as input.

contingency table of the ranks, plotting the proximity between SRM Initiatives and -Processes. The "closeness" or proximity of individual *SRM Process* and *SRM Initiative* indicate whether they are interdependent.

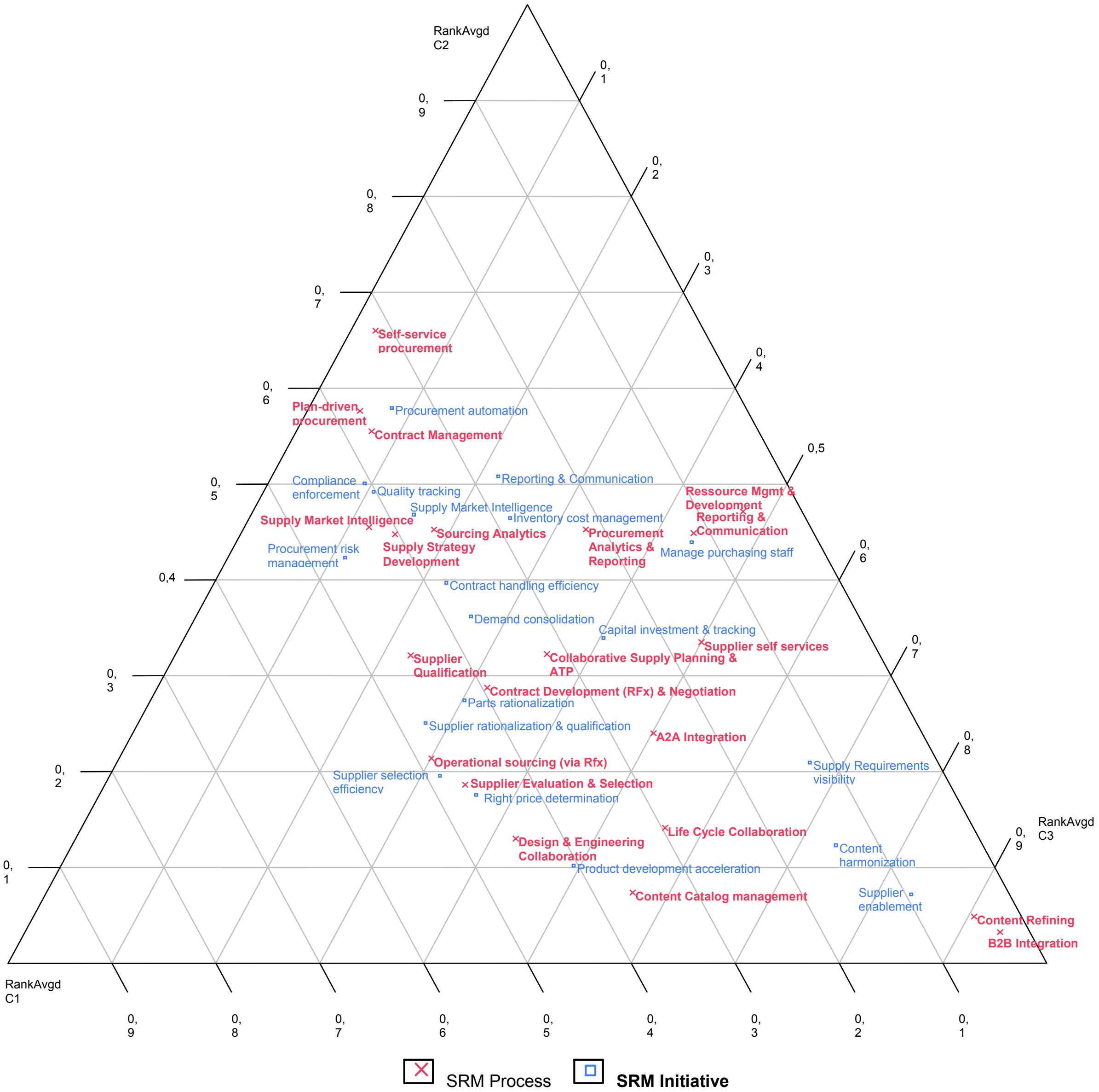


Figure 77: Ternary Plot of 3-axis from Correspondence Analysis of SRM Initiatives versus Processes

As plotted, the initiative "Process Automation" was not shown to dependent on B2B Integration. While the Ternary plot show all relationships it is difficult to get a full understanding of the interdependencies. Hence, to ease interpretation we estimated the

---

[82] Correspondence analysis is a graphical technique to show which rows or columns of a frequency table have similar patterns of counts. In the plot there is a point for each row and for each column. Define the row profile to be the counts in a row divided by the total count for that row. If two rows have very similar row profiles, their points in the correspondence analysis plot will be close together. Squared distances between row points are approximately proportional to chi–square distances that test the homogeneity between the pair of rows. Columns work the same

correspondence proximity values with Sass's JMP, into a score that was plotted as colors in the table below. What is evident is that SRM Realization Initiatives represent typical "packages" of competencies related to transforming the Procurement & Sourcing domain in companies. This is a modular view of competencies that is not necessarily linked 1:1 to comparable processes. Hence, SRM initiatives are based on and focusing on improving the capabilities of the firm by defining objectives and actions that affect roles and workflows in a company – they do not represent the processes directly, yet they do influence them as we have originally hypothesized.

SRM Processes / SRM Initiatives	Supply Market Intelligence	Supply Strategy Development	Supplier Qualification	Supplier Evaluation & Selection	Contract Development (RFx) & Negotiation	Contract Management	Design & Engineering Collaboration	Life Cycle Collaboration	Collaborative Supply Planning & ATP	Supplier self services	Self-service procurement	Plan-driven procurement	Operational sourcing (via RFx)	Sourcing Analytics & Evaluation	Procurement Analytics & Reporting	Content Catalog management	Content Refining	Integration with internal systems	Integration with external systems	Manage & Develop	Reporting & Communication
Compliance enforcement		Secondary				Primary					Secondary	Secondary		Primary		Secondary					
Demand consolidation		Primary	Secondary		Secondary									Secondary	Secondary			Primary			
Right price determination				Primary			Primary						Secondary	Secondary							
Supplier rationalization & qualification		Secondary	Primary	Primary										Secondary		Secondary					
Procurement risk management	Primary	Primary	Primary									Secondary	Secondary	Secondary							
Supply Market Intelligence	Primary	Secondary												Secondary	Secondary						
Procurement automation										Secondary	Primary	Primary		Secondary				Secondary			
Contract handling efficiency		Secondary			Primary	Primary		Secondary						Primary							
Supplier selection efficiency			Secondary	Primary									Primary								
Supplier enablement								Primary		Primary						Primary	Primary	Secondary	Primary		
Content harmonization								Secondary							Secondary	Secondary	Primary	Primary			
Parts rationalization	Secondary		Primary				Secondary	Secondary	Secondary						Secondary						
Capital investment & tracking								Primary		Secondary				Primary	Secondary						
Product development acceleration					Secondary		Primary	Primary								Secondary		Secondary			
Inventory cost management									Primary	Primary		Primary		Secondary				Secondary			
Quality tracking			Secondary							Secondary	Secondary	Primary		Primary	Secondary						
Supply Requirements visibility									Primary	Secondary		Secondary						Secondary	Secondary		Secondary
Reporting & Communication	Secondary	Primary				Secondary				Secondary	Secondary	Secondary		Primary	Primary			Secondary			
Manage purchasing staff														Secondary	Primary					Primary	Primary
SRM Process Groups:	EVALUATE			SOURCE			COLLABORATE				TRANSACT			MONITOR		CONTENT		INTEGRATE		MANAGE	

Legends of Dependency: ***Primary*** ***Secondary*** ***No Influence***

Table 16: Overview of the Interdependency of the SRM Processes and SRM Realization Initiatives.

This completed our initial effort to identify, define and then elaborate the competence-based initiatives that help the company plan for a transformation within the SRM domain.

as rows, since the problem is defined symmetrically. Although the distance between a row point and a column point has no meaning, the directions of columns and rows from the origin do have meaning, and the relationships will help interpret the plot.

6.2.4 Social Network Analysis of SRM Initiatives and Interdependencies

Beyond the relationship between the competency-driven SRM initiatives leading to clear objectives, actions, and transformation guidelines (e.g. roles), and the typical processes enabled partially by contemporary software applications, it was apparent that there was a need to understand their relative positioning and timing of instantiation (Hedaa & Törnroos, 1997).

6.2.4.1 Introduction

The conceptual value clusters and their realization SRM initiatives identified by the council members are in the end a representation of an imperative transformation-driving organizational IQ or intelligence in the area of procurement and sourcing . Liebowitz (2000), highlighted the comparability between an individual's IQ, and what he terms Organizational Intelligence (OI), defined by the collection of all resident individual intelligences contributing towards building a shared vision, renewal process thus transforming their host entity. A key part of OI is organizational learning and building systems and processes to encourage continuous learning. Similarly, Nahapiet and Ghoshal (1998), emphasized that the sources and conditions of what has been described as "the organizational advantage," is dependent upon a company's *Social Capital* that facilitates the creation of new intellectual capital. Many of these research efforts and resulting conceptualizations stem from sociological studies on patterns of interaction and its effects on social networks of interconnected actors. In organizational theory, *Social Network Analysis* (SNA) has been described by Burt (1992), who examined network position in relation to access to social capital, while within the IMP group researchers examined network position in relation to the organization's role within the network and its overall connectedness within the network (Wilkinson & Young 2002). Another common theme related to network position is that of network structure. Network structure examines how the nodes/entities/actors are linked and from this research stream concepts such as clustering, centrality, density, and connectivity length (Wasserman & Faust, 1994). Within the IS Research field, analysis of social networks has been typically applied in studying technology power dissipation, network externalities and inter-departmental collaboration, yet only recently Hassan, Richards and Becker (2006) used Social Network Analysis to evaluate IT-Enabled organizational transformation. The authors used social network analysis to study dynamic relationships among the technology, its adopters, and the social context they are in, hence testing Galbraith's Organizational *Information Processing* Theory. SNA coupled with the organizational theories on information processing and social capital is capable of explaining how technological innovation and process innovation interact.

This part of our analysis is utilizing these latest advances in the IS Research filed to examine the concept of network clustering among the SRM initiatives identified. We will use mathematical models of connectivity and accessibility/centrality developed within SNA (Wasserman & Faust, 1994), to study the relationships and grouping of our SRM initiatives. Initially we will provide a brief overview of SNA in context of our analysis and then we will show the results we reached by using SNA software (UCINet-Netdraw) on the ranked data we collected during the council workshops.

6.2.4.2 A brief overview of Social Network Analysis

Writers often suggest that modern social network analysis began with the publication in 1934 of Jacob L. Moreno's pioneering book on sociometry, Who Shall Survive? (Wasserman & Faust, 1994:12). *Social network analysis* is a set of survey methods and statistics that reveal the hidden connections between people and provides a useful tool for understanding how these connections develop over time and their impact on employee productivity and job satisfaction. As mentioned, SNA as a technique is gaining prominence for determining knowledge flows in organizations to facilitate the communication, collaboration and innovation. According to Cross and Parker (2004), network of informal relationships has a critical influence on work and innovation. Research shows that appropriate connectivity in well-managed networks within organizations can have a major impact on performance, learning and innovation. SNA is a way to understand better these informal relationships in that it allows the mapping of relationships and flows in organizations to identify key sources, sinks and relationships (links/ties) among actors/nodes (individuals/units) in an organization. Hence, SNA is prone in mapping power, information and knowledge flows between actors, whether individuals, departments, companies, or even IT-enabled work or roles (Liebowitz, 2000, Hassan et al. 2006). SNA usually follows six key steps (Cross and Parker, 2004):

1. identify a strategically important group of actors or concepts;
2. assess meaningful and actionable relationships (e.g. relationships or interdependencies)
3. visually analyze the results typically done through SNA software like UCINet-Netdraw (Borgatti, Everett & Freeman, 1999)

4. quantitatively analyze the results to identify patterns in the network position and structure of the concepts under analysis.

In the final step 4, there are individual network and group measures that are frequently used to statistically analyze the results[83]. Individual network measures include various types of centrality. For example, *in-degree centrality* refers to the number of incoming ties an actor has for a given relationship. *Out-degree centrality* is the number of outgoing ties an actor has for a given relationship. *Betweenness centrality* is the extent to which a particular person lies 'between' various other people in the network – those actors with high betweenness centrality values could affect knowledge flows in networks if they were to exit. *Closeness centrality* is the extent to which an actor lies at short distances to many others in the network. Individuals are highly central with respect to closeness tend to hear information in advance than others (Cross and Parker, 2004). Group measures such as density and cohesion are often used in SNA. *Density* is the number of actors who have a given type of tie with each other, expressed as a percentage of the maximum possible. If each node in a network were connected to every other, the density would be 100% or 1.0. *Cohesion* is the average of the shortest paths between every pair of people in the network. The average cohesion score should be about two in groups, where managers are interested in employees leveraging each other's expertise (Cross and Parker, 2004). Geodesic distances between pairs of actors are the most commonly used measure of closeness. *Geodesic distance* is the minimum distance between actors. Usually multidimensional scaling or component factor analysis are used to lay out the nodes.

In our case, we viewed our concepts of SRM initiatives as "owned" by various actors involved in such transformation efforts, yet we attributed an importance and direction in the links (bonds, links and ties) between the various SRM initiatives denoting the importance and direction of the relationship. This particular pattern of interaction and sequencing was possible

[83] Social network analysis is more a branch of "mathematical" sociology than of "statistical or quantitative analysis," though social network analysts most certainly practice both approaches. The distinction between the two approaches is not clear-cut. Mathematical approaches to network analysis tend to treat the data as "deterministic" in that they tend to regard the measured relationships and relationship strengths as accurately reflecting the "real" or "final" or "equilibrium" status of the network. Contrary to inferential statistics, they also tend to assume that the observations are not a "sample" of some larger population of possible observations; rather, the observations are usually regarded as the population of interest. According to Hanneman and Riddle (2005): "Statistical analysts tend to regard the particular scores on relationship strengths as stochastic or probabilistic realizations of an underlying true tendency or probability distribution of relationship strengths. Statistical analysts also tend to think of a particular set of network data as a "sample" of a larger class or population of such networks or network elements -- and have a concern for the results of the current study would be reproduced in the "next" study of similar samples". SNA is used to study a particular network or set of networks, and researchers have no interest in generalizing to a larger population (in any

to analyze via SNA methods which could help us refine the clustering/grouping and sequencing of our construct as an hierarchical structure. Being a central node in our network of SRM initiatives means that it had to be implemented prior the subsequent "child" nodes. Our inferences are thus primarily focusing on the relationships and grouping of the nodes based on their homophily/similarity in order to understand the staging of their realization.

6.2.4.3 Staging Realization – Identifying Relationships between SRM Initiatives

What did emerge during the Council workshops was that the identified SRM initiatives could not be brought to life all at once. Each one, e.g. *content harmonization* may represent a significant project, which needs to commence before we can start *rationalizing parts* or *automating processes*. As, content, change management and integration were found in our original pilot survey to be instrumental to the success of IT deployment, we needed to address them early on, followed by a progression into other initiatives. While most companies would like to commence with rationalizing their supplier base, after discussions in the group we found that it was the effect/goal of a long sequence of other initiatives, rather than the cause. So, as described in the Research Approach section, we pursued this analysis of the most common sequencing of and grouping of our strategic and operational SRM initiatives with the help of Social Network Analysis (SNA). Consequently, we collaborated in an exercise with the council members, where each had to assign "directed arcs" or arrows between the SRM initiatives, and then evaluate the Strength of an initiative's interdependencies. Participants were asked to evaluate their original scoring of the strength of relationship in 2 rounds (2 ensure lower entry bias – Segev, 1988).

Upon completion of this exercise, the network of initiatives their directed arcs and their relationships were entered in the software UCINet-Netdraw (Social Network Analysis Software for Modeling and Inferences) provided by Borgotti, Everett & Freeman (1999). We drew the given consensus relationships between the various initiatives (as a graph), used completion or completed realization as the hypothesis verifying the network consistency. Then we run a series of inferential analyses calculating posterior probabilities and likelihood scores for the network structure and the position of the various initiatives vis-à-vis each other.

---

probabilistic way). The approach of most network analysts interested in statistical inference for testing hypotheses about network properties is to work out the probability distributions for statistics directly (Wasserman & Faust, 1994).

One of the first results of the analysis conducted with UCINet-Netdraw was a circle diagram depicted below. Each of the participants provided the links and scores on a paper resembling the diagram in the following figure. These were re-created and each evaluator's links and scores were entered in UCINet-Netdraw's spreadsheet. The individual case responses were summed, normalized and transposed as a detailed From-To matrix .

Table 17: Normalized Scores of the Weighting provided between Initiatives.

From \ To	Compliance enforcement	Demand consolidation	Right Price determination	Supplier rationalization & prequalification	Procurement risk management	Supply market intelligence	Procurement automation	Contract handling efficiency	Supplier selection efficiency	Supplier enablement	Content harmonization	Parts rationalization	Capital investment and tracking	Product development acceleration	Inventory cost management	Quality tracking	Supply requirements visibility	Reporting and communication	Manage Purchasing staff
Compliance enforcement		0,44						0,77											
Demand consolidation				0,20		0,33		0,77				0,25			0,77				
Right price determination																	0,17		
Supplier rationalization & qualification			0,25						0,50										
Procurement risk management				0,16											0,38				
Supply Market Intelligence				0,80										0,40					
Procurement automation						0,33		0,77		0,50	0,33	0,13					0,17	0,75	
Contract handling efficiency	0,36							0,77											0,36
Supplier selection efficiency			0,25											0,10			0,17		
Supplier enablement	0,27						0,44				0,33			0,20			0,17		0,27
Content harmonization		0,33	0,83				0,44	0,38				0,38							
Parts rationalization				0,12										0,20	0,38	0,33			
Capital investment & tracking			0,17	0,80					0,13										
Product development acceleration																			
Inventory cost management																			
Quality tracking			0,17	0,12					0,25										
Supply Requirements visibility		0,11		0,20	0,50							0,13			0,23				
Reporting & Communication	0,27				0,38			0,38					0,80			0,50	0,17		0,27
Manage purchasing staff	0,91	0,11	0,83	0,40	0,13	0,33	0,11	0,77	0,13	0,50	0,33	0,13	0,20	0,10	0,77	0,17	0,17	0,25	0,91

This initial interdependency matrix was used to create the actual network graph with directed arcs/ties, while the scores were used as attributes of the individual arcs. This initial network consisting of the various SRM initiatives was then generated with the arc weights shown as lines with different thickness. From the reproduced circle-diagram below, it is obvious how the interdependencies between various SRM Initiatives were ordered given the participants' views on how the "strengths" between the various nodes and the "weights" between them. These were then added in UCINet as a multidimensional table which contained the table of Ties, the table of the direction of the arcs and then the final table of attributes from the above relationship matrix.

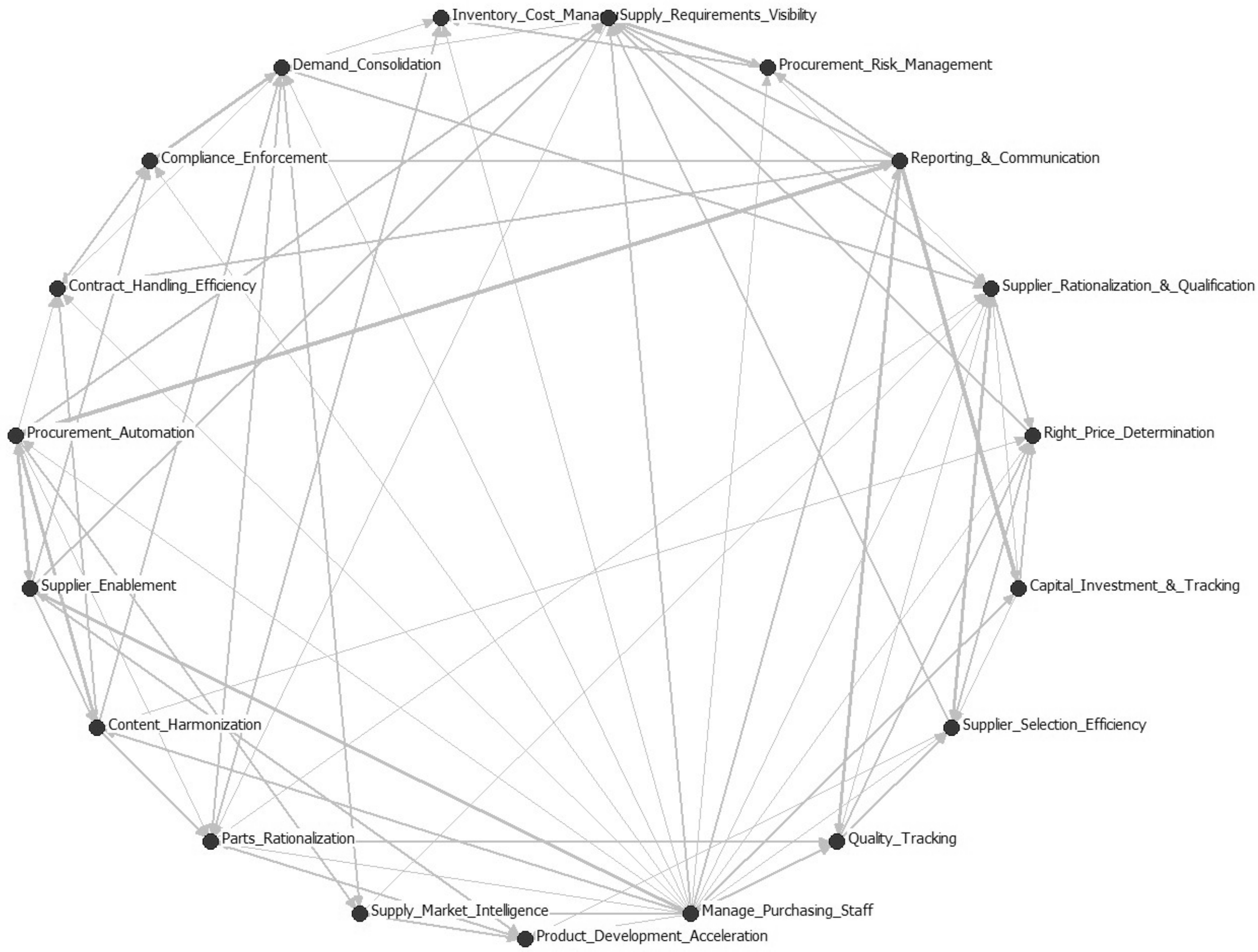


Figure 78: Directed Circle Graph of Weighted Interrelationships among the various SRM Initiatives

Given the number of responses we then used UCINet-Netdraw's capabilities in re-ordering the nodes into "groups" and studied the result (Freeman, 2000). Initially we studied the Dissimilarities Graph based on the geodesic distances between pairs of initiatives estimated from the scores as a measure of closeness. We used *multidimensional scaling* (MDS)[84] to find optimal proximity and network positions for the initiates. The following figure was generated using the Layout>Graph Theoretic Layout>MDS tool of NetDraw. From the diagram it is evident how the various SRM initiatives are ordered and the distances between them indicate their relative proximity.

---

[84] According to Hanneman and Riddle (2005): "MDS is a family of techniques that is used (in network analysis) to assign locations to nodes in multi-dimensional space (in the case of the drawing, a 2-dimensional space) such that nodes that are "more similar" are closer together. There are many reasonable definitions of what it means for two nodes to be "similar." In this example, two nodes are "similar" to the extent that they have similar shortest paths (geodesic distances) to all other nodes. There are many ways of doing MDS, but the default tools chosen in NetDraw can often generate meaningful renderings of graphs that provide insights. NetDraw has several built-in algorithms for generating coordinates based on similarity (metric and non-metric two-dimensional scaling, and principle components analysis)."

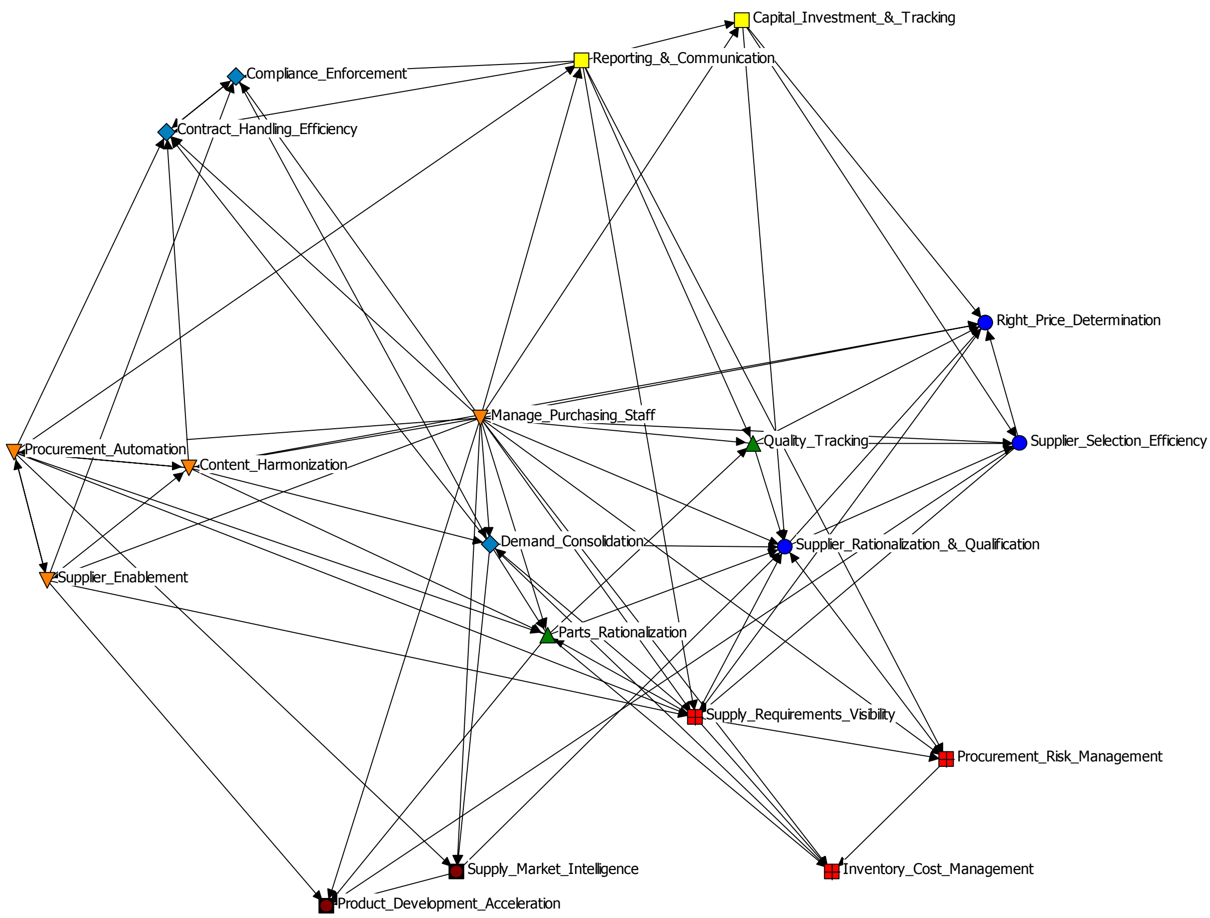


Figure 79: Non-parametric MDS of the SRM Initiatives – we colored nodes based on proximity (conducted in UCINET and NetDraw)

Visually the MDS network is ordered with a central node (Manage Purchase Staff) and then groups of initiatives in different distances. As this was a 2D graph some nodes like Parts Rationalization was shown further away from its proximity group. Generally, any MDS image that is shaped like a ring/outer rimmed disk in two dimensions or a sphere in three, suggests that the links are unpatterned (Freeman, 2000). We then used the 2nd approach to visually study the network of initiatives by using an algebraic procedure, singular value decomposition (SVD)[85]. SVD itself is always calculated the same way, but there are differences in the ways the data are pre-processed before SVD is run. We initially used Netdraw's PCA (principal components analysis) option which removes the effects of differences in means and the variances in rows and columns. The result is shown below where the hub-node was split apart

[85] SVD transforms the N original variables into N new variables, or dimensions. These new dimensions are ordered from largest to smallest in terms how much of the variance, or patterning, in the original data is associated with each. The most variance is always associated with the first dimension. Each succeeding dimension is, in turn, associated with progressively less of the variance. If a one, two or three dimensional visual image is going to be useful, the hope is that the first two or three of these new dimensions will be associated with virtually all of the

while the remaining nodes were ordered in 2 extreme groups and one intermediate one consisting of 2-3 subgroups. As the ties or arcs are directed it is interesting that all groups eventually point to the top nodes (i.e. Supplier Selection Efficiency and Right Price Determination). It was the first indication of a sequencing grouping where the directed arcs where moving from left to right then dispersed in the central and lower group with a final transition to the top group.

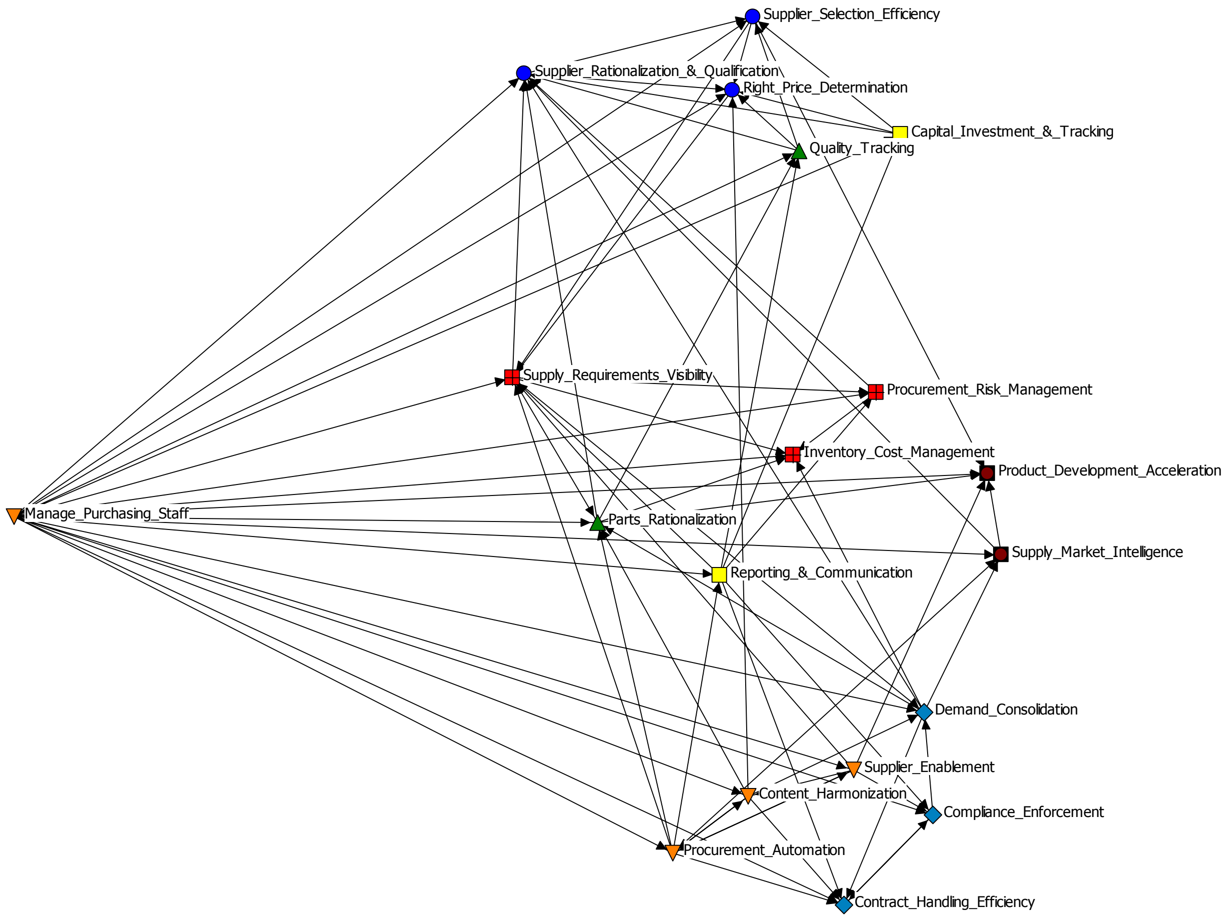


Figure 80: Non-parametric Principal Components Network Diagram (generated by NetDraw).

This finding confirmed that there were not only proximity, but also directional groupings. To verify this we also used *Correspondence Analysis* to study the effects of differences in the sizes of the row and column totals producing the figure below where closeness is shown for points near to each other. This initial visual SNA supported by the NetDraw program helped to identify significant groupings among the various initiatives, an gave us hints on the grouping and sequencing.

---

variance contained in the original data (Borgotti, Everett & Freeman, 1999). If, in contrast, the first few dimensions are associated with very little of the original variance, SVD will not yield useful results (Freeman, 2000).

Figure 81: Correspondence Analysis conducted in UCINET given the Arc values between Initiatives

6.2.4.4 Network Clustering of SRM Initiatives – Towards a Resolution

According to SNA methodological guidance (Wasserman & Faust, 1994, Hanneman & Riddle, 2005), when such network groups or clusters we are actually interested in uncovering the “structural equivalence” of the nodes. This describes the degree to which two nodes have the same profile of relations across all other nodes in the network[86].

As we did have a measure of the similarity or dissimilarity of the various SRM initiatives based on the provided scores of tie strength, we could then start searching for patterns and simplifications The whole idea of "equivalence" is an effort to understand the pattern of relationships in a graph by creating classes, or groups of nodes who are "equivalent" in one sense or another. Hierarchical cluster analysis is widely used to study the similarity or distance among cases, and for identifying classes of similar cases. In addition, the "block model" is also commonly used to describe structural similarity classes. The table below reports the statistics we computed based on our similarity data sorted by the geodesic Eigenvector of Closeness.

[86] Exact structural equivalence is rare in most social structures (one interpretation of exact structural equivalence is that it represents systematic redundancy of actors; which may be functional in some way to the network (Hanneman & Riddle, 2005)

SNA Centrality Statistics per Initiative	**Degree**	**Closeness**	**Betweenness**	**Eigenvector**	**Clustering Coefficients**	**nPairs**
Manage_Purchasing_Staff	100,00	100,00	27,79	62,28	0,18	153
Supply_Requirements_Visibility	61,11	72,00	6,32	44,23	0,23	55
Supplier_Rationalization_&_Qualification	55,56	69,23	4,90	39,99	0,24	45
Parts_Rationalization	50,00	66,67	3,67	37,71	0,25	36
Demand_Consolidation	50,00	66,67	4,29	36,46	0,25	36
Procurement_Automation	44,44	64,29	2,55	32,95	0,25	28
Reporting_&_Communication	44,44	64,29	4,02	30,84	0,21	28
Right_Price_Determination	38,89	62,07	1,51	30,31	0,31	21
Content_Harmonization	38,89	62,07	1,79	29,65	0,29	21
Supplier_Selection_Efficiency	38,89	62,07	1,57	29,40	0,31	21
Quality_Tracking	33,33	60,00	0,88	27,33	0,30	15
Contract_Handling_Efficiency	33,33	60,00	0,82	25,31	0,37	15
Supplier_Enablement	33,33	60,00	1,47	25,07	0,27	15
Inventory_Cost_Management	27,78	58,07	0,33	24,25	0,40	10
Procurement_Risk_Management	27,78	58,07	0,48	23,90	0,35	10
Capital_Investment_&_Tracking	27,78	58,07	0,46	22,86	0,35	10
Supply_Market_Intelligence	27,78	58,07	0,82	22,84	0,25	10
Compliance_Enforcement	27,78	58,07	0,65	21,33	0,30	10
Product_Development_Acceleration	27,78	58,07	1,05	21,02	0,20	10
SNA Univariate Statistics						
Mean	41,52	64,09	3,44	30,93	Overall graph clustering coefficient: **0.279**	Weighted Overall graph clustering coefficient: **0.244**
Std Dev	17,04	9,38	5,98	9,79		
Sum	788,89	1217,73	65,36	587,71		
Variance	290,35	88,01	35,80	95,84		
SSQ	38271,61	79717,70	905,00	20000,01		
MCSSQ	5516,57	1672,16	680,16	1821,04		
Euc Norm	195,63	282,34	30,08	141,42		
Minimum	27,78	58,07	0,33	21,02		
Maximum	100,00	100,00	27,79	62,28		

Table 18: Multiple Centrality measures sorted from high to low with univariate statistics for the Initiatives.

Initiatives as nodes that have more many ties have more powerful positions. In our directed data, we distinguish *degree centrality* based on *in-degree* from centrality based on *out-degree*, where the former denotes that these nodes are influential while out-degree indicates prominent position in the network structure. Typical end nodes have low scores. *Closeness centrality* approaches emphasize the distance of a node to all others in the network by focusing on their intermediate distances, while *betweenness centrality* views a node as being in a central position to the extent that it falls on the geodesic paths between other pairs of nodes in the network..

Initiatives on the first 5-6 rows of the table like *Managing Staff*, *Supply Requirements Visibility*, *Supplier-* and *Parts Rationalization,* and *Demand Consolidation* are undoubtedly central, prominent nodes in the network of initiatives. We can infer from this that we need to take these initiates into consideration early on and prior to a realization effort. Subsequently, after confirming that we could distinguish clusters[87], we conducted clustering of nodes with UCINet on the basis of the similarity of their profiles. We conducted a number of cluster runs

[87] That was done by comparing the overall network density with the clustering coefficient (Cc) shown in Table 18. Cc is one of the parameters used to characterize the topology of complex networks as it measures the probability with which two neighbors of a node are also neighbors to each other (nodes i and j are neighbors if there is a link between i and j). It has been found that many real world networks present a clustering coecient much larger than the corresponding random graph (Hanneman & Riddle, 2005).

to initially identify the natural grouping of initiatives into cliques. Then we applied a variant of the K-clustering algorithm – Optimization by the Tabu Search[88] – which could handle valued data (i.e. arcs with attributes).

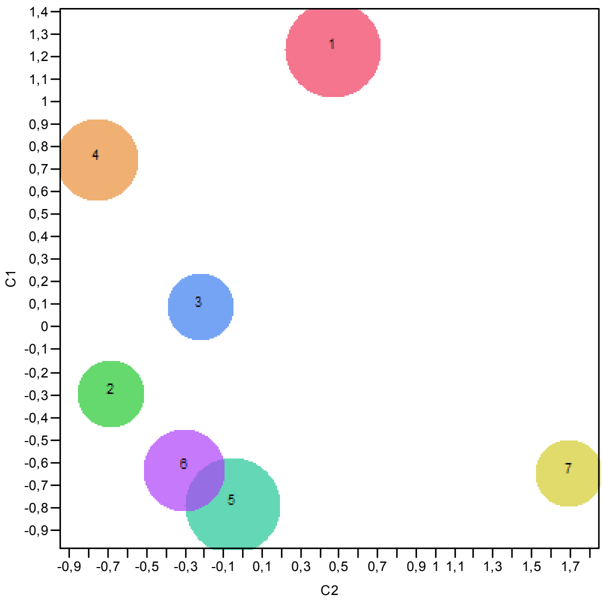
Table 19: K-Clusters via Tabu Search Analysis with R^2=0.44, on Similarities/Strengths. Individual SRM initiative Loadings are presented as well as the 7 identified clusters.

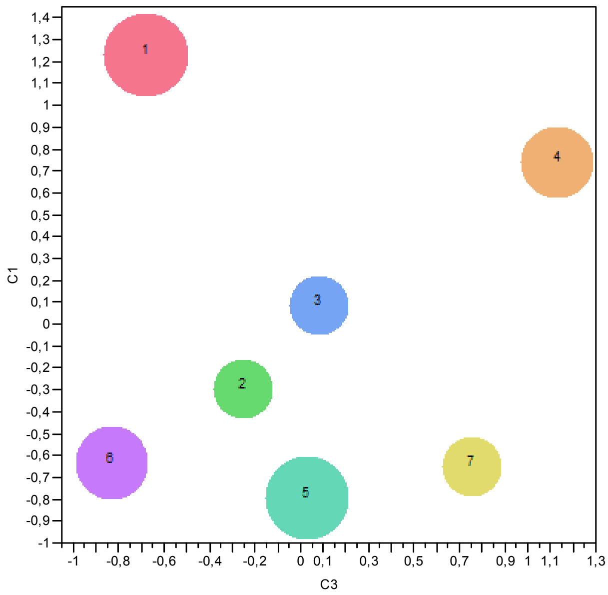
Cluster	SRM Initiatives	Supplier Selection Efficiency	Supplier Rationalization & Qualification	Right Price Determination	Reporting & Communication	Capital Investment & Tracking	Parts Rationalization	Quality Tracking	Inventory Cost Management	Procurement Risk Management	Supply Requirements Visibility	Supplier Enablement	Content Harmonization	Manage Purchasing Staff	Procurement Automation	Demand Consolidation	Compliance Enforcement	Contract Handling Efficiency	Product Development Acceleration	Supply Market Intelligence
1	**Supplier Selection Efficiency**	0,80		0,25						0,17									0,10	
	Supplier Rationalization & Qualification	0,50	0,80	0,25																
	Right Price Determination		0,80							0,17										
2	**Reporting & Communication**				0,80	0,80		0,50		0,38	0,17						0,27	0,31		
	Capital Investment & Tracking	0,13	0,08	0,17		0,80														
3	**Parts Rationalization**		0,12				0,80	0,33	0,31										0,20	
	Quality Tracking	0,25	0,12	0,17				0,80												
4	**Inventory Cost Management**								0,80											
	Procurement Risk Management		0,16						0,31	0,80										
	Supply Requirements Visibility		0,20				0,13		0,23	0,50	0,80					0,11				
5	**Supplier Enablement**									0,17		0,80	0,33	0,44			0,27		0,20	
	Content Harmonization		0,08				0,38						0,80	0,44		0,33	0,31			
	Manage Purchasing Staff	0,13	0,04	0,08	0,25	0,20	0,13	0,17	0,08	0,13	0,17	0,50	0,33	0,80	0,11	0,11	0,09	0,08	0,10	0,33
	Procurement Automation				0,75		0,13			0,17		0,50	0,33		0,80		0,08			0,33
6	**Demand Consolidation**		0,20				0,25		0,08							0,80		0,08		0,33
	Compliance Enforcement															0,44	0,80	0,08		
	Contract Handling Efficiency																0,36	0,80		
7	**Product Development Acceleration**																		0,80	
	Supply Market Intelligence		0,08																0,40	0,80

We used the E-I index as the adequacy parameter for N=2 to 10 clusters, while we used R^2 to estimate goodness-of-fit (Hanneman & Riddle, 2005) by "assessed by correlating the permuted matrix (the block model) against a "perfect" model". The above table summarizes our "best-fit" solution, while the bubble diagrams below summarize the relative position and 50% of estimated density as the size of the bubbles. The 7 clusters are depicted on axes-values extracted via Correspondence Analysis – where C1xC2 is used in left, while C1xC3 in the

[88] *Optimization by Tabu* search method of blocking has been developed more recently, and uses a more modern algorithm than CONCOR, yet is trying to implement the same idea of grouping together actors who are most similar into a block. It uses a direct method of permutation and search for perfect zero and one blocks in the adjacency matrix. Tabu search does this by searching for sets of actors who, if placed into a blocks, produce the smallest sum of within-block variances in the tie profiles. That is, if actors in a block have similar ties, their variance around the block mean profile will be small. So, the partitioning that minimizes the sum of within block variances is minimizing the overall variance in tie profiles (Hanneman & Riddle, 2005).

right. As these 3 axes represent app. 59% of the variance in the data, it is obvious that our identified cluster solution are distinct, yet in SNA we cannot infer anything about the significance of the solution. Nevertheless, the grouping of the various initiatives was.



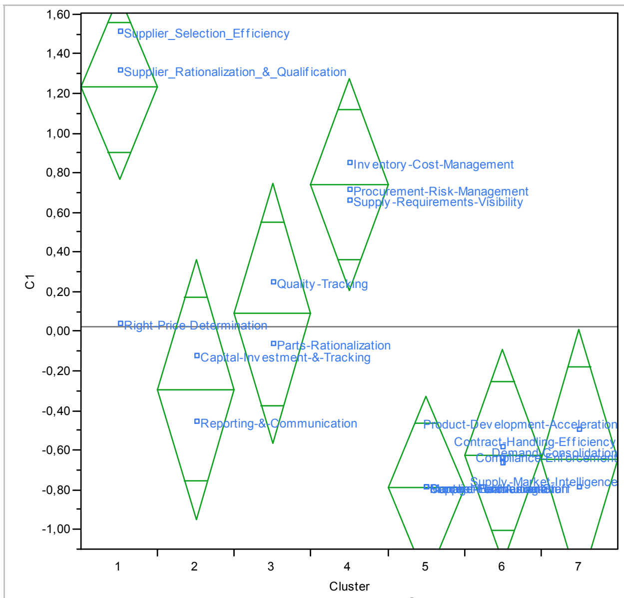


Singular Value	Inertia	Portion	Cumulative
0,81627	0,66630	0,2304	0,2304
0,75011	0,56266	0,1945	0,4249
0,68927	0,47510	0,1643	0,5891
0,66955	0,44830	0,1550	0,7441
0,65457	0,42846	0,1481	0,8923
0,55826	0,31166	0,1077	1,0000

Cluster	c1	c2	c3
1	1,691	0,803	-0,867
2	-0,038	-0,753	-0,272
3	0,430	-0,026	0,200
4	0,908	-0,793	1,280
5	-0,644	-0,044	0,017
6	-0,603	-0,180	-0,885
7	-0,665	2,297	1,093

Figure 82: Diagram of the SRM Initiatives *Clusters* based on Correspondence Analysis 3 Score Axes.

After establishing the set of clusters that distinguished the various SRM initiatives we used the UCINet's Testing Hypothesis feature and then *Density ANOVA* to investigate for our Structural Block model (i.e. Clusters), to test whether the clusters had significantly different interaction patterns (UCInet reported significant Adj R-Sqr of 21,6% at p<0.001). Then we utilized the *Relational Contingency* Table Analysis for Directed Networks, to generate a set of coefficients to represent the differences in normalized density means across the various clusters. The combined dataset was loaded into SAS' JMP to produce a graphical representation of the non-parametric ANOVA differences on the 2 estimated correspondence axes as shown below.

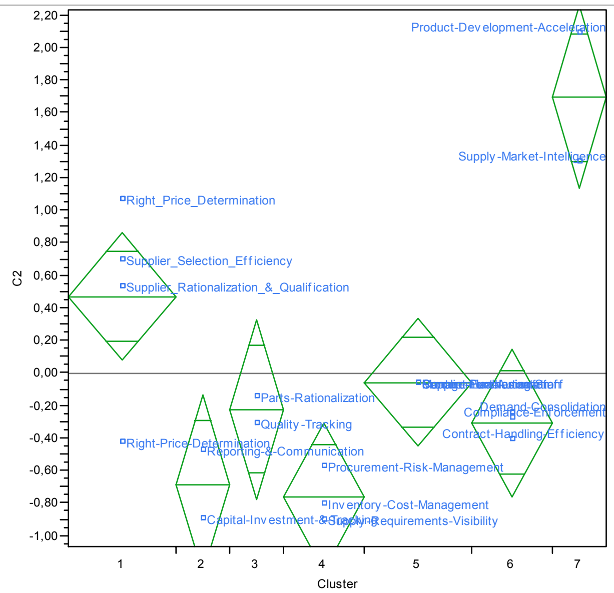


Kruskal-Wallis non-parametric Tests (Rank Sums)

Cluster	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	4	70,000	17,5000	2,599
2	2	21,000	10,5000	0,000
3	2	26,000	13,0000	0,567
4	3	48,000	16,0000	1,694
5	4	14,000	3,5000	-2,599
6	3	21,000	7,0000	-1,059
7	2	10,000	5,0000	-1,323

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
16,9413	6	0,0095



Kruskal-Wallis non-parametric Tests (Rank Sums)

Cluster	Count	Score Sum	Score Mean	(Mean-Mean0)/Std0
1	4	57,000	14,2500	1,370
2	2	7,000	3,5000	-1,701
3	2	19,000	9,5000	-0,189
4	3	8,000	2,6667	-2,435
5	4	54,000	13,5000	1,087
6	3	26,000	8,6667	-0,529
7	2	39,000	19,5000	2,205

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
15,6690	6	0,0156

Note: The diamonds in the ANOVA graph are a schematic of the mean (line in middle) and standard error of the mean (vertical bars) for each sample group or cluster in our case; the height of each diamond represents the 95% confidence interval for each group, and the diamond width represents the group sample size. Given that the sample is small, we used the Kruskal-Wallis, as it the most powerful rank test for errors with logistic distributions (we could actually fit an Johnson's SI to the non-normal distribution), hence even with that small sample, the no-par Chi square can be used in indicative manner (JMP Help)

Figure 83: Non-parametric, Density ANOVA results for the 7 Clusters of SRM Initiatives.

From the figure above it is clear that clusters 5+6 are very close to each other in the first correspondence axes, yet they increasingly diverge as we use C2, with the biggest deviation on C4 (not shown here). The remaining clusters are displaying borderline significant differences under different axes. While SNA does not allow us to make valid statistical inferences given sample sizes, we are able to identify that the evaluations of the Council members lead to a grouping that distinguishes the various SRM initiatives in similar groups in terms of density and closeness. Thus, without being able to draw a final normative conclusion, the SNA tests helped us structure the belief system of the council members from a probabilistic perspective.

Invariably, the seduction of numbers in SNA can undermine the value of SNA and lead to error where outcomes are not triangulated with fieldwork and observation. As Cross, Parker, Prusak and Borgatti (2003:229) argue, only interviews can yield full understanding of the significance of the empirical results – in our case the distinction of initiatives representing transformative behavior based on social capital and competence.

6.2.5 Final Model of SRM Adoption Strategic & Operational Initiatives – A Discussion

Consequently, we verified the results and reached a finally consensus with the Council group on the reclassification of the initial value clusters and the initiatives placement. The final result and labeling of the 7 clusters identified by SNA is shown in the figure below.

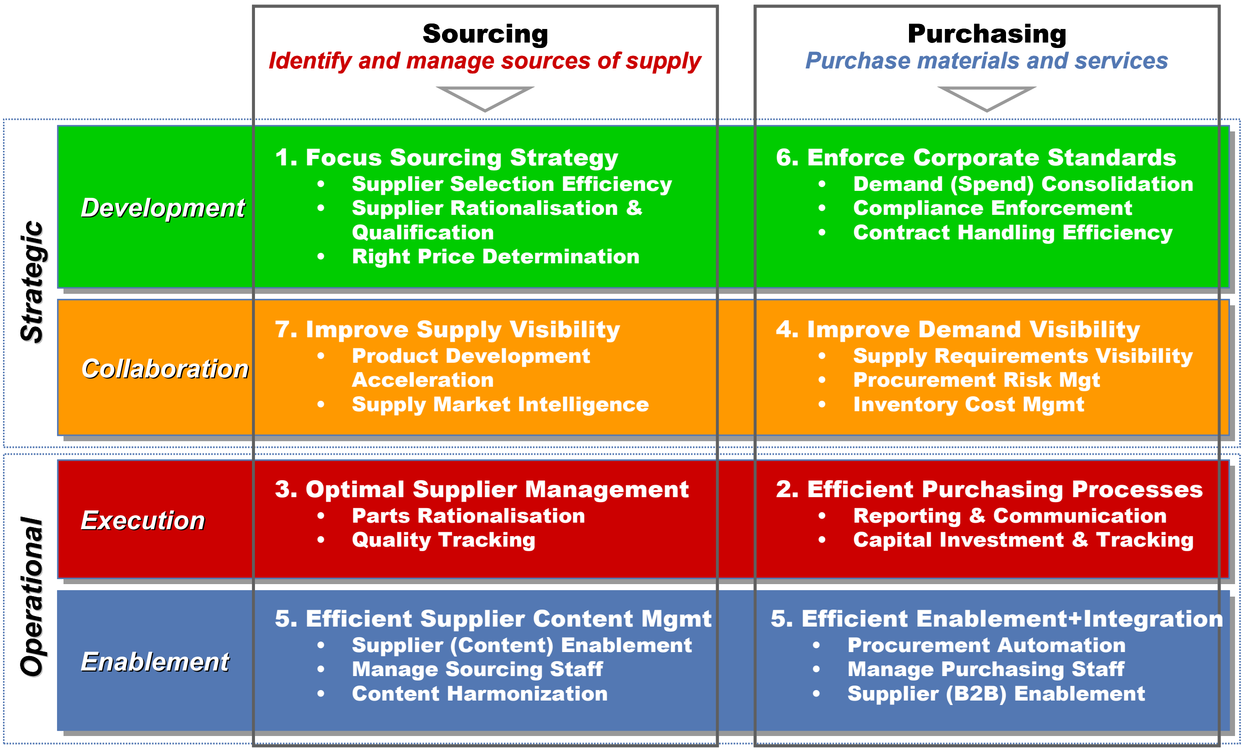


Figure 84: Final SRM Classification Matrix and Grouping of Transformation Initiatives within the Suppler Relationship Management domain.

This is then the result of our explorations and clarification of our research theme T2:"What are the Transformation Initiatives that typically drive change in a Business Domain Model and indirectly affect the IT-enablement of the same?". We managed to identify value-driven and capability-based set of initiatives that in a networked mode of realization help the companies to transform the supplier-side network. We have shown how these initiatives interact with the best-practice processes, hence proving the validity of the notion that companies should not use processes alone as the guidance and steering mechanism for realizing change.

Another important finding, which we provided amble evidence on, is that we cannot "parallelize" and *simultaneously execute* all of these SRM initiatives in one go[89]. Our analysis revealed that we need to gain an improved insight of the goals and their metrics/KPIs driving value in a company, and then based on a goal-to-capability analysis, evaluate the sequencing of realization initiatives and potential benefits. Such a scheduling is imperative to estimate cost and value of any transformation set of initiatives. We have shown in our analysis how the interdependencies between the various initiatives exposed a natural sequence of how we can carry such transformation in organizations – see figure below.

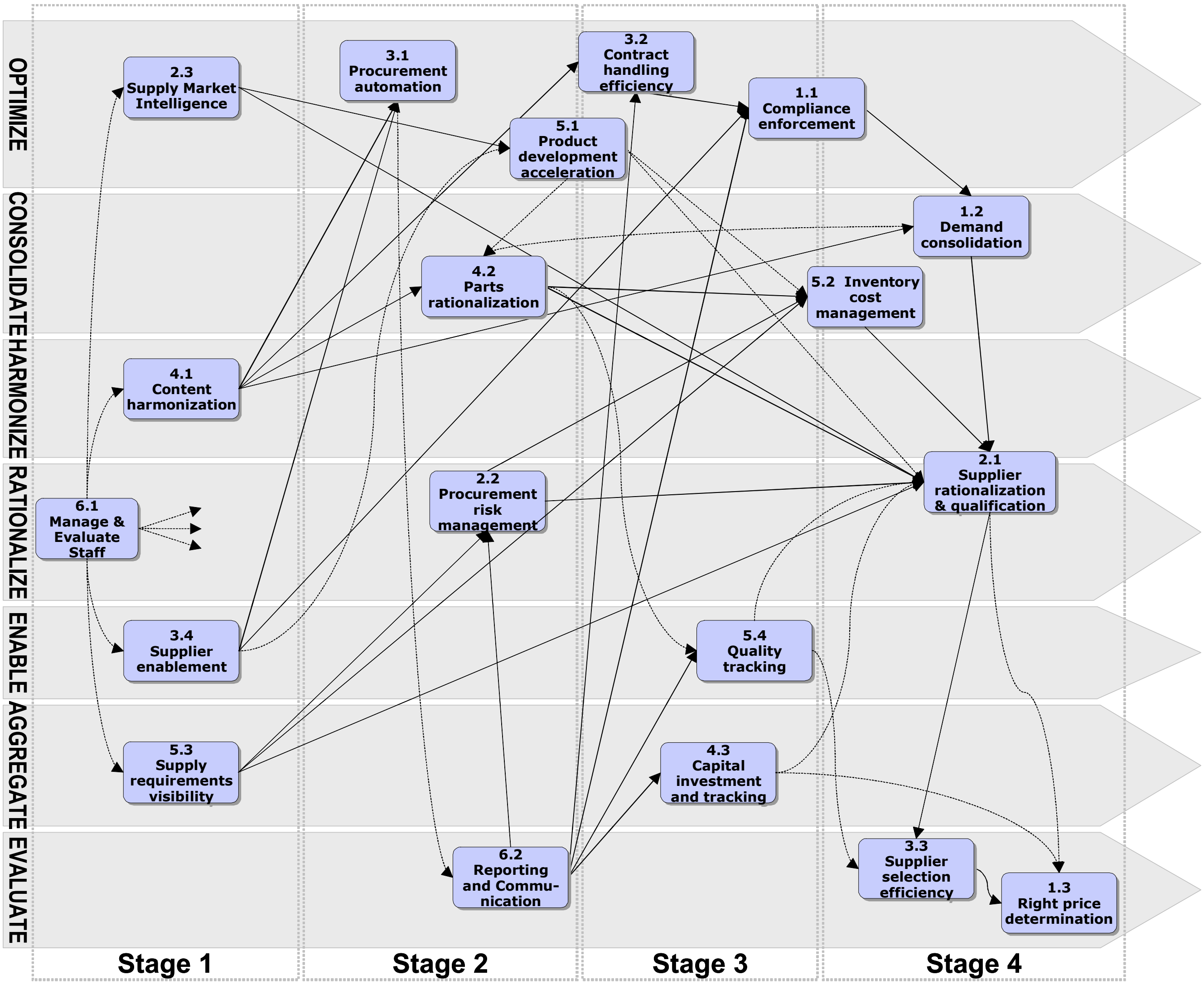


Figure 85: Merging Streams of Realization and SRM Initiative Sequencing based on Interdependencies. This layout of the SRM initiatives is an attempt to show how they are sequenced as we progress from base skills towards more complex initiatives (Source: Adapted from Nøkkentved, 2003).

[89] This is a favorite "game" between consulting services providers and companies employing the skills they don't possess, where the latter put pressure on shorter "time-to-benefits" on a "fixed cost" basis.

For example, to be able to pursue a successful Demand Consolidation across the enterprise, one needs to have pursued a number of initiatives like Compliance Enforcement, Parts Rationalization and Content Harmonization.

These important findings were some of the input guiding the refinement of our Context Factors of our 2nd iteration construct (see Figure 8 and then Figure 65), thus enriched the design of our parameter definition and measurement that were used in our subsequent survey. That led us then to the next stage of our investigation – the *Quantitative* Analysis of the SRM Adoption Factors construct. Before we commence with that chapter we will close this one with a practical summary for managers.

6.3 Managerial Implications of the SRM Initiatives Construct

An important question in the mind of many managers and practitioners in the SRM domain relates to the "right approach" to implement such initiatives in organizations. Knowing how they may enable or constrain value and what factors affect this value is important to answering this question.

6.3.1 Transforming the SRM Domain – Key Steps and Method Guidance

Our research attempted to construct such a framework to identify the organizational, competence-based initiatives and performance measures that are impacted by such applications, and how the process, organization, and "extended enterprise" process-level characteristics determine the level of the value (Subramanian & Shaw, 2001). Our research has identified a number of *value drivers* operationalized via SRM enablers or Initiatives, which in the end summarize the Critical Success Factors (CSFs), inherent in such transformation efforts that may help the prioritization process of such efforts. Given the complexity of realizing such a supply network architecture, it seems viable that the identified SRM Initiatives may by used during the beginning of such a project to investigate the status and maturity of the organization to embark upon such a project. Below we summarize the recommendations.

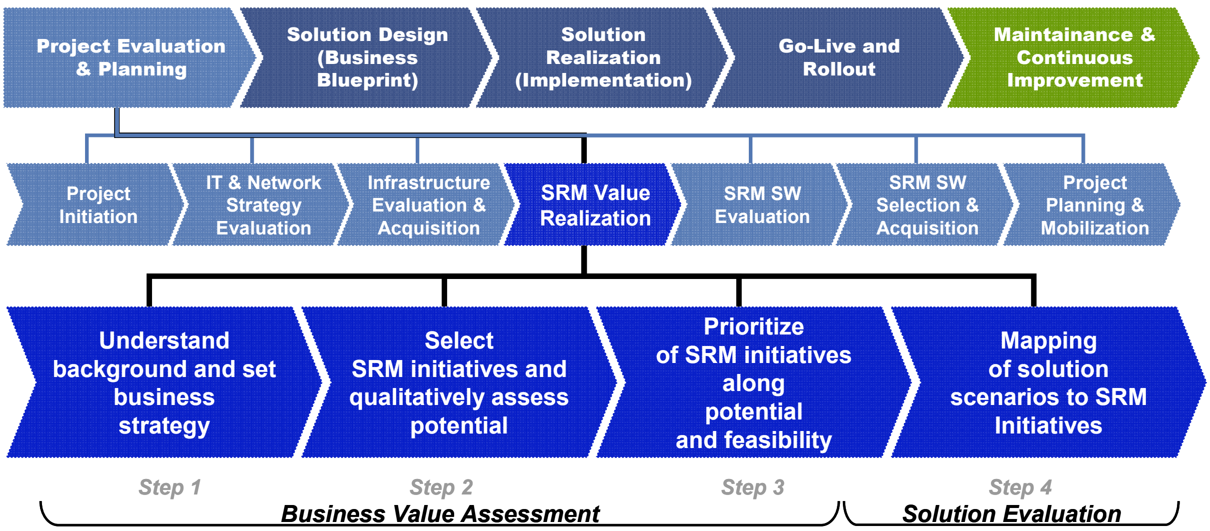


Figure 86: Typical Transformation Steps in developing an SRM Information Infrastructure.

Another perspective is related to the sequence or timing that these SRM transformation initiatives are supposed to be realized. Very few companies have the ability to embark on a "monolithic" transformation effort (Davenport, 1998), thus it is imperative for such adoption projects to link strategic necessity, with current needs, capabilities, potential for value creation and ease of implementation. Managers can use the SRM initiatives framework and the highlighted KPIs (see Table 15), to calculate their value potential. Based on their organization's maturity with regard to the SRM processes, they will be then able to identify which initiatives and subsequent application features they would pursue.

6.3.2 Transforming the SRM Domain – A Phased-, Value-Driven Approach

As we attempted to depict in the explanatory graph containing the sequencing of SRM initiatives, such transformation efforts need to be staged so that a realistic deployment will succeed. Remark that there might be multiple paths of implementation.

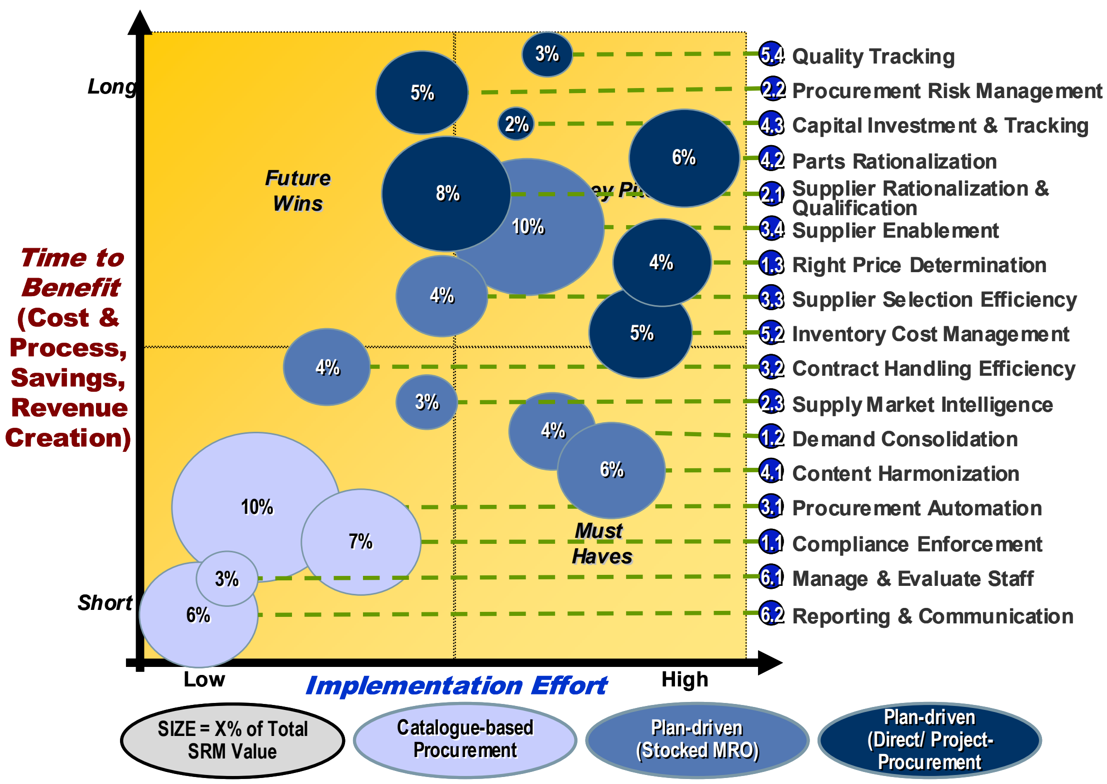


Figure 87: Staging Realization of SRM Initiatives via Benefit+Effort Phases (Bubble Size = % of Benefit).

It is rather obvious that a lot of preparation needs to take place before we even start "IT-enabling procurement and sourcing processes". Companies need to have:

1. defined clear roles, responsibilities and procedures for managing and developing staff,

2. clear procedures for scanning the market for new or additional suppliers (defined evaluation criteria, RFI procedures, etc.)
3. defined clear and standardized content in the form of product classifications (e.g. UN-SPSC), and supplier records (e.g. DUNS),
4. clear procedures and roles in relation to supplier adoption – exchange data standards (XML/EDI) for transactional and content information,
5. clear overview of the internal requirements for goods & services based on customer demand (i.e. the ability to create demand, maintenance and MRO forecasts).

6.3.3 Transforming the SRM Domain – Building the Lego Stack of Competences

It's all about the way we use current and new technologies to improve relationships with suppliers to drive business value for both parties to create long-term, sustainable relationships. Although technology is the enabler, SRM initiatives encapsulate a different way of thinking about how companies should deploy technology to work with suppliers. Making these improvements may require some radical thinking about the way that companies can work together to create that win-win scenario. From this capability driven perspective we need to be careful what goals an organization expects to achieve versus what is attainable. Our research showed that there is a natural sequence of how a company develops capabilities, processes and enablement in an attainable manner from the bottom-up as shown in Figure 88.

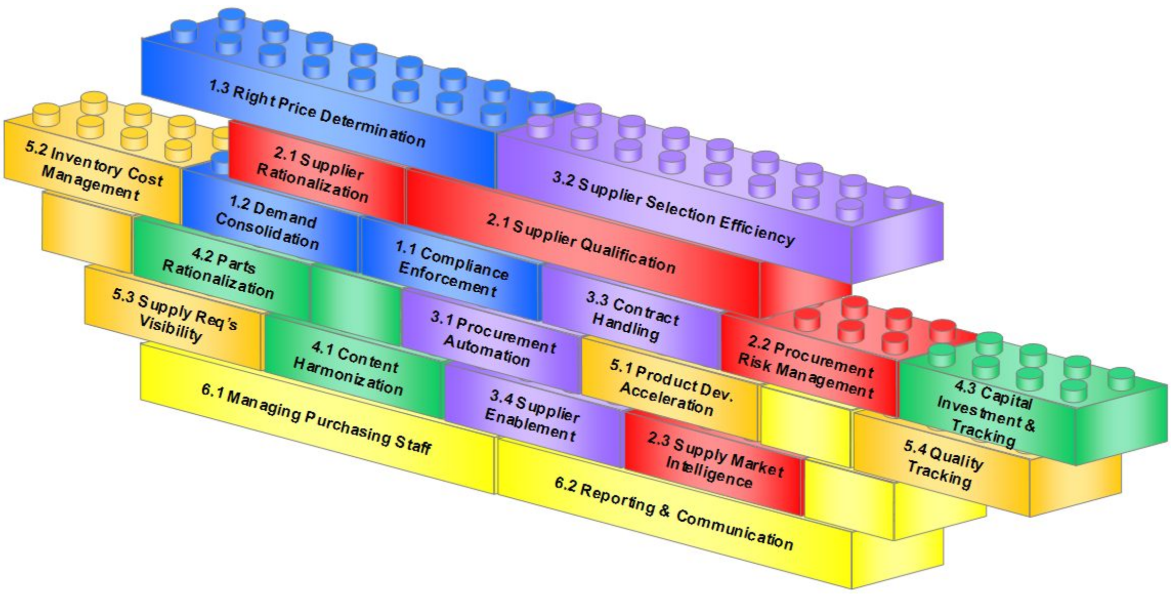


Figure 88: Transforming Supply Networks with the SRM Initiatives; remark that blank blocks are showing how lower level SRM initiatives extend and touch upon higher-level ones (Source: Nøkkentved, 2003)

Figure 88 was created as a summary of the Initiatives and their interdependencies as shown in Figure 85. It implies that "You can't Build from the Top", hence companies need to realize their SRM infrastructure from the ground up as shown in the Lego blocks. They need to orchestrate initiatives that improve organizations via upskilling staff and more transparent communications before they even attempt to commence with the second layer of bricks. This depiction together with Figure 84 (i.e. "Final SRM Classification Matrix and Grouping of Transformation Initiatives within the Suppler Relationship Management domain") can be used to define objectives and chart the road towards them with the help of these SRM initiatives.

6.3.4 Limitations of our SRM Initiatives Adoption Framework

There are many obvious limitations to the chosen methodology. For example, a one-year study does not provide a detailed historic perspective of the projects studied. We attempted to ameliorate this by asking interviewees their perceptions and experiences stretching beyond these projects. It must also be noted that the survey was not designed to demonstrate the existence of all suggested obstacles and CSFs, but rather to explore the replicability of "common" factors leading to success or failure. Obviously this research has concentrated on a small number of factors. The role of information infrastructures in the other relationships that surround the firm also needs investigating, as do the typology of tentative initiatives and value drivers described above. Additionally, it must be recognized that this is only an exploratory study and it is difficult to generalize the findings from such a small sample. Although we will test our findings in the subsequent survey-based quantitative analysis, it is still a cross-sectional view of the state of this business domain. future studies should be designed to test some of these findings from a longitudinal perspective in order to better cross-fertilize findings between the theoretical disciplines of information infrastructures and industrial networks.

Clearly, there is much scope for further development of a theory in this area and further empirical testing is needed in order to confirm the general applicability of the framework presented. The SRM Adoption Initiatives transformation framework is still under development. We are currently investigating total potential savings and improvement possibilities produced by each business initiative by utilizing benchmarks on sourcing categories, processes and KPIs. Some of these benefits are moderated by the industry and current purchasing practices. Quantification of these SRM benefits may lead into a clear view of potential benefits by implementing such practices.

This completes our initial, iterative round of interpretism. Our qualitative studies provided a lot of material and insights of the domain of study. Moreover, they enabled us to shed more light on our second research theme by identifying the adoption initiatives that may drive transformation in the SRM-domain of a Supply Network. Our preliminary model was a major input into the next stage that attempted to take the verify and validate these initiatives, contextual factors and performance effects of the state of procurement and sourcing among 344 companies around the Globe. The resulting Data Set became our base for our Quantitative Study.

7. Research Analysis – Construct Development From the Quantitative Survey

7.1 Introduction

This chapter will inquire into a detailed quantitative analysis based on the CPO survey designed by the author that was executed with IBM's Business Consulting Services in 2004,. Most of the survey questions utilized the findings of our qualitative analysis reported in the previous section and were defined by a team facilitated by the author within IBM's Institute of Business Value (IBV). The study had two tenets; one that focused on interviewing CPOs in Europe, while the second one was conducted as an online survey. The online survey was executed by IBV in collaboration with the Economist's Intelligence Unit, yet all of the descriptive, uni- and multi-variate statistical analyses were undertaken by the author. The results of the interviews were used to verify the validity of the received responses.

We will commence with a brief description of the Demographics of the survey, followed by a detailed descriptive analysis of the answers received from the surveyed companies. This introductory analysis will be followed by an in-depth investigation of the parameters that are significant different with regards to various performance levels. These have been identified via a cluster analysis that pointed to groups of companies in below, average and above average performance levels given the reported levels of effectiveness of the current operations. This analysis will provide the initial impetus to verify some of the hypotheses that we posed in the section on Research Themes and Propositions.

A central part of our analysis is focusing on evaluating and extending our conceptual, exploratory construct formulated in the previous chapter. This was undertaken with the help of a Structural Equation Modeling (SEM) technique – the PLS (Partial Least Squares) method. We will introduce PLS in detail, and explain why we selected this method rather than the most commonly utilized (i.e. covariance-based LISREL). The detailed analysis of our conceptual SRM Adoption construct will be presented where most of the hypotheses posed will evaluated. Finally, we will discuss our analytical findings based on the PLS analysis, then critique the results, analysis and method, and provide some relevant managerial implications that can be drawn from the significant relationships uncovered so far.

7.1.1 Quantitative Survey Background – The 3rd Iteration on our Construct

In section 5.1.2 we introduced our amended construct given that we started building a perspective – purely conceptual and qualitative – of the groups of Context Factors that sufficiently described our domain of study – Supplier Relationship Management. During the Council study we detailed the SRM transformation initiatives while also exposing some of the background capability-based actions and impacts that they had. These were classified under the headings of our preliminary concepts and then defined in greater detail. The final measurement model is shown in the figure below complete with the research themes,

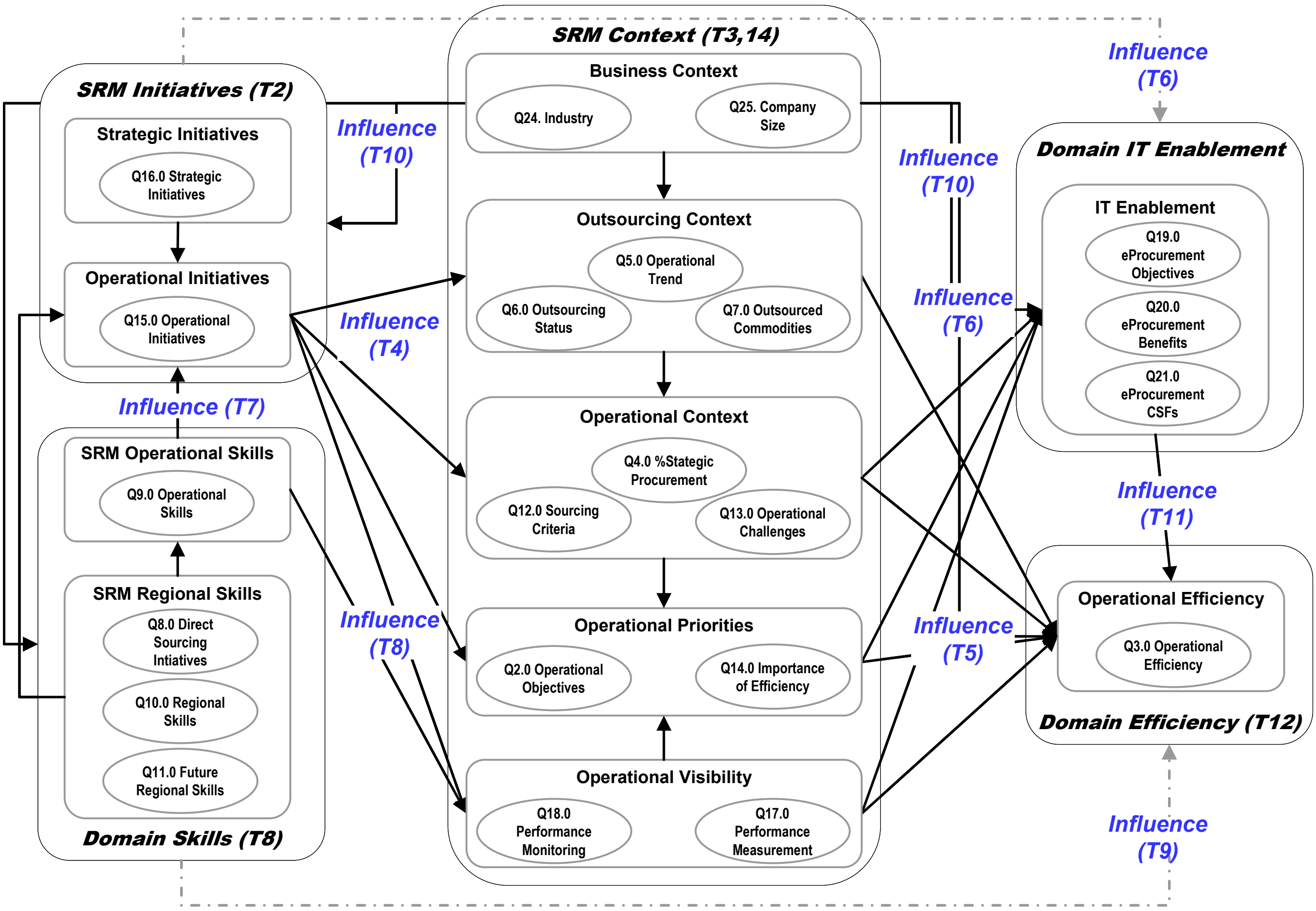


Figure 89: Hypothesized Constructs with Measured Parameters (introduced in Figure 66) and Research Themes. Each construct is shown with its measurement parameters, while arrows between constructs depict hypothesized dependencies. Dotted arrows denote what we presumed to be weak dependencies. Remark that we labeled individual or groups of dependencies as a means to explore and validate our research themes.

7.2 Quantitative Survey – Overview of the CPO Survey 2004

In order to better understand current procurement performance and future expectations, IBM's IBV team spoke, at length, with 45 chief procurement officers (CPOs) from 14 different industries and 8 countries across Europe, surveying these leaders about current performance and their views on critical procurement topics. As mentioned in the introduction, the author designed the questionnaire. IBM's IBV collaborated with the *Economist Intelligence Unit*, in order to execute the web-based/ online survey. Although responses came from 64 different countries and a wide variety of industries, the 50 CPOs and 250 other C-level executives that responded electronically voiced similar perspectives. This analysis focuses then on the data provided via the online survey, while the results of the interviews have been published in a report by IBM's IBV. As described the respondents of the online survey came from a wide swath of countries and industries, hence providing us a truly global view of the state and future of the procurement and sourcing activities.

7.2.1 Demographics of the Study

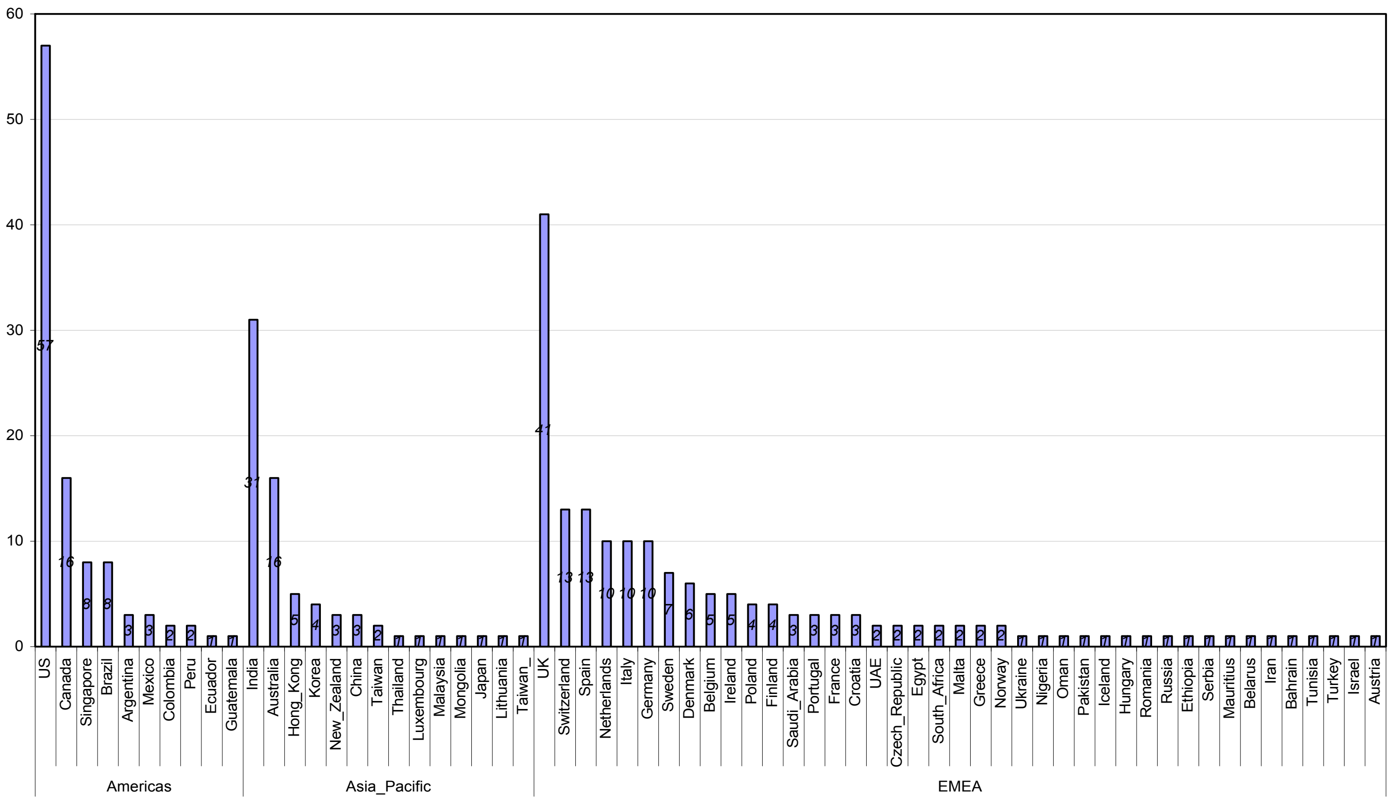


Figure 90: Number of Responses by Country

The above bar-chart shows the amount of responses per country, grouped per major geographical region in the world as Americas (North & South), EMEA (Europe-Middle East & Africa), and Asia-Pacific. The following pie-chart provides an overview of the distribution of responses per Geographic Area with EMEA being the lead contributor. We also requested from the surveyed companies to provide their view on an approximate Company Size based on their reported annual revenue. We subsequently coded responses as:

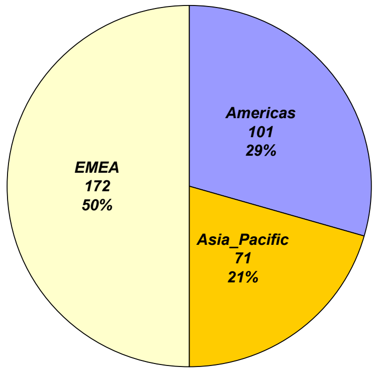


Figure 91: Number of Responses by Geographic Area

- Under \$250m as "Small size"
- \$250m – \$500m as "Small-Mid size"
- \$500m – \$1bn as "Mid-size"
- \$1bn – \$3bn as "Mid-Large size"
- \$3bn – \$8bn as "Large size" and
- Over – \$8bn as "Very Large".

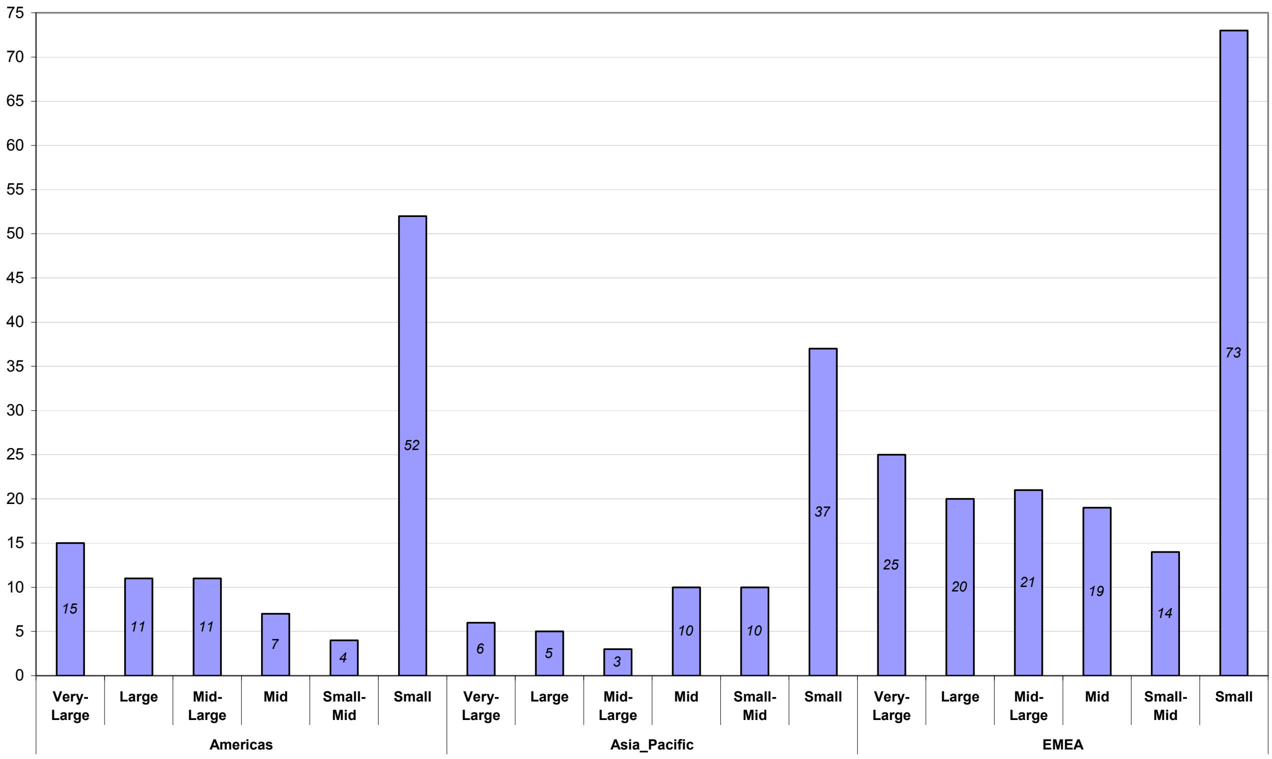


Figure 92: Number of Responses by Company Size (measured on Reported Revenue Size).

Above we show a bar chart of the responses distributed into Geographical region and Company Size. It is apparent that the sample includes a high proportion of small firms which we subsequently investigated with our Actor Role hypotheses compared to company size. This is also visible in the following bar-chart where we show the distribution of responses per Geographic Region and reported Job Title. We additionally grouped the responses into the reported Company Size. It is evident that mostly CPOs in Very Large to Small-Mid sized companies were the primary respondents, while it was interesting, yet not unusual that CEOs in smaller companies were involved in operational procurement and sourcing activities.

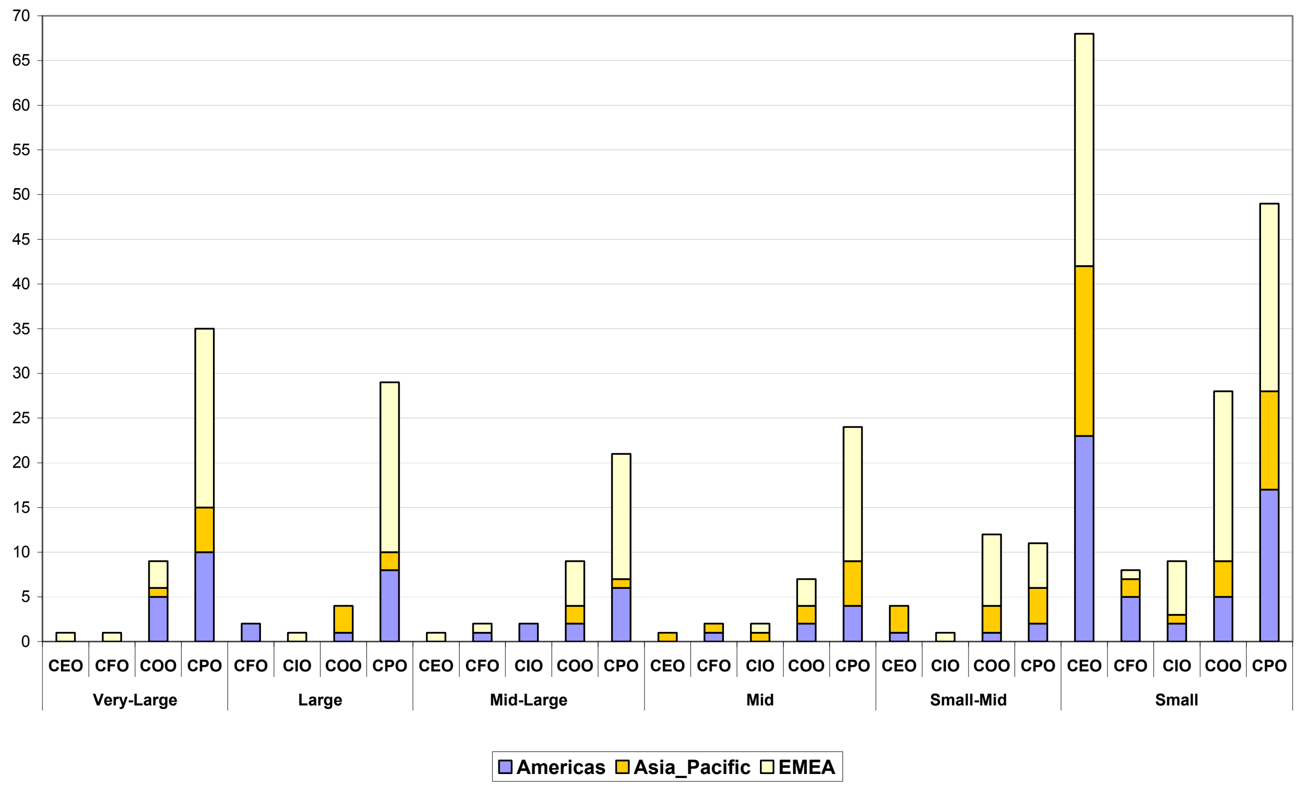


Figure 93: Number of Responses by Company Size, Region and Title.

Industries from Media, Telecoms, Consumer Goods, Travel & Transportation, Financial Services, Automotive, Construction, Electronics, Industrial Products and Healthcare are well represented in our survey with more than 15 responses from each. If we review the subsequent figure, it is clear that a lot of Small companies (i.e. revenues <$250M) have answered our survey, with a fair distribution of the remaining company sizes.

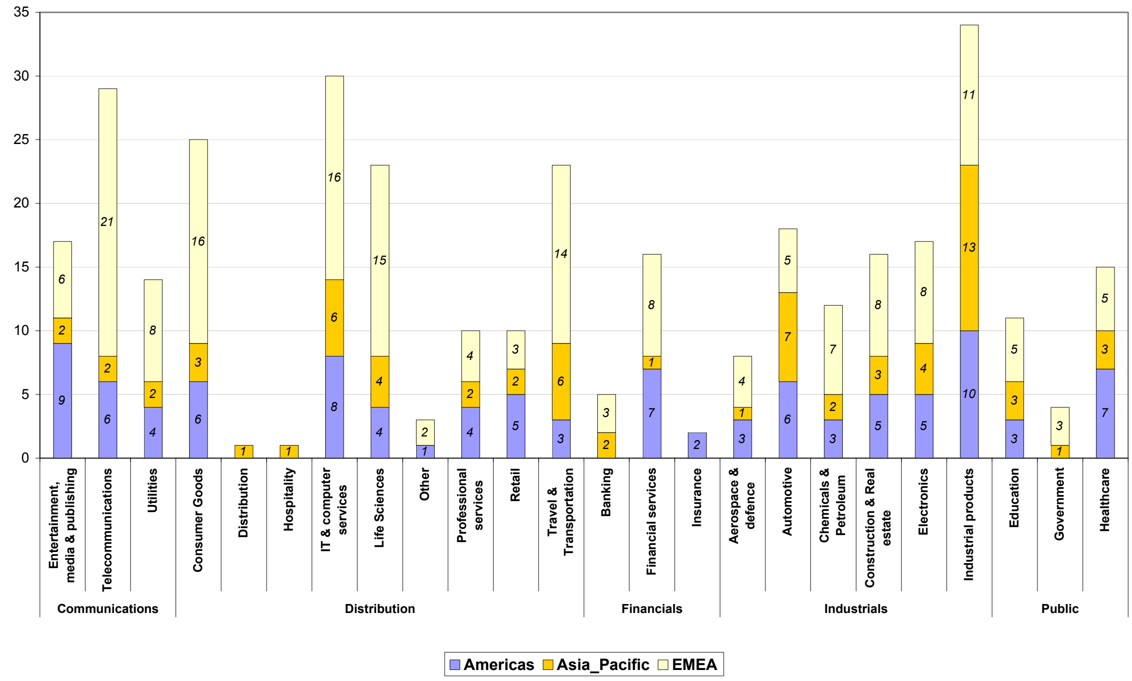


Figure 94: Number of Responses by Industry, Region and Sector (as defined by IBM GBS)

Finally, we show a bar-chart of the number of respondents per Region, Industry Sector and Subjective Revenue size (as this was provided by the respondents). Most of the Small companies are coming form the Distribution and Industrial Sectors with an even distribution among regions. In general, Asia-Pacific is not as well represented in the other categories.

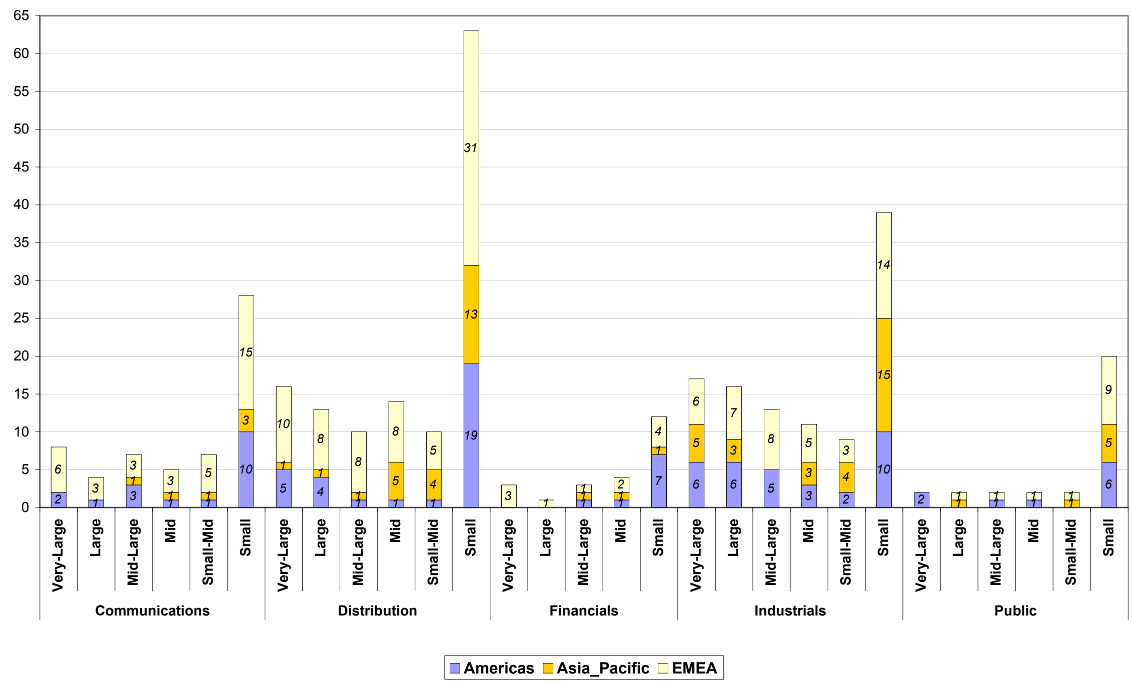


Figure 95: Number of Respondents by Region, Industry Sector and Revenue Size

7.2.2 Overview of Surveyed Questions, Parameters & Options with Univariate Statistics

The table in this section summarizes all the responses provided by the survey respondents, with indications on whether we have used the responses for further analysis, whether any were missing, the mean of the provided responses and then the median. We also highlight across the parameters whether the means of responses where above-, at to below-average with the respective colors of green, yellow and red. As a guidance on reading through this voluminous table we have provided the figure below that groups the Question Numbers under our subconstructs.

Figure 96: An overview of the Surveyed Parameters within their Sub-constructs affecting Operational Efficiency.

Table 20: Overview of Surveyed Parameters with Questions and their Options with Univariate Statistics.

Question		Parameter	Valid	Missing	Mean	Median
Q1: Are you involved in or do you have significant influence over your company's procurement decisions?			304	45	1,00	1,00
Q2: What are the main strategic objectives for your procurement operation over the next three years?			0	349		
	Q2o1	Reduce product/service costs	345	4	4,09	4,00
	Q2o2	Manage quality of products/services procured	343	6	4,06	4,00
	Q2o3	Reduce maverick spending	344	5	3,35	3,00
	Q2o4	Make the supply chain more responsive to market demands	345	4	3,64	4,00
	Q2o5	Improve security and resilience of supply chain	343	6	3,32	3,00
	Q2o6	Find better value suppliers in domestic market	342	7	3,41	4,00
	Q2o7	Find better value suppliers globally	340	9	3,42	4,00
	Q2o8	Support/facilitate business process outsourcing	343	6	3,07	3,00
	Q2o9	Introduction of eProcurement system	298	51	2,84	3,00
	Q2o10	Introduction of eSourcing system	302	47	2,77	3,00
Q3: How would you rate your procurement operation's effectiveness in the following areas?			0	349		
	Q3o1	Leveraging volume (e.g. to achieve discounts)	337	12	3,44	3,00
	Q3o2	Global sourcing of indirect materials (e.g. office supplies)	309	40	2,61	3,00
	Q3o3	Global sourcing of direct materials (e.g. components)	313	36	3,28	3,00
	Q3o4	Collaboration with suppliers	342	7	3,38	3,00
	Q3o5	Management of supplier performance	343	6	3,17	3,00
	Q3o6	Efficiency of payment processes	344	5	3,28	3,00
	Q3o7	Internal compliance to procurement policy	341	8	3,37	3,00
	Q3o8	eSourcing	314	35	2,48	2,00
	Q3o9	eProcurement	315	34	2,54	2,00
Q4: Approximately what percentage of the following are procured on a strategic (non ad-hoc) basis?			0	349		
	Q4o1	Indirect materials (e.g. office supplies)	345	4	2,17	2,00
	Q4o2	Direct materials (e.g. components)	338	11	2,90	3,00
	Q4o3	Services	344	5	2,55	3,00
Q5: How would you classify the following procurement activities in your company?			0	349		
	Q5o1	Sourcing of direct materials (e.g. components)	337	12	2,15	2,00
	Q5o2	Sourcing of indirect materials (e.g. office supplies)	343	6	2,84	3,00
	Q5o3	Transaction processing for procurement	341	8	2,54	2,00
	Q5o4	Accounts payable for procurement	342	7	2,57	2,00
	Q5o5	Procurement technology	343	6	2,47	3,00
Q6: What is the status of procurement outsourcing within your business in each of the following areas?			0	349		
	Q6o1	Indirect materials (e.g. office supplies)	342	7	3,22	4,00
	Q6o2	Direct materials (e.g. components)	337	12	3,33	4,00
	Q6o3	Sourcing	341	8	3,33	4,00
	Q6o4	Payment processes	343	6	3,52	4,00
	Q6o5	Procurement administration	342	7	3,58	4,00
	Q6o6	Procurement technology	343	6	3,43	4,00
Q7: Does your company outsource or plan to outsource the procurement function for any of the commodities?			0	349		
	Q7o1	Technical services procurement	343	6	2,38	3,00
	Q7o2	Software procurement	342	7	2,22	2,00
	Q7o3	Facilities maintenance procurement	341	8	2,16	2,00
	Q7o4	Telecommunications procurement	341	8	2,22	2,00
	Q7o5	Marketing communications procurement	340	9	2,48	3,00
	Q7o6	IT equipment procurement	342	7	2,17	2,00
	Q7o7	Travel procurement	343	6	1,88	2,00
	Q7o8	Business services procurement	339	10	2,38	3,00
	Q7o9	Temporary staffing procurement	341	8	2,13	2,00
	Q7o10	Facilities services procurement	338	11	2,09	2,00
	Q7o11	Hardware maintenance procurement	341	8	1,99	2,00
	Q7o12	Printing services procurement	338	11	2,05	2,00
Q8: What is the current status of global sourcing initiatives for direct materials/components in your company?			339	10	4,31	4,00
Q9: Does the procurement organization in your company have the right skills and capabilities for each of the following functions or do you believe that it needs to develop them?			0	349		
	Q9o1	Global sourcing of direct materials/components	337	12	1,93	2,00
	Q9o2	Global sourcing of indirect materials/services	341	8	2,10	2,00
	Q9o3	Outsourcing of non-core/back office business processes	343	6	2,11	2,00
	Q9o4	Outsourcing of core business processes	343	6	2,30	2,00
	Q9o5	Ensuring compliance with procurement contracts	344	5	1,86	2,00
Q10: In which of the following regions does your organization have the knowledge and expertise necessary to efficiently source goods and services?			0	349		

Question		Parameter	Valid	Missing	Mean	Median
	Q10o1	China	150	199	0,87	1,00
	Q10o2	Eastern Europe	124	225	0,88	1,00
	Q10o3	Latin America	106	243	0,82	1,00
	Q10o4	Russia	71	278	0,61	1,00
	Q10o5	South Asia (India, Sri Lanka and Bangladesh)	138	211	0,86	1,00
	Q10o6	South-East Asia (except China)	143	206	0,84	1,00
Q11: In which of the following regions does your organization intend to improve its ability to source goods and services over the next 3 years?			0	349		
	Q11o1	China	177	172	0,92	1,00
	Q11o2	Eastern Europe	129	220	0,84	1,00
	Q11o3	Latin America	82	267	0,63	1,00
	Q11o4	Russia	87	262	0,70	1,00
	Q11o5	South Asia (India, Sri Lanka and Bangladesh)	116	233	0,78	1,00
	Q11o6	South-East Asia (except China)	116	233	0,76	1,00
Q12: Please rate the following criteria in terms of how much they influence your sourcing decisions today?			0	349		
	Q12o1	Supply risk	342	7	3,96	4,00
	Q12o2	Delivery / Logistics service	342	7	3,85	4,00
	Q12o3	Environmental issues	340	9	2,86	3,00
	Q12o4	Technology enablement	341	8	3,39	3,00
	Q12o5	Price	342	7	4,37	5,00
	Q12o6	Financial stability of supplier	341	8	3,77	4,00
	Q12o7	Technology competencies and innovation	341	8	3,69	4,00
	Q12o8	Product/Service quality	341	8	4,38	5,00
	Q12o9	Aftermarket / Field Service / Warranty Costs	340	9	3,64	4,00
	Q12o10	Supplier's ability to collaborate and communicate	342	7	3,83	4,00
Q13: What are your company's top three challenges in improving its procurement and sourcing operations? Please check three answers only			0	349		
	Q13o1	Reduce sourcing cycle times	219	130	0,89	1,00
	Q13o2	Standardizing procurement decision making according to corporate policies	191	158	0,91	1,00
	Q13o3	Create an audit trail for each step in a negotiation with suppliers	93	256	0,58	1,00
	Q13o4	Gaining visibility over spending activities	174	175	0,93	1,00
	Q13o5	Measuring contract compliance	110	239	0,77	1,00
	Q13o6	Achieving better prices	278	71	0,94	1,00
	Q13o7	Improving e-procurement system	59	290	0,95	1,00
	Q13o8	Other	316	33	0,99	1,00
Q14: Are procurement savings targets likely to become more or less important over the next three years?			343	6	4,57	5,00
Q15: Which of the following do you expect to make the biggest contribution to improving the efficiency of your company's supply chain over the next three years? Score from 1 to 5, with 1 being least important and 5 being most important			0	349		
	Q15o1	Rationalization of preferred suppliers	338	11	3,58	4,00
	Q15o2	Supplier collaboration in product development	339	10	3,38	3,00
	Q15o3	Supplier collaboration in managing the supply chain	338	11	3,54	4,00
	Q15o4	Managing supplier performance	339	10	3,75	4,00
	Q15o5	RFID (radio frequency identification)	336	13	2,12	2,00
	Q15o6	Developing new approaches based on Total Cost of Ownership (TCO)	336	13	3,30	3,50
Q16: What will be your main strategies for improving procurement performance over the next three years? Score from 1 to 5, where 1 is the least important and 5 the most important strategy			0	349		
	Q16o1	Process automation	339	10	3,24	3,00
	Q16o2	Process re-engineering of purchase-to-pay transaction process	340	9	3,18	3,00
	Q16o3	Introduction of new best practice sourcing processes (e.g. eSourcing)	338	11	3,43	3,50
	Q16o4	Management and retention of talent	340	9	3,81	4,00
	Q16o5	Training of procurement staff to improve traditional core procurement skills	339	10	3,61	4,00
	Q16o6	Upgrading of people capabilities to take on new skills	339	10	3,78	4,00
	Q16o7	Transformation of the procurement organization	337	12	3,39	3,00
	Q16o8	Procurement outsourcing	339	10	2,49	2,00
Q17: How do you measure performance of your procurement activities?			0	349		
	Q17o1	Process efficiency/costs	337	12	2,04	2,00
	Q17o2	Order cycle times	338	11	2,11	2,00
	Q17o3	Spend reduction/savings achievements	336	13	2,38	2,00
	Q17o4	Procurement internal service performance	337	12	1,86	2,00
	Q17o5	Quality of products/services procured	337	12	2,39	2,00
	Q17o6	Resiliency of goods/service supply	335	14	1,97	2,00
	Q17o7	Benefits of eProcurement	334	15	1,52	1,00
	Q17o8	Total Cost of Ownership (TCO)	337	12	1,74	2,00
Q18: How would you rate your ability to monitor and manage procurement spending in the following areas? Please rate on a scale of 1 - 5, where 1 is least capable and 5 most capable.			0	349		
	Q18o1	Improve transparency of spend	335	14	3,39	3,00

Question		Parameter	Valid	Missing	Mean	Median
	Q18o2	Challenge business unit demands	332	17	3,26	3,00
	Q18o3	Identify areas for improvement	335	14	3,70	4,00
	Q18o4	Gaining information for the development of supply strategies	334	15	3,34	3,00
	Q18o5	Measuring performance of procurement departments and buyers	333	16	3,32	3,00
Q19: Which of the following electronic procurement (eProcurement) objectives are most important to your organization? Please rate on a score of 1 to 5, where 1 is least important and 5 is critical.			0	349		
	Q19o1	Reduce prices	333	16	3,95	4,00
	Q19o2	Reduce maverick buying and increase contract compliance	334	15	3,53	4,00
	Q19o3	Improve spend control and transparency	334	15	3,77	4,00
	Q19o4	Reduce transaction costs	333	16	3,89	4,00
	Q19o5	Reduce stock and inventory	333	16	3,55	4,00
	Q19o6	Decrease procurement cycle times through simpler or automated processes	334	15	3,56	4,00
	Q19o7	Reduction of administration workload	333	16	3,62	4,00
	Q19o8	Realize real-time collaboration	331	18	3,17	3,00
	Q19o9	Provide transparent procurement data across the supply chain	330	19	3,35	3,00
Q20: If you have implemented an e-procurement solution, what have the main benefits been to your organization? Score from 1 to 5, where 1 is no benefit and 5 is massive benefit. Skip to section 3 if you have no e-procurement solution			0	349		
	Q20o1	Reduce prices	130	219	3,57	4,00
	Q20o2	Reduce maverick buying and increase contract compliance	128	221	3,45	4,00
	Q20o3	Improve spend control and transparency	129	220	3,60	4,00
	Q20o4	Reduce transaction costs	129	220	3,60	4,00
	Q20o5	Reduce stock and inventory	127	222	3,31	3,00
	Q20o6	Decrease procurement cycle times through simpler or automated processes	128	221	3,52	4,00
	Q20o7	Reduction of administration workload	127	222	3,46	3,00
	Q20o8	Realize real-time collaboration	127	222	3,02	3,00
	Q20o9	Provide visibility of distributed procurement data centrally and in common format	126	223	3,39	4,00
Q21: What are the three most important factors in the success of an e-procurement strategy? Check three answers only.			0	349		
	Q21o1	Sufficient support at Executive Committee level	112	237	0,88	1,00
	Q21o2	Spend analysis in advance to identify main focus points	76	273	0,63	1,00
	Q21o3	Business Case in advance to control cost and benefit	75	274	0,75	1,00
	Q21o4	Identification and elimination of (e.g. legal) restrictions	45	304	0,31	0,00
	Q21o5	Appropriate implementation approach	93	256	0,76	1,00
	Q21o6	Professional and competent external support for procurement process issues	57	292	0,51	1,00
	Q21o7	Change Management program to avoid cultural and organizational resistance	73	276	0,78	1,00
	Q21o8	Training and awareness of all users	82	267	0,68	1,00
	Q21o9	Get strategy and organization right first, then implement eProcurement	94	255	0,78	1,00
	Q21o10	Implement in parallel with strategic sourcing initiatives	53	296	0,58	1,00
	Q21o11	Other	307	42	1,00	1,00
Q22: In which country are you personally located?			349	0	39,10	40,00
Q23: Which of the following titles best describes your job?			349	0	6,54	7,00
Q24: What is your company's primary industry?			349	0	17,83	21,00
Q25: What are your company's total annual revenues?			349	0	8,67	10,00
Data collection method			347	2	1,12	1,00
In which Region are you personally located?			345	4	4,31	5,00
In which Geo are you personally located?			345	4	2,24	3,00

With regards to the *Missing Values* treatment during the various statistical analyses, we will explain as needed what we did. In general, we have not conducted any major imputations of missing data, but rather used a list-/case wise deletion since we had a sufficient data-set, yet wanted to avoid the variance consequences of other techniques like mean value imputation. We did try however a run on JMP's NIPALS algorithm for an Full-Information Maximum Likelihood (FIML), and compared the results during the PLS analysis.

7.3 Overview of the Survey Results – An Actor Role-based Review

In this section we will present the descriptive results of the survey data by looking at the way that CPOs versus the other leading officers among the surveyed companies have answered the questions posed. Just as (Gadde & Håkansson,2001) recommends, one of the reasons that we present this view is to provide a perspective on the differences of opinion different actors have within such our well-defined domain of Supplier Relationship Management. After the brief exposition of the descriptive results, we will present the significant results via an Analysis of Variance conducted between the two actor roles and the surveyed questions.

7.3.1 Operational Priorities – Raising Importance of Procurement & Sourcing

Procurement is back on the board room agenda driven by a combination of permanent structural shifts and renewed cost pressures. The old challenges remain but traditional approaches are no longer enough to deliver market leading performance

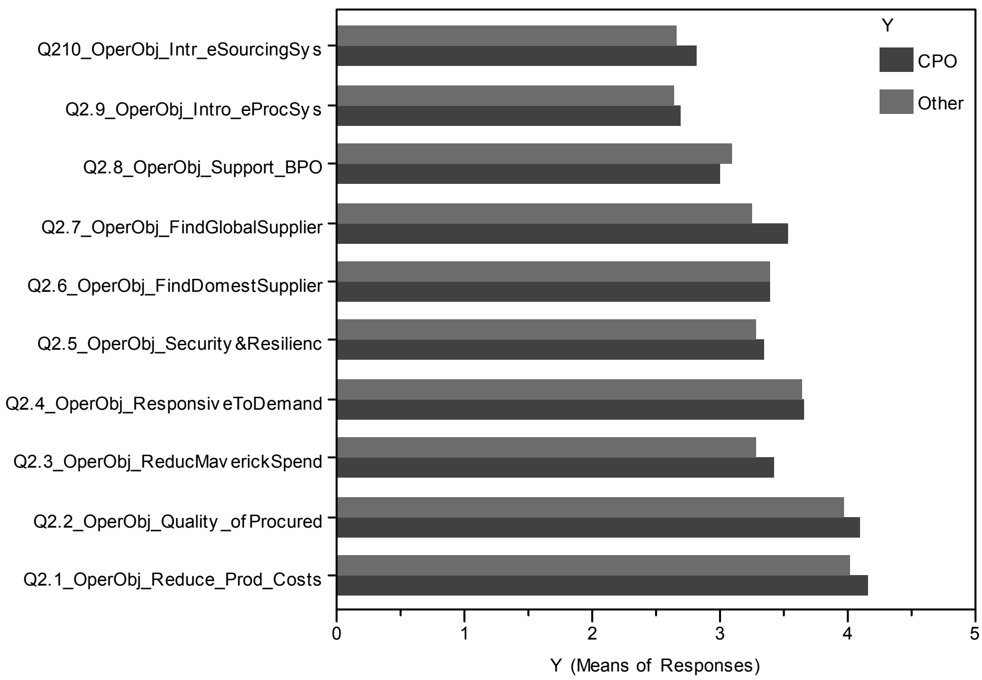


Figure 97: Question 2 (What are the main strategic objectives for your procurement operation over the next three years?)

As shown in the figure above, while cost reduction is still key, most leaders explore new avenues to create breakthrough Procurement performance. Beyond the common Cost, Quality and Service Responsiveness that continue to be critical for the business, new objectives like Responsiveness, Supply Risk and Supply Chain Security are becoming more important in supplier selection.

CPOs in the survey, have verified the need to achieve cost reduction but also to procure good quality products and services, hence price is not the absolute king. They are also searching for the Best-Fit products globally to ensuring the company's responsiveness to market demands, while they believe that this would naturally require them to consider the global supplier market. Other C-Level Execs. would also like to see Procurement make the supply chain more responsive.

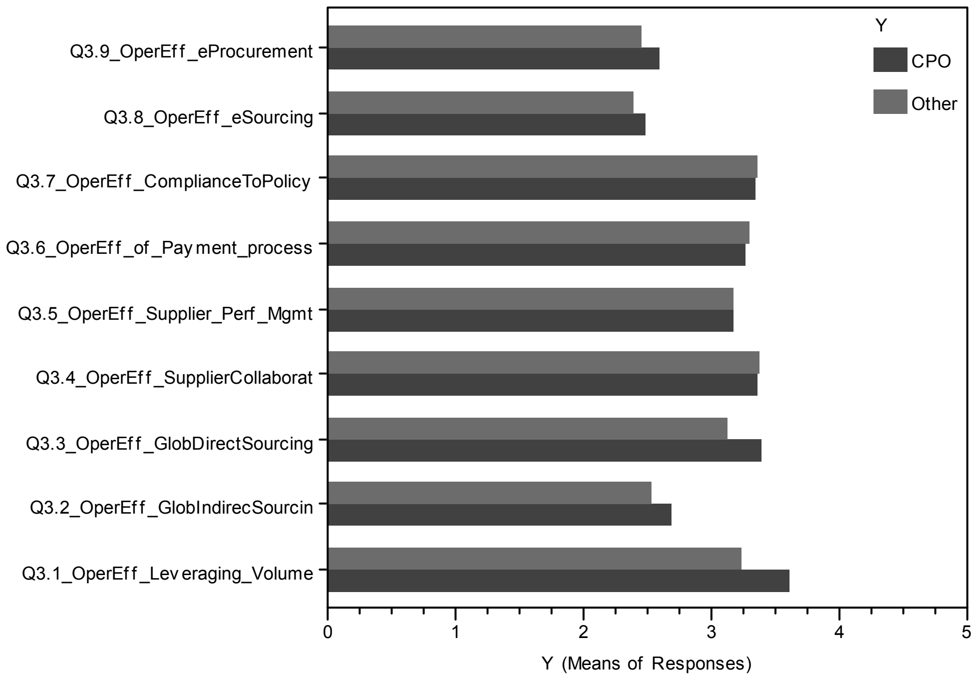


Figure 98: Question 3 (How would you rate your procurement operation's effectiveness in the following areas?)

On the question on the respondents' view on their own operational efficiency (i.e. performance), it seems that beyond the typical objectives of cost efficiency like leveraging volume and supplier consolidation for direct materials, there is an increased focus on the supplier relationships, both increased collaboration and measurement of the relationship performance. CPOs consider that Procurement is efficient in the leveraging of large volumes and Global sourcing of Direct materials. CPOs and other C-Level Execs. share the same view on efficiency. All C-level Execs consider that their procurement organization could make significant progress. It is clearly evident and this was subsequently controlled with the question on whether they had implemented an eProcurement system, most respondents agree that their organizations have not yet harnessed e-sourcing and e-procurement.

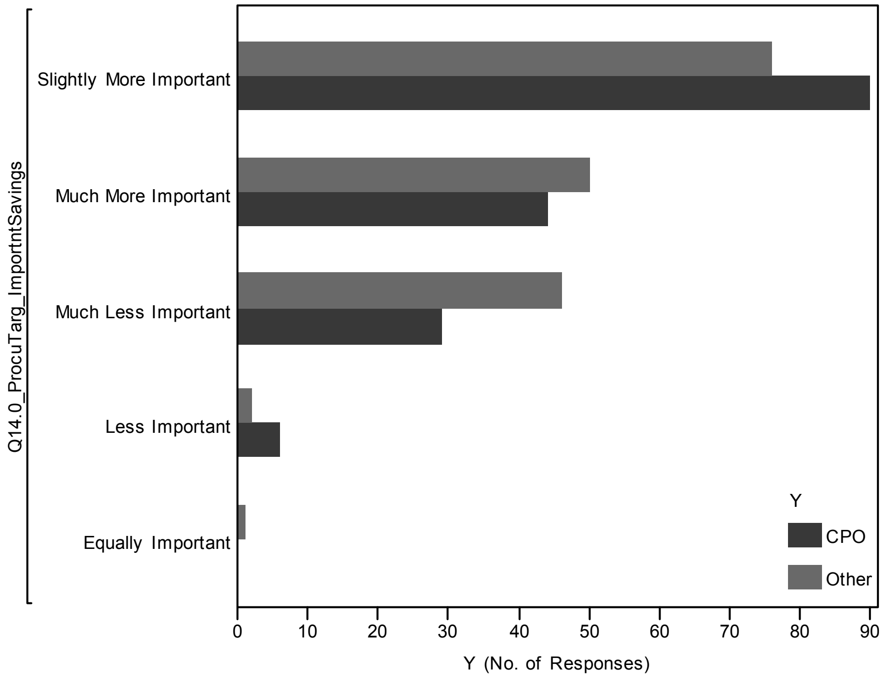


Figure 99: Question 14 (Are procurement savings targets likely to become more or less important over the next 3 years?)

7.3.2 Operational Context – Increased Focus on TCO and Collaboration

In the literature, there is an increased focus on Category Management as the driver for continuous value creation, while there is widespread agreement that more complex contracting, drives the requirement for Total Cost of Ownership (TCO) visibility. These trends were validated by the following responses.

Reduced costs, managed quality of products, and managed supply risks seemed to be the top sourcing criteria among most executives. CPOs are still using the traditional criteria of Price and Quality as their top sourcing criteria, while the need for global sourcing and the quest for resilience have pushed them to put more emphasis on reducing supply risk. Given the later focus on the environment, we were surprised to see that most executives still do not view environmental issues as key sourcing criteria. Most responded that sourcing decisions are influenced by the collaborative, logistic and technological ability of the supplier they evaluate hence confirming that most are seeking to develop fewer, deeper Supplier Relationships with an emphasis on long term value creation.

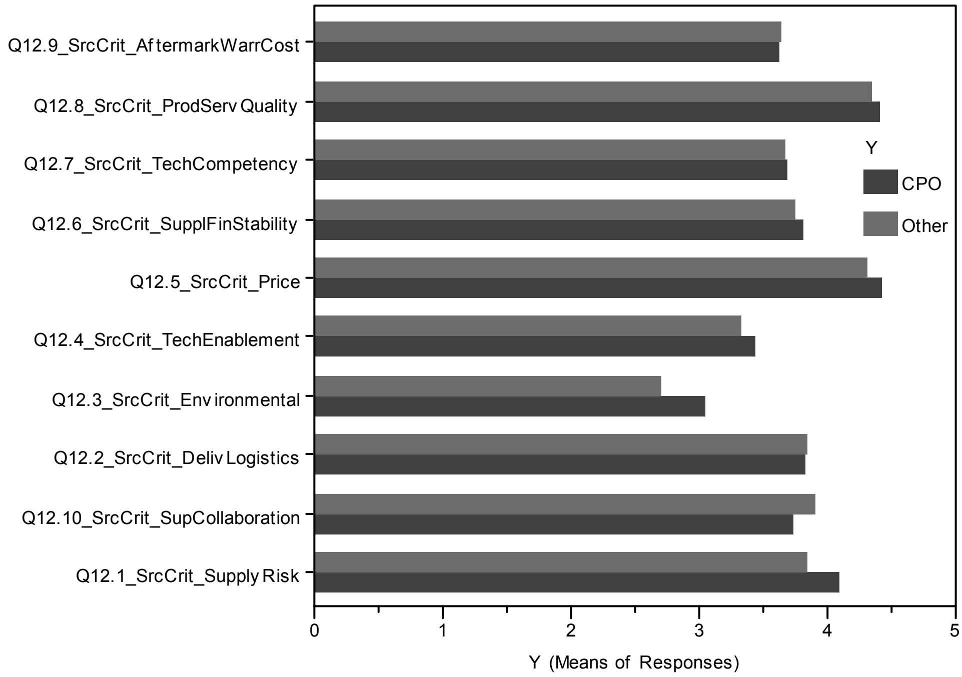


Figure 100: Question 12 (Please rate the following criteria in terms of how much they influence your sourcing decisions today?)

When asked about the Top 3 procurement challenges the responses indicated unresolved operational issues in the areas of spend visibility, pricing and process standardization. By looking at the distribution of results per region we also found out that visibility over spend activities is the top issue for CPOs from EMEA, but only one of the top 4 for other CPOs and other C-level Execs, yet it remarkable in confirmation with our previous Council Analysis that determining the “right price” is critical for all. From the figure below it also interesting that other C-Level Execs. are focusing more than CPOs on reducing sourcing cycle times and are more concerned with the levels of contract compliance.

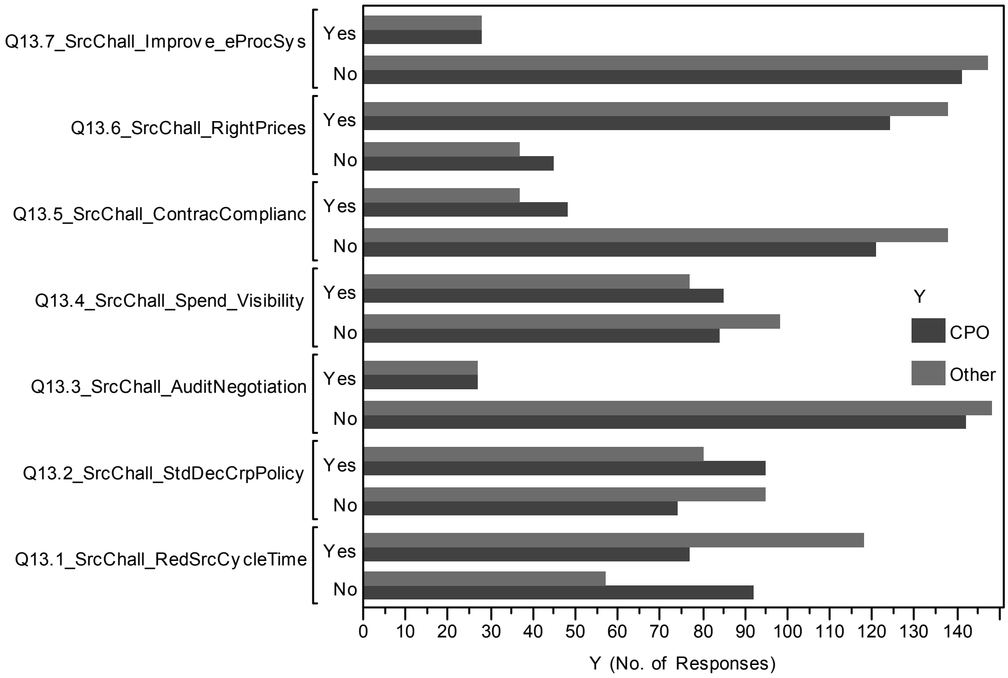


Figure 101: Question 13 (What are your company's top three challenges in improving its procurement and sourcing operations?)

On question 4, i.e. the % of materials and services procured under contract, as shown in the following figure, most CPOs have managed to develop stronger relationships with suppliers of direct materials through contracts, indicating that they are well on their way to establish the foundation for strategic supplier management.

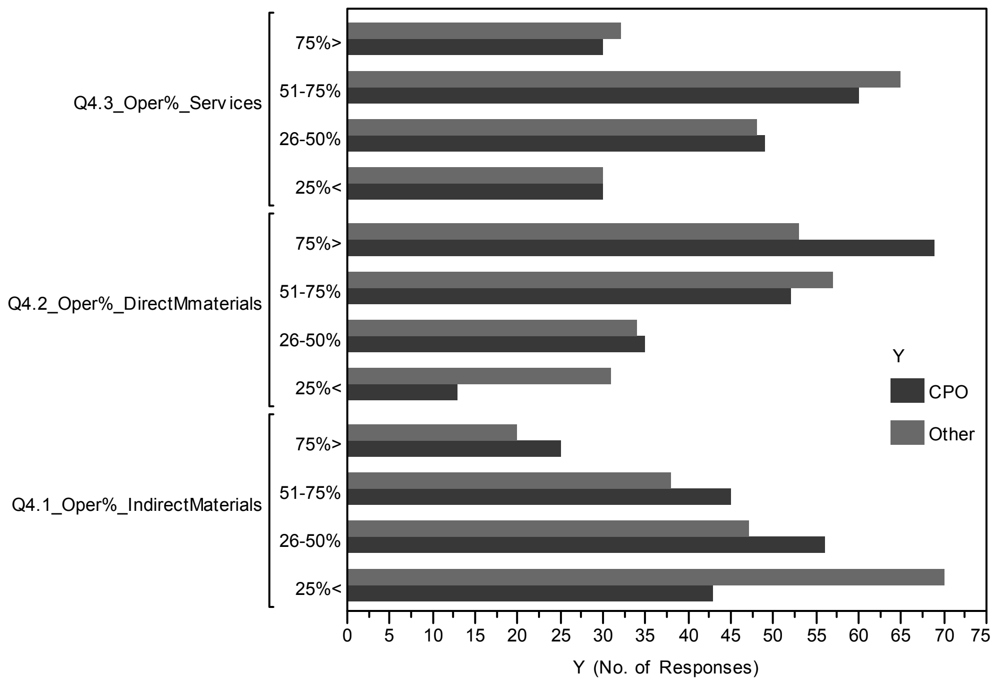
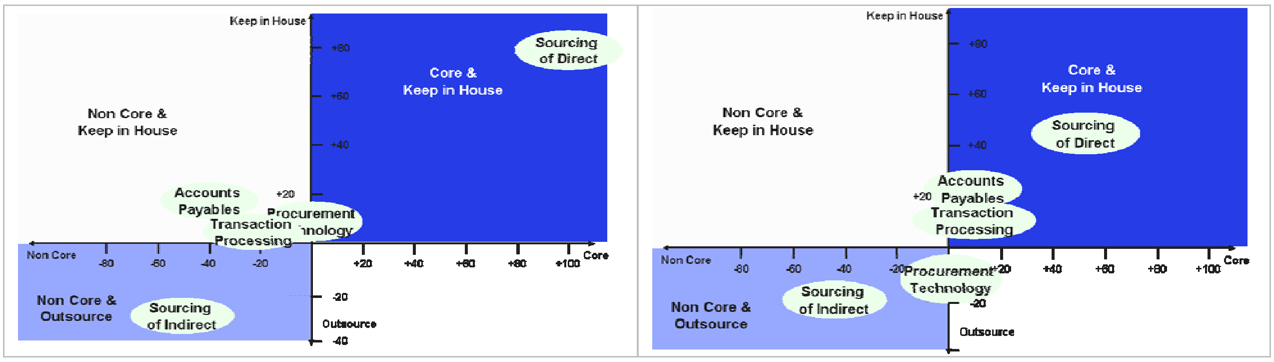


Figure 102: Question 4 (Approximately what percentage of the following are procured on a strategic basis?)

Yet, it was also evident from the responses, that there is still a large opportunity to consolidate spend and get better supplier management for indirect materials and services. More than 50% of the companies procure less than 50% of indirect materials and services through contracts, indicating that there is margin for significant improvement.

7.3.3 Outsourcing Context – Domain Process and Category Outsourcing is Maturing

Our survey confirmed that growth in the use of Outsourcing to unlock new value is expected to continue. CPOs are promoting Category Outsourcing but growth is constrained by skill shortages. As you can view in the figures beneath a shift in Procurement Outsourcing is on the rise, especially for Indirect Goods and Services.



View of CPOs *View of other C-Levels*

Figure 103: Attitude to Procurement Outsourcing among CPOs and Other CxO Roles

While Indirect outsourcing is where most executives agree, there are differences of perspective when it comes to Procurement Technology, Accounts Payable and Transaction Processing. Most CPOs view that most of these activities are non-core, yet they still keep them in house, while other executives view them as Core hence keeping them in-house. CPOs have less of an appetite to outsource Procurement Administration, and their choices lead us to deduce that they will strive to centralize them across the corporation via Shared Service Centers (SSCs).

As we presented in the chapter about eMarkets, our survey confirmed that indirect sourcing is still the business case driver for significant levels of category based outsourcing activity to date. Outsourcing procurement for Direct Materials is low priority on most agendas. Current activities relate mostly to contract manufacturing supply arrangements.

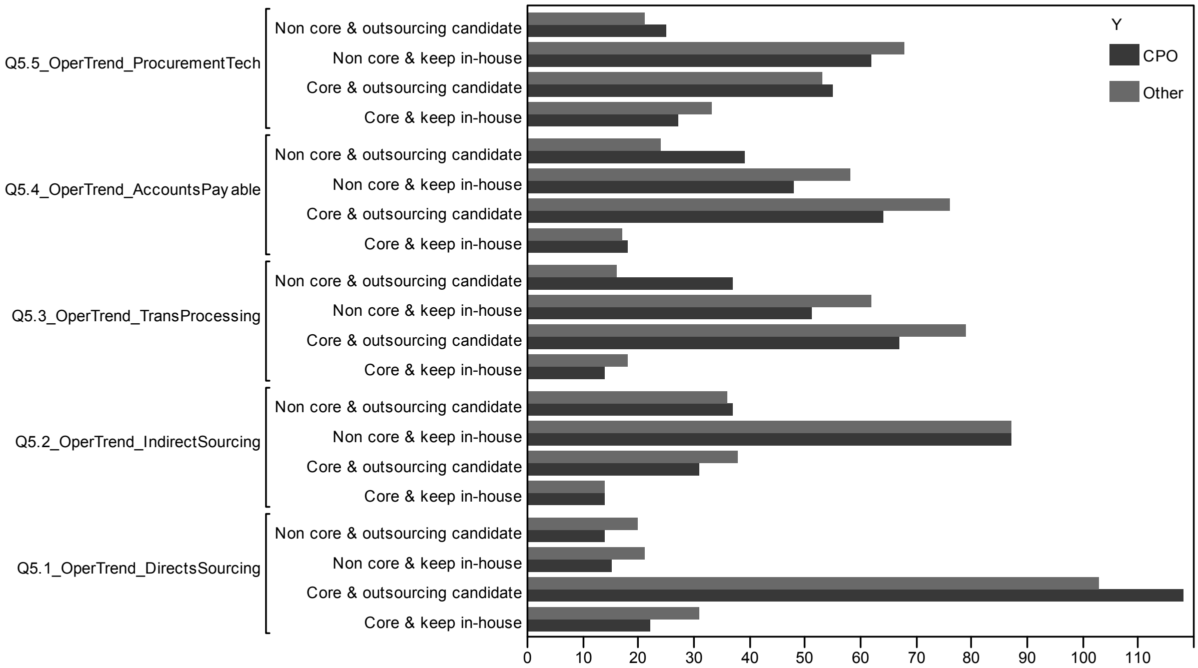


Figure 104: Question 5 (How would you classify the following procurement activities in your company?)

Companies have already piloted the outsourcing of indirect procurement or are planning to do it (Q6). More than 35% of the CPOs have already experienced outsourcing of some indirect procurement. At least an additional 15% are planning to do it.

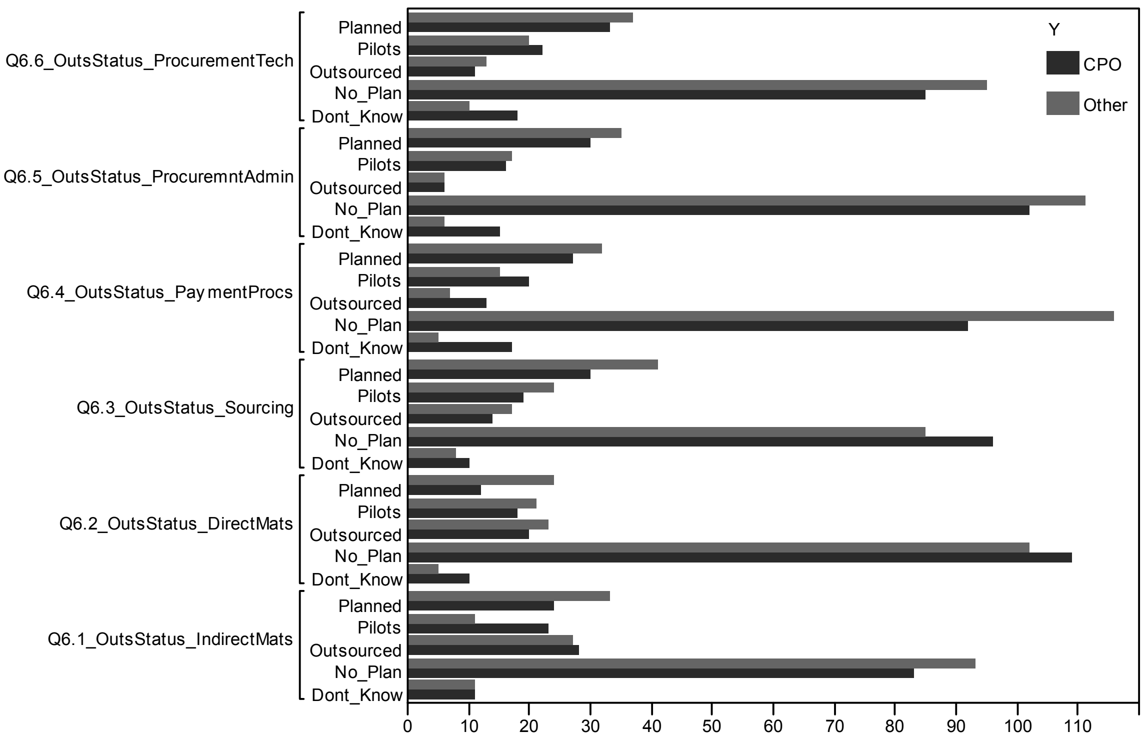


Figure 105: Question 6 (What is the status of procurement outsourcing within your business in each of the following areas?)

As seen in the next two figures of Question 7, the high levels of planned and pilot activity confirms a growth trend in outsourcing. Notwithstanding, outsourcing penetration, and value has been greatest in more commodity based, 'one size fits all' market categories vs. more bespoke, 'custom designed' services.

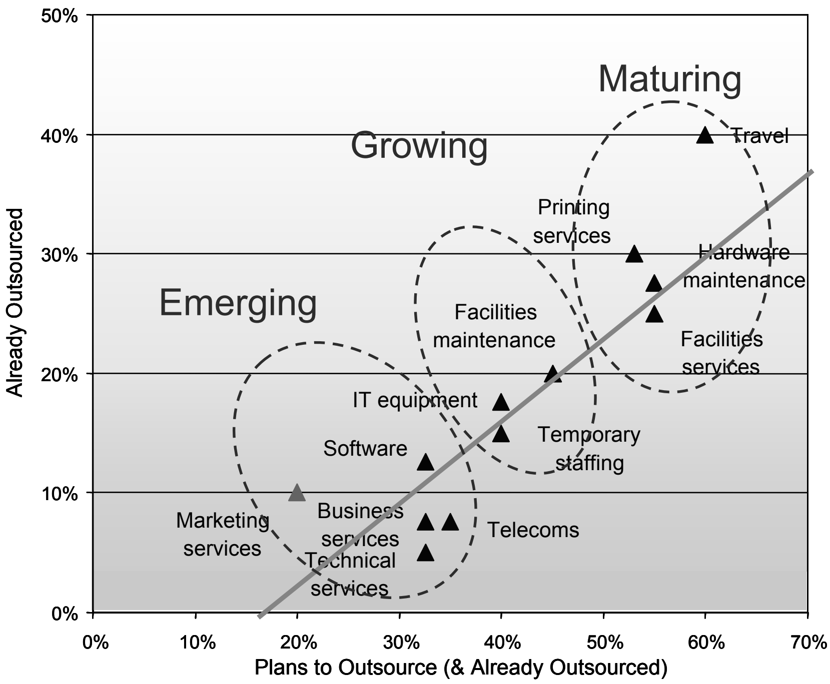


Figure 106: Category Outsourcing – Overview of Status (Q7) from the Survey

Companies are promoting category outsourcing when established Category providers exist. Travel, Printing, Facilities services and Hardware maintenance are the mature categories for Outsourcing. High Value services (Marketing, Consulting and other business services) are the less mature categories due to the fragmentation of the market and the lack of CPO control of these areas.

Undoubtedly, markets, and supply base capabilities are maturing for certain categories (e.g. Travel, Facilities Management), yet it seems that there are critical skill shortages and resource bandwidth posing constraints inhibiting further growth.

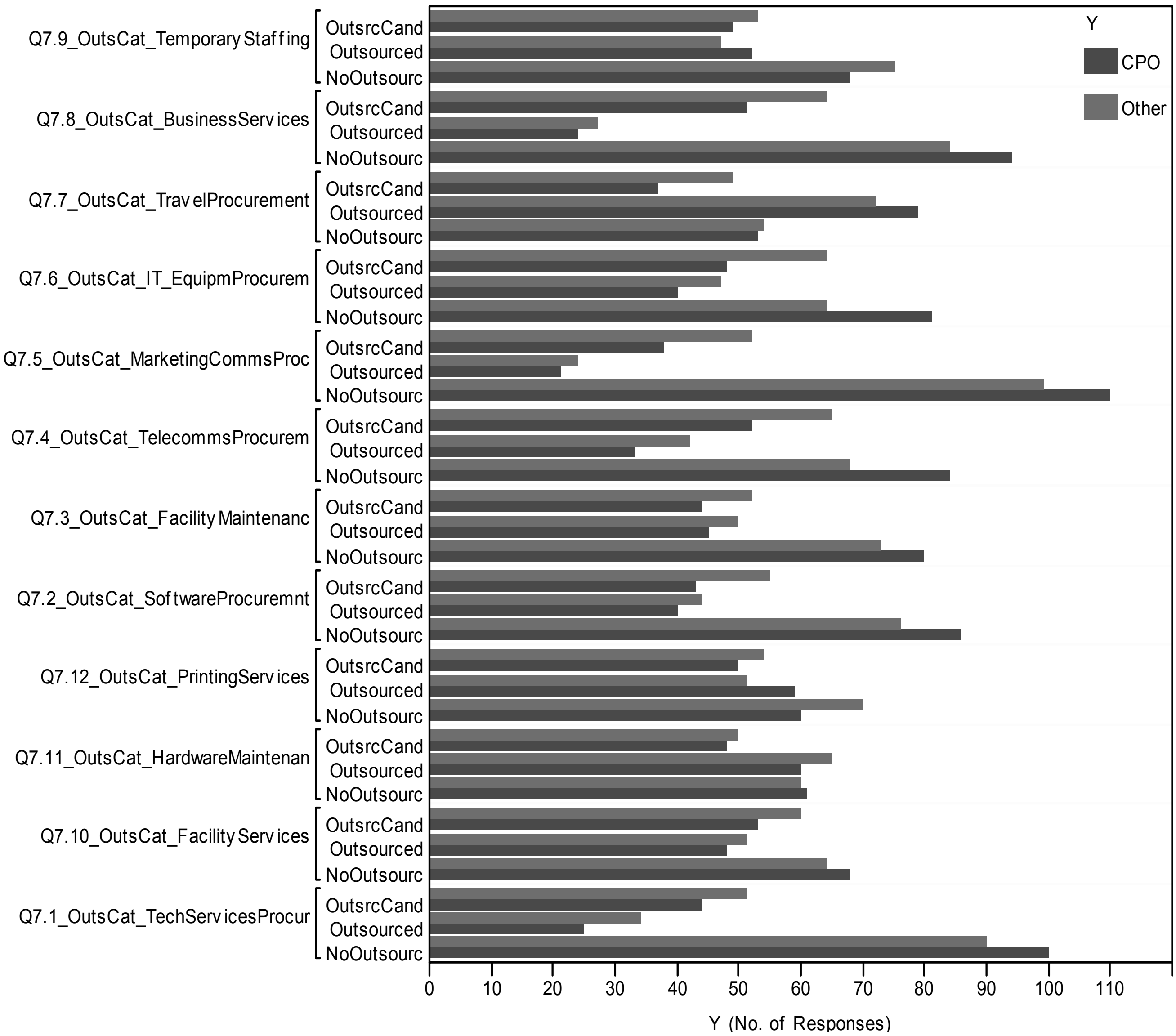


Figure 107: Question 7 (Does your company outsource or plan to outsource following procurement function for any of the following commodities?)

7.3.4 The Globalization of Sourcing - Growth in the use of Low Cost Regions

On the status of the global sourcing initiatives in direct materials (Question 8), only 34% of the European CPOs have no Global sourcing capability or no plans to develop this capability. Yet, less than 40% of the surveyed organizations have fully developed global sourcing capabilities or at least organization, people and processes in place.

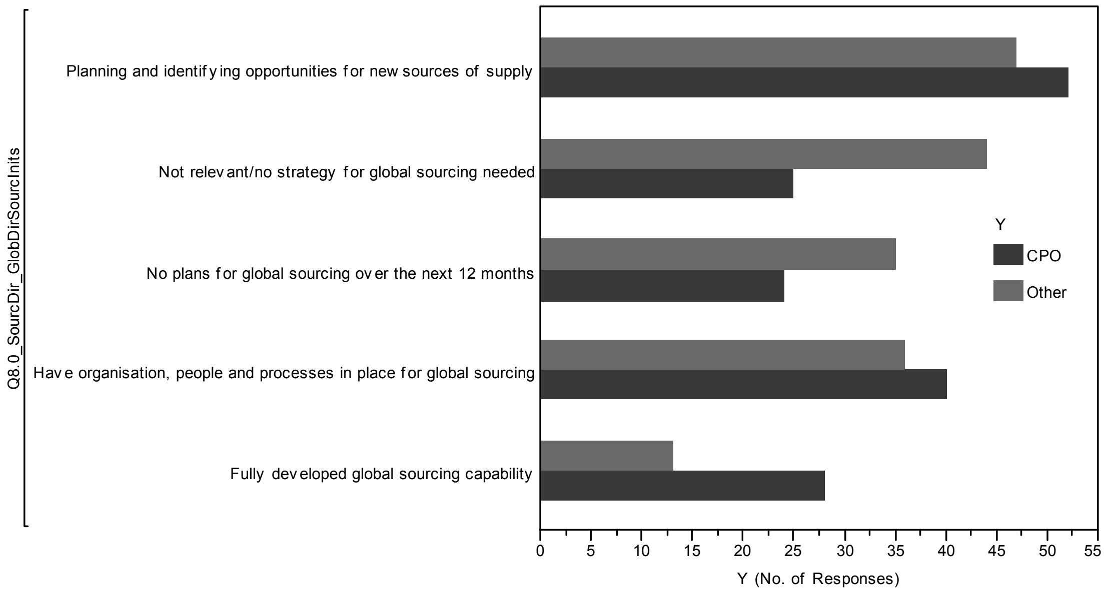


Figure 108: Question 8 (What is the current status of global sourcing initiatives for direct materials/components in your company?)

By crossing new sourcing frontiers, unprecedented levels of Value and Savings are now achievable. Most respondents indicated that growth in the use of Low Cost Jurisdictions is planned, driven by intense competitive cost pressures. Over 60% of the CPOs intend to develop their ability to do sourcing in China[90] over the next three years (Q11). European CPOs are also increasing their ability to source in Eastern Europe following EU enlargement, while South Asia and South-East Asia are the other targeted areas for sourcing.

[90] Evolution of Trade with China (source Eurostat, 05-2004): EU 25 Imports from China: 1999: 52.4 b€ / 2001: 81.6 b€ (+ 56% in 2 years) / 2003: 105.0 (+100% in 4 years). China GDP: about 8% growth per year (CAGR), Trade Balance EU 25 - China 25 by product (2003), Machinery: 45.1 b€ imports, 18.7 b€ exports and Textiles & clothing: 14.3 b€ imports, 0.48 b€ exports

Over 1/3 of the companies have already developed sourcing capabilities in Eastern Europe And Asia (including India and China), while less than 20% have a significant knowledge of Russia as a sourcing region.

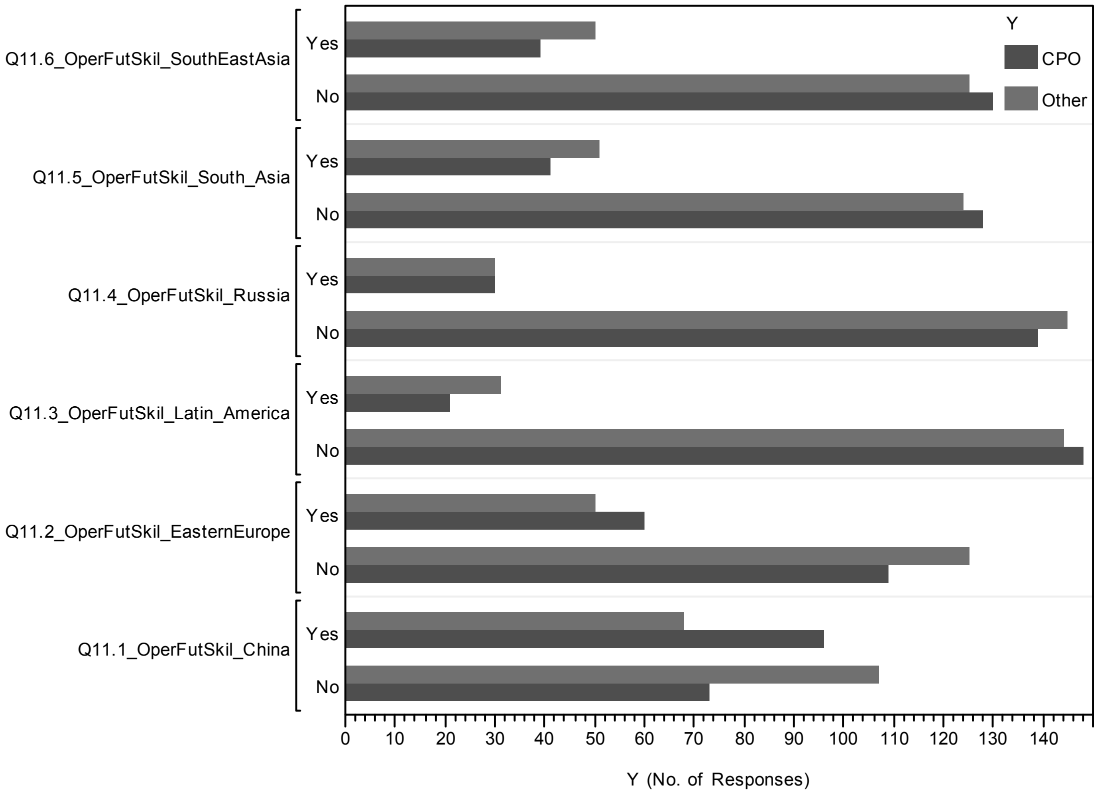


Figure 109: Question 11 (In which of the following regions does your organization intend to improve its ability to source goods and services over the next 3 years?)

7.3.5 Operational Initiatives – Partnering as the key differentiator

With the shift in focus from Price to Value, CPOs recognize the fundamental importance of Supplier Collaboration and Total Cost of Ownership (TCO) in the new environment as a way to rationalize costs and pursue greater value as well as minimize risk.

The responses are indicative of an increased focus on partnering where supplier involvement on the full product lifecycle and impact on the supply chain is increasing, thus steering most operational initiatives towards deeper collaboration and performance-based alignment. By the high average mean of responses, it is clear that companies in our sample pursue more complex, long term relationships and partnerships with a small number of suppliers. All roles view these areas from a similar perspective.

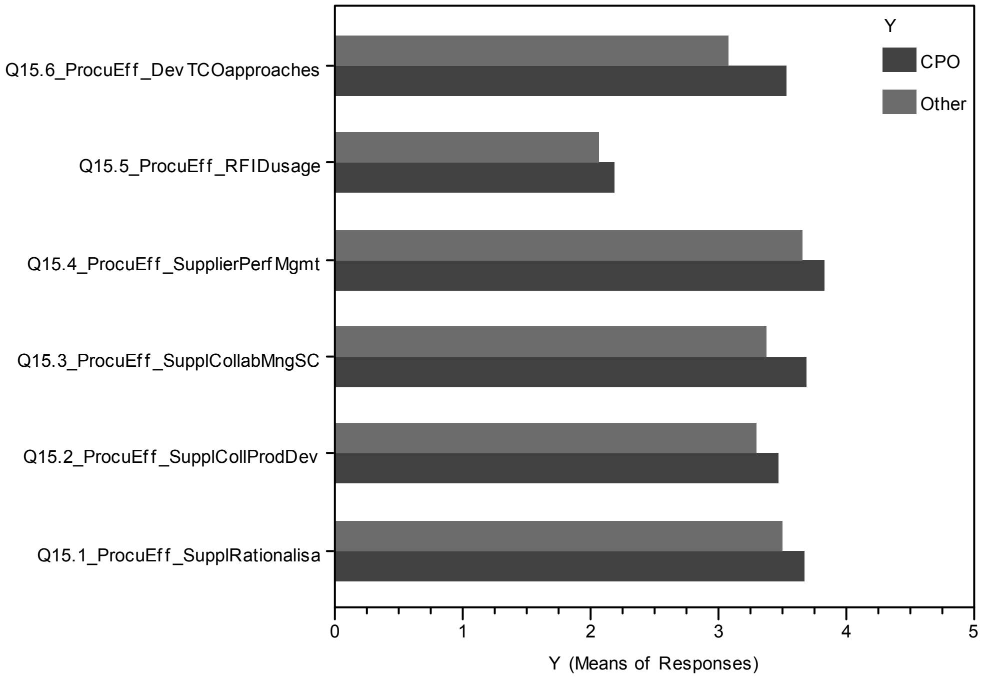


Figure 110: Question 15 (Which of the following do you expect to make the biggest contribution to improving the efficiency of your company's supply chain over the next 3 years?)

7.3.6 Strategic Initiatives – Building Key Competencies

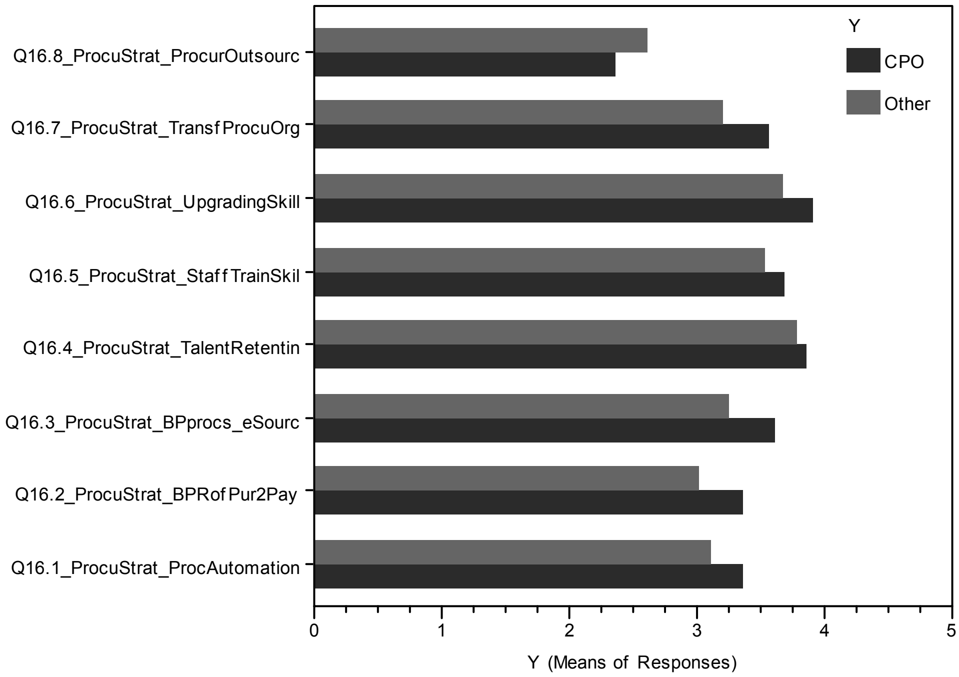


Figure 111: Question 16 (What will be your main strategies for improving procurement performance over the next 3 years?)

Our survey showed that skills shortages will be a major obstacle to success and the ability to equip businesses with new competencies and behaviors will differentiate leaders from laggards in the new environment. Executives are viewing that procurement and sourcing competencies are key, hence the focus on training and upgrading the skills of the employees.

CPOs are especially aware of the constant need to transform their organization. They believe that improvement of procurement performance will only happen through relationship management, retention and training of procurement talent (Gadde & Håkansson, 2001). Interestingly, most executives do not ascribe to the trend that procurement outsourcing alone will improve the performance.

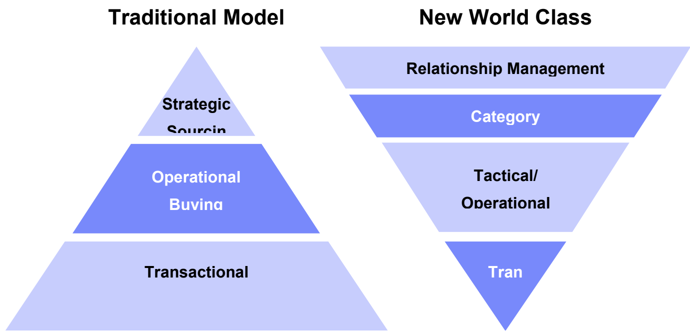


Figure 112: Turning the organization on it's head – Executives are transforming their business models

7.3.7 *Operational Visibility – Defining & Monitoring Performance Measures for Action*

CPOs are moving from a cost-optimization to a value creator role focusing on performance. This should per definition be reflected into the Performance Measurements.

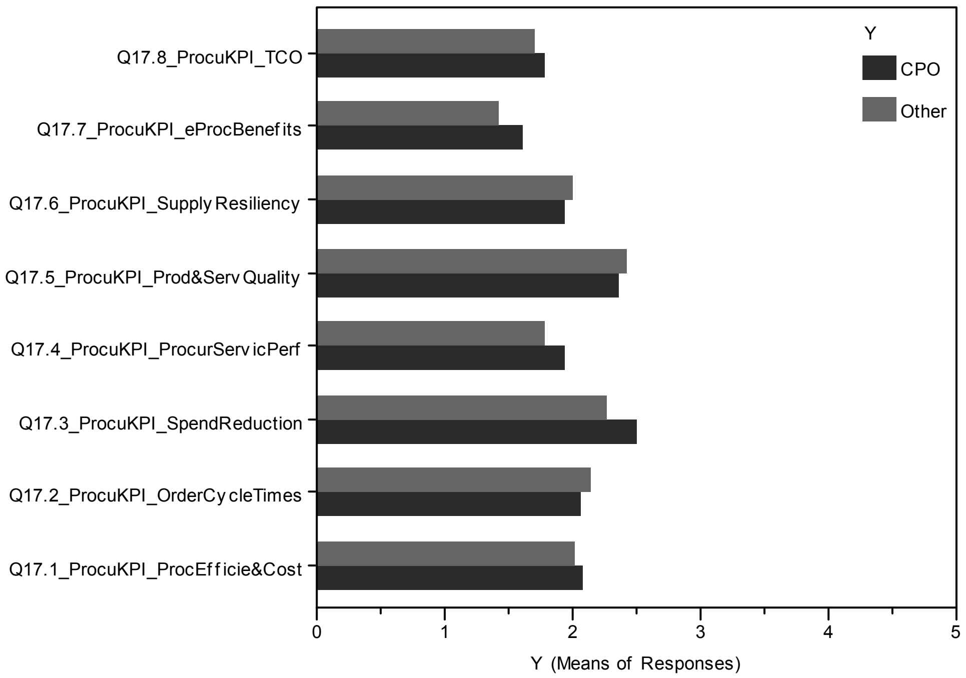


Figure 113: Question 17 (How do you measure performance of your procurement activities?)

Alas, while CPOs systematically measure external drivers such as the quality of the product/service, the resilience of the supply and the spend reduction, very few measure the internal performance, the process efficiency and even the TCO. For example, 73% of CPOs systematically measure savings achievement but less than 29% measure Total Cost of Ownership (see Q17). So, the responses indicate a minor discrepancy between initiatives and operational reality, as performance measures are narrowly focused and would need upgrading. Moreover, as shown in the figure below, lower usage of well-defined performance measurements is related to the degree of technology enablement.

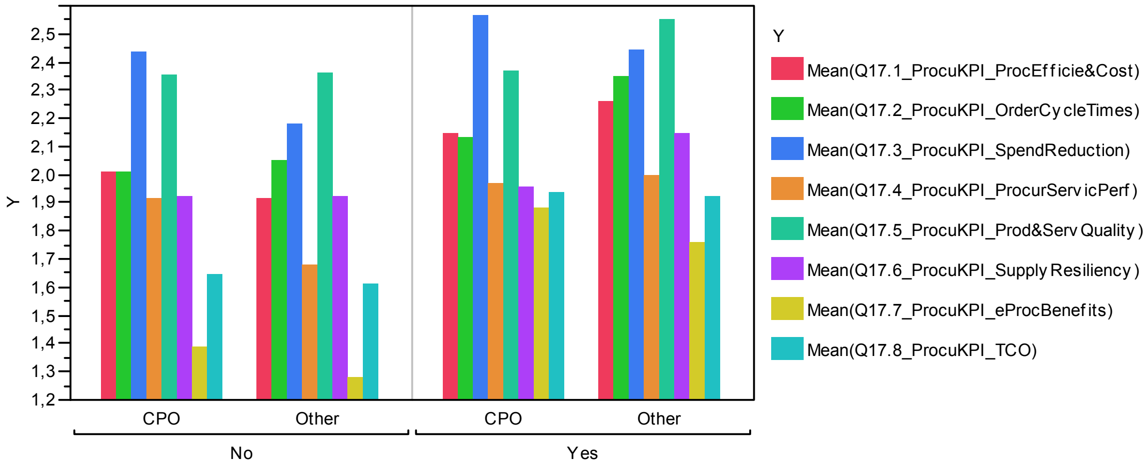


Figure 114: Mean Averages of Use of KPIs depending on use of eProcurement and Role.

Most executives expect that Performance Monitoring will lead an improved capability to identify areas of improvement and develop better informed supplier strategies.

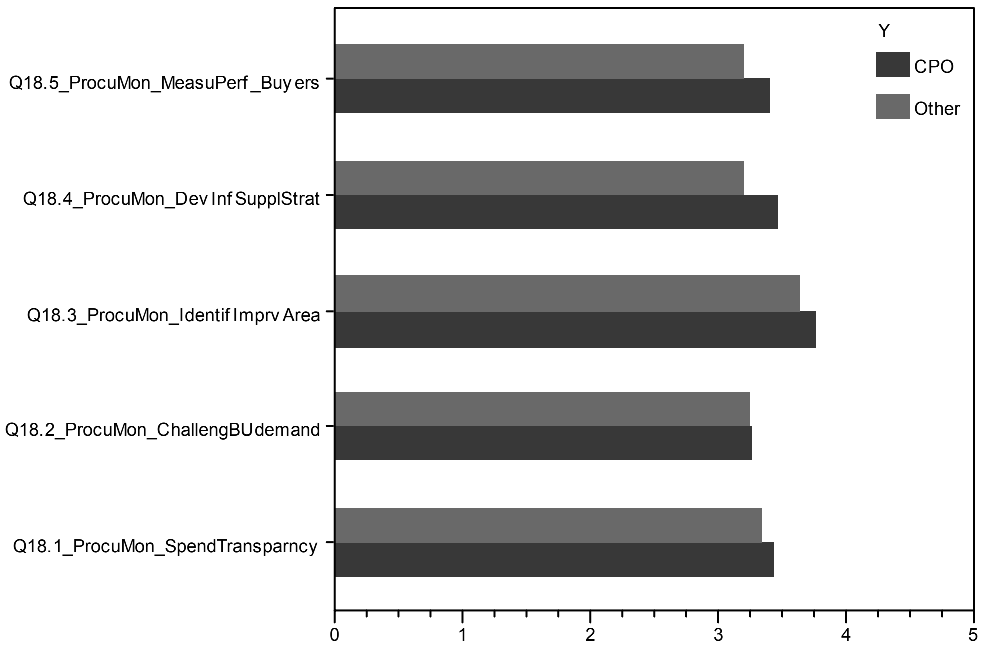


Figure 115: Question 18 (How would you rate your ability to monitor and manage procurement spending?)

7.3.8 Increased importance of IT Domain Enablement – Objectives, Benefits & CSFs

CPOs expect eProcurement to reduce transaction costs, workload, cycle times and levels of maverick behavior (Q19).

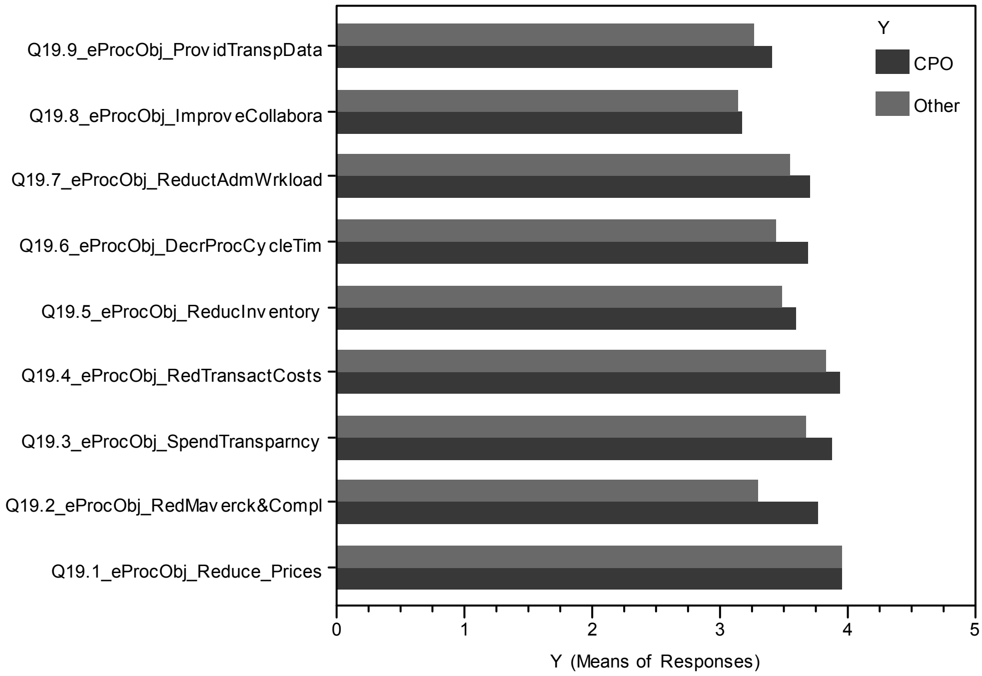


Figure 116: Question 19 (Which of the following electronic procurement (eProcurement) objectives are most important to your organization?)

Most executives expect that technology will enable them to improve operations by pursuing more detailed objectives like improve spend transparency, reduce transaction costs and inventory, decrease cycle times and reduce administrative workload. On the other hand, eProcurement is not expected to provide real time collaboration or more transparent data, as most companies in parallel rationalize and expand their supplier base upon using eProcurement and eSourcing technologies. C-Level primarily expect eProcurement to reduce prices administrative workload and transaction costs.

When implemented, eProcurement met most of the objectives regarding spend visibility and procurement transaction costs. E-Procurement has primarily helped to improve compliance and has also helped to reduce Procurement costs (Q20).

When it comes the Critical Success Factors for realizing such enablement, we received few responses, yet it was evident that support at the Executive Committee level is key for a successful eProcurement strategy, while Implementation and right Strategy approach is key to benefits realization (Q21). This was one of the areas where there were major differences in view among the various executives, with CPOs scoring higher on most CSFs.

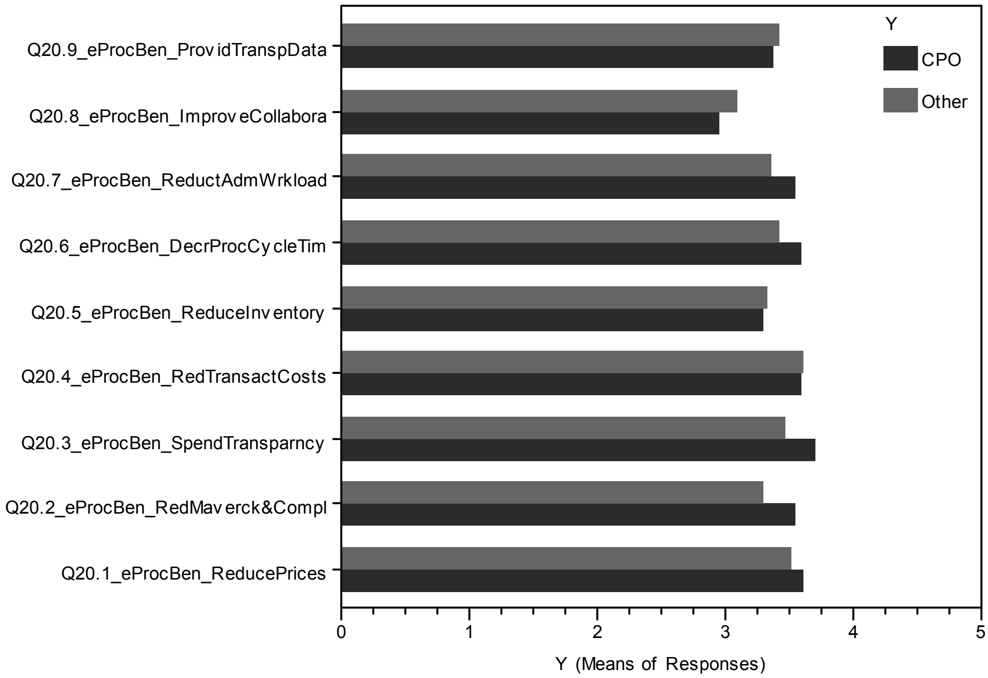


Figure 117: Question 20 (If you have implemented an e-procurement solution, what have the main benefits been to your organization?)

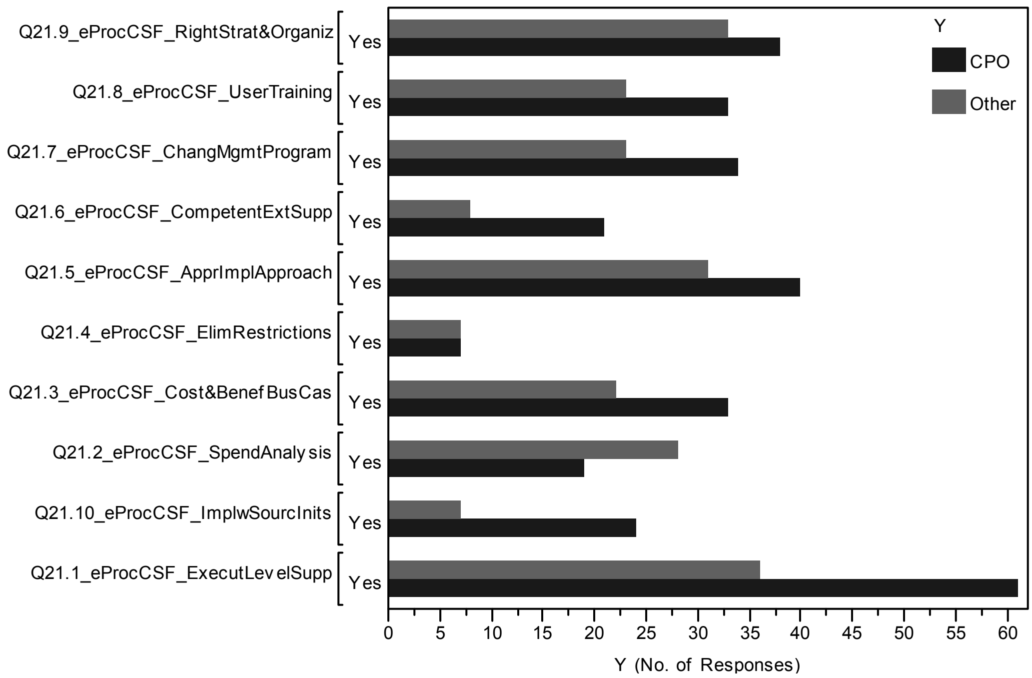


Figure 118: Question 21 (What are the three most important factors in the success of an e-procurement strategy?)

This completes our descriptive journey through the surveyed answers. Now will commence our analysis of the hypotheses posed in our initial section.

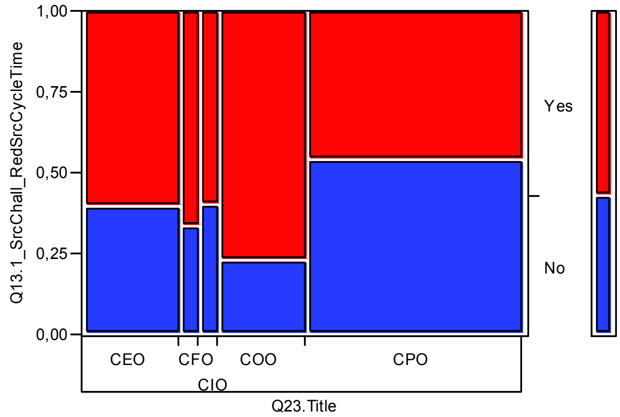
7.4 Assessing T13: "Actors Define State & Enablement of SRM Domain"

In this section we will investigate the statistical significance of the role-based view of the survey data by looking at the way that CPOs versus the other leading officers among the surveyed companies have answered the questions posed. Just as Gadde & Håkansson (2001) describe, one of the reasons that we present this view is to test our original hypothesis that different actors within a company (in our case leaders in different positions) do have differing views on the priorities within a functional domain (i.e. SRM). The Table below presents the significant results ($p<0.05$) of an investigation of the relationships between the "Title" of the Respondent versus the remaining parameters. The statistical analysis was conducted via JMP's ANOVA - Analysis of Variance (for a Continuous dependent), or Contingency Analysis (in case of Ordinal or Nominal dependent).

Table 21: Significant ANOVA & Contingency Analysis Results vis-à-vis Title.

Question	Parameter (ANOVA/Contingency by Title)	F / Chi^2 Ratio	Prob > F / Chi^2
Q4.0_Oper%_Approximately what percentage of the following are procured on a strategic (non ad-hoc) basis?	Q4.2_Oper%_DirectMaterials	24,098	0,0197
Q12.0_SrcCrit_Please rate the following criteria in terms of how much they influence your Sourcing decisions today?	Q12.3_SrcCrit_Environmental	2,7477	0,0283
	Q12.4_SrcCrit_TechEnablement	4,3144	0,0020
	Q12.5_SrcCrit_Price	3,9639	0,0037
Q13.0_SrcChall_What are your company's top three challenges in improving its procurement and Sourcing operations?	Q13.1_SrcChall_RedSrcCycleTime	21,782	0,0002
Q15.0_ProcuEff_Which of the following do you expect to make the biggest contribution to improving the efficiency of your company's supply chain over the next three years?	Q15.3_ProcuEff_SupplCollabMngSC	2,6322	0,0342
	Q15.6_ProcuEff_DevTCOapproaches	4,3907	0,0018
Q16.0_ProcuStrat_What will be your main strategies for improving procurement performance over the next three years?	Q16.1_ProcuStrat_ProcAutomation	2,9207	0,0213
	Q16.2_ProcuStrat_BPRofPur2Pay	3,9204	0,0040
	Q16.7_ProcuStrat_TransfProcuOrg	2,7347	0,0289
Q17.0_ProcuKPI_How do you measure performance of your procurement activities?	Q17.3_ProcuKPI_SpendReduction	3,6576	0,0062
Q18.0_ProcuMon_How would you rate your ability to monitor and manage procurement spending in the following areas?	Q18.2_ProcuMon_ChallengBUdemand	2,4658	0,0449
	Q18.3_ProcuMon_IdentifimprvArea	3,625	0,0066
Q19.0_eProcObj_Which of the following electronic procurement (eProcurement) objectives are most important to your organization?	Q19.2_eProcObj_RedMaverck&Compl	4,8306	0,0008
	Q19.3_eProcObj_SpendTransparncy	2,75	0,0282
	Q19.5_eProcObj_ReducInventory	4,1384	0,0028
	Q19.6_eProcObj_DecrProcCycleTim	2,9065	0,0218
	Q19.9_eProcObj_ProvidTranspData	2,5973	0,0362
Q21.0_eProcCSF_What are the three most important factors in the success of an e-procurement strategy?	Q21.5_eProcCSF_ApprImplApproach	9,933	0,0416
Q24.1_Industry_Other	Q24.0_Sector	28,337	0,0288
Q25.0_RevenueAnnual	Q25.o_CompSize	118,292	<,0001
Q28.0_GEO	Q28.0_GEO	18,444	0,0181

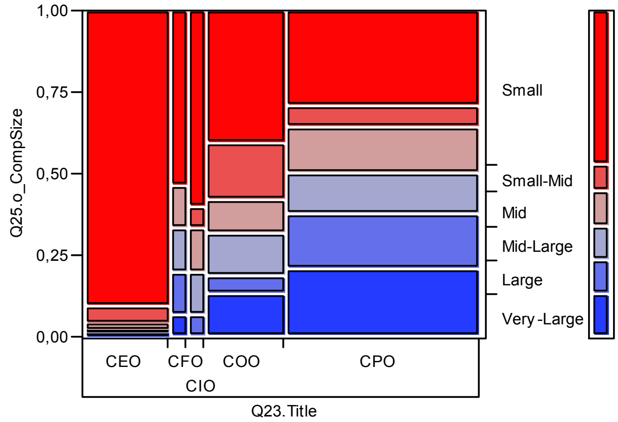
From the above Analyses it is obvious that there are significant differences between the perspectives of the various actors given their title and position. Most prominent and significant differences (p<0,01) were identified in the parameters: a) Company Size (Q25.o), b) Reduction of Sourcing Cycle Times as a main Sourcing Challenge (Q13.1), c) Reduce Maverick Spending and Increase Contract Compliance (Q19.2), and finally in d) Developing new approaches based on Total Cost of Ownership (Q15.6). Below we provide some of detailed graphs and statistical results derived from our analysis.



Contingency Analysis – Mosaic Plot & Statistics

N	DF	-LogLike	RSquare (U)
344	4	10,890847	0,0463

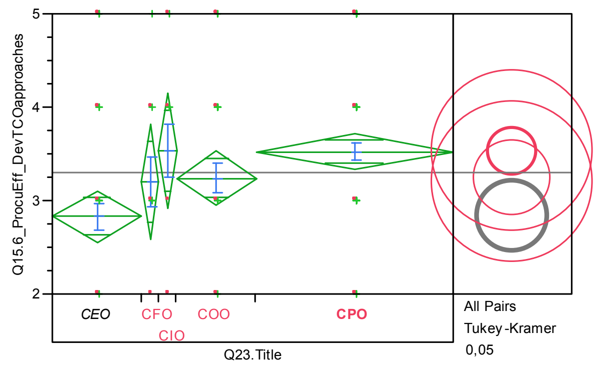
Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	21,782	0,0002
Pearson	21,032	0,0003



Contingency Analysis – Mosaic Plot & Statistics

N	DF	-LogLike	RSquare (U)
343	20	59,145805	0,1124

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	118,292	<,0001
Pearson	102,988	<,0001

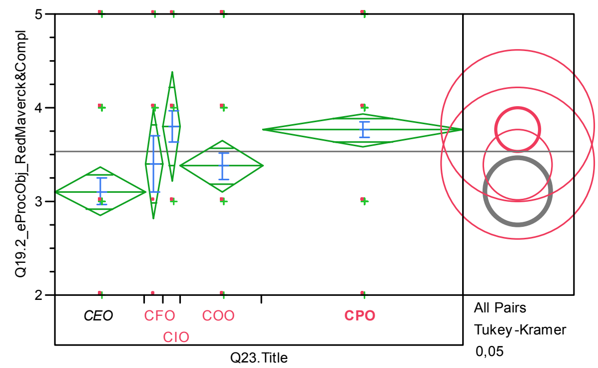


Summary of Fit

Rsquare	0,049534
Adj Rsquare	0,038252
Root Mean Square Error	1,229038
Mean of Response	3,298246
Observations (or Sum Wgts)	342

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q23.Title	4	26,52924	6,63231	4,3907	0,0018
Error	337	509,04971	1,51053		
C. Total	341	535,57895			



Summary of Fit

Rsquare	0,053925
Adj Rsquare	0,042762
Root Mean Square Error	1,157116
Mean of Response	3,526163
Observations (or Sum Wgts)	344

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q23.Title	4	25,87120	6,46780	4,8306	0,0008
Error	339	453,89334	1,33892		
C. Total	343	479,76453			

Figure 119: Contingency and ANOVA results of Actor Title versus Significant Parameters.

Note: The diamonds in the ANOVA graph are a schematic of the mean (line in middle) and standard error of the mean (vertical bars) for each sample group or cluster in our case; the height of each diamond represents the 95% confidence interval for each group, and the diamond width represents the group sample size. ANOVA plots are supplied by a means comparison circles box. The outside angle of intersection tells whether or not group means are significantly different. Circles for means that are significantly different either do not intersect or intersect slightly so that the outside angle of intersection is less than 90 degrees. If the circles intersect by an angle of more than 90 degrees or if they are nested, the means are not significantly different.

From the above analysis, it is evident that the various roles do have differing priorities when it comes to driving transformation within a functional domain like SRM. For example, COO's are interested in reducing sourcing cycle-times, while CPOs are driving initiatives in larger companies to transform their TCO practices, reduce maverick spending and increase contract compliance.

One clear indication that drives transformation is naturally Company Size. The Tree Map below is initially segmenting the respondents into the five major groups of executives and then within each title group it further segments into blocks representing the amount of respondents from each Company Size. It is evident that most respondents from "Small" companies were CEOs, thus their priorities and focus differs from their counterparts in larger companies that do delegate such responsibilities to specialized functional roles.

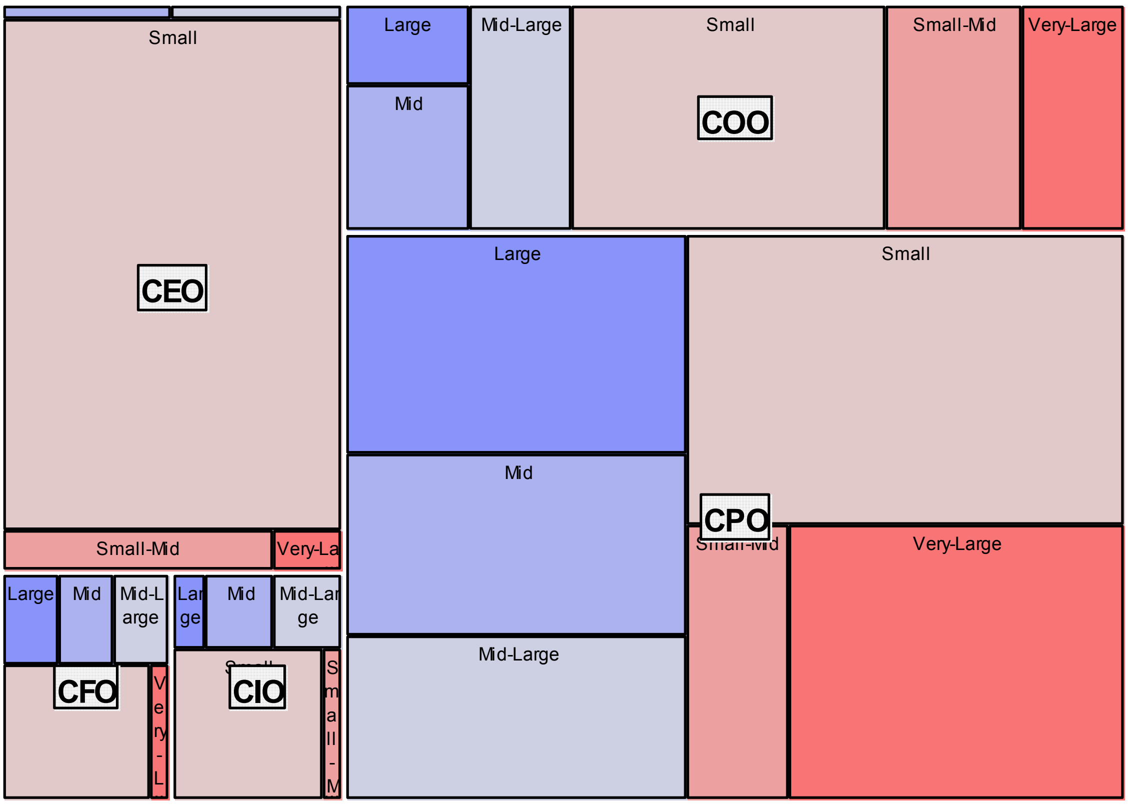


Figure 120: Tree Map Diagram showing the proportions of Company Size within the various Titles.

To visualize these differences across multiple areas we studied 2 contextual parameters (Size and Geographic location) in a multivariate fashion in JMP via Recursive Partitioning Analysis and show the multivariate relationships via JMP's Tree Maps. If we now look into the same relationship from two differing angles and with the help of Tree maps one can easily deduce that the significant relationships between Actor Title and Company Size, it is evident that CPOs reside in larger companies that do focus on a more diverse range of initiatives and objectives. Smaller companies are dominated from CEOs, who do have a more operational and short-term perspective on procurement and sourcing. This shows that there are not only differences on role but also on size.

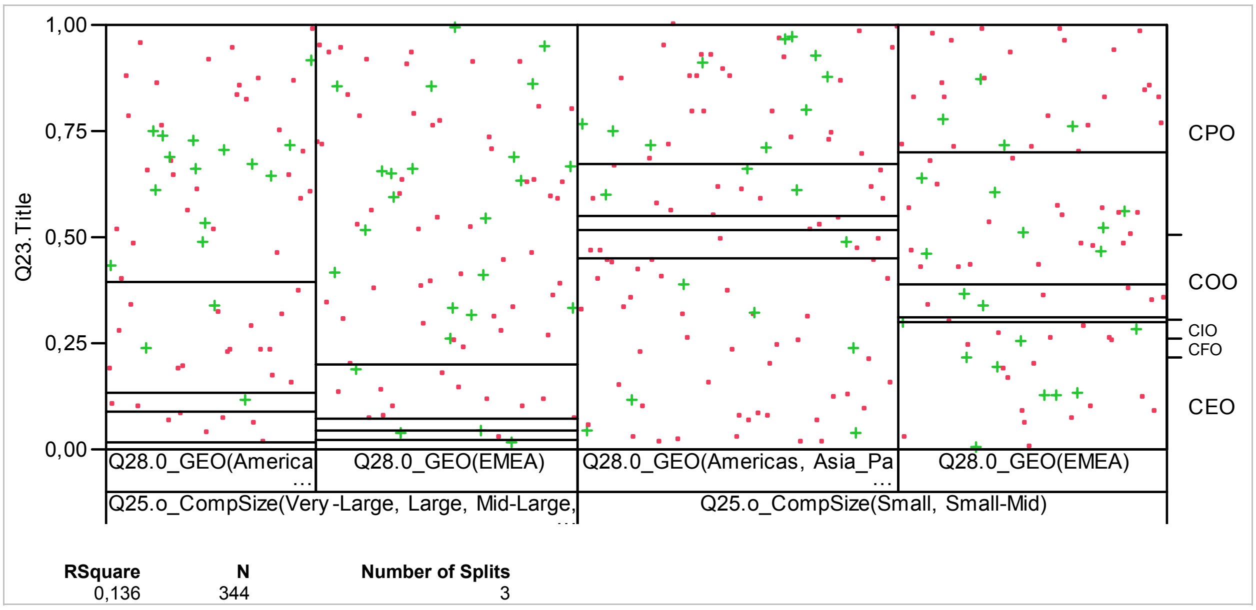


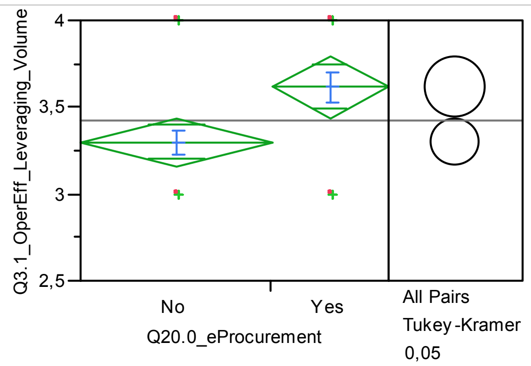
Figure 121: Recursive Partitioning of Title versus Company Size and Geographical Region (GEO)..

Beyond the most significant parameters when comparing to Title, a number of other variables were significant at $p<0.05$. These were Technology enablement and Price (Q12.4_SrcCrit), Process re-engineering of purchase-to-pay transaction process (Q16.2_ProcuStrat), Spend reduction/savings achievements (Q17.3_ProcuKPI), Identify areas for improvement (Q18.3_ProcuMon), and Reduce stock and inventory (Q19.5_eProcObj).

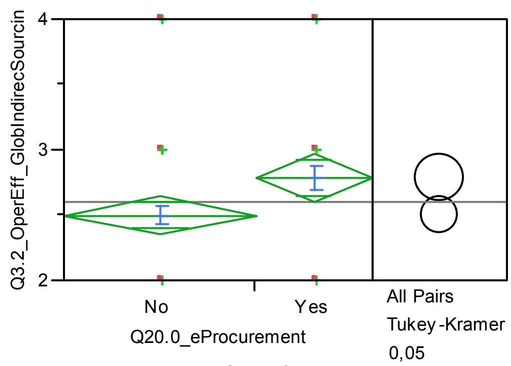
In summary, we have found significant support for our research theme that different Actor Roles as defined by Titles in our survey have different perspectives on how SRM is supposed to be transformed and enabled via technology, in correspondence with Gadde and Håkansson (2001). It is thus an important contextual parameter to take into consideration when companies embark on such journeys of transforming their procurement and sourcing operations. Amend your transformation ambitions and place the right leader in charge!

7.5 Assessing T11: "Effective IT Enablement leads to Higher Efficiency"

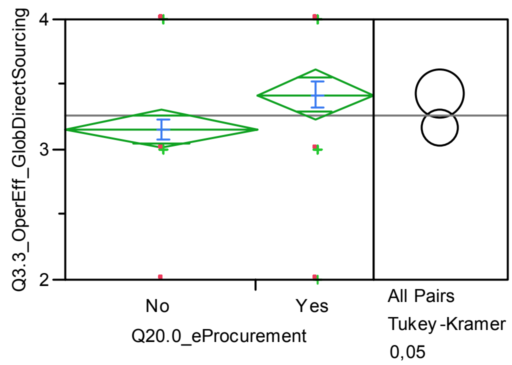
In this initial section we will delve into one of our hypotheses where IT enablement leads to a higher level of Operational Efficiency. A lot of research has been conducted in this area and it seems that our own survey provided similar results. Below we present a series a ANOVA diagrams and statistics exploring this hypothesis (see Note on next page on how the ANOVA graphs).



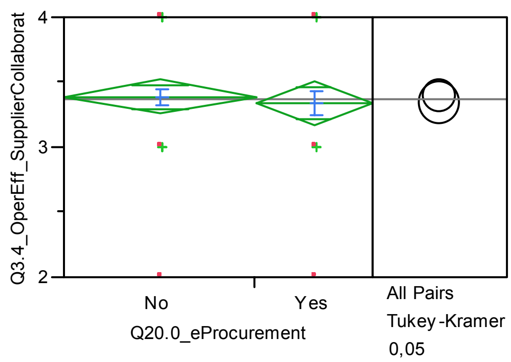
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	8,09189	8,09189	7,4870	0,0065
Error	342	369,62904	1,08079		
C. Total	343	377,72093			



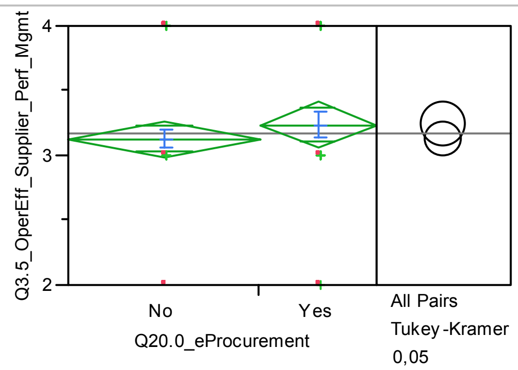
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	6,55112	6,55112	5,6369	0,0181
Error	342	397,46923	1,16219		
C. Total	343	404,02035			



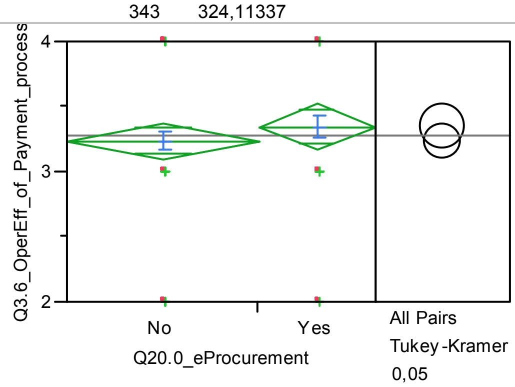
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	5,64494	5,64494	4,5497	0,0336
Error	342	424,32890	1,24073		
C. Total	343	429,97384			



Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	0,19727	0,197269	0,2083	0,6484
Error	342	323,91610	0,947123		
C. Total	343	324,11337			



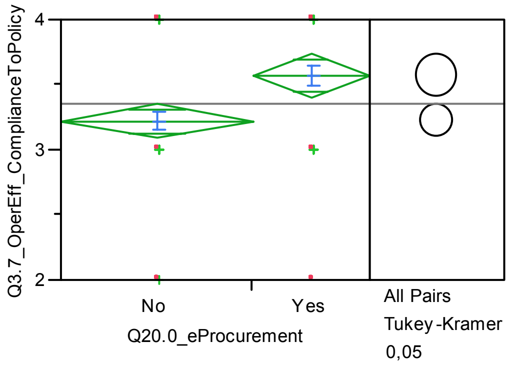
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	1,01978	1,01978	0,9149	0,3395
Error	342	381,20115	1,11462		



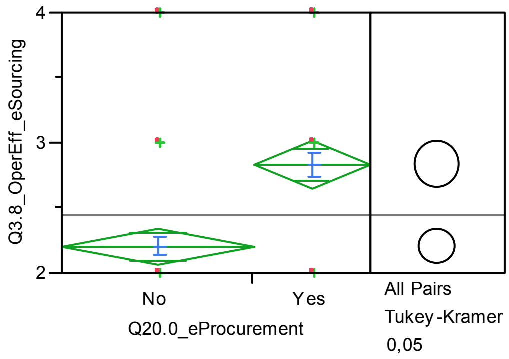
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	1,02370	1,02370	0,9573	0,3286
Error	342	365,74083	1,06942		

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
C. Total	343	382,22093			

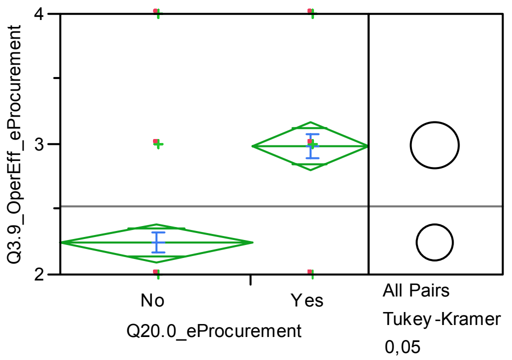
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
C. Total	343	366,76453			



Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	9,88446	9,88446	10,8853	0,0011
Error	342	310,55449	0,90805		
C. Total	343	320,43895			



Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	32,08129	32,0813	28,3775	<,0001
Error	342	386,63674	1,1305		
C. Total	343	418,71802			



Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Q20.0_eProcurement	1	44,48024	44,4802	37,1634	<,0001
Error	342	409,33372	1,1969		
C. Total	343	453,81395			

Note: These are the ANOVA diagrams produced by SAS' JMP. The vertical axis is the Parameter while the X or horizontal presents whether a Company uses eProcurement solutions or not. The diamonds in the graph are a schematic of the mean (line in middle) and standard error of the mean (vertical bars) for each sample group or cluster in our case; the height of each diamond represents the 95% confidence interval for each group, and the diamond width represents the group sample size. ANOVA plots are supplied by a means comparison circles box. The outside angle of intersection explains whether or not group means are significantly different, e.g. circles for means that are significantly different either do not intersect or intersect slightly so that the outside angle of intersection is less than 90 degrees. If the circles intersect by an angle of more than 90 degrees or if they are nested, the means are not significantly different. Within group means and the robust Tukey-Kramer's HSM multiple range tests were used to interpret the differences among usage of eProcurement.

Table 22: ANOVA results of Companies Using eProcurement systems versus Operational Efficiency

As hypothesized IT enablement of the SRM domain leads to higher efficiencies in leveraging volume to achieve better prices, higher compliance to contracts, and improved sourcing in the indirect and direct space. Surprisingly, there were areas where using of eProcurement and eSourcing technologies was not necessarily leading to higher efficiencies, like Supplier Collaboration and Supplier Performance Management. While this is in line with previous research (Subramanian & Shaw, 2002), it seems that companies that use technology are using it primarily for automating standard transactions and well-defined processes. Payment Processes displayed similar trend, yet the explanation here is more straightforward as most companies execute such processes in their ERP Financials systems, hence these processes are taking place outside the their eProcurement systems. The evidence though is sufficient to conclude that our Hypotheses was proved, yet we need to exercise caution. We need a broader view of the interdependencies between our various construct. That is what we will pursue henceforth..

7.6 Assessing T14: "High Performers Focus on Broader Transformation"

In this section we will present a broader statistical analysis results where we delve into resolving whether high-performing companies are putting more emphasis on broader, continuous transformation in a number of fronts – from Objectives , to Skills, to Outsourcing to Strategic and Operational Initiatives, Visibility and finally the use of Procurement and Sourcing technologies realizing an SRM Collaborative Information Infrastructure. Implicit in this theme is the proposition that average to below-average performers are more busy establishing their internal operational transformation rather than focus on externalizing their operations. To test this hypothesis we followed the following sequence:

- First, we tried to identify differentiating groups of subjective performance by Cluster Analyzing the responses in the parameters from Question 3 ("How would you rate your procurement operation's effectiveness in the following areas?").
  We commenced by a study of the multivariate nonparametric correlations and covariances among the parameters and established their item reliability. An evaluation of potential Exploratory Factors was then undertaken with JMP's rotated principal components platform in order to study parameter loadings and statistical power a Factor-based performance construct.
- Second, we evaluated the results of various clustering algorithms vis-à-vis the parameters that where not used in the original analysis. As the objective of this exploratory exercise is to study the differences of perspective among various performance levels, it made sense to select a winning grouping on its amount of significant differentiation of the parameters studied. This is also in alignment with the recommendations from Harrigan (1985) and Rauber et al. (2000).
- Third, we verified the discriminative power of the various Cluster groupings based on Discriminant analysis of the original clustering parameters.
- Fourth, to initially test our hypothesis we conducted a detailed bivariate Analysis of Variance, utilizing non-parametric ANOVA to explore and identify significant relationships between the surveyed parameters and the identified Performance Levels.
- Finally, we utilized Discriminant Analysis to evaluate the multivariate significance of the identified clusters versus the hypothesis related parameters.

By utilizing this substantial set of analytical approaches we will be able us to evaluate the truthfulness of our hypothesis that above average performing companies are more focused on continuously transforming and enabling their organizations. Each of the subsequent sections will follow the aforementioned sequence and will end with a discussion of the results before we venture towards the path analysis of our overall construct. We have tried, as much as possible, to avoid tedious statistical tables, but rather try to visualize our analytical results through easy-to-grasp statistical graphics provided via SAS' JMP. Yet, before we commence with the analysis, we will briefly elaborate on the appropriateness of our approach of evaluating operational performance in the procurement and sourcing domain via subjective measures provided by the respondents.

7.6.1 How Valid Indicators of Performance are the Effectiveness Options?

Based on the research questions we have proposed, can the deployment of an SRM collaborative information infrastructure be one of the determinants of, or rather contributors to corporate operational performance? Our theoretical rationale has been empirically justified by Hansen and Wernerfeldt (1989), who after studying the relative importance of economic and organizational factors in explaining inter-firm differences in profit rates, they concluded that 19 percent of the variance could be explained by industry membership (stable and fluctuating effects), but that administrative practices were roughly twice as important (38%).

To assess performance we have to use measures which can illustrate the quality of a firm's internal and external adaptation. Chakravarthy (1986: 438) states that, the quality of a firm's adaptation can be evaluated on a number of "fits", which include whether: a) a firm's strategy is congruent with its industry structure and competitive context or scope (Porter, 1985); b) its management style is tailored to its strategic context; c) its organization structure is appropriate to its environment and strategy (Egelhoff, 1991); and d) its management systems fit its strategy, structure and environment (Miles & Snow, 1978; Goold & Campbell, 1987). Consequently, a well adapted corporation is able to match given environmental contingencies with internal strengths, and to achieve internal cohesion by aligning its processes to its current strategy and capabilities. Empirical research has verified that high performing organizations are characterized by such internal consistency (Chakravarthy, 1986).

Financial criteria in particular have been shown as insufficient discriminators of "excellence" (Chakravarthy, 1986: 442). Overreliance on single accounting-measures of performance (e.g. ROA) can lead to erroneous assessments, because of the distortability of the financial data used in their calculation . Beyond the most common criticism, that accounting measures record history, not future potential, a number of other problems, as cited by Chakravarthy (1986: 443), are: a) the potential scope of accounting manipulation; b) underevaluation of assets (especially of intangible assets); c) distortions due to depreciation policies; d) distortions due to inventory valuation; e) distortions due to treatment of capital expenditure items. F.ex. accounting ratios such as Return on total assets (ROA), derived from asset-based values tend to hinder inter-company performance comparison because they display greater distortion than operating-based measures. Furthermore, results from different methods of depreciation, local tax regulations, domestic inflation, and foreign exchange fluctuations, can distort comparisons of data.

Although we would have liked to pursue an in-depth investigation of corporate performance, we have been limited by the nature of our survey, which was anonymous, hence we tried to overcome some of these limitations by using a set of composite performance indexes evaluated by managers. All performance indicators reflect respondents' perceptions of improvement in those outcomes due to current state of operations which also include enabling technology. Effectiveness was measured with a 5-item scale developed based on the frameworks presented by Sethi & King (1994), and Subramanian & Shaw (2002)—this scale assessed the operational state of procurement and sourcing in the improvements in respondents' domain operations.

The fact that our detailed measures of domain specific performance state were based on managerial perceptions can be justified on multiple accounts. First, researchers have demonstrated that managerial assessments of functional/domain performance, are generally consistent with objective measures (e.g., Hart and Banbury 1994; Naman and Slevin 1993). Second, in our case, adopting eProcurement and eSourcing practices beyond the internal enablement via ERP systems, SRM, requires more domain specific value transformation state indicators that are normally not available in publicly available financial information (Hartmann, Ritter and Gemuenden, 2002). Third, researchers have noted that measuring the impact of technology adoption at aggregate levels (e.g., using firm-level financial performance measures) often yields inconclusive results, and that measuring such impact at more disaggregate, process-oriented levels is often a more appropriate and useful way to proceed (e.g., Barua et al, 1995). Finally, the process-level measures are consistent with our contention that researchers must move beyond a generic characterization of electronically enabled business operation (or e-business), and instead adopt a more discriminating view of its antecedents, adoption intensity, and performance outcomes (Gribbins et al, 2006). Our own qualitative survey and subsequent council work revealed that intangibles relating to strategic and operational issues, like supplier collaboration and adoption, are just as important as tangible benefits of cost savings and shorter payback periods.

7.6.2 Identifying differentiating Dimensions of Performance Levels

In this section we will present the analysis made to identify differentiating groups of performance by Cluster Analyzing the responses in the parameters from Question 3 (How would you rate your procurement operation's effectiveness in the following areas?).

7.6.2.1 Multivariate Correlations and Item Reliability

We commenced by a study of the multivariate correlations and covariances among the parameters, and also established the item reliability for needed in the subsequent analyses. As nearly all of the parameters were not fitting into Normal Distributions, we have used non-parametric indices (Spearman ρ and Kendall τ) to evaluate the correlations and their significance. It is evident that responses in eProcurement and eSourcing, as well as Supplier Performance Management and Supplier Collaboration, show substantial ρ (and τ) and significant $p<0.001$. In general it is evident that most parameters display significant but low correlation values, which will naturally effect the opportunity to create few exploratory dimensions (via Factor Analysis).

Table 23: Sorted non-parametric Correlations among parameters of Operational Effectiveness (Q3)

Variable	by Variable	Spearman ρ	Prob>|ρ|	Kendall τ	Prob>|τ|
Q3.9_OperEff_eProcurement	Q3.8_OperEff_eSourcing	0,791	0,000	0,752	0,000
Q3.5_OperEff_Supplier_Perf_Mgmt	Q3.4_OperEff_SupplierCollaborat	0,505	0,000	0,444	0,000
Q3.3_OperEff_GlobDirectSourcing	Q3.1_OperEff_Leveraging_Volume	0,376	0,000	0,321	0,000
Q3.8_OperEff_eSourcing	Q3.2_OperEff_GlobIndirecSourcin	0,320	0,000	0,270	0,000
Q3.9_OperEff_eProcurement	Q3.2_OperEff_GlobIndirecSourcin	0,312	0,000	0,263	0,000
Q3.7_OperEff_ComplianceToPolicy	Q3.5_OperEff_Supplier_Perf_Mgmt	0,298	0,000	0,256	0,000
Q3.7_OperEff_ComplianceToPolicy	Q3.6_OperEff_of_Payment_process	0,292	0,000	0,253	0,000
Q3.9_OperEff_eProcurement	Q3.3_OperEff_GlobDirectSourcing	0,287	0,000	0,240	0,000
Q3.3_OperEff_GlobDirectSourcing	Q3.2_OperEff_GlobIndirecSourcin	0,281	0,000	0,241	0,000
Q3.5_OperEff_Supplier_Perf_Mgmt	Q3.3_OperEff_GlobDirectSourcing	0,256	0,000	0,217	0,000
Q3.7_OperEff_ComplianceToPolicy	Q3.1_OperEff_Leveraging_Volume	0,253	0,000	0,219	0,000
Q3.7_OperEff_ComplianceToPolicy	Q3.3_OperEff_GlobDirectSourcing	0,247	0,000	0,212	0,000
Q3.4_OperEff_SupplierCollaborat	Q3.3_OperEff_GlobDirectSourcing	0,240	0,000	0,203	0,000
Q3.9_OperEff_eProcurement	Q3.5_OperEff_Supplier_Perf_Mgmt	0,239	0,000	0,203	0,000
Q3.9_OperEff_eProcurement	Q3.1_OperEff_Leveraging_Volume	0,225	0,000	0,189	0,000
Q3.6_OperEff_of_Payment_process	Q3.5_OperEff_Supplier_Perf_Mgmt	0,224	0,000	0,191	0,000
Q3.8_OperEff_eSourcing	Q3.3_OperEff_GlobDirectSourcing	0,221	0,000	0,187	0,000
Q3.2_OperEff_GlobIndirecSourcin	Q3.1_OperEff_Leveraging_Volume	0,220	0,000	0,185	0,000
Q3.7_OperEff_ComplianceToPolicy	Q3.4_OperEff_SupplierCollaborat	0,216	0,000	0,186	0,000

Variable	by Variable	Spearman ρ	Prob>|ρ|	Kendall τ	Prob>|τ|
Q3.5_OperEff_Supplier_Perf_Mgmt	Q3.1_OperEff_Leveraging_Volume	0,211	0,000	0,180	0,000
Q3.4_OperEff_SupplierCollaborat	Q3.1_OperEff_Leveraging_Volume	0,195	0,000	0,166	0,000
Q3.9_OperEff_eProcurement	Q3.4_OperEff_SupplierCollaborat	0,189	0,000	0,162	0,000
Q3.8_OperEff_eSourcing	Q3.5_OperEff_Supplier_Perf_Mgmt	0,171	0,001	0,145	0,001
Q3.9_OperEff_eProcurement	Q3.7_OperEff_ComplianceToPolicy	0,171	0,001	0,147	0,001
Q3.5_OperEff_Supplier_Perf_Mgmt	Q3.2_OperEff_GlobIndirecSourcin	0,165	0,002	0,139	0,002
Q3.7_OperEff_ComplianceToPolicy	Q3.2_OperEff_GlobIndirecSourcin	0,157	0,003	0,134	0,003
Q3.9_OperEff_eProcurement	Q3.6_OperEff_of_Payment_process	0,145	0,007	0,124	0,006
Q3.8_OperEff_eSourcing	Q3.7_OperEff_ComplianceToPolicy	0,142	0,008	0,124	0,006
Q3.4_OperEff_SupplierCollaborat	Q3.2_OperEff_GlobIndirecSourcin	0,142	0,008	0,121	0,007
Q3.8_OperEff_eSourcing	Q3.4_OperEff_SupplierCollaborat	0,141	0,009	0,121	0,007
Q3.8_OperEff_eSourcing	Q3.6_OperEff_of_Payment_process	0,135	0,012	0,115	0,011
Q3.8_OperEff_eSourcing	Q3.1_OperEff_Leveraging_Volume	0,128	0,018	0,108	0,016
Q3.6_OperEff_of_Payment_process	Q3.2_OperEff_GlobIndirecSourcin	0,122	0,024	0,103	0,022
Q3.6_OperEff_of_Payment_process	Q3.4_OperEff_SupplierCollaborat	0,099	0,067	0,086	0,060
Q3.6_OperEff_of_Payment_process	Q3.3_OperEff_GlobDirectSourcing	0,086	0,111	0,075	0,095
Q3.6_OperEff_of_Payment_process	Q3.1_OperEff_Leveraging_Volume	0,041	0,446	0,035	0,437

7.6.2.2 Exploratory Factor Analysis of the Operational Effectiveness parameters

An evaluation of potential Exploratory Factors was undertaken with JMP's PCA platform in order to compare the power of the differentiation between groupings reached via our subsequent Cluster and the derived explanatory Factor. In our analysis we commenced with extracting Principal Components which were subsequently rotated with the Varimax rotation method. All input parameters were normalized with Tukey's lambda ordinal-to-interval transformation. JMP's Factor analyses were fed with either the normalized parameter responses and finally with a non-parametric Kendall Tau-b correlation matrix. The number of factors or process dimensions were determined through examinations of scree test, Eagan values, and Chi-square. In the table below we present the Rotated Factor Loading, their Communalities and the Item Reliability measure (Cronbach's a).

Table 24: Operational Effectiveness Parameters Item Reliability and Principal Components Loadings.

Parameter in PCA	Cronbach's α	Rotated PC-1	Rotated PC-2	Communality
Q3.1_OperEff_Leveraging_Volume	0,723	**0,535**	0,191	0,323
Q3.2_OperEff_GlobIndirecSourcin	0,722	0,243	**0,531**	0,342
Q3.3_OperEff_GlobDirectSourcing	0,710	**0,516**	0,336	0,379
Q3.4_OperEff_SupplierCollaborat	0,720	**0,703**	0,041	0,496
Q3.5_OperEff_Supplier_Perf_Mgmt	0,706	**0,761**	0,076	0,584
Q3.6_OperEff_of_Payment_process	0,742	*0,387*	*0,127*	0,166
Q3.7_OperEff_ComplianceToPolicy	0,718	**0,611**	0,117	0,387
Q3.8_OperEff_eSourcing	0,709	0,049	**0,908**	0,826
Q3.9_OperEff_eProcurement	0,694	0,171	**0,885**	0,812

From the above table it is visible that 2 primary factors were extracted where especially the responded ability to conduct global sourcing in indirect materials loads with the driving parameters of enablement – usage of eSourcing and eProcurement. However, just as the table and figures below indicate the uncorrelated nature of the responses in these areas of operational performance leads to low Eigenvalues, hence even the 2 factor model does explain less than 50% of the variance in the provided data.

Number	1	2	3	4	5	6	7	8	9
Eigenvalues	2,970	1,345	1,094	1,006	0,749	0,613	0,579	0,433	0,210
Percent	33,0%	14,9%	12,2%	11,2%	8,3%	6,8%	6,4%	4,8%	2,3%
Cum Percent	33,0%	47,9%	60,1%	71,3%	79,6%	86,4%	92,9%	97,7%	100,0%

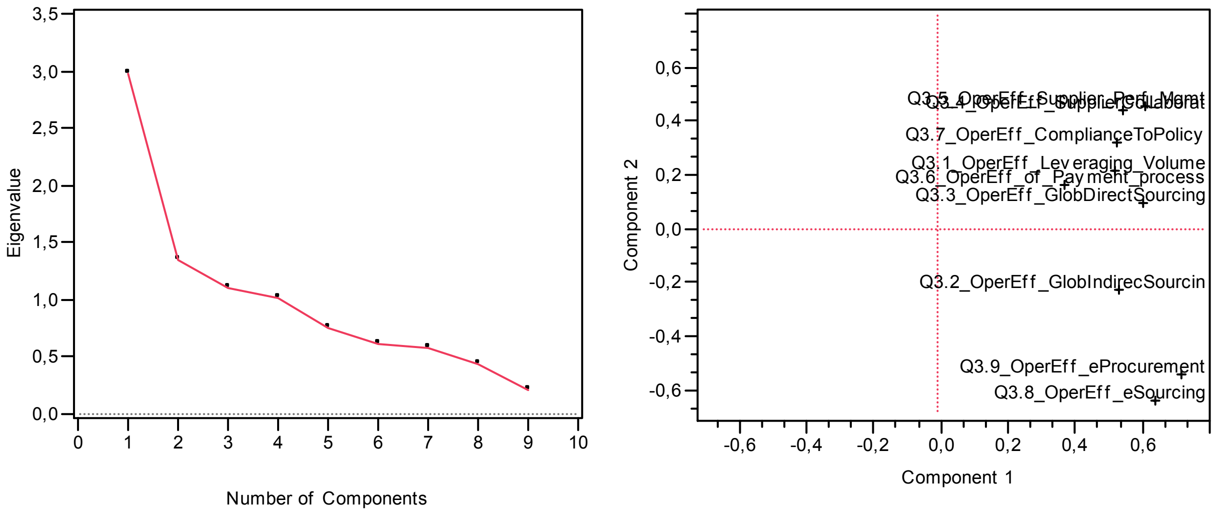


Figure 122: Eigenvalues Table with Scree Plot & Leverage Plot of the rotated Principal Components.

It is obvious that a Factor based dimensioning of performance levels will be only capturing a small part of the true variance indicated by the data. Thus, we commenced with a more encompassing cluster analysis to group the companies into performance levels.

7.6.3 Developing a Robust Performance Levels Classification

To reach a valid classification we used cluster analysis, which identifies homogeneous groups or clusters of cases based on their values for a set of variables. Through cluster analysis a well segregated description of a group can be generated, a stark contrast to the illustrative research in strategic management which often theorizes the existence of differing groups or configurations and then attempt to represent their differences without the benefit of consistent dimensions (Goold and Campbell, 1987). In fact, such typologies lack the scientific rigor of taxonomies however useful they seem.

7.6.3.1 Problems Attached To Cluster Analysis

While many researchers have used multi-dimensional cluster analysis within the area of intra-industry Strategic Groups and Business strategy (Porter, 1980, Miller and Friesen, 1984) and process research (Nøkkentved & Rosenø, 1998). Furthermore, in case that a number of dimensions are identified, they must be given careful scrutiny, because a taxonomic approach could select dimensions which are essentially "white noise" as being of great Discriminant importance. Multiple clustering algorithms should be employed to ensure a correct and consistent categorization. This is often avoided in research, which often relies upon application of a single clustering algorithm, because the subsequent tests are very time-consuming.

Researchers seldom question the values of the dimensions they adopt and their effect on the final categorizations (Venkatraman & Ramanujam, 1986). For example, consistent dimensions can be achieved by a varying number of factor analysis (and factor rotations), thus leading to different factor scores per dimension. Traditionally such scores are fed as the input values per observation (e.g. firm) into a clustering algorithm. Different initial scores per dimension can then lead to different groupings of the cases under study. An in-depth test will end up with a number of cluster solutions. But which one of them should be chosen? Statistical theory is often unclear, both with regard to the number of clusters as well as final solutions, because like factor techniques, clustering techniques were first developed in an applied field (biological taxonomy) and are rarely accompanied by the expected statistical clothing of significance tests, probability models, log functions or optimal procedures (Harrigan, 1985).

Another problem commonly seen in management research, is the use of non-interval or ordinal data extracted from Likert scales in the calculation of the n-dimensional Euclidean distances for each pair of cases. Such misuse of cluster analysis can lead to disreputable results when the primary assumptions of the algorithm (i.e. interval-scaled variables) are plainly disregarded. While our statistical toolbox is constantly expanding by providing us with new algorithms to study distances among categorical variables, there are very few instances where such nonparametric aspects have been taken into consideration. Finally, the situation is exacerbated by the predominantly linear analytic perspective of management and IS research, which excludes important non-linear relationships as unique or unexplained variance!

Hence, the requirements for reaching a consistent classification of Performance Levels is dependent upon a multitude of factors, from the cluster algorithms to the evaluations of the various cluster results. In the following we will present our elaborations and results.

7.6.4 Classification Analysis – Selecting Clustering Methods and Approach

We commenced our analysis by creating the various cluster and then evaluated the ability of the various clustering algorithms to differentiate among the parameters. As our exploratory endeavor is focused on identifying differences of subjective judgment or perspective from the managers answering our survey leading to clusters or performance levels, we will according to Rauber et al. (2000) evaluate and rank the various groupings thus selecting the one that provides the highest significant differentiation among the parameters surveyed. We conducted a multitude of cluster analysis on the Efficiency parameter responses of Question 3. Within the “Hierarchical” or agglomerative clustering we utilized “Ward's minimum variance” to calculate distances between clusters, while in parallel we also used the “K-means” clustering method with the more nonparametrically robust Self-Organizing Maps (SOM) platform.

7.6.4.1 About the Selected Clustering Algorithms – Ward’s and SOM

One of the reasons why we selected Ward’s and SOM as our main exploratory clustering techniques was based on the fact that most of our Likert-based, yet ordinal responses were not normal (i.e. not following a normal distribution). As the ranges of our parameters also vary significantly (i.e. Y/N, 5, or 4 scale Likert), it is difficult to normalize them without creating distorting biases. Therefore, we choose to use more robust distance metrics of similarity as used by the Ward’s and SOM methods.

In **Ward's minimum variance** method, the distance between two clusters is the ANOVA sum of squares between the two clusters added up over all the variables. At each generation, the within-cluster sum of squares is minimized over all partitions obtainable by merging two clusters from the previous generation. The sums of squares are easier to interpret when they are divided by the total sum of squares to give the proportions of variance (squared semi partial correlations). Ward's method joins clusters to maximize the likelihood at each level of the hierarchy under the assumptions of multivariate normal mixtures, spherical covariance matrices, and equal sampling probabilities. Ward's method tends to join clusters with a small number of observations as it is strongly biased toward producing clusters with roughly the same number of observations. It is also very sensitive to outliers (Milligan 1980 in JMP Help).

Our second utilized clustering technique, **Kohonen's Self-Organizing Maps** (SOMs) is an unsupervised neural network algorithm that provides cartographic visualization of the results (Kohonen, 2001). SOMs are a robust variation on k-means[91] with the additional constraint that cluster centers be located on a regular grid (or some other topographic structure) and furthermore their location on the grid be monotonically related to pair wise proximity (Murtagh and Hernández-Pajares, 1995). Included in the causes of what may be characterized as lack of precision in the Kohonen map are the following: the specific criterion being iteratively optimized in training, the existence of local optima, dependence on starting configuration, and lack of interpretation characteristics such as meaningfulness of output representational space axes. However, as stressed in Murtagh and Hernández-Pajares (1995), a regular grid output representation space minimizes these issues and brings SOM closer to the K-Means framework[92]. Furthermore, SOM displays robustness to the weaknesses of K-means like the normalization bias, local optima convergence and handling of ordinal parameters (Bação, Lobo & Painho, 2005) and is available in our statistical toolset – JMP[93]. We interpreted the results of the calculations and label the clusters we did an initial ANOVA comparison with the original operational effectives parameters in question 3.

---

[91] The K-means approach to clustering performs an iterative alternating fitting process to form the number of specified clusters. The k-means method first selects a set n points called cluster seeds as a first guess of the means of the clusters. Each observation is assigned to the nearest seed to form a set of temporary clusters. The seeds are then replaced by the cluster means, the points are reassigned, and the process continues until no further changes occur in the clusters. When the clustering process is finished, you see tables showing brief summaries of the clusters. The k-means approach is a special case of a general approach called the EM algorithm, where E stands for Expectation (the cluster means in this case) and the M stands for maximization, which means assigning points to closest clusters in this case. K-means clustering suffers all the problems on not being able to handle ordinal data very well, is sensitíve to normalization baises, entry sequencing and outliers. It is suitable only for simple numerical data, especially laboratory-generated clean scientific data. Generally, business data consist of many categorical variables with complex taxonomic domain structure. These data generally contains noisy information. Thus, K-means is simply not suitable for accurate clustering for our current survey data.

[92] One important statistical conclusion that can be drawn from this study is that SOM is less prone to local optima than k-means. During the tests conducted by Bação, Lobo and Painho (2005) tests it was evident that the search spaces provided were better explored by SOM. This is due to the effect of the neighborhood parameter which forces units to move according to each other in the early stages of the process. This characteristic can be seen as an "annealing schedule" which provides an early exploration of the search space. On the other hand, k-means gradient orientation forces a premature convergence which, depending on the initialization, may frequently yield local optimum solutions. It is important to note that there are certain conditions that must be observed in order to render robust performances from SOM, such as to start the process using a high neighborhood radius, and progressively reduce both parameters to zero (done in JMP via the Bandwidth setting in SOM).

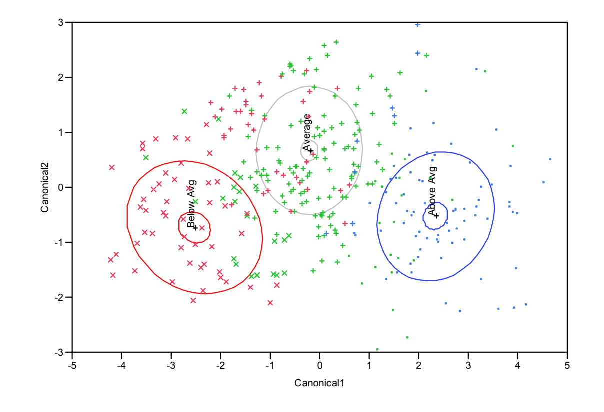
[93] The original SOM neural net algorithms are implemented in SAS's JMP as a simple variation on k-means clustering, hence a batch algorithm using a locally weighted linear smoother. The goal of a SOM is to not only form clusters, but form them in a particular layout on a cluster grid, such that points in clusters that are near each other in the SOM grid are also near each other in multivariate space. In classical k-means clustering, the structure of the clusters is arbitrary, but in SOMs the clusters have the grid structure. This grid structure may be invaluable in interpreting the clusters in two dimensions.

7.6.4.2 Initial Multivariate Comparison of the various Clustering Results

To be able to evaluate the results we used alternative techniques – both bi- and multivariate. Initially we conducted a set of Discriminant analysis of the clustering parameters versus the identified clusters – see below the table containing 2 of these analyses.

Table 25: Discriminant Analysis of Clusters vs. Parameters – SOM and Ward's 3 cluster solutions.

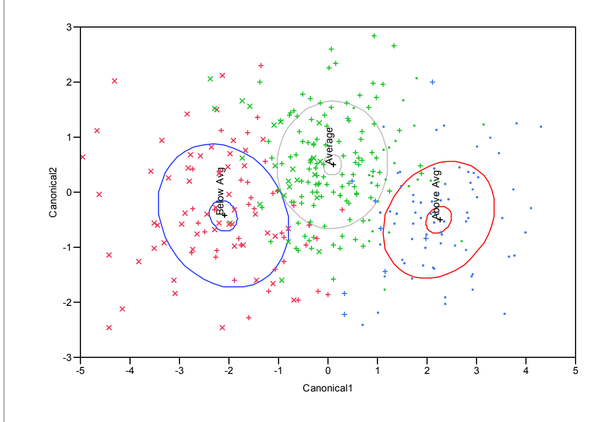
3 Cluster (SOM) vs. Clustering Parameters (Q3)



Test	Value	Approx. F	NumDF	DenDF	Prob>F
Wilks' Lambda	0,1711981	52,4236	18	666	<,0001
Pillai's Trace	1,0529436	41,2604	18	668	<,0001
Hotelling-Lawley	3,5319331	65,1445	18	664	<,0001
Roy's Max Root	3,1111002	115,4564	9	334	<,0001

Number Misclassified	16
Percent Misclassified	4,651
-2LogLikelihood	58,62

3 Cluster (Ward's) vs. Clustering Parameters (Q3)



Test	Value	Approx. F	NumDF	DenDF	Prob>F
Wilks' Lambda	0,2340789	39,4752	18	666	<,0001
Pillai's Trace	0,9005886	30,3998	18	668	<,0001
Hotelling-Lawley	2,6967562	49,7402	18	664	<,0001
Roy's Max Root	2,4631943	91,4119	9	334	<,0001

Number Misclassified	27
Percent Misclassified	7,849
-2LogLikelihood	69,78

Instead of linear, we utilized the Quadratic Discriminant method in that it can handle different covariances and thus more inclusive. In the charts below the size of the inner circles corresponds to a 95% confidence limit for the mean, while the outer contour shows the areas containing app. 50% of the points for that group. It is evident that SOM has created more independent clusters that are also more distinguishable via the Discriminant analysis (i.e. low no. of mismatches)

7.6.5 Classification Analysis – Comparing Different Clustering Results

An additional technique to derive 'valid' classifications is based on an post-hoc examination of their discriminatory power vis-à-vis a number of external parameters <u>not</u> used in the generation of the classification (Harrigan, 1985).

To check the discriminatory power of the various cluster solutions, we investigated significance levels for measures of parameters 2,9,15-20 for each separate cluster solution. The procedure that tested discriminatory power was run in Sass's JMP statistical tool. In the first part of the comparison we used Logistic Regressions while in the second one we utilized the Discriminant analysis.

7.6.5.1 Comparing Ward's and SOM Clusters via Ordinal Logistic Regressions

Second, we evaluated the derived number of clusters (N=3,4,5) by conducting a *Logistical Ordinal Regression*[94] (with the clusters as the dependent and the not used survey parameters as the independent in JMP).

The table below shows how we compared the final six candidates; in the top we report the R^2, then the *Log Likelihood*, which records an associated negative log-likelihood for each of the models via the difference between the Reduced and Full models and measures the significance of the regressors as a whole to the fit. Moreover, in the Model level, we provide the Likelihood-ratio *Chi-square* test for the hypothesis that all regression parameters are zero, and then the *Prob>ChiSq*.

Finally, instead of reporting Parameter estimates, we had JMP generate the *Likelihood Ratio Tests* Chi-square tests (i.e. calculated as twice the difference of the log-likelihoods between the full model and the model constrained by the hypothesis to be tested hence the model without the effect). These tests were time-consuming yet they provided a reliable indication of the significance of the various parameters that were not used in the clustering method.

Table 26: Comparing Ward's and SOM Clusters with Ordinal Log-Regression on non-used parameters.

Whole Model	**3 Cluster (Wald)**		**4 Cluster (Wald)**		**5 Cluster (Wald)**		**3 Cluster (SOM)**		**4 Cluster (SOM)**		**5 Cluster (SOM)**	
RSquare (U)	0,56		0,36		0,32		0,67		0,27		0,55	
-Log Likelihood	*63,26*		44,05		50,71		77,92		41,69		88,80	
ChiSquare	126,51		88,11		101,42		155,83		83,39		177,59	
Prob>ChiSq		*<,0001*		0,0298		0,0026		<,0001		0,0619		<,0001
Effect Likelihood Ratio Tests on Hypothesis Parameters	***L-R Chi^2***	***Prob> Chi^2***	***L-R Chi2***	***Prob> Chi2***	***L-R Chi2***	***Prob> Chi2***	***L-R Chi2***	***Prob> Chi2***	***L-R Chi2***	***Prob> Chi2***	***L-R Chi2***	***Prob> Chi2***
Q2.1_OperObj_Reduce_Prod_Costs	*0,5*	0,476	*0,8*	0,382	*1,3*	0,256	*13,3*	**0,000**	*4,4*	*0,036*	*2,8*	0,097
Q2.2_OperObj_Quality_ofProcured	*1,7*	0,198	*2,4*	0,119	*2,7*	0,100	*8,3*	**0,004**	*0,4*	0,527	*6,1*	*0,013*
Q2.3_OperObj_ReducMaverickSpend	*6,0*	*0,014*	*0,7*	0,413	*3,8*	0,052	*3,8*	0,050	*9,4*	**0,002**	*2,2*	0,136
Q2.4_OperObj_ResponsiveToDemand	*8,2*	**0,004**	*0,2*	0,626	*1,0*	0,318	*2,9*	0,089	*0,0*	0,902	*0,0*	0,985
Q2.5_OperObj_Security&Resilienc	*0,9*	0,344	*1,3*	0,251	*13,7*	**0,000**	*1,8*	0,180	*1,3*	0,255	*0,0*	0,967

[94] SAS's JMP implements Ordinal Logistic Models via a linear model to a multi-level logistic response function using maximum likelihood. Likelihood-ratio test statistics are computed for the whole model. Lack of Fit tests and Wald test statistics are computed for each effect in the model. Options give likelihood-ratio tests for effects and confidence limits and odds ratios for the maximum likelihood parameter estimates. In our case, the response variable is ordinal, hence the platform fits the cumulative response probabilities to the logistic distribution function of a linear model using maximum likelihood. Likelihood-ratio test statistics are provided for the whole model and lack of fit.

Whole Model	3 Cluster (Wald)		4 Cluster (Wald)		5 Cluster (Wald)		3 Cluster (SOM)		4 Cluster (SOM)		5 Cluster (SOM)	
Q2.6_OperObj_FindDomestSupplier	2,1	0,152	0,2	0,640	6,5	0,011	1,1	0,299	0,1	0,786	1,0	0,325
Q2.7_OperObj_FindGlobalSupplier	5,4	0,021	0,0	0,966	2,3	0,126	2,2	0,137	0,6	0,457	16,6	0,000
Q2.8_OperObj_Support_BPO	0,0	0,895	3,5	0,062	0,4	0,521	5,8	0,016	0,0	0,882	7,0	0,008
Q2.9_OperObj_Intro_eProcSys	0,2	0,617	0,4	0,510	1,7	0,191	0,3	0,573	0,0	0,964	0,2	0,619
Q2.10_OperObj_Intr_eSourcingSys	3,3	0,067	0,4	0,515	0,1	0,706	1,7	0,188	2,0	0,156	2,7	0,101
Q9.1_OperSkil_Glob_SourcDirects	2,8	0,241	2,6	0,270	14,7	0,001	0,1	0,938	1,8	0,405	4,3	0,118
Q9.2_OperSkil_GlobSourcIndirect	24,2	0,000	0,5	0,770	0,7	0,709	6,5	0,039	0,7	0,713	6,0	0,050
Q9.3_OperSkil_NonCoreOutsourcng	1,1	0,586	0,0	0,994	3,9	0,140	4,0	0,135	0,2	0,902	0,8	0,674
Q9.4_OperSkil_CoreBProcsOutsour	2,2	0,341	6,5	0,038	4,5	0,107	9,5	0,009	6,2	0,044	9,1	0,011
Q9.5_OperSkil_ContractComplianc	6,4	0,041	2,5	0,282	2,4	0,305	17,1	0,000	9,0	0,011	19,1	0,000
Q15.1_ProcuEff_SupplRationalisa	0,5	0,493	0,4	0,513	3,1	0,080	0,7	0,411	0,7	0,415	1,2	0,282
Q15.2_ProcuEff_SupplCollProdDev	0,5	0,495	5,8	0,016	0,2	0,643	1,4	0,242	0,2	0,642	0,2	0,666
Q15.3_ProcuEff_SupplCollabMngSC	5,5	0,019	0,3	0,575	2,5	0,114	8,6	0,003	10,5	0,001	0,0	0,829
Q15.4_ProcuEff_SupplierPerfMgmt	2,0	0,157	0,8	0,360	0,9	0,342	1,1	0,301	0,2	0,675	1,2	0,276
Q15.5_ProcuEff_RFIDusage	0,1	0,785	0,3	0,597	9,3	0,002	3,4	0,063	4,2	0,041	3,0	0,083
Q15.6_ProcuEff_DevTCOapproaches	2,2	0,139	1,9	0,171	0,8	0,358	6,9	0,009	1,8	0,178	11,2	0,001
Q16.1_ProcuStrat_ProcAutomation	0,0	0,891	1,2	0,275	0,0	0,956	1,2	0,274	0,3	0,563	0,4	0,505
Q16.2_ProcuStrat_BPRofPur2Pay	0,6	0,441	2,9	0,089	0,1	0,771	4,2	0,039	3,4	0,066	0,3	0,594
Q16.3_ProcuStrat_BPprocs_eSourc	0,6	0,424	1,1	0,294	1,0	0,306	5,5	0,019	3,8	0,051	3,5	0,060
Q16.4_ProcuStrat_TalentRetentin	0,4	0,540	2,9	0,088	0,0	0,854	2,0	0,157	2,9	0,089	0,6	0,421
Q16.5_ProcuStrat_StaffTrainSkil	0,2	0,637	0,1	0,757	0,4	0,503	2,9	0,088	1,0	0,325	4,7	0,030
Q16.6_ProcuStrat_UpgradingSkill	0,1	0,701	0,8	0,361	0,7	0,415	0,7	0,397	2,2	0,142	1,7	0,189
Q16.7_ProcuStrat_TransfProcuOrg	0,0	0,845	0,1	0,809	2,3	0,133	3,7	0,056	1,4	0,233	0,1	0,757
Q16.8_ProcuStrat_ProcurOutsourc	0,6	0,455	1,1	0,296	12,6	0,000	4,7	0,030	4,3	0,039	0,7	0,405
Q17.1_ProcuKPI_ProcEfficie&Cost	5,2	0,023	0,0	0,936	0,2	0,696	6,1	0,014	0,8	0,379	1,0	0,306
Q17.2_ProcuKPI_OrderCycleTimes	0,3	0,557	0,8	0,370	1,0	0,314	0,0	0,838	2,0	0,162	1,8	0,178
Q17.3_ProcuKPI_SpendReduction	0,1	0,765	0,1	0,720	0,4	0,527	0,8	0,382	14,8	0,000	0,2	0,647
Q17.4_ProcuKPI_ProcurServicPerf	1,9	0,164	0,0	0,973	0,8	0,375	10,8	0,001	0,0	0,998	6,6	0,010
Q17.5_ProcuKPI_Prod&ServQuality	0,0	0,931	1,0	0,326	17,0	0,000	0,7	0,412	0,5	0,470	3,3	0,069
Q17.6_ProcuKPI_SupplyResiliency	5,4	0,021	0,1	0,725	0,3	0,591	2,8	0,092	1,2	0,274	2,5	0,112
Q17.7_ProcuKPI_eProcBenefits	0,0	0,937	0,1	0,740	5,2	0,022	0,8	0,360	5,6	0,018	0,2	0,667
Q17.8_ProcuKPI_TCO	0,2	0,681	0,0	0,827	0,2	0,678	2,0	0,153	0,7	0,403	2,4	0,125
Q18.1_ProcuMon_SpendTransparncy	1,7	0,196	0,5	0,482	1,6	0,208	6,9	0,009	2,0	0,161	7,9	0,005
Q18.2_ProcuMon_ChallengBUdemand	0,7	0,396	0,4	0,513	1,9	0,163	0,0	0,932	1,1	0,295	0,2	0,683
Q18.3_ProcuMon_IdentifimprvArea	1,9	0,171	0,2	0,641	10,6	0,001	3,1	0,079	0,1	0,740	2,5	0,115
Q18.4_ProcuMon_DevInfSupplStrat	0,4	0,524	0,0	0,836	0,7	0,409	1,9	0,169	2,7	0,100	0,0	0,920
Q18.5_ProcuMon_MeasuPerf_Buyers	0,0	0,871	1,7	0,195	4,1	0,042	5,7	0,017	0,5	0,482	0,0	0,875
Q19.1_eProcObj_Reduce_Prices	5,0	0,026	0,2	0,619	10,3	0,001	3,0	0,085	0,2	0,664	2,3	0,130
Q19.2_eProcObj_RedMaverck&Compl	11,7	0,001	0,0	0,876	3,0	0,084	12,2	0,000	0,2	0,620	4,2	0,040
Q19.3_eProcObj_SpendTransparncy	4,0	0,046	1,3	0,263	5,8	0,016	1,9	0,168	1,9	0,171	0,4	0,531
Q19.4_eProcObj_RedTransactCosts	2,6	0,104	1,1	0,286	7,3	0,007	0,1	0,745	2,9	0,086	1,4	0,243
Q19.5_eProcObj_ReducInventory	2,5	0,115	0,0	0,935	1,0	0,328	2,3	0,126	0,5	0,488	2,6	0,104
Q19.6_eProcObj_DecrProcCycleTim	0,1	0,732	3,4	0,066	0,1	0,793	0,1	0,755	0,5	0,470	7,8	0,005
Q19.7_eProcObj_ReductAdmWrkload	1,3	0,254	0,1	0,712	0,0	0,923	4,7	0,030	1,3	0,255	1,1	0,302
Q19.8_eProcObj_ImproveCollabora	0,4	0,523	0,0	0,835	0,7	0,387	0,6	0,453	1,1	0,297	0,2	0,698
Q19.9_eProcObj_ProvidTranspData	0,0	0,854	2,9	0,091	4,6	0,032	0,1	0,753	0,4	0,507	0,0	0,938
Q20.1_eProcBen_ReducePrices	0,3	0,590	1,8	0,178	4,7	0,029	0,1	0,768	0,8	0,358	1,3	0,261
Q20.2_eProcBen_RedMaverck&Compl	0,0	0,874	0,7	0,410	5,3	0,021	2,2	0,137	1,3	0,249	0,2	0,621
Q20.3_eProcBen_SpendTransparncy	4,4	0,035	0,4	0,532	0,6	0,433	15,7	0,000	1,0	0,318	9,3	0,002
Q20.4_eProcBen_RedTransactCosts	2,0	0,156	1,9	0,163	12,7	0,000	0,4	0,538	0,2	0,686	1,4	0,240
Q20.5_eProcBen_ReduceInventory	0,3	0,610	0,1	0,804	1,8	0,175	0,0	0,838	2,8	0,097	0,2	0,690
Q20.6_eProcBen_DecrProcCycleTim	0,1	0,760	2,1	0,143	1,3	0,261	0,0	0,949	0,3	0,575	3,8	0,052
Q20.7_eProcBen_ReductAdmWrkload	3,1	0,080	8,9	0,003	6,9	0,009	7,2	0,007	0,9	0,341	2,2	0,135
Q20.8_eProcBen_ImproveCollabora	3,1	0,079	0,0	0,955	1,6	0,212	10,1	0,001	1,7	0,196	8,4	0,004
Q20.9_eProcBen_ProvidTranspData	0,2	0,631	0,3	0,592	0,7	0,393	0,5	0,463	0,3	0,573	2,0	0,160
Pseudo-ChiSquare SUM	**137,3**		**72,3**		**206,3**		**228,4**		**123,1**		**184,0**	
Pseudo-Probability SUM		**23,72**		**28,79**		**17,15**		**15,02**		**21,94**		**19,07**

By looking at the amount of variance explained (R^2), and then the pseudo-/qualitative sum of total probabilities, e.g. less is better – Harrigan (1985), it is evident that the **SOM-based**

Cluster 3 is the most significant effect-differentiating and most explanatory classification of the parameters affected by our hypothesis.

7.6.5.2 Comparing Ward's and SOM Clusters via Discriminant Analysis

The final part of the comparative analysis was then undertaken as we used Discriminant Analysis to evaluate the multivariate significance of the identified clusters versus the hypothesis related parameters. The table below presents the Statistical tests[95] of the 8 clusters we generated using Ward's and SOM methods. Table 27 below shows the significant results of the SOM Cluster 3 solution; this solution was easiest to distinguish for the Quadratic Discriminant method. Most of the other ones are not reaching significance in *Pillai's trace*.

Table 27: Statistical Multivariate Tests of the Discriminant Analyses conducted on the 8 Clustering cases.

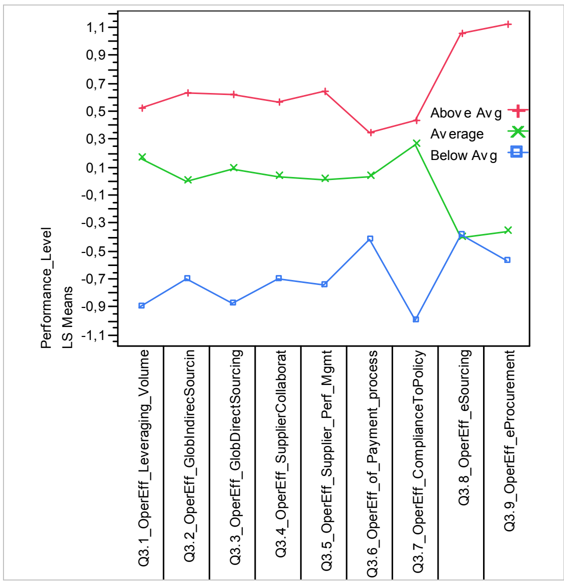
Cluster Models	Test	Pillai's Trace	Wilks' Lambda	Hotelling-Lawley	Roy's Max Root
3 Cluster (Wald)	Appr.F	1,25	1,25	1,25	1,63
	Prob>F	*0,125*	*0,126*	*0,129*	**0,039**
4 Cluster (Wald)	Appr.F	1,08	1,08	1,08	1,67
	Prob>F	*0,304*	*0,312*	*0,320*	**0,031**
5 Cluster (Wald)	Appr.F	1,14	1,13	1,13	2,00
	Prob>F	*0,171*	*0,183*	*0,195*	**0,006**
3 Cluster (SOM)	Appr.F	1,38	1,38	1,38	1,80
	Prob>F	**0,046**	**0,047**	**0,048**	**0,017**
4 Cluster (SOM)	Appr.F	1,23	1,25	1,26	1,88
	Prob>F	*0,094*	*0,081*	*0,074*	**0,011**
5 Cluster (SOM)	Appr.F	0,78	1,00	1,18	2,58
	Prob>F	*0,971*	*0,501*	*0,113*	**0,000**

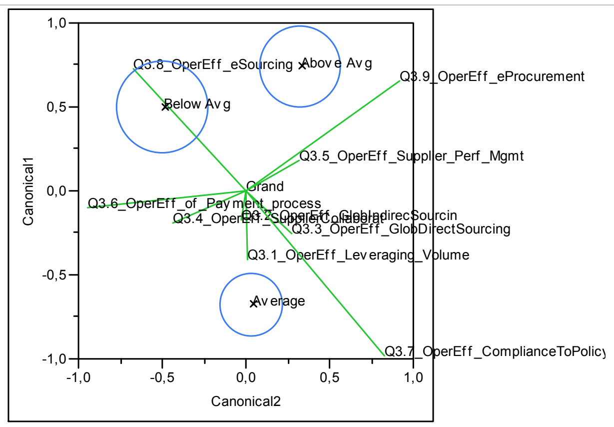
7.6.5.3 Awarding the Most Appropriate Performance Clustering Solution

As shown by Table 5 and 6 it is evident that the "winning" solution was a 3 cluster solution reached via Self-Organizing Maps clustering algorithm. The solution was able to include even outliers that were affecting the Ward's algorithmic results. We viewed that as an important element as we only had 117 observations we could use out of the total of 344 survey responses when it came to the questions on eProcurement. The grouping was within the N/30 to N/40 boundary, where N is the number of observations in the data set, suggested by most researchers. This then concludes the comparative analysis and now we move into characterizing this particular clustering solution for the Performance Levels.

7.6.6 Details of the most differentiating clustering - SOM's 3 Cluster solution

The SOM Algorithm managed in 8 runs to identify the 3 cluster solution . The chart below shows the means of the clustering parameters for the 3 clusters. It is visible that cluster 1 (or Above Avg operational effectiveness) is containing companies which scored high on all parameters. Where the high performers distinguish themselves is that they also rate themselves high on eSourcing and eProcurement (i.e. the enabling technologies), whereas the remaining ones are scoring very low. In comparison to low performers, the other two groups score high on the 7th parameter – Internal compliance to procurement policy.





Test	Value	Approx. F	NumDF	DenDF	Prob>F
Wilks' Lambda	0,6383849	10,5035	16	668	<,0001
Pillai's Trace	0,3864429	10,0290	16	670	<,0001
Hotelling-Lawley	0,5275614	10,9799	16	666	<,0001
Roy's Max Root	0,4389624	18,3815	8	335	<,0001

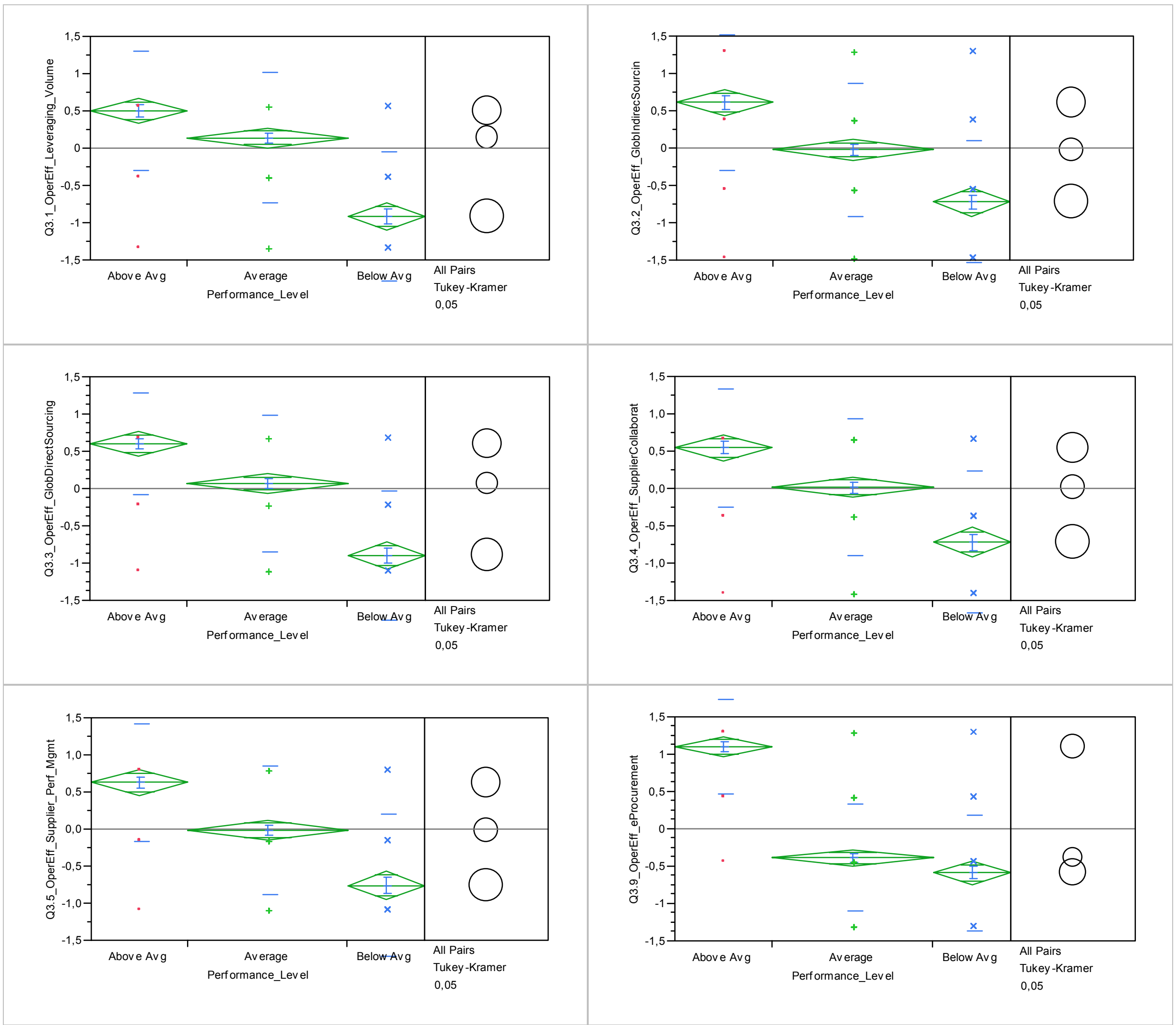
Eigenvalues	Canonical Corr
0,43896237	0,55231766
0,08859905	0,28528607

Figure 123: Cluster Means per Clustering Parameter, and MANOVA of Pars vs. Cluster with Sign. Tests.

To investigate the direction and significance of the differences between the means, we conducted a MANOVA (see above Centroid Plot with Rays showing the parameters). To study bivariate relationships we also conducted an ANOVA per relationship and found that all means were significantly different ($p<0.01$) – all graphs and statistics are shown in the Appendix XX.

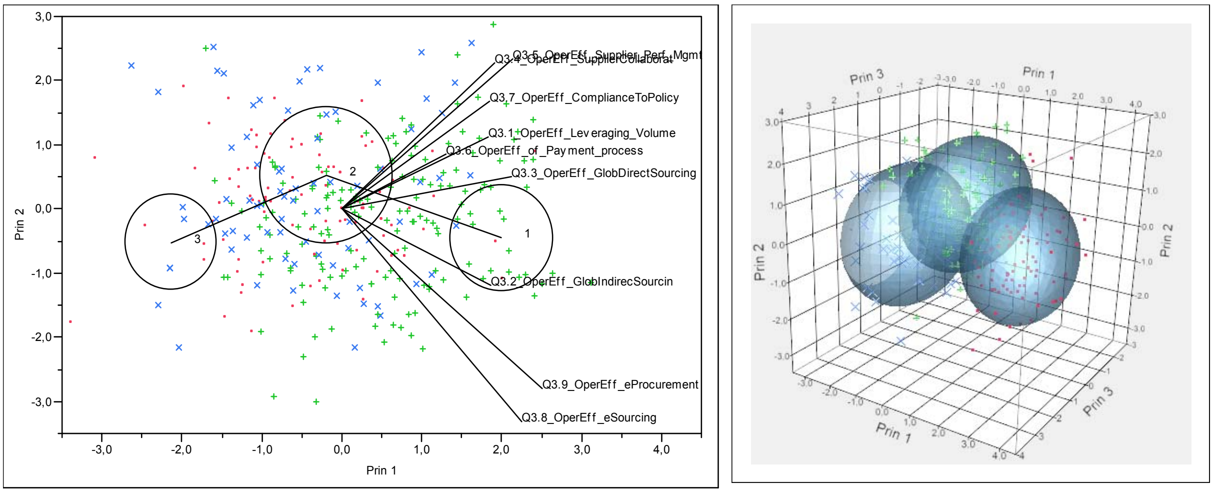
[95] Multivariate test statistics are given with approximate F tests: Wilk's Lambda (Λ), Pillai's Trace, the Hotelling-Lawley Trace, and Roy's Maximum Root. Pillai's Trace is the most powerful of them given that the egenvalues do not differ widely, or else it's Roy's Max Root.

Table 28: Some of the ANOVA results of Clusters by Parameters as Diagrams – all significant at p<0.01.



Note: These are the ANOVA diagrams produced by SAS' JMP. The vertical axis is the Parameter while the X or horizontal presents the cluster solutions. The diamonds in the graph are a schematic of the mean (line in middle) and standard error of the mean (vertical bars) for each sample group or cluster in our case; the height of each diamond represents the 95% confidence interval for each group, and the diamond width represents the group sample size. ANOVA plots are supplied by a means comparison circles box. The outside angle of intersection explains whether or not group means are significantly different, e.g. circles for means that are significantly different either do not intersect or intersect slightly so that the outside angle of intersection is less than 90 degrees. If the circles intersect by an angle of more than 90 degrees or if they are nested, the means are not significantly different. Within group means and Tukey-Kramer's HSM multiple range tests were used to interpret the differences among clusters.

Below we show the SOM Biplot of the clustering parameters and then the positioning of the 3 clusters in 2D and subsequently 3D space defined by the vectors or factors generated by the analysis – we also provide the eigenvalues. The Rays represent the clustering parameters and their direction indicates their relationship with the provided factors, while length is indicative of their contribution to the clustering grid. As shown in the ANOVA above (and our previous Factor analysis, eProcurement and eSourcing are differentiating parameter that also bundle in like one factor with an inverse or negative relationship to the SOM's Principal Component 2.



Eigenvalues
2,9699681 1,34548 1,094354 1,0063323 0,7491287 0,613316 0,5788821 0,4329425 0,2095963

Figure 124: Visualization of the 3 cluster SOM solution, based on identified vectors. Rays in the 2D plot represent the effect and relationship of the clustering parameters. In 3D we show the 90% Density Ellipses.

With regards to Bartlett's Test of Sphericity (Harrigan, 1985) we evaluated the clusters via a MANOVA, found the Chi^2 significant, indicating that we can only evaluate discrimination with multivariate tests. In other words, we can not reduce the Performance levels to one, univariate dimension. Hence, beyond the higher regression coefficients, these results further validates our usage of a cluster approach to group performance rather than a factor based one. This is also shown in the 3D plot above, as it depicts the form of the spheres constituting the SOM clusters. As it also shows the 3rd Principal component it provides a visual cue on the distinction between the left or low and right or high performers (cluster 3 and 1 respectively).

7.6.6.1 Summary of the Performance Grouping

As we mentioned in the beginning of this analysis, this part of the investigation was imperative in order for us to be able to evaluate our hypotheses on the role of a number of contextual parameters given different levels of operational effectiveness.

While a factor analytical approach has been utilized by most of the research in the area, we found that the explanatory power of reducing our 9 parameters down to 2 factors provided a suboptimal solution that deduced the richness of the data and still not managed to reach sufficient coverage of the variance in the sample (2 factor solution covered <48% of the variance). Hence we continued with the clustering approach in reaching a richer and more data-fitting performance grouping. We evaluated various clustering methods and the ones selected were rigorously tested to identify the most explanatory, distinguishing and significant solution.

After this analysis, we concluded that the 3 clusters solution extracted via the more non-parametric and robust variant of the K-Means method, the Self-Organizing Maps (SOMs), was the one that best characterized the sample into a number of performance levels. We finally established its discriminatory significance and reviewed the significance of the parameter-based differences among the performance cluster's means.. Now we will continue our hypotheses evaluation by reviewing the bivariate and multivariate relationships between our parameters and the performance achieved.

7.6.7 Testing the High Performance Uses More Factors Theme with the Parameters

After establishing the validity and discriminating power of the selected Performance Level groupings, we can venture into a detailed study of the relevance of our stated hypothesis that performance differentiates the focus of companies on transformation initiatives, more detailed objectives, outsourcing, measurement & monitoring and technology enablement. These hypothesized relationships are summarized via the following graph; hypotheses group our parameters into groups while all point towards the middle – levels of operational efficiency.

Figure 125: Hypothesized Constructs and Surveyed Parameters Affecting Operational Efficiency

7.6.7.1 Analyzing the Performance Hypotheses with Bivariate ANOVAs

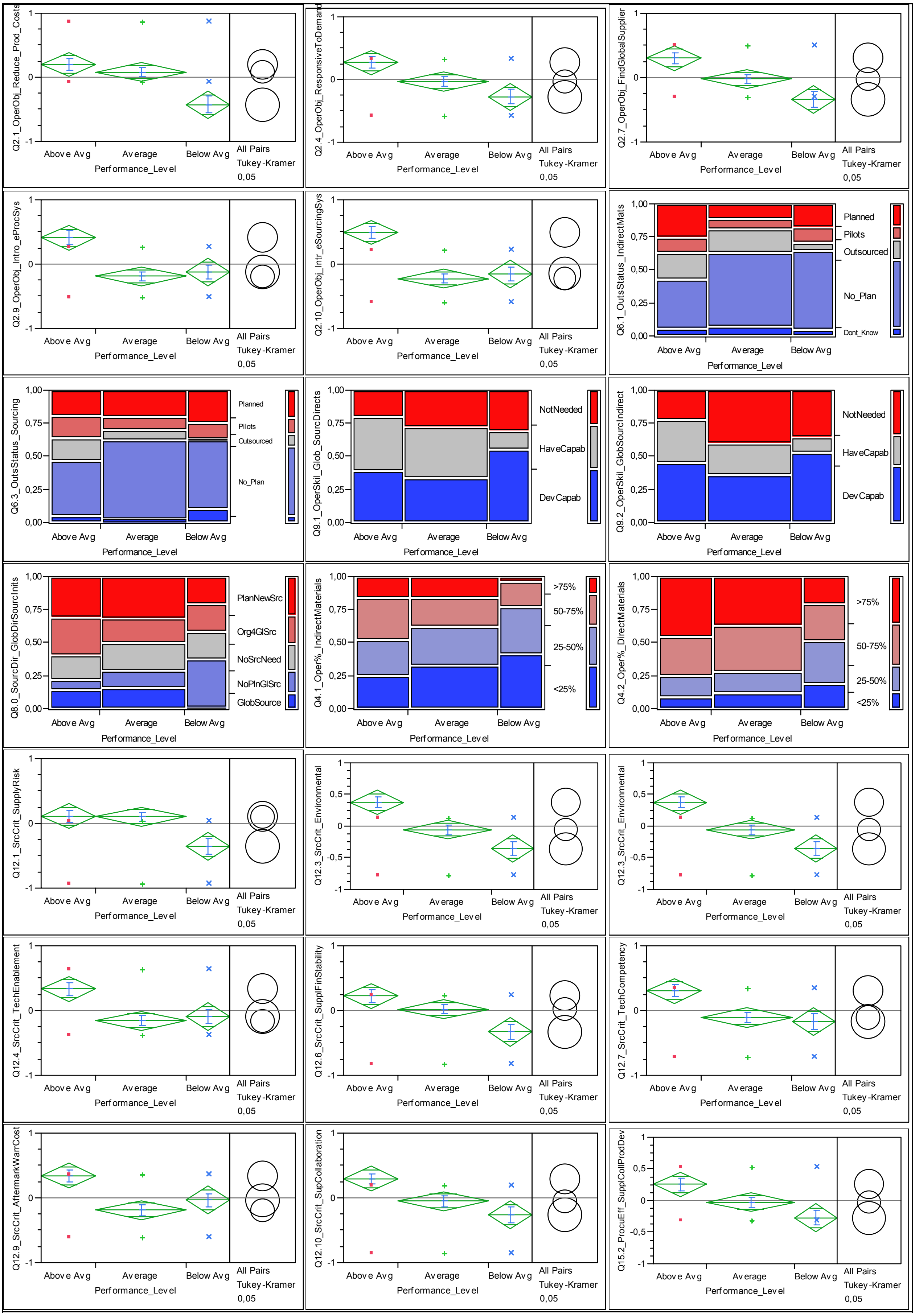
We conducted a bivariate Analysis of Variance with non-parametric ANOVA statistics to explore and identify significant relationships between the surveyed parameters and the identified Performance Levels. The table below summarizes all the most significant parameters vis-à-vis the identified Performance Levels. Significance was tested with Prob>Chi2 while the colors like Red depicts high significance (p<=0.01), Green means significant (0.01<p<=0.05), while borderline significant (0.05<p<=0.1) is shown as yellow.

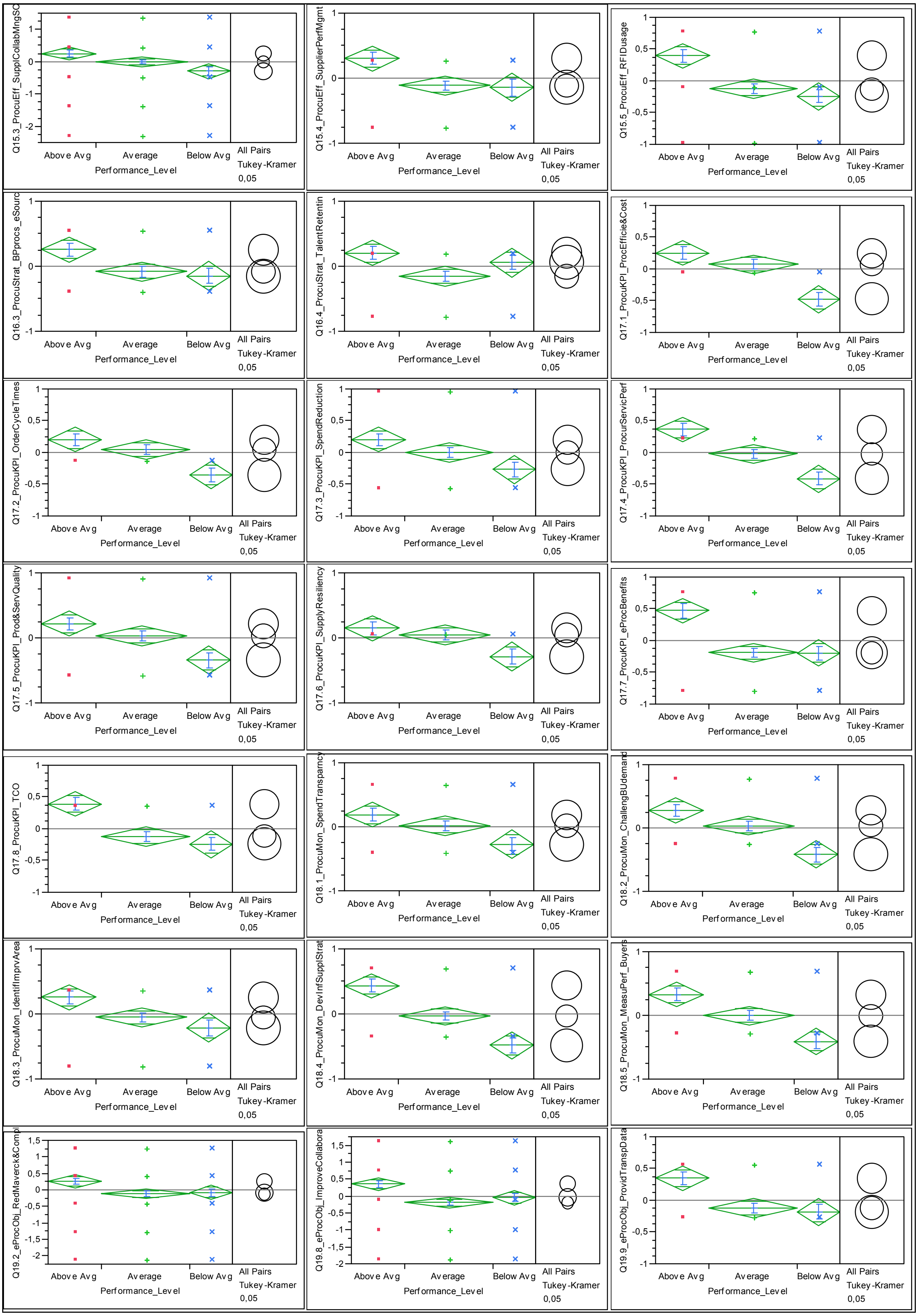
Factor	Parameters	Chi^2 Ratio	Prob > Chi2
Operational Priorities	Q2.1_OperObj_Reduce_Prod_Costs	18,9	0,000
	Q2.2_OperObj_Quality_ofProcured	9,1	0,011
	Q2.4_OperObj_ResponsiveToDemand	14,4	0,001
	Q2.5_OperObj_Security&Resilienc	8,8	0,012
	Q2.7_OperObj_FindGlobalSupplier	17,2	0,000
	Q2.8_OperObj_Support_BPO	9,1	0,011
	Q2.9_OperObj_Intro_eProcSys	23,8	0,000
	Q2.10_OperObj_Intr_eSourcingSys	35,5	0,000
Outsourcing Context	Q5.2_OperTrend_IndirectSourcing	16,2	0,013
	Q6.1_OutsStatus_IndirectMats	22,6	0,004
	Q6.3_OutsStatus_Sourcing	25,7	0,001
	Q7.12_OutsCat_PrintingServices	9,9	0,042
Operational Skills	Q9.1_OperSkil_Glob_SourcDirects	22,4	0,000
	Q9.2_OperSkil_GlobSourcIndirect	19,7	0,001
	Q9.3_OperSkil_NonCoreOutsourcng	8,1	0,089
	Q9.5_OperSkil_ContractComplianc	12,8	0,012
Regional Skills	Q8.0_SourcDir_GlobDirSourcInits	40,6	0,000
	Q10.5_OperCurSkil_South_Asia	6,6	0,036
	Q10.6_OperCurSkil_SouthEastAsia	8,9	0,012
	Q11.2_OperFutSkil_EasternEurope	5,2	0,074
	Q11.3_OperFutSkil_Latin_America	5,2	0,074
	Q11.5_OperFutSkil_South_Asia	4,8	0,092
	Q11.6_OperFutSkil_SouthEastAsia	8,5	0,014
Operational Context	Q4.1_Oper%_IndirectMaterials	17,3	0,008
	Q4.2_Oper%_DirectMaterials	20,4	0,002
	Q4.3_Oper%_Services	14,3	0,027
	Q12.1_SrcCrit_SupplyRisk	13,3	0,001
	Q12.2_SrcCrit_DelivLogistics	6	0,049
	Q12.3_SrcCrit_Environmental	24,6	0,000
	Q12.4_SrcCrit_TechEnablement	16,4	0,000
	Q12.5_SrcCrit_Price	7,7	0,021
	Q12.6_SrcCrit_SupplFinStability	15,1	0,001
	Q12.7_SrcCrit_TechCompetency	14,2	0,001
	Q12.8_SrcCrit_ProdServQuality	6,2	0,046
	Q12.9_SrcCrit_AftermarkWarrCost	17,7	0,000
	Q12.10_SrcCrit_SupCollaboration	13,7	0,001
	Q13.4_SrcChall_Spend_Visibility	9	0,011
	Q13.6_SrcChall_RightPrices	8,4	0,015
	Q13.7_SrcChall_Improve_eProcSys	8,7	0,013

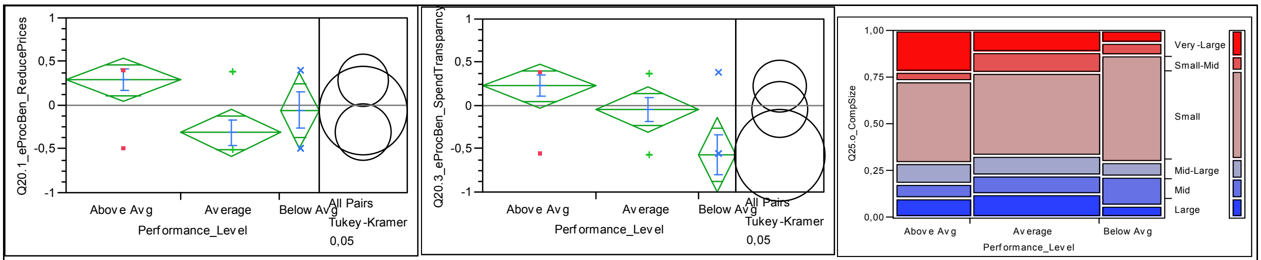
Factor	Parameters	Chi^2 Ratio	Prob > Chi2
Strategic Initiatives	Q15.2_ProcuEff_SupplCollProdDev	14	0,001
	Q15.3_ProcuEff_SupplCollabMngSC	13,2	0,001
	Q15.4_ProcuEff_SupplierPerfMgmt	13,8	0,001
	Q15.5_ProcuEff_RFIDusage	25,4	0,000
	Q15.6_ProcuEff_DevTCOapproaches	9,2	0,01
	Q16.1_ProcuStrat_ProcAutomation	8,1	0,017
	Q16.2_ProcuStrat_BPRofPur2Pay	7,9	0,02
	Q16.3_ProcuStrat_BPprocs_eSourc	10,6	0,005
	Q16.4_ProcuStrat_TalentRetentin	10,7	0,005
	Q16.6_ProcuStrat_UpgradingSkill	7,8	0,02
	Q16.8_ProcuStrat_ProcurOutsourc	6,2	0,046
Operational Visibility	Q17.1_ProcuKPI_ProcEfficie&Cost	24,5	0,000
	Q17.2_ProcuKPI_OrderCycleTimes	14,5	0,001
	Q17.3_ProcuKPI_SpendReduction	10	0,007
	Q17.4_ProcuKPI_ProcurServicPerf	25,5	0,000
	Q17.5_ProcuKPI_Prod&ServQuality	15,9	0,000
	Q17.6_ProcuKPI_SupplyResiliency	9,9	0,007
	Q17.7_ProcuKPI_eProcBenefits	30,1	0,000
	Q17.8_ProcuKPI_TCO	21,2	0,000
	Q18.1_ProcuMon_SpendTransparncy	11,8	0,003
	Q18.2_ProcuMon_ChallengBUdemand	22,3	0,000
	Q18.3_ProcuMon_IdentifimprvArea	10,2	0,006
	Q18.4_ProcuMon_DevInfSupplStrat	37,2	0,000
	Q18.5_ProcuMon_MeasuPerf_Buyers	25	0,000
SRM IT- Enablement	Q19.2_eProcObj_RedMaverck&Compl	10,9	0,004
	Q19.5_eProcObj_ReducInventory	10,6	0,005
	Q19.6_eProcObj_DecrProcCycleTim	6,9	0,031
	Q19.7_eProcObj_ReductAdmWrkload	5,8	0,054
	Q19.8_eProcObj_ImproveCollabora	18,9	0
	Q19.9_eProcObj_ProvidTranspData	18,5	0
	Q20.1_eProcBen_ReducePrices	11,4	0,003
	Q20.2_eProcBen_RedMaverck&Compl	7,8	0,02
	Q20.3_eProcBen_SpendTransparncy	9,8	0,008
	Q20.4_eProcBen_RedTransactCosts	7,7	0,021
	Q20.5_eProcBen_ReduceInventory	6,5	0,04
	Q20.8_eProcBen_ImproveCollabora	4,8	0,091
	Q20.9_eProcBen_ProvidTranspData	6,5	0,04
Context	Q24.0_Industry	64,8	0,054
	Q24.0_Sector	18	0,021
	Q25.o_CompSize	19,1	0,039

Table 29: Significant results of the ANOVA and Contingency Analysis of all parameters vis-à-vis Performance Clusters

In the following Table we have provided an overview of all the Parameters' means that displayed significant differences among the three Performance Level clusters.


Q2.1_OperObj_Reduce_Prod_Costs
Q2.4_OperObj_ResponsiveToDemand
Q2.7_OperObj_FindGlobalSupplier
Q2.9_OperObj_Intro_eProcSys
Q2.10_OperObj_Intr_eSourcingSys
Q6.1_OutsStatus_IndirectMats
Q6.3_OutsStatus_Sourcing
Q9.1_OperSkil_Glob_SourcDirects
Q9.2_OperSkil_GlobSourcIndirect
Q8.0_SourcDir_GlobDirSourcInits
Q4.1_Oper%_IndirectMaterials
Q4.2_Oper%_DirectMaterials
Q12.1_SrcCrit_SupplyRisk
Q12.3_SrcCrit_Environmental
Q12.3_SrcCrit_Environmental
Q12.4_SrcCrit_TechEnablement
Q12.6_SrcCrit_SupplFinStability
Q12.7_SrcCrit_TechCompetency
Q12.9_SrcCrit_AftermarkWarrCost
Q12.10_SrcCrit_SupCollaboration
Q15.2_ProcuEff_SupplCollProdDev
Above Avg
Average
Below Avg
Performance_Level
All Pairs
Tukey-Kramer
0,05
Planned
Pilots
Outsourced
No_Plan
Dont_Know
NotNeeded
HaveCapab
DevCapab
PlanNewSrc
Org4GlSrc
NoSrcNeed
NoPlnGlSrc
GlobSource
>75%
50-75%
25-50%
<25%


Q15.3_ProcuEff_SupplCollabMngSC
Q15.4_ProcuEff_SupplierPerfMgmt
Q15.5_ProcuEff_RFIDusage
Q16.3_ProcuStrat_BPprocs_eSourc
Q16.4_ProcuStrat_TalentRetentin
Q17.1_ProcuKPI_ProcEffic&Cost
Q17.2_ProcuKPI_OrderCycleTimes
Q17.3_ProcuKPI_SpendReduction
Q17.4_ProcuKPI_ProcurServicPerf
Q17.5_ProcuKPI_Prod&ServQuality
Q17.6_ProcuKPI_SupplyResiliency
Q17.7_ProcuKPI_eProcBenefits
Q17.8_ProcuKPI_TCO
Q18.1_ProcuMon_SpendTranspancy
Q18.2_ProcuMon_ChallengBUdemand
Q18.3_ProcuMon_IdentifImprvArea
Q18.4_ProcuMon_DevInfSupplStrat
Q18.5_ProcuMon_MeasuPerf_Buyers
Q19.2_eProcObj_RedMaverck&Compl
Q19.8_eProcObj_ImproveCollabora
Q19.9_eProcObj_ProvidTranspData
Above Avg
Average
Below Avg
Performance_Level
All Pairs
Tukey-Kramer
0,05



NOTE: The **diamonds** in the ANOVA graph represent the mean (line in middle) and standard error of the mean (vertical bars) for each sample group or cluster. The height of a diamond represents the 95% confidence interval for each group, and the width represents the group sample size. ANOVA plots are supplied by Tukey-Kramer's HSM multiple range tests means comparison **circles** box, where the outside angle of intersection tells you whether or not group means are significantly different, e.g. circles for means that are significantly different either do not intersect or intersect slightly so that the outside angle of intersection is less than 90 degrees. If the circles intersect by an angle of more than 90 degrees or if they are nested, the means are not significantly different.

Table 30: ANOVA & Contingency Analysis of Performance Clusters versus Significant Parameters.

7.6.7.2 Evaluating the Bivariate Performance Hypotheses

From this bivariate ANOVA (analysis of variance for ordinal/continuous parameters) and contingency analysis (for nominal parameters), we can conclude that there are many visibly significant relationships between our parameters and our performance clusters of operational efficiency. This was studied with Tukey-Kramer's HSD (honestly significant difference) all-pairs multiple range tests that helped us interpret the differences among performance levels.

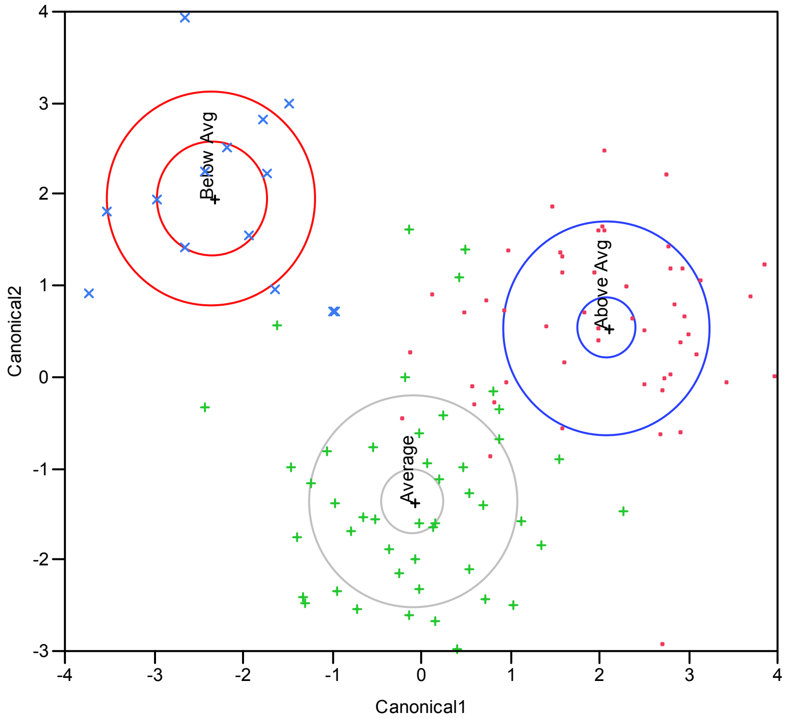
With the exception of especially the Outsourcing-related parameters (Q5-7) , most of the other parameters were proven to have significant relationship with the performance clusters. We will elaborate in detail our conclusions with regards to our hypotheses in the subsequent discussion section.

Thus far, our approach did not take into consideration the multivariate effect of the parameters onto the dependent variable. Moreover, we did not analyze dependencies or causality between the various constructs and the potential sequencing and interaction effects between constructs. Therefore, to investigate the former we continue our hypotheses evaluation from a multivariate perspective, while the latter will be the subject of the subsequent Structural Equation Model analysis via Partial Least Squares (PLS) of the following chapter.

7.6.7.3 Evaluating the Performance Hypothesis via Multivariate Discriminant Analysis

In this part of the multivariate analysis we utilized Discriminant Analysis to evaluate the multivariate significance of the identified clusters versus the hypothesis related parameters. Given that the Discriminant platform requires continuous parameters, we were able to test the overall discrimination among a subset of our surveyed parameters. These were Q2, Q12 and then Q15 to Q20. Hence we were not able to test discrimination for areas like Outsourcing, Operational and Regional Skills, or eProcurement CSFs.

Below we present the results of the Discriminant analysis conducted in the aforementioned areas. The Biplot below shows that the parameters in Q2,12, 15, 16, 17, 18, 19, and 20 the discriminate among the 3 performance groups with sufficient significance (p<0.05).



Test	Value	Approx. F	NumDF	DenDF	Prob>F
Wilks' Lambda	0,1211481	1,3832	130	96	0,0471
Pillai's Trace	1,2943535	1,3828	130	98	0,0461
Hotelling-Lawley	3,8246605	1,3828	130	94	0,0484
Roy's Max Root	2,3890982	1,8010	65	49	0,0165

Figure 126: Result of the Discriminant Analysis of the Performance Levels/Clusters versus Continuous Parameters (i.e. Q2, 12, 15-20).

7.6.7.4 Evaluating the Performance Hypothesis via Ordinal Logistic Regressions

We also conducted an Ordinal Logistics Regression (OLR) in JMP with all the parameters as independents with performance levels being the dependent one. The OLR could not converge for all parameters as the algorithm was encountering many singularities in that there were more too many parameters compares to observations. Thus, we reduced the parameters to the ones shown in the table below – the OLR converged with an Rsq of 67%. The table shows the various parameters' Effect Likelihood Ratio Chi^2 and Prob> Chi^2 Tests.

OLR Model and Effect L-R Tests	**Performance Levels (SOM CI3) versus most Parameters**				
RSquare (U)	0,67		ChiSquare	155,83	
-Log Likelihood	77,92		Prob>ChiSq		<,0001

OLR Model and Effect L-R Tests			Performance Levels (SOM CI3) versus most Parameters		
Effect Likelihood Ratio Tests					
Parameters (independent in OLR)	L-R Chi^2	Prob>Chi^2	Parameters (independent in OLR)	L-R Chi^2	Prob>Chi^2
Q2.1_OperObj_Reduce_Prod_Costs	13,3	**0,000**	Q17.2_ProcuKPI_OrderCycleTimes	0,0	0,838
Q2.2_OperObj_Quality_ofProcured	8,3	**0,004**	Q17.3_ProcuKPI_SpendReduction	0,8	0,382
Q2.3_OperObj_ReducMaverickSpend	3,8	0,050	Q17.4_ProcuKPI_ProcurServicPerf	10,8	**0,001**
Q2.4_OperObj_ResponsiveToDemand	2,9	0,089	Q17.5_ProcuKPI_Prod&ServQuality	0,7	0,413
Q2.5_OperObj_Security&Resilienc	1,8	0,180	Q17.6_ProcuKPI_SupplyResiliency	2,8	0,092
Q2.6_OperObj_FindDomestSupplier	1,1	0,299	Q17.7_ProcuKPI_eProcBenefits	0,8	0,360
Q2.7_OperObj_FindGlobalSupplier	2,2	0,137	Q17.8_ProcuKPI_TCO	2,0	0,153
Q2.8_OperObj_Support_BPO	5,8	*0,016*	Q18.1_ProcuMon_SpendTransparncy	6,9	**0,009**
Q2.9_OperObj_Intro_eProcSys	0,3	0,573	Q18.2_ProcuMon_ChallengBUdemand	0,0	0,932
Q2.10_OperObj_Intr_eSourcingSys	1,7	0,188	Q18.3_ProcuMon_IdentifimprvArea	3,1	0,079
Q9.1_OperSkil_Glob_SourcDirects	0,1	0,938	Q18.4_ProcuMon_DevInfSupplStrat	1,9	0,169
Q9.2_OperSkil_GlobSourcIndirect	6,5	*0,039*	Q18.5_ProcuMon_MeasuPerf_Buyers	5,7	*0,017*
Q9.3_OperSkil_NonCoreOutsourcng	4,0	0,135	Q19.1_eProcObj_Reduce_Prices	3,0	0,085
Q9.4_OperSkil_CoreBProcsOutsour	9,5	**0,009**	Q19.2_eProcObj_RedMaverck&Compl	12,2	**0,001**
Q9.5_OperSkil_ContractComplianc	17,1	**0,000**	Q19.3_eProcObj_SpendTransparncy	1,9	0,168
Q15.1_ProcuEff_SupplRationalisa	0,7	0,411	Q19.4_eProcObj_RedTransactCosts	0,1	0,745
Q15.2_ProcuEff_SupplCollProdDev	1,4	0,243	Q19.5_eProcObj_ReducInventory	2,3	0,126
Q15.3_ProcuEff_SupplCollabMngSC	8,6	**0,003**	Q19.6_eProcObj_DecrProcCycleTim	0,1	0,755
Q15.4_ProcuEff_SupplierPerfMgmt	1,1	0,301	Q19.7_eProcObj_ReductAdmWrkload	4,7	*0,030*
Q15.5_ProcuEff_RFIDusage	3,4	0,063	Q19.8_eProcObj_ImproveCollabora	0,6	0,453
Q15.6_ProcuEff_DevTCOapproaches	6,9	**0,009**	Q19.9_eProcObj_ProvidTranspData	0,1	0,754
Q16.1_ProcuStrat_ProcAutomation	1,2	0,274	Q20.1_eProcBen_ReducePrices	0,1	0,768
Q16.2_ProcuStrat_BPRofPur2Pay	4,2	*0,040*	Q20.2_eProcBen_RedMaverck&Compl	2,2	0,137
Q16.3_ProcuStrat_BPprocs_eSourc	5,5	*0,019*	Q20.3_eProcBen_SpendTransparncy	15,7	**0,000**
Q16.4_ProcuStrat_TalentRetentin	2,0	0,157	Q20.4_eProcBen_RedTransactCosts	0,4	0,538
Q16.5_ProcuStrat_StaffTrainSkil	2,9	0,088	Q20.5_eProcBen_ReduceInventory	0,0	0,838
Q16.6_ProcuStrat_UpgradingSkill	0,7	0,397	Q20.6_eProcBen_DecrProcCycleTim	0,0	0,949
Q16.7_ProcuStrat_TransfProcuOrg	3,7	0,056	Q20.7_eProcBen_ReductAdmWrkload	7,2	**0,007**
Q16.8_ProcuStrat_ProcurOutsourc	4,7	*0,030*	Q20.8_eProcBen_ImproveCollabora	10,1	**0,002**
Q17.1_ProcuKPI_ProcEfficie&Cost	6,1	*0,014*	Q20.9_eProcBen_ProvidTranspData	0,5	0,463

Table 31: Result of the OLR Analysis of the Performance Levels versus Parameters (i.e. Q2, 9, 15-20).

What is clearly evident is that many of the parameters from the bivariate analysis are still loading in our broader OLR model, yet there are a substantial amount of divergence, and we were missing many of our key parameters. Therefore we did run a series of Ordinal Logistic Regressions, this time by grouping our parameters to the hypothesized groupings. The results are reported in the table below. If one compares these results with the bivariate ANOVA-based ones, it is evident that the parameters are having an effect on each other, hence there are less significant relationships. Nevertheless, the ones reported below as significant ($p<0.05$) are also significant in the previous bivariate analysis.

OLR Hypothesized Groups (with R^2)	Parameters	Chi^2 Ratio	Prob > Chi2
Operational Priorities (Rsq=0,0868*)	Q2.1_OperObj_Reduce_Prod_Costs	13,2	**0,00**
	Q2.3_OperObj_ReducMaverickSpend	3,3	0,07
	Q2.4_OperObj_ResponsiveToDemand	4,4	**0,04**
	Q2.7_OperObj_FindGlobalSupplier	3,3	0,07
	Q2.10_OperObj_Intr_eSourcingSys	5,1	**0,02**
Outsourcing Context (Rsq=0,1088*)	Q5.2_OperTrend_IndirectSourcing	9,0	**0,03**
	Q6.1_OutsStatus_IndirectMats	12,6	**0,01**

	Q6.3_OutsStatus_Sourcing	13,5	**0,01**
Operational Skills (Rsq= 0,0383*)	Q9.1_OperSkil_Glob_SourcDirects	7,9	**0,02**
	Q9.5_OperSkil_ContractComplianc	5,1	0,08
Regional Skills (Rsq=0,0608*)	Q8.0_SourcDir_GlobDirSourcInits	18,3	**0,00**
	Q11.3_OperFutSkil_Latin_America	4,2	**0,04**
	Q11.6_OperFutSkil_SouthEastAsia	3,7	0,05
Operational Context (Rsq=0,1155*)	Q4.1_Oper%_IndirectMaterials	6,5	0,09
	Q4.2_Oper%_DirectMaterials	11,4	**0,01**
	Q4.3_Oper%_Services	7,5	0,06
	Q12.3_SrcCrit_Environmental	11,4	**0,00**
	Q12.10_SrcCrit_SupCollaboration	2,9	0,09
	Q13.4_SrcChall_Spend_Visibility	5,7	**0,02**
Operational Initiatives (Rsq=0,0492*)	Q15.2_ProcuEff_SupplCollProdDev	3,7	0,05
	Q15.4_ProcuEff_SupplierPerfMgmt	4,0	**0,05**
	Q15.5_ProcuEff_RFIDusage	8,5	**0,00**
Strategic Initiatives (Rsq=0,0153*)	Q16.3_ProcuStrat_BPprocs_eSourc	5,4	**0,02**
Operational Visibility (Rsq=0,1294*)	Q17.1_ProcuKPI_ProcEfficie&Cost	3,0	0,08
	Q17.4_ProcuKPI_ProcurServicPerf	5,1	**0,02**
	Q17.5_ProcuKPI_Prod&ServQuality	5,2	**0,02**
	Q17.7_ProcuKPI_eProcBenefits	4,3	**0,04**
	Q17.8_ProcuKPI_TCO	3,1	0,08
	Q18.2_ProcuMon_ChallengBUdemand	3,2	0,07
	Q18.4_ProcuMon_DevInfSupplStrat	14,5	**0,00**
eProcurement Objectives (Rsq=0,0288*)	Q19.9_eProcObj_ProvidTranspData	3,9	**0,05**
eProcurement Benefits (Rsq=0,0804*)	Q20.4_eProcBen_RedTransactCosts	3,2	0,07
	Q20.9_eProcBen_ProvidTranspData	4,9	**0,03**
Business Context (Rsq=0,179*)	Q23.Title	8,2	0,08
	Q24.0_Industry	34,1	0,08
	Q25.o_CompSize	14,1	**0,01**

Table 32: Significant Likelihood Tests Results of multiple Ordinal Logistic Regressions (OLR) Analyses of the Performance Levels versus Hypothesis-related Grouped Parameters (*: p<0.01)

This analysis shows the relative importance of the hypothesized groupings in terms of the Rsquare (or rather OLR's U). From this statistic it is evident that groupings like Operational-Objectives, -Outsourcing, -Focus, -Visibility and the Contingency/Context, each explain more than 8% of the total variation among the Performance Levels/Clusters. On the other hand, it seems that Strategic Initiatives, Operational Skills and eProcurement Objectives explain less of the total variance, hence indicating that these groups are part of a background set of effects affecting our primary effects.

7.6.7.5 Studying Interaction Effects of the Parameters versus Clusters

An important deficiency of the analyses we conducted thus far is that all consider each of the parameters as individual and linear combinations in their effort to distinguish relevant clusters or evaluate the strength and significance of covariance. Given our latter OLR analysis, we subsequently focused on the study of these potentially disrupting or some times, further explanatory *interaction effects* between the group of parameters and the Performance Level clusters, by utilizing the individual regression equations per group as en entry .

We then executed a stepwise OLR approach and entered and/or exited interaction effects with the purpose of maximizing the R Square (U). Below we depicted the most balanced result consisting of significant main effects and interaction effects compared to the max Rsq of 63,3% (ChiSquare: 144,08, and Prob>ChiSq as <,0001).

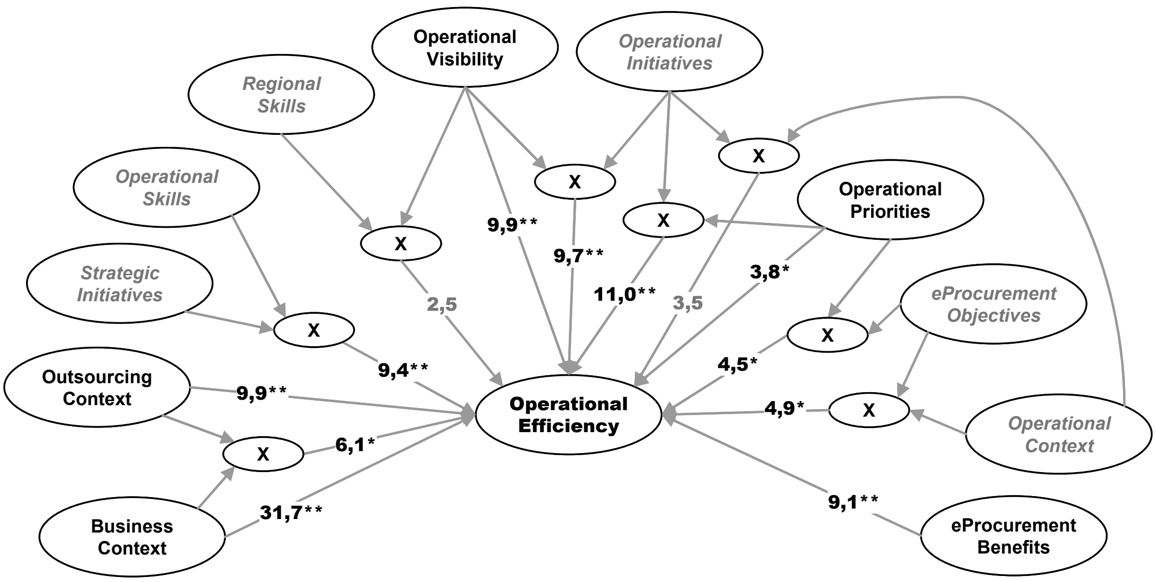


Figure 127: Main & Interaction Effects OLR Analysis with Likelihood chi2 Tests (**: p<0.01, *: p<0.05).

What became apparent was that there were main effects (i.e. OLR Factors) visibly not directly contributing to our dependent variable – operational efficiency, yet these same effects play an instrumental part in generating significant interaction effects. One thing is certain, there are causalities that are not directly leading towards an explanation of higher performance.

OLR has a number of issues converging when we have so few cases (n=115) to so many factorial effects. Moreover, we are certain that the groupings achieved via the OLR process did not truly represent the full variation of the underlying parameters – the OLR factors are focusing on the amount of variation that is linearly related to operational efficiency. There could be interaction effects and mutual causalities that were not unearthed given the way the OLR factors were constructed. In summary, our method of studying interaction effects highlighted an important attribute of direct and indirect causality, nevertheless, the current results are only indicative – we cannot conclude on them given the constraints. This was one of the motivations and necessities we faced as we needed to study the full construct of effects and their interdependencies, which led to the application of an alternative, more robust technique (Structural Equation Modeling) to study the path dependencies between construct parameters.

7.6.7.6 Initial "Cause-Effect" Representation of Interaction Effects

As a final step in our comprehensive multivariate analysis, and preparation for the subsequent full model Structural Equation Modeling effort with PLS, we utilized Sass's JMP *Ishikawa Fishbone* Platform to evaluate the parameter-level interactions. Based on the OLR and the OLR-based Factorial Analysis of interactions we provided the Chi2 values as a measure of effect and then estimated a distance metric and an interaction effects of the 2' degree to order the distances between Causes and Final Effect (i.e. Operational Efficiency). The produced diagram is shown below. Remark that multiple parameter-sets are "reused" across various branches, which indicates interactions, yet we would need another analysis to verify these.

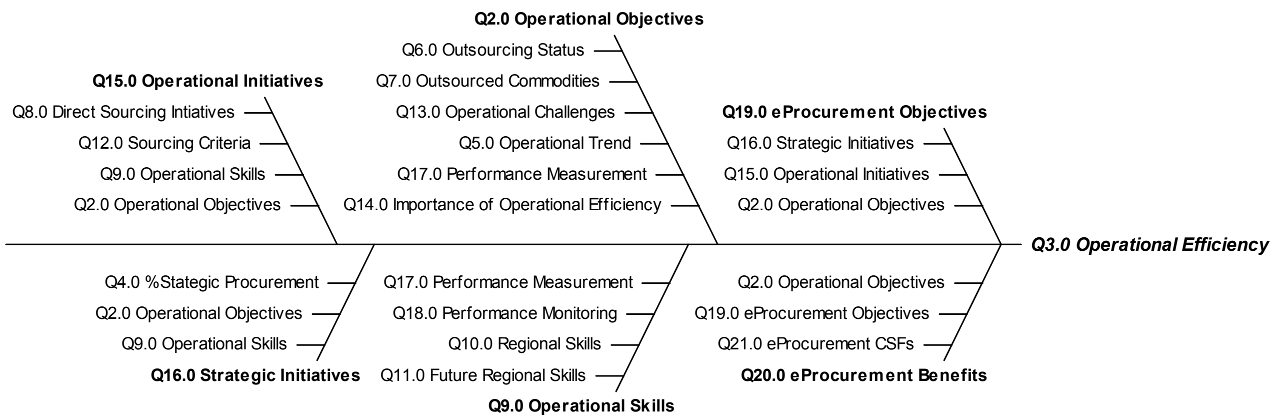


Figure 128: Ishikawa Fishbone Representation of Primary, Secondary and Interaction Effects.

7.6.8 Evaluation of the Results on the Performance-to-Broad Transformation Theme.

Given the analysis above, it is evident that there is significant support for the hypothesized theme (T14). *Above Average Performers* are evidently scoring higher on most parameters than their lower performing counterparts. The results of our bivariate and multivariate analysis led us to the following conclusions that we have grouped by subconstructs:

1. **Operational Priorities** consisting of the Q2: Objectives are showing significant differences among the Performance Levels, with Above average ones showing

consistently higher scores. The only exception are objectives as "Reduce Maverick Spending" and "Find better value suppliers in domestic market" that seem relevant for all performance levels. Below average performers have also been shown to be smaller companies, which explains the latter. Moreover, Parameter Q14 ("Are procurement savings targets likely to become more or less important over the next 3 years?") was not significantly different, while the overall mean was high across the groups signifying that most companies in our sample are focusing on such savings. The multivariate OLR Likelihood tests showed that primarily Q2 explained app. 8,6% of the total variance, while in the interaction effect evaluation it proved that this group is both a main effect and also interacts with other parameter sets like Operational Initiatives and eProcurement Objectives. Overall the theme seems plausible.

2. **Outsourcing Context** proved to be less of a differential between the various performance levels. The only exception was that Q6 parameters like outsourcing status of Indirect Materials and Sourcing was significantly higher among the Above Average performers who do have more of these activities outsourced, run pilots or plan to outsource them. This is in line with findings from other researchers, and the overall success of Public eMarkets in the area of Indirect procurement and Sourcing (e.g. IBX, Trade Ranger, Elemica, Transora, e2open, etc). Overall, it seems that our hypothesis is not fully proven, as different performance levels do not necessarily display large differences in their outsourcing practices with the exception of Indirect and Sourcing. Nevertheless, this is not conclusive as the multivariate tests showed Outsourcing as both a main effect and also contributing with Contingencies as Company Size and Industry to the overall variance of the performance groups. Thus, we need to test this theme more in detail in a true multi-contingency apparatus like the one in the following section.

3. **Operational Skills** seem also to follow a similar trajectory as only Global Sourcing of Directs and Indirect displayed significant differences among the performance levels, with the above average performers reporting clear skills in these two areas, while the below average ones are currently developing them. It seems that our hypothesis is not fully proven. Multivariate tests provided further evidence that Operational Skills is a secondary effect with low direct impact (low R^2) . Notwithstanding, in interaction with Strategic Initiatives it ends up explaining a significant part of operational efficiency group variation. Again, this theme is not fully clarified for this group.

4. **Regional Skills** proved to be not significantly different among the performance levels, with the exception of Southeast Asia, which seems natural given the current trends. Moreover, parameter Q8 ("What is the current status of global sourcing initiatives for direct materials/components in your company?") proved significant, with below average performers displaying less need or planning for global sourcing. Overall, it seems that Regional Skills are not different between the various performance levels, hence disproving our hypothesis. Multivariate analysis supported this conclusion too.
5. **Operational Context** based on Sourcing Status, Criteria and Challenges seemed different among the various groups. Supply Risk, Environmental Issues, Technology Enablement, Financial Stability Of Supplier, Technology Competencies & Innovation, Aftermarket / Field Service / Warranty Costs And Supplier's Ability To Collaborate and Communicate, showed significant differences, with high performers being ahead of the field when it comes to utilizing such criteria in their Sourcing Decisions. Interestingly, Price, Delivery and Product/Service quality seemed non-significant, yet the high means across the groups signify that these are the baseline criteria across most companies. In line with the Sourcing criteria in the Q4 parameters, high performers seem to have higher % of their procurement under contract, hence actively pursuing higher contract compliance. With the exception of options Spend visibility, Right Prices and Improving eProcurement (all with $p<0.05$), it seems like the remaining Sourcing Challenges are less different among the performance clusters. Overall, it seems that our theme is partially proved on the richness of Sourcing Criteria and % of Strategic Procurement. Our multivariate investigations supports this conclusion in that Operational Focus is not showing any significant direct effect on operational efficiency; rather it interacts primarily with eProcurement Objectives and secondarily with Operational Initiatives in significant interaction effects. Given the constraints of our multivariate analysis we would need to investigate this in our structural equation model.
6. **Operational Initiatives** proved to be an interesting parameter, where Supplier Collaboration ranged high in areas like product development, managing the supply chain, and performance management. This group of parameters seemed differentiating with the additional view that substantial contributions could be achieved via new technologies like RFID (radio frequency identification), and new approaches like Total Cost of Ownership (TCO). Overall, it seems that high performers are more focusing on closer partnerships and deeper collaboration with their suppliers hence providing significant support for our hypothesis. Some interesting observations were derived from

our multivariate tests, where such initiatives have less direct impact on operational efficiency. Instead the interaction evaluation showed that this was a powerful background factor, with contributions with many other main effects like Operational Objectives and Visibility (Performance Measurement and Monitoring). So, even before our final conclusive PLS analysis we can assert that Operational Initiatives have an indirect yet substantial effect on operational efficiency.

7. **Strategic Initiatives** proved that most high performers are pursuing strategies to improve primarily Introduction of new best practice sourcing processes (e.g. eSourcing) and Management & retention of talent. Moreover, they were significant differences ($p<0.05$) on strategies pertaining areas like Process automation and Re-engineering of purchase-to-pay process, Upgrading of people capabilities to take on new skills and Procurement outsourcing. It seems that when it comes to eSourcing our hypothesis is proved, yet there are deviations in Talent retention with Average performers scoring low, which most probably indicates well established practices. Overall, our hypothesis that high performers have clear strategies for improving the procurement practice only reaches partial support. The multivariate analysis showed a different pattern, where this group of parameters interacted with operational skills to affect operational efficiency to a significant degree. Hence, again, we cannot fully conclude on this hypothesis, yet we can state that Strategic Initiatives have an indirect effect on operational efficiency.
8. **Operational Visibility** in terms of Operational Performance Measurement KPIs (Q17) and Performance Monitoring (Q18) seems to be highly significant ($p<0.01$) across all indicators. Higher performers place a lot of emphasis on this area with active efforts to define relevant KPIs and monitor their progress. Hence, it seems that our hypothesis that above average performers focus on improving visibility is proven. This also supported via the multivariate evaluation where the OLR test showed significant R Square of nearly 13%, while Visibility interact significantly with Operational Initiatives.
9. On the differences of **IT Enablement**, above average performers define clear eProcurement objectives as reductions in Maverick buying (i.e. increased contract compliance), less inventory, and improvements in Supplier collaboration and higher transparency in procurement data. Consequently, above average performers reported primary eProcurement benefits on achieving reductions in procured prices and improved spend control/transparency, while also displaying significant differences

(p<0.05) on reducing transaction costs, inventory and less maverick buying and (thus increased contract compliance). Interestingly, tools are only providing partial support on improving supplier real-time collaboration (i.e. borderline significance with p<0.1 for high performers), with average performers scoring lower than the other two groups. Even more interesting was our finding that none of the performance groups were differentiated in their views on critical success factors of an e-procurement strategy - most scored evenly across the questions. Overall, it seems that our hypothesis on the usage of eProcurement technology as an enabler for higher levels of performance is supported, yet there is no support for the clear views on CSFs. The latter indicates that there are still no "golden best practices", hence companies are still searching for the precise formula of enabling their procurement and sourcing practices with ICT. Our conclusions are also supported by the multivariate tests that proved that eProcurement Benefits are a significant main effect, while eProcurement Objectives interact with Operational Focus and Operational Objectives as a main interactive effect. In general it seems that both analyses proved the importance of technological enablement in explaining success in the operational efficiency groups.

10. On the **Business Contextual** parameters our bivariate analyses showed that only membership in an Industrial Sector and Company size displayed significant (p<0.05) differences among the performance groups, with above average performers being larger companies in the Distribution and Industrials sectors. In general, and in line with previous research (Subramanian & Shaw, 2002)) it seems that there is partial support that other contextual or contingency parameters affect operational efficiency. It seems that other sectors like Public and Financials have not fully developed their SRM practices or fully reaped the benefits of technological enablement. In multivariate terms there was a substantial shift, where both Industry membership, role of the respondent and the size of the responding company plays a significant part in explaining variation in operational efficiency (OLR Rsquare= 17,8%), while our interaction analysis showed that Context is also contributing to a significant interaction effect with the Outsourcing parameters. Overall, the bivariate analysis showed less support for our hypothesis, while the multivariate analysis contradicted them. We will evaluate the main effect and interactions in our Structural Equation Model section before reaching a final conclusion.

It is difficult to summarize across all of the above, yet we can state that there was sufficient support for our hypothesized theme that high performers are utilizing a broader palette of contextual factors, initiatives, skills and are subsequently active in enabling their SRM practices. Based on our extensive experiences in the 90s with multivariate analysis (Nøkkentved & Rosenø, 1998) we were in general suspicious of any statistical grouping as it generally decreases the inferential richness of the results. Thus we choose to expose our tests at the parameter option level, which some may criticize as being too fine-grained. Nevertheless, the conclusion we have drawn are as close to the respondents' survey answers as possible.

Further, instead of blindingly trusting the bivariate ANOVA results we did engage in a broader evaluation using Ordinal Logistics Regression (OLR) to study both the direct and interaction effects. While the overall theme was supported in both bivariate and multivariate sense, what emerged was a set of interesting amendments and contradictions of using the parameters individually as done in ANOVAs versus a groups as done in OLR. For example, while operational visibility, operational objectives and IT enablement show unequivocal support across all analyses as areas high performers differ from their counterparts, the remaining areas show divergent behavior – e.g. outsourcing is not that different in ANOVAs while a significant effect in OLR, while strategic initiatives have a significant effect in OLR, yet only as part of an interaction effect with operational skills.

These partially conclusive remarks round off our first attempt to study the Direct (and Interaction) effects of our various SRM-specific Context Factors on Operational Efficiency. Most of these analyses' provided commentary and ideas of the need of a more comprehensive study of the multivariate dependencies and causalities we need to understand before reaching a final inferential conclusion on our hypothesis. This is the subject of the following section that will build and explore a Structural Equation Model with a robust analytical technique – PLS.

7.7 Construct Development – "SRM Adoption" Impact on Performance

This final analytical section of the quantitative chapter will delve into analyzing our whole conceptual construct as put forward originally in the Research Themes and Propositions and then further detailed in the Qualitative analysis section.

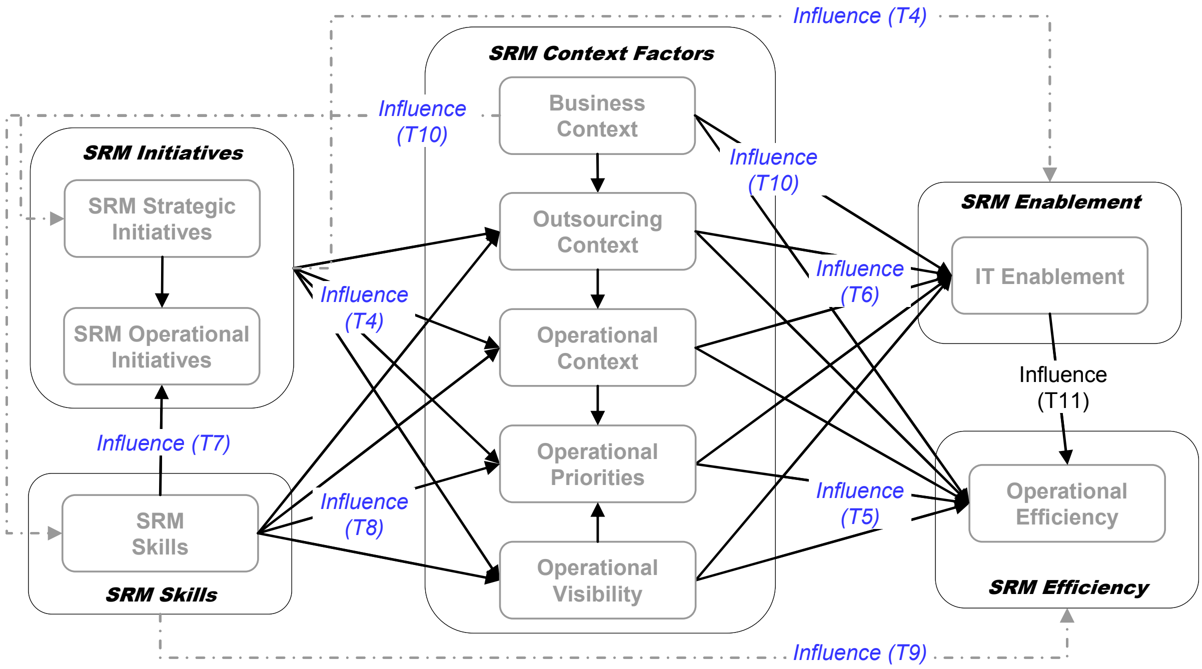


Figure 129: A simpler view of the Collaborative Supply Network Construct for SRM Adoption aligned to results from the previous analyses; remark that we are not showing the parameters per construct.

We will commence our analysis by a detailed presentation of our considerations on what construct statistical modeling technique we will pursue. In this area of Management and IT-related Research Structural Equation Modeling (SEM) is used to investigate the relevance and causality of the various parameters that define a construct.

In the previous section, we conducted a detailed investigation of the various groupings of parameters and their potential for interaction effects between them and our construct of Performance Level clusters based on our operational efficiency parameters and extracted via the *SOM* (Self-organized Maps) Neural Networks clustering algorithm. We studied the bivariate and subsequently the multivariate relationships between our parameters, the identified groupings and their underlying parameters vis-à-vis our performance construct.

As our discussion of our results indicated, many of our hypotheses needed further testing before we could reach a justifiable characterization, hence, given our analytical results we will in this section focus on the subsequent full model Structural Equation Modeling effort with PLS. Especially the Interaction analysis provided some vivid clues on our Collaborative Enterprise Architecture for SRM Adoption construct depicted below, which we will now delve and evaluate.

Up to this point, general implications of SRM practices and adoption have been derived through cluster analysis (SOM), mean comparisons (ANOVA), and ordinal logistic regressions (OLR). In order to analyze the above framework initially tested in the previous section, and evaluate its implications, we will pursue Structural equation modeling (SEM). SEM allows estimating a hypotheses model in its entirety and therefore considers hypothesized relationships in its overall estimation (Hulland, 1999). In our analysis, the partial least squares (PLS) method has been selected to conduct SEM for the our framework. Since PLS is becoming increasingly popular in MIS and Strategic Management research (Goodhue, Lewis & Thompson, 2006), we will first is introduce the approach, compare it with its similar method, LISREL, and subsequently, analyze and estimate the SRM Adoption framework using the PLS methodology where after implications will drawn based upon our results.

7.7.1 Path Model Estimation Using Partial Least Squares (PLS) – An Overview

Structural equation models (SEM) have been gaining popularity since the beginning of the 1970s (Wold, 1989). They are characterized by evaluating relationships between latent, i.e. not directly measurable, variables, which are conceptualized by indicators that reflect or influence them.

The partial least square (PLS) method is a variance-based causal modeling approach, developed in the 1960s by Herman Wold (1989). In contrast to PLS, most other SEM are covariance-based, with LISREL (Linear Structural Relation) being the most. Both approaches are used to analyze similar models and PLS and LISREL are considered to be complementary rather than competitive prominent (Gefen, Straub, & Boudreau, 2000). After a brief introduction of PLS, it will be compared to LISREL in order to point out important differences and the conditions under which the application of each is more suitable. Finally, we will briefly present the application and interpretation of PLS, including the procedures we will utilize to validate our models.

7.7.1.1 Introduction to the partial least squares PLS method

PLS is a so-called "2nd generation" modeling technique that covers and extends traditional statistical analysis techniques such as canonical correlation, redundancy analysis, multiple regression, multivariate analysis of variance, and factor analysis in order to formulate and estimate more complex path models (Chin, Marcolin & Newsted, 2003). One of the main issues faced by traditional multivariate analysis methods is that "the measurement model, analogous to factor analysis, is tested independently of the structural model, created by regression. Thus, a maximally efficient fit between the data and a structural model is not likely to occur."(Amoroso & Cheney, 1991) This is addressed by SEM as it combines elements of path and factor analysis in one comprehensive model an attribute that explains its popularity in social sciences too[96]. Overall, SEM represents a technique which according to Chin (2000):

- Combines an econometric perspective focusing on prediction.
- A psychometric perspective modeling latent (unobserved) variables inferred from observed – measured variables.
- Resulting in greater flexibility in modeling theory with data compared to 1st generation techniques.

SEM methods pursue confirmatory, rather than exploratory approaches, hence researchers often use them to verify whether a certain model is valid, rather than trying to "seek & find" a suitable model. According to Gefen et al. (2000:4), "the intricate causal networks enable by SEM characterize real-world processes better than simple correlation-based models", hence better suited for the mathematical modeling of complex processes to serve both theory and practice (Vinzi & Tenenhaus, 2004) than regression models. "SEM not only assesses the structural model - the assumed causation among a set of dependent and independent constructs

---

[96] Many questions in social sciences, including study of management and information systems, can only be addressed through individual perceptions and judgments given in ordinal scales. According to Westland (2007): "Questions involving a consumer's willingness to pay for a product or service, for example, can be measured prior to purchase by the stated buying intentions of a group of consumers; or they could be measured after purchase by the money spent. Both are noisy signals about an unobservable "willingness" – the former involves assertions on which the consumer has no obligation to follow through; the latter possibly reflects impulse buying, with subsequent regret. "Willingness to pay" reflects personal utility, and is inherently unobservable – it has to be modeled as a latent variable. Statements of intent, or even actual purchases, can only be considered rough indicators of "willingness" – but they are observable". This is a typical scenario in MIS Research where perceptions, rapid trends and unsubstantiated theoretical constructs makes SEM attractive. Especially PLS' Latent constructs enable us to build theory, yet account for unobservable variance via reflective indicators. Such constructs will inexplicitly be multicollinear – in that we are not always sure whether a construct is sufficiently explained by few parameters, hence researchers assemble a lot of them. Typically, such parameters are non-normal, and skewed among ordinally bases scales that often lead to heteroscedasity, or unequal variances, which invalidates most multivariate assumptions of regression techniques.

– but, in the same analysis, also evaluates the measurement model – loadings of observed items (measurements) on their expected latent variables (constructs)" (Gefen et al. 2000:5).

The variance-based PLS is the preferred method if researchers are interested in a good explanation of changes or in the prediction of objective variables, as it is able to give explanations of variances. Furthermore, it is more suitable than other techniques in the theory-generation process because the inclusion of indicators with uncertain validity is less problematic with regard to the overall model estimation (Chin & Newsted, 1999). SEM techniques like PLS involves three primary components (Chin, 2000):

- *Indicators* (often called manifest variables or observed measures/variables). Indicators are usually represented as squares. For questionnaire-based research, each indicator represents a particular question (in our analysis these are the parameters).
- *Latent variables* (or construct, concept, factor) are normally drawn as circles, and used to represent phenomena that cannot be measured directly.
- *Path relationships* (correlation, one-way paths, or two way paths) are defined by using arrows and are indicative of path causality.

7.7.1.2 Structure of a PLS model

As mentioned, PLS consists of indicator variables and latent variables, with latent variables being constructs of these indicators. The relationships between the indicator variables and the latent variables are specified by the measurement (outer) model, whereas the relationships between latent variables are specified by the structural (inner) model. Both models are estimated together. The following chart provides a schematic overview of a PLS measurement model.

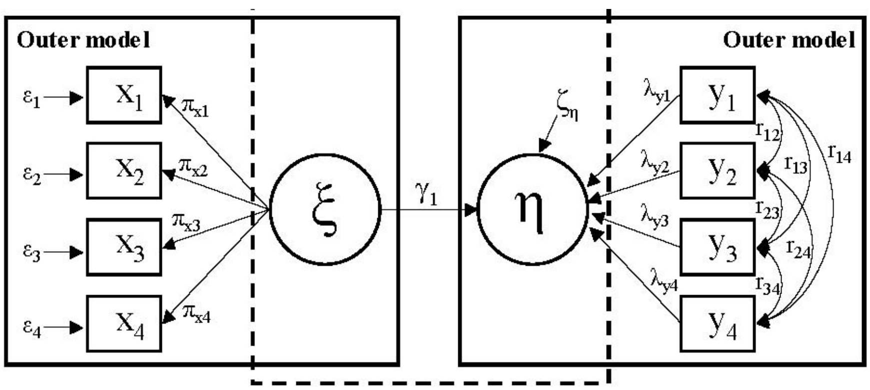


Figure 130: A Path Model with Structural Relationships (Source: Vinzi & Tenenhaus, 2004).

A SEM may include two types of latent constructs - exogenous and endogenous, represented respectively as ξ and $\boldsymbol{\eta}$. These two types of constructs are distinguished on the basis of whether or not they are dependent variables in any equation in the system of equations represented by the model. Exogenous constructs are independent variables in all equations, in which they appear, while endogenous constructs are dependent variables in at least one equation--although they may be independent variables in other equations in the system. In graphical terms, each endogenous construct is the target of at least one one-headed arrow, while two-headed arrows only target exogenous constructs.

When it comes to the indicators, Chin (2002) describes *reflective* and *formative* indicators. The former indicators, the Reflective or effect ones, are reflections of the extent a latent variable is characterized, but they do not directly influence them. Therefore, they could be exchanged without a loss of validity if a better way is indicated to reflect a latent variable. To illustrate reflective indicators in a PLS model, arrows point from the latent variable to the indicators, as shown above for indicators **x1** – **x4** and the exogenous latent variable ξ. Reflective indicators can be tested by means of factor analysis, and weights **πx1** – **πx4** are assigned to the loadings based on the overall model estimation. They are always required to be positively correlated.

In contrast, formative indicators determine a latent variable directly – also cause indicators. They should in effect fully describe the construct, therefore, changing a formative indicator also changes the actual construct value. Therefore, they cannot be excluded without a strong theoretical justification (Chin, 2002). reflective measures. Correlations between formative indicators are depicted in the schematic PLS figure through the r symbol and the respective indicator numbers as subscript (Vinzi & Tenenhaus, 2004). Formative indicators are illustrated in a PLS model, by arrows pointing from the indicators to the latent variable, as can be seen above for the indicators **y1** – **y4** and the latent variable $\boldsymbol{\eta}$; **λy1** – **λy4** represent the weights assigned to the indicators after model estimation. The variable r shows the correlation between each indicator of a formative measure.

One of the strengths of the PLS approach is that it is capable of including both reflective and formative indicators. With respect to former, the selection of appropriate indicators reflecting the corresponding latent variables is subject to debate among researchers, where some propose using quantitative methods in order to identify relevant indicators, while others argue that only theoretical and logical considerations and justifications should be the basis for the proper indicator selection. Furthermore, the decision between the formative and the reflective nature of the indicators should follow the causal reasoning between indicators and construct. Though statistical methods may assist in identifying relevant indicators, the substantive knowledge and theoretical justification should be the major concern (Chin & Todd, 1995). PLS assesses the relationships between constructs and their indicators, and among constructs with the aim to minimize error variance. The estimation of the PLS model is conducted in three stages:

1. The first stage consists of an iterative estimation of weights and latent variable scores. Based on a random start matrix of outside approximation, first inner weights are estimated, followed by an inside approximation. Then, the outer weights are determined, followed by an outside approximation. This procedure continues until no further changes occur and therefore convergence is obtained.
2. In stage two, factor loadings and path coefficients are estimated using ordinary least square regression.
3. In stage three, the location parameters of the linear regression functions are estimated.

Chin and Newsted (1999) summarize this procedure as follows:

> "The PLS procedure is … used to estimate the latent variables as an exact linear combination of its indicators with the goal of maximizing the explained variance for the indicators and latent variables. Following a series of ordinary least squares analyses, PLS optimally weights the indicators such that a resulting latent variable estimate can be obtained. The weights provide an exact linear combination of the indicators for forming the latent variable score which is not only maximally correlated with its own set of indicators"

7.7.1.3 Structural Equation Modeling – Comparing LISREL to PLS

Within SEM the two approaches of LISREL versus PLS will now be elaborated, as it would have been more typical to utilize LISREL to test theoretical constructs. LISREL is a *covariance-based* method whereas PLS is a *variance-based* approach, and pursues a confirmatory path as it tests a model and produces goodness-of-fit measures that explain how well the observed data corresponds to the theoretical model; i.e. LISREL attempts to explain observed covariance. However, the requirements and assumptions towards the data are rather restrictive. For example, data have to be normally distributed and rather large sample sizes are required. In comparison, PLS does not perform as well as LISREL on parameter estimation but in turn is able to explain variances, the extent to which latent variables relate to each other, and the extent to which indicators are able to describe a construct. Thus, PLS analysis puts emphasis on the estimation of the relation weights. Additionally, PLS requires smaller sample sizes and has no demands in terms of data distribution (Gefen et al. 2000:5). The subsequent table in this section compares PLS with the covariance-based LISREL.

Criterion	PLS	Covariance-based LISREL
Objective	Prediction oriented	Parameter oriented
Approach	Variance based	Covariance based
Assumptions	Predictor specification (non parametric)	Typically multivariate normal distribution and independent observations (parametric)
Objective of Overall Analysis	Reject a set of path-specific null hypotheses of no effect.	Show that the null hypothesis of the entire proposed model is plausible, while rejecting path-specific null hypotheses of no effect.
Parameter estimates	Consistent as indicators and sample size increase (i.e., consistency at large)	Consistent
Latent variable scores	Explicitly estimated	Indeterminate
Epistemic relationship between a latent variable and its measures	Can be modeled in either formative or reflective mode	Typically only with reflective indicators (however, procedures to consider formative indicators exist)
Model complexity	Large complexity (e.g., 100 constructs and 1000 indicators)	Small to moderate complexity (e.g., less than 100 indicators)
Sample size	Power analysis based on the portion of the model with the largest number of predictors. Minimal recommendations range from 30 to 100 cases	Ideally based on power analysis of specific model – minimal recommendations range from 100 to 800.658
Objective of Variance Analysis	Variance explanation (high R-square)	Overall model fit, such as insignificant chi-square or high AGFI.
Required Theory Base	Does not necessarily require sound theory base. Supports both exploratory and confirmatory research.	Requires sound theory base. Supports confirmatory research.
Assumed Distribution	Relatively robust to deviations from a multivariate distribution.	Multivariate normal, if estimation is through ML. Deviations from multivariate normal are supported with other estimation techniques.
Implications	Optimal for prediction accuracy	Optimal for parameter accuracy

Table 33: Comparative analysis between PLS & LISREL SEM techniques (adopted from Chin & Newsted, 1999, and Gefen et al. 2000).

Compared to LISREL, PLS avoids two serious problems: inadmissible solutions and factor indeterminacy (Vinzi & Tenenhaus, 2004). The philosophical distinction between these approaches is whether to use SEM for theory testing and development or for predictive applications (Anderson & Gerbing 1988). In situations where prior theory is well-founded and further testing and development is the goal, covariance based full-information estimation methods (i.e., Maximum Likelihood or Generalized Least Squares) are more appropriate. Yet, due to the indeterminacy of factor score estimations, there exists a loss of predictive accuracy. This, of course, is not of concern in theory testing where structural relationships (i.e., parameter estimation) among concepts are of prime concern.

On the other hand, for application and prediction, a PLS approach is often more appropriate. Under this approach, it is assumed that all the measured variance is useful variance to be explained. Since the approach estimates the latent variables as exact linear combinations of the observed measures, it avoids the indeterminacy problem and provides an exact definition of component scores. Using the iterative estimation technique (Wold, 1989), the PLS approach provides a general model which encompasses, among other techniques, canonical correlation, redundancy analysis, multiple regression, multivariate analysis of variance, and principal components. Because the iterative algorithm generally consists of a series of ordinary least squares analyses, identification is not a problem for recursive models nor does it presume any distributional form for measured variables.

7.7.1.4 Why did we select PLS technique in the Context of our study?

Chin (2000) refers the conditions when we might consider in utilizing a technique like PLS:

1. Do you work with theoretical models that involve latent constructs?
2. Do you have multicollinearity problems with variables that tap into the same issues?
3. Do you want to account for measurement error?
4. Do you have non-normal data?
5. Do you have a small sample set?
6. Do you wish to determine whether the measures you developed are valid and reliable within the context of the theory you working in?
7. Do you have formative as well as reflective measures?

Given that most of the above attributes are fulfilled in our study, it seems straightforward that PLS should be the appropriate analytical SEM method. Beyond heuristics there are some additional considerations that makes PLS an even more plausible option:

- Firstly, the degree of influence of the constructs on each other and on performance is of interest. Only then can the model provide decision making support for companies as to where to set priorities in improvement and transformation initiatives.

- Secondly, the underlying theory has not been fully developed yet, and even though the survey design is well founded in previous research, it was certainly not all inclusive with regards to the parameters that could have been measured, so it highly probable that there exists an inherent measurement error to some degree.
- Thirdly, though the overall sample size is relatively large (N=344), when it comes to the Technology Enablement parameters (i.e. eProcurement), we did receive app. 127 answers, which is certainly not considered a sufficient sample size for a covariance methods (i.e. LISREL).

The nature of the indicators is also of relevance to our SRM Technology Adoption model under consideration. Our survey did not track the names of the responding companies, thus it was not possible to assemble objective performance indices (or composite financial measures according to Nøkkentved & Rosenø, 1998) necessary to study this as a formative indicator. In the model under consideration, our operational efficiency-based performance construct is of subjective nature that is assumed to explain identified performance indicators.

Notwithstanding, previous research efforts verified the consistency of utilizing managerial assessments of functional/domain performance, with comparative objective measures (e.g., Hart and Banbury 1994; Naman and Slevin 1993).

In our research design, performance parameters (i.e. .Question 3 options) have been modeled in PLS as reflective indicators. As mentioned, this would be different if the performance indicators actually defined the performance construct. In this case, the performance construct would have been a formative one. The same condition applies to most of our latent factors as most of the measured parameters do not fully reflect the indicators (e.g. outsourcing).

In summary, we will therefore pursue our SEM analysis with PLS, whereas from a theoretical perspective it would have been preferable to use LISREL. In the following section we will thus focus on the statistical underpinnings and reporting viable via PLS.

7.7.2 Statistical Assessment of Partial Least Squares (PLS) models

As parameter estimation is not conducted simultaneously in PLS analysis, there is no overall goodness-of-fit measure that evaluates the overall model, as it is the case for covariance-based methods like LISREL. In order to assess a model's validity, several methods and procedures considering the different measurement models should be applied (Chin, 1998). According to Hulland (1999), PLS models are analyzed and interpreted in two consecutive steps. First, the reliability and validity of the *measurement model* is assessed, and then second, the *structural model* is assessed (Vinzi & Tenenhaus, 2004). These steps can help us ensure that reliable and valid measures of constructs are used before the construct relationships are interpreted.

To assess the measurement model, reliability and validity is investigated via the following indicators for constructs with reflective indicators:

1. *Individual item reliability* is assessed by examining the loadings and cross-loadings of each of the construct's indicators – in our case the loadings of parameters to the latent variables (or factors). Loadings higher than 0.7 are indicative of high item reliability while the lower threshold varies between 0.4 and 0.5. (Hulland, 1999). In case of reflective indicators, the higher the measure loadings, the lower the required number of indicators to explain a construct.

2. *Convergent validity*, also called *composite reliability*, measures the combined construct validity. Operationally, reliability is defined as the internal consistency of a scale, which assesses the degree to which the items are homogeneous. A commonly used reliability measure is Cronbach's *alpha*, where a value of 0.7 is considered to be a good threshold for composite reliability. An alternative conceptualization of reliability is that it represents the proportion of measure variance attributable to the underlying dimension (Chin 1998). According to Chin, Marcolin & Newsted (1996: 33), "while Cronbach's alpha with its assumption of parallel measures represents a lower bound estimate of internal consistency, a better estimate can be gained using the composite reliability formula" also known as "latent variable reliability" or Dillon-Goldstein's $\rho_{c.}$ Values of >0.8 are considered to show a good composite reliability.

3. *Discriminant validity* measures how indicators of one construct differ from the indicators of other constructs in the same model, i.e. discriminate other constructs. One criterion for Discriminant validity is that the square root of *average variance explained* (AVE) by a construct should be greater than the correlations among other constructs

(Gefen et al., 2000). AVE is calculated as: $\sum\lambda_i^2 var(F) / (\sum\lambda_i^2 var(F) + \sum\theta_{ii})$ where λ_I, F, and θ_{ii} are the factor loading, factor variance, and unique/error variance respectively. Convergent and Discriminant validity are assessed by checking that that AVE of each construct is larger than its correlation with the other constructs, and each item has a higher loading (calculated as the correlation between the factor scores and the standardized measures) on its assigned construct than the other constructs.

After this evaluation, the structural model can be interpreted. with PLS statistics such as the R^2 values of the latent variables, where we are seeking higher R^2values, in that higher values explain the model's variance and therefore increase its predictive power. According to Chin and Newsted (1999), to achieve "good" variance explanation demands R^2values >0.66, considered to be substantial, yet 0,66> R^2>0,33 are viewed as more typical and sufficient, while below 0.33 is viewed as average, and 0.19 weak or noisy. The change in R^2 is used to assess the impact of a specific latent variable on other latent variables and the effect size is measured by f^2. This tests the *Structural Prediction* or *Explanatory Power* of the Structural Model, and is calculated as:

$$f^2 = (R^2_{\text{included}} - R^2_{\text{excluded}}) / (1 - R^2_{\text{included}})$$

By comparing R^2 before and after exclusion of a latent variable, the effect can be assessed. Values of 0.02, 0.15, and 0.35 for f^2 are considered to imply a small, medium, or large effect at the structural level (Geffen et al. 2000). The model can be interpreted based on the estimated path coefficients, which indicate the direction of a relationship, i.e. negative, positive, or neutral. T-statistics showing the significance of both paths and loadings are then calculated. As PLS does not automatically report significance, bootstrapping or jackknifing procedures are used to determine the significance of the stated means of path coefficients and weights. Most researchers recommend bootstrapping which means that the model is estimated a certain number of times (a standard iteration number is 100) with changing fractions of the sample. Then, the resulting means of this procedure are compared with the model results and tested for significance. From this procedure we can obtain the *T-statistic*. Gefen at al. (2000) recommend a minimum significant path coefficient of 0.15, while values of 0.2 and above are considered significant.[97]

As our structural model is primarily based on *reflective* indicators, we will also utilize the Q^2 Blindfolding *Predictive Relevance* test also called the *Stone-Geisser* test. The Q^2 test follows a blindfolding procedure: repeated (for all data points) omission part of the data (by row and column, where jackknife proceeds exclusively by row) matrix while estimating parameters, and then reconstruct the omitted. In other words, Q^2assesses the predictive power of the model by essentially examining how well it performs compared to performance by chance by using blindfolding procedures. $Q^2>0$ indicates predictive relevance, thus the larger the value, the better predictive power of the model, while values below zero indicate that trivial prediction is better than the model equation prediction and so results might be misleading. When noise predictors are removed from the model, this might lead to an increase in Q^2 values as well as significance, in contrast to R^2, which always decreases with such a deletion. It is differentiated between a cross-validated communality and a cross-validated redundancy Q^2 . The latter should be considered if the predictive relevance of a theoretical, causal model is examined or if prediction is made by those latent variables that predict a dependent variable under consideration (Chin, 2000).

A procedure equivalent to that of the f^2 values to determine the impact of a specific latent variable on R^2exists also for Q^2 . In order to determine the influence of a latent variable on the *Predictive Power* of the model, q^2 can be calculated in a similar way as f^2, determined by excluding the latent variable under consideration and compared to before Q^2 exclusion, as shown in Equation below:

$$q^2 = (Q^2_{\text{included}} - Q^2_{\text{excluded}}) / (1 - Q^2_{\text{included}})$$

Compared to f^2, q^2 can also reach negative values which implies that an exclusion of a latent variable might increase the predictive power of a model and therefore the value for Q^2. In such cases, such a latent variable would be considered to add noise to the model (Chin, 2000).

---

[97] Chin (1996) proposes the following Significance Heuristic for 2-Tail T-values: 1.645, at p<0.1; 1,96 at p<0.05; and 2,57 at p<0.01. The 1-Tail test are 1,281 at p<0.1; 1,645 at p<0.05; and 2,196 at p<0.01.

7.7.3 Steps in Developing a Construct with Partial Least Squares (PLS)

We will utilize both of these structural model indices to evaluate the *structural* and *predictive validity* of the models we will explore. We use plural, as we do expect to refine our model as proposed by Cheng (2001) via an incremental approach (see figure below).

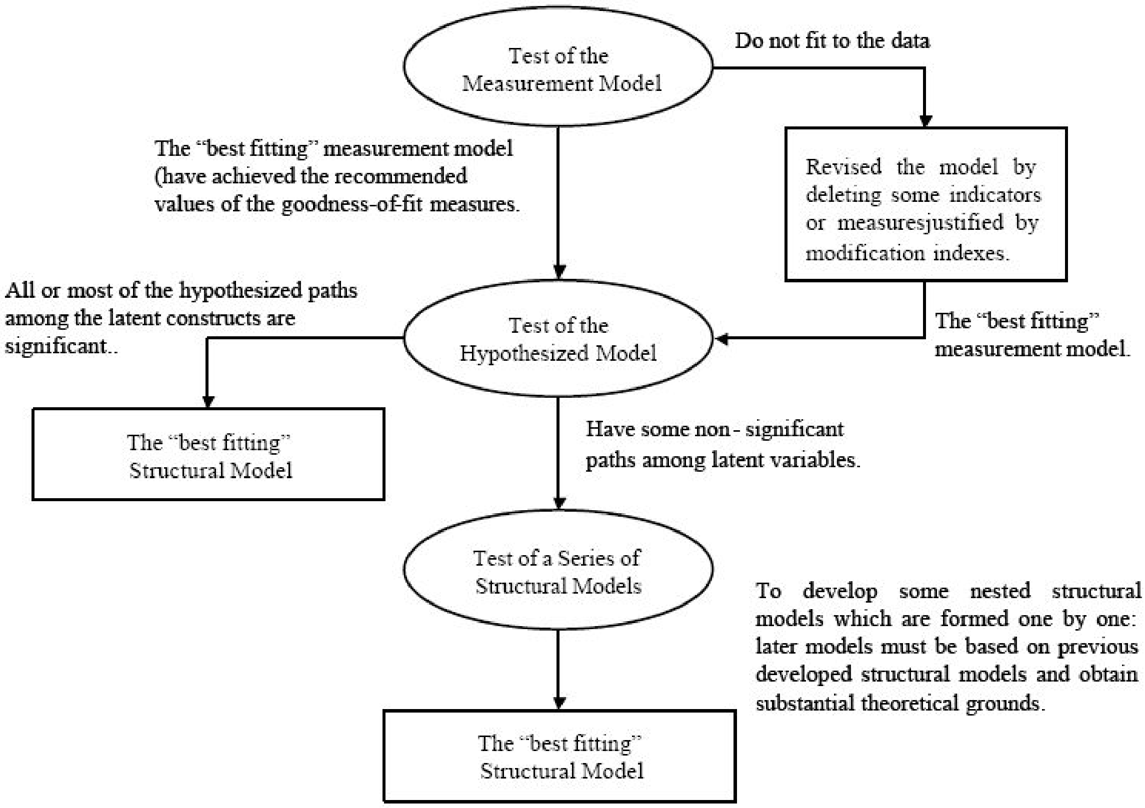


Figure 131: An SEM incremental approach technique (Source: Cheng, 2001).

This approach distinguishes clearly the analysis of SEM measurement and structural models. Researchers like Cheng(2000), Chin et. al. (2003) and Hulland (1999) clearly indicate that the strength of PLS is its ability to elaborate various models and synchronously test their path causalities.

By studying the overall % of Variance explained and the T-statistics of significance (via bootstrapping[98]), PLS enable us to follow an incremental approach as we analyze our original hypotheses. Therefore, as recommended, we will proceed in an incremental and iterative fashion, by:

---

[98] Goodhue, Lewis and Thompson (2006:8) mention that "path estimates derived from PLS are almost identical, whether bootstrapping or normal theory testing is employed". For normal theory testing the authors applied a regression analysis that estimated betas and t-statistics – then they compared the T-Statistics from Bootstrapping and Regression.

1. First, we will commence with an exploratory evaluation of the originally proposed construct; analyze path-coefficient significance, R^2 and overall Model Significance with T-Statistics (via Bootstrapping). Iterate until we reach a minimal model with sufficient R^2. This will lead us into our initial observations.
2. Second, we will start with the comprehensive, parameter-based construct where the original surveyed questions figure as the latent variables; test our measurement model, its items' reliability and validity, then proceed with an iterative process of removing items (e.g. parameters in our model) with low factor loadings to increase the latent variables' explanatory strength (in variance terms).
3. Third, we will iterate through an optimization of the path coefficients, by establishing their significance and power (via T-statistics produced via bootstrapping). In parallel, we will atempt to optimize the overall R square of our dependent latent factor (i.e. operational efficiency).
4. Third, from the whole model, we will optimize f^2 while adding and removing latent variables from our nested construct, thus ending with the most "plausible" model balancing theoretical underpinnings, predictability and statistical power. We thus seek the parsimonious or best model among a set of theoretically feasible models.
5. Fourth, we will conduct an exploratory investigation of the direction of causality between the constructs. Just like the debate between the lead of structure versus strategy or the reverse (Chakravarthy, 1986), we will reverse the path causalities and investigate the models produced.
6. Fifth, and optionally given our dataset constraints, we will attempt to investigate the effect of interactions between the latent variables and their reflective indicators.
7. Finally, we will conclude on the most "plausible" model and draw our inferences.

Using the procedures and methodology as described in this section, we will attempt to build, assess, prune, verify and validate fairly complex PLS models like the *SRM Adoption* framework developed in the following section.

7.7.4 SRM Adoption Framework – Assessing the Initial PLS Model

In this section we will provide an overview of our own exploratory journey towards a significant construct, enabled by the software tool SmartPLS's superior SEM representations of path coefficients, R^2 and T-Statistics for latent (inner model) and indicator (outer model) variables. We will commence with an initial exploration of our construct based on the configuration of our survey questions into groups representing the hypothesized Domain contexts leading to operational efficiency as represented in the initial figure in section 7.6. Instead of concluding with the "best fitting" measurement model after removing indicators, we will then continue with a series of iterations where we will progressively enrich the model with more detail and then removing the insignificant paths between the resulting latent variables. We will thus evolve the model towards a higher significance (2-tailed T-statistic) and R^2 for most latent variables and especially our dependent variable, operational efficiency.

7.7.4.1 Initial Evaluation of PLS Model for SRM Adoption (Original Construct)

We started by constructing the initial PLS model with our conceptual groups as latent variables clustering the underlying parameters based on our hypothesized construct.

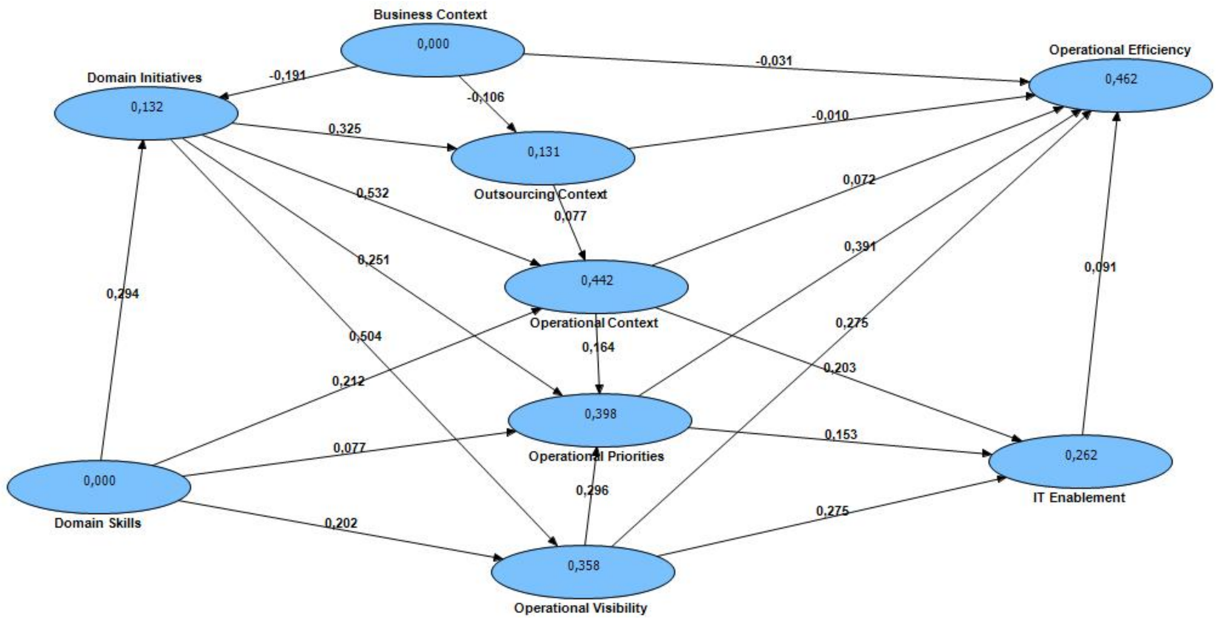


Figure 132: Initial Nested PLS Model of Hypothesized Constructs with Significant *Path-Coefficients* and R^2 vis-à-vis IT Enablement and Operational Efficiency.

A first indicator for evaluating the initial structural PLS model is the R^2 value of the dependent latent variable as this reflects explained variance. The R^2 value obtained for the dependent latent variable is 0.462 or 46,2% variance explained by the model. There are a number of Path Coefficients that are either too low or even negative. For the latter, especially the Business Context latent variable showed a substantial negative coefficient. After studying the factor loading of its underlying reflective indicators, Industry and Company Size, we found that Company Size loaded negatively, thus indicating that higher size leads to higher scores in the Domain Initiatives (which consisted of the Q16 – Strategic Initiatives and Q15. Operational Initiatives). Subsequently we divided this latent variable into its constituents. Moreover, in the model above, there are some low coefficients – especially between operational efficiency and the 3 context latent variables – business-, outsourcing- and operational context.

The significance of PLS' estimates can be measured through Bootstrapping. As a result, t-statistics provide the necessary information about the significance levels of the construct linkages. These initial Bootstrapping T-Statistic estimates are shown below, confirming that the paths with low coefficients were also not-significant[99]. A number of additional paths were shown non-significant on a 1-Tail, $p<0.1$, with T-values less than 1.281 – these were removed.

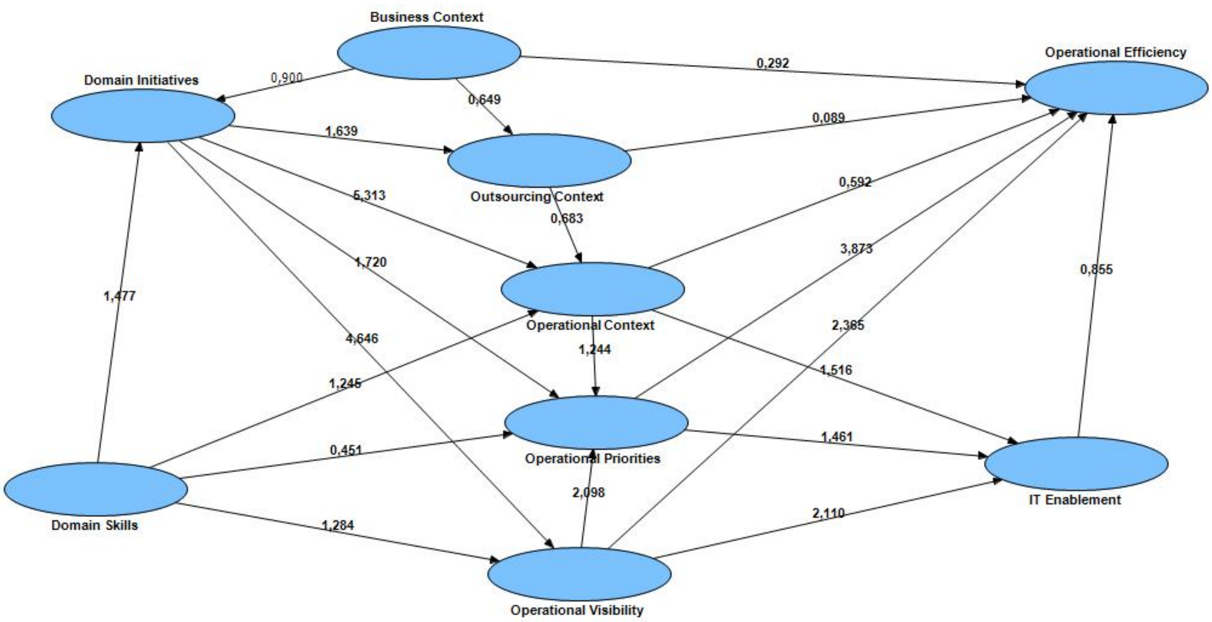


Figure 133: Initial Nested PLS Model of Hypothesized Constructs with *T-Statistics* for Path Coefficients.

7.7.4.2 Evaluation of initial PLS Model for SRM Adoption (Reduced Original Construct)

Based on this result, all insignificant paths and consequently latent variables like Business- and Outsourcing Context and were removed and the model was re-estimated. The trimmed second causal model path estimations is shown in the next figure. We could deduce from this PLS model that our conceptual constructs could explain 46,7% of the Efficiency variance.

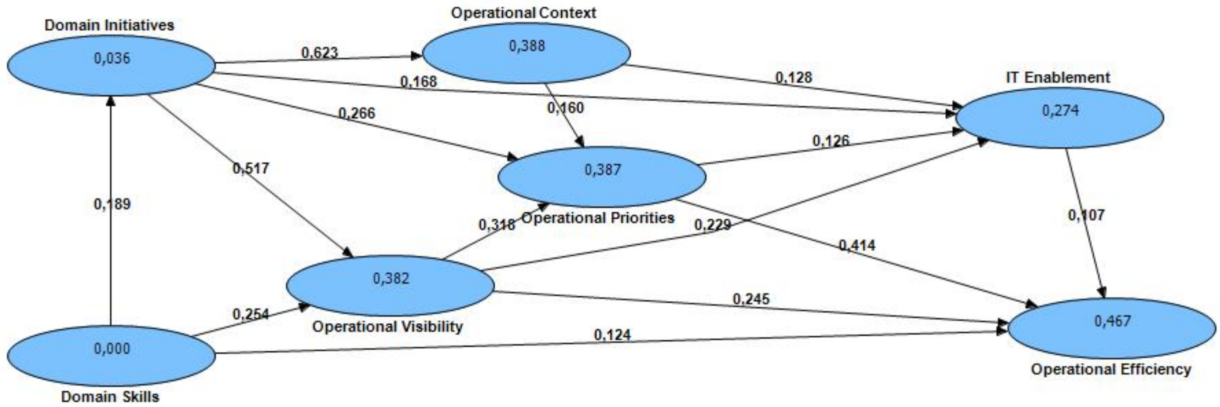


Figure 134: Reduced PLS Model of Hypothesized Constructs with Significant *Path-Coefficients* and R^2 vis-à-vis IT Enablement and Operational Efficiency.

After running a bootstrapping procedure, we extracted the T-statistic values for the path coefficients. While most paths are significant at the p<0.05 level, there were too many paths that didn't prove significant.

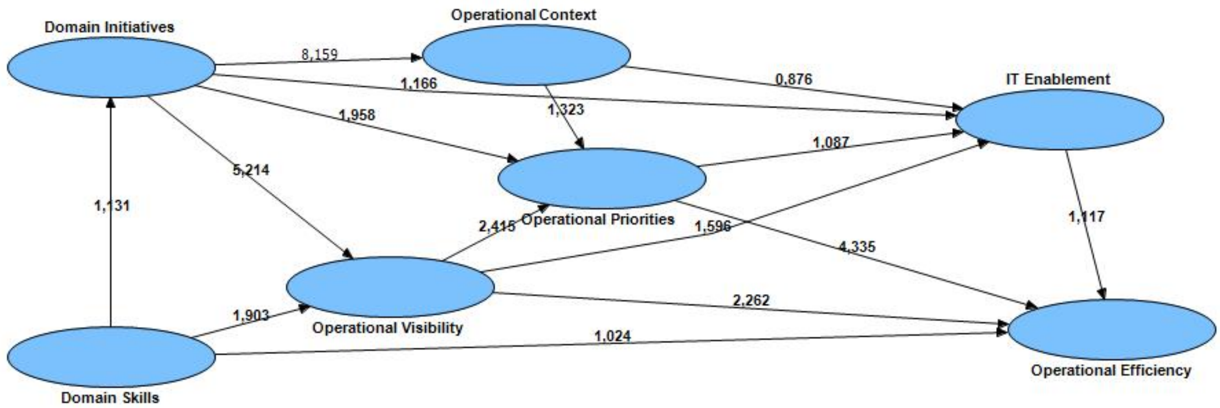


Figure 135: Reduced PLS Model of Hypothesized Constructs with T-Statistics for Path Coefficients

[99] By noting that t-values are significant, we are rejecting the hypothesis that correlation or path coefficient is equal to zero in the population. Chin (1996) proposes the following Significance Heuristic for 2-Tail T-values: 1.645, at p<0.1; 1,96 at p<0.05; and 2,57 at p<0.01. The 1-Tail test are 1,281 at p<0.1; 1,645 at p<0.05; and 2,196 at p<0.01.

As Chin (1998, 2003) recommends, if a structural model has too low predictive power, then the author should evaluate the indicators that constitute the latent variables, in that theory and measures are to developed and tested simultaneously. After an initial examination, it became apparent that the factor loadings into the aforementioned latent variables were indicating that there were more factors than the ones extracted in confirmatory fashion[100]. The figure below shows the underlying parameters (from our survey) that were initially grouped into conceptual factors. Hence the decision was made to rather re-construct the PLS model on the parameters, which was in alignment with the guidelines from Cheng (2001).

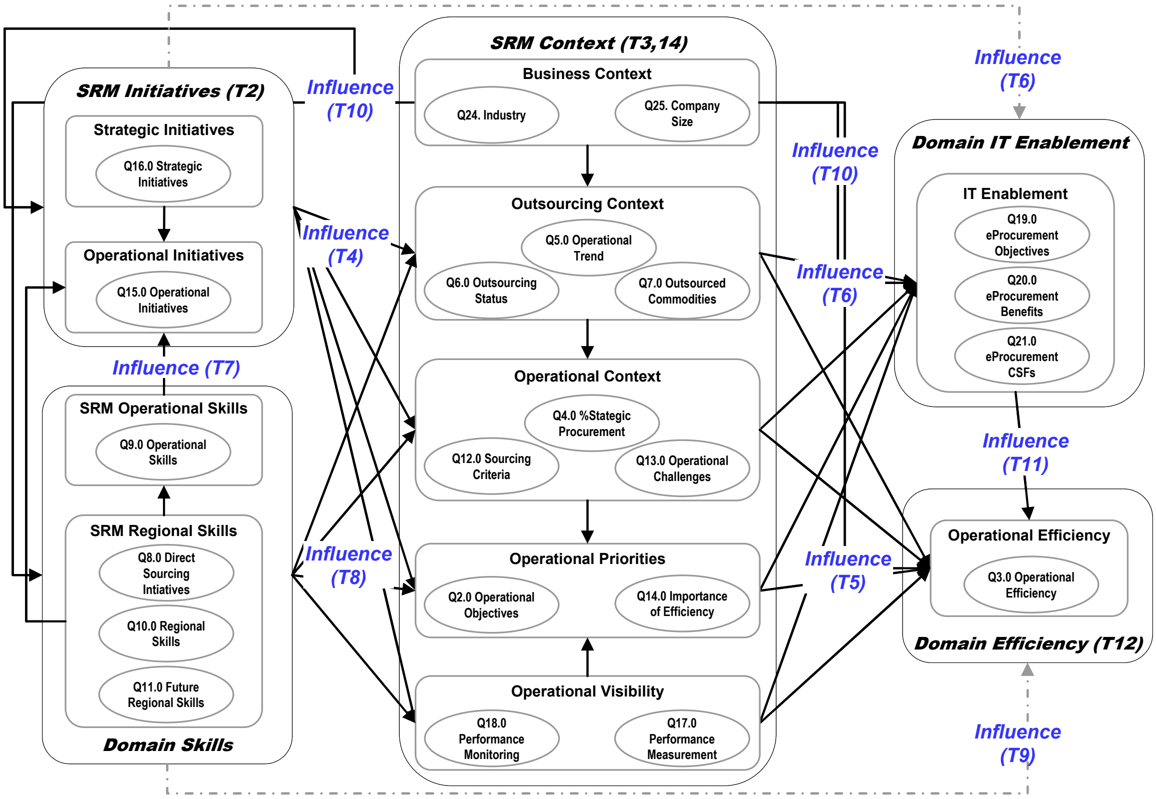


Figure 136: Detailed *SRM Adoption* Construct with Latent Groups of the Surveyed Questions.

7.7.4.3 PLS Model for SRM Adoption with Original Questions as Latent Variables

In that light, we commenced with the full model consisting of all parameters in alignment with a “richer” SEM incremental approach (Cheng, 2001), where we modeled not only the

---

[100] What do we mean when we assert that we are ‘confirming’ a hypothesized model through PLS analysis? Hermann Wold (1989) noted that such ‘confirmation’ occurs under a very broad range of circumstances, including small data sets and complex models, emphasizing that model predictions can only be considered "plausible", rather than confirmed by the data testing. In this study we align with this concept of plausible confirmation as it conveys that rather than an priori hypothesized model being shown to be the end-state of a researcher's endevours, there might exist just as plausible alternative models, which we need to take into consideration in an inperfect theoretical perspective. Typically, that means that we need to be prone to prune our a priori imperfect models before concluding on our hypotheses.

parameters, but also the causal paths in between them. This was done in an iterative fashion, as we initially linked all parameters given the hypothesized links. The R^2 of the latent variables, their path coefficients and significance were studied by running the PLS algorithm and then the Bootstrapping option in the SmartPLS tool. After the first round of pruning insignificant links and latent variables we reached the initial model as shown below. One thing was apparent – the remaining parameters were clearly clustered in the 7 groups. Both the *Initiates* and *Skills* groups were primarily contributing to the intermediary parameters in the middle, which consisted of the *Outsourcing*- & *Operational Context*, and the *Operational-Priorities* and -*Visibility* groups. The *IT enablement* group was visibly a receiver of a number of causal paths, while both this group together with the visibility and priorities groups were providing substantial contributions to our latent dependent variable - Operational Efficiency. Its regression coefficient in this construct increased significantly to 53%.

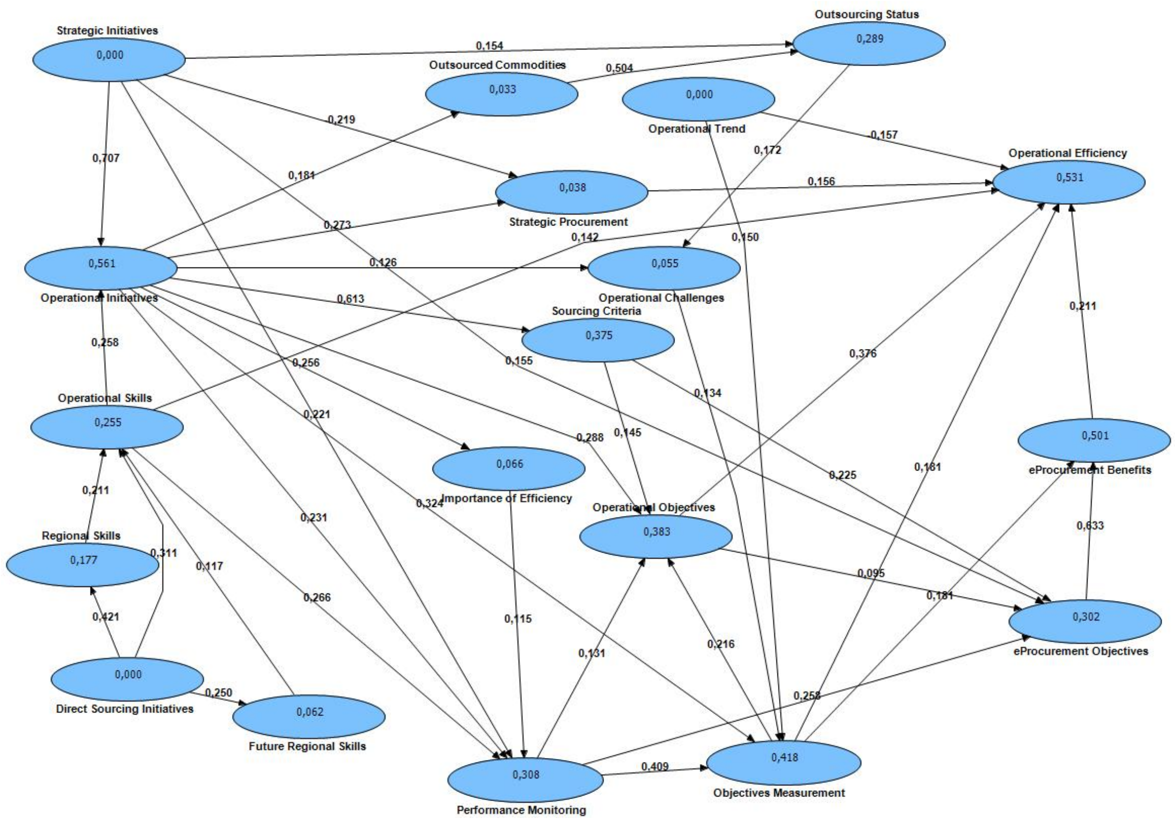


Figure 137: SRM Adoption Construct with R^2 and *Path Coefficients* with Surveyed Questions as Latent Variables instead of the Groups. Remark that Industry and Company Size were removed given insignificant T-Statistics.

We subsequently investigated the significance of relevant path coefficient via bootstrapping. It was apparent that there were many paths that were not significant especially in 2-tailed tests.

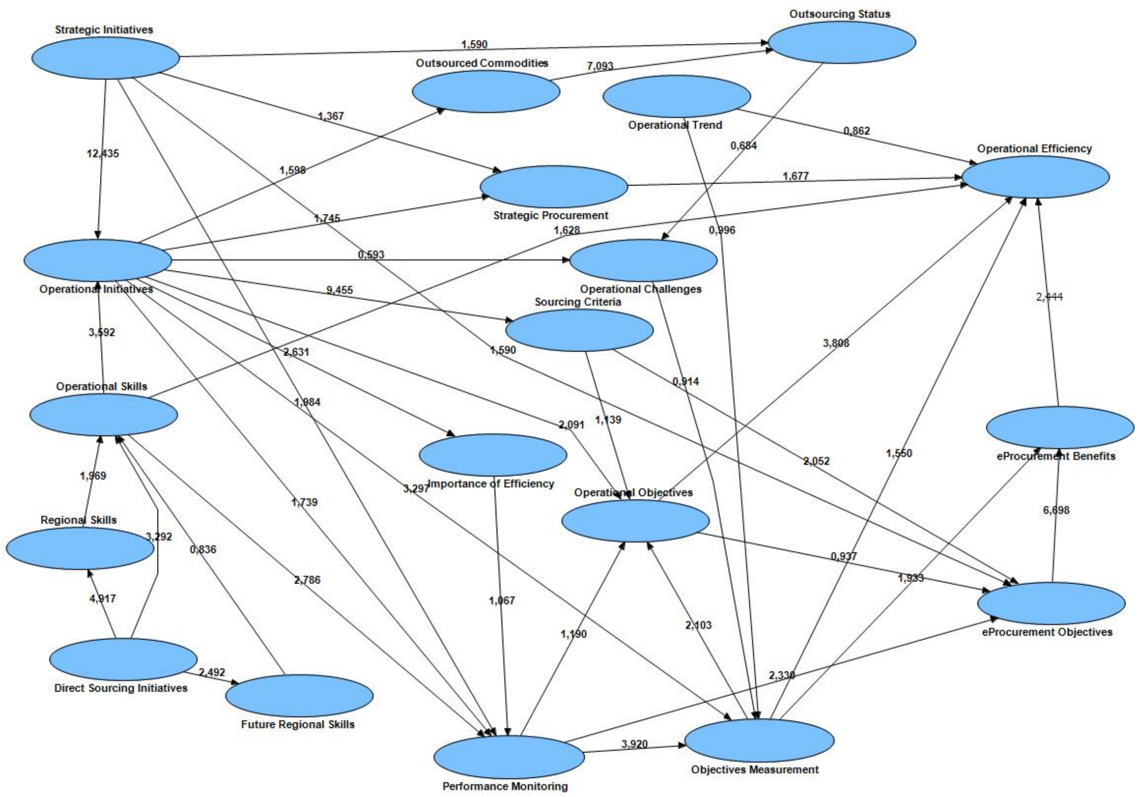


Figure 138: Path Coefficient *T-Statistics* values – Significance Evaluation of the Construct via PLS Bootstrapping.

7.7.4.4 Trimming the SRM Adoption Construct via Structural Prediction Tests

Given the above analysis, we utilized the f^2 index (see previous section) in an attempt to better understand the effects of not only causal paths, but also latent variables from our overall construct. The table below summarizes the relative change in R^2's of progressively optimizing the model be removing paths an latent variables leading to substantive impact. Instead of studying the f^2 index for the dependent latent variable, we primarily focused here on understanding mutual dependency effects among the constructs' latent variables. Table 34 below summarizes a set of multiple blindfolding runs, where from an original model with an R^2 of 53% for the dependent variable, we in turn removed each of the latent variables (as shown in the first column) based on their R^2 and path-causality significance via T-Statistics and estimated the f^2 indice for each of the remaining latent variables. The non-blank cells in the table report our findings where indices were >0.01. Each of the column report on the evolution of the indice as we were progressively removing latent variables (shown in the 1st column). We also attributed the size of the indice by using colors, red for substantial, green for medium and yellow for low impact. What was evident after reordering our findings was that a group of 7 latent variables as denoted by the red border in the lower right corner of the table were the main contributors of the variance explained in our dependent latent variable.

*f^2 Index estimates based on the prior & posterior R^2 values per Latent Variable (i.e. column) after removal of an LV shown in Column 1. Cells highlighted in Green indicate medium impact while in red denote that specific exogenous LV has substantive impact. LVs where removed as shown in the column below. Area enclosed in **red** was selected as the final model containing the most significant LVs & Paths with regards to our Dependent LV.*	Operational Efficiency (R^2)	Outsourced Commodities	Outsourcing Status	Operational Challenges	Strategic Procurement	Future Regional Skills	Importance of Efficiency	Operational Trend	Direct Sourcing Initiatives	Regional Skills	Sourcing Criteria	Strategic Initiatives	Operational Initiatives	Operational Skills	eProcurement Benefits	Performance Monitoring	Objectives Measurement	eProcurement Objectives	Operational Objectives
Removed Latent Variables ▼	*53%*	*3,3%*	*28,9%*	*5,5%*	*3,8%*	*6,2%*	*6,6%*			*17,7%*	*37,5%*		*56,1%*	*25,5%*	*50,1%*	*30,8%*	*41,8%*	*30,2%*	*38,3%*
Outsourced Commodities	**53%**	*Off*	0,35																
Outsourcing Status	**53%**		*Off*	0,02															
Operational Challenges	**53%**			*Off*													0,03		
Strategic Procurement	**51%**				*Off*												0,03		
Future Regional Skills	**51%**					*Off*								0,02			0,03		
Importance of Efficiency	**51%**						*Off*									0,02	0,03		
Operational Trend	**49%**							*Off*								0,02	0,07		
Direct Sourcing Initiatives	**49%**								*Off*					0,14			0,07		0,03
Regional Skills	**48%**									*Off*							0,07		0,03
Sourcing Criteria	**48%**										*Off*				0,05		0,07	0,07	0,23
Strategic Initiatives	**47%**											*Off*	1,12			0,02	0,07	0,17	0,02
Operational Initiatives	**47%**												*Off*			0,27	0,22	0,17	0,22
Operational Skills	**46%**													*Off*			0,22	0,17	0,22
eProcurement Benefits	**46%**														*Off*		0,21	0,24	0,23
Performance Monitoring	**42%**															*Off*		0,22	0,22
eProcurement Objectives	**28%**																*Off*		0,36
Objectives Measurement	**22%**																	*Off*	

Table 34: Table of f^2 values estimated via the R^2 deltas per Latent Variable after R^2 size & T-Stat pruning.

Based on the numbers shown above we also studied the actual R^2 evolution of the various latent variables and identified the impact of removing lesser ones to each others' explanatory power[101]. We were trying here to justify the exclusion of latent variables as to reach a more explanatory model where the remaining group of latent variables were having at least sufficient degrees of R^2. Hence we looked at the progression of R^2 of the individual variables and the overall impact onto the dependent variable's R^2. This is summarized in the chart below, which on the horizontal x-axis denotes the latent variables that we excluded just as the table above, while in the vertical axis we provide the amount of R^2 explained by each plus its progression.

What is interesting in the figure below is the effect of the last 4 latent variables on the dependent' R^2, with especially the importance of Operational Visibility (i.e. Performance Monitoring and Objectives Measurement) on explaining the lions share of variance. Moreover as this a nested model, latent variables further away from the ultimate node, operational

[101] This stage of analysis involves the evaluation of the relationships between the latent variables. "If a structural model has non-significant paths, it reveals the need to propose new relationships on condition that these new paths are theoretically justified. The process is to produce a series of nested structural models for testing. These structural models must be developed one by one where later models must be stemmed from previous models and must have theoretical grounds" (Cheng 2001:654).

efficiency, have less impact. Yet, this does correspond to our proposition supported by previous research (Subramanian & Shaw, 2002), that IT-related eProcurement and B2B transformation affect company performance indirectly.

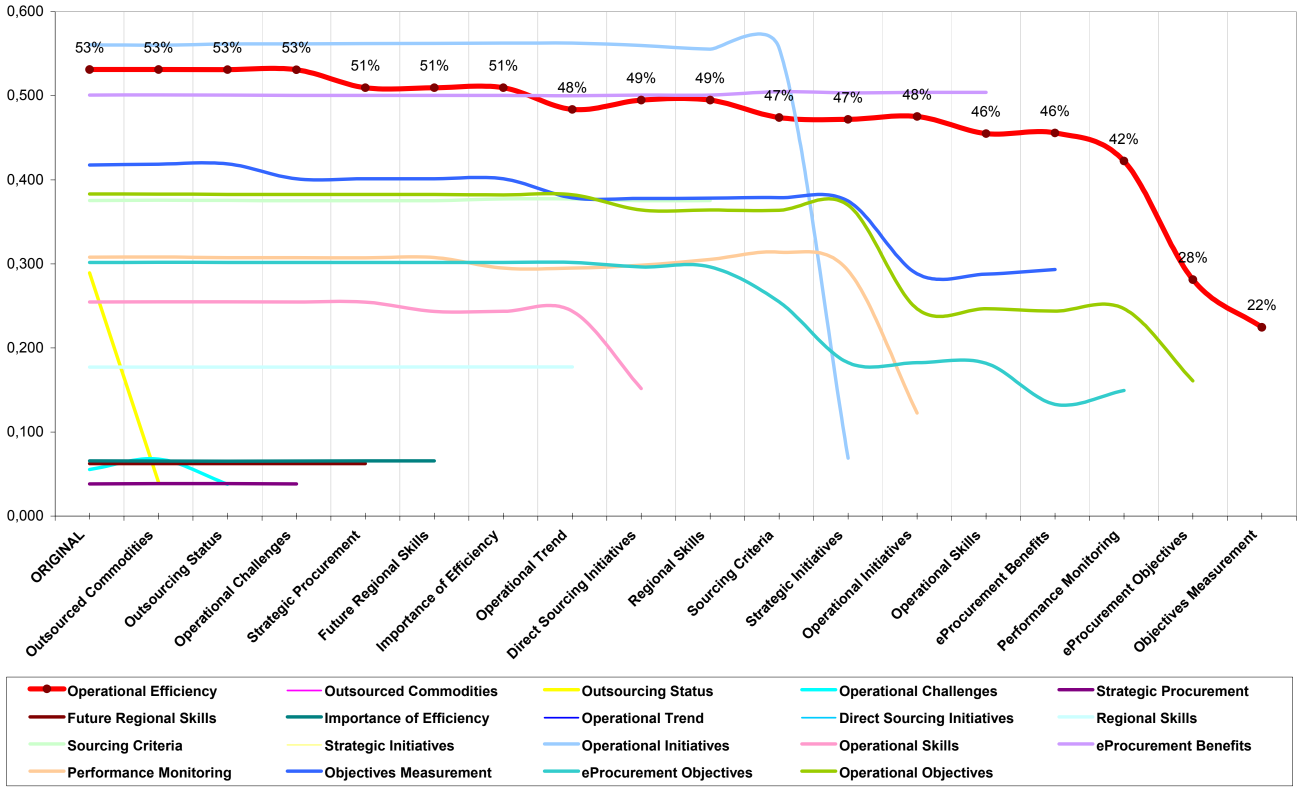


Figure 139: Evaluation of R^2 for all latent variables during the model trimming (in red is our dependent variable). When a latent variable is excluded then it's R^2 is abruptly stopping.

As a final assessment of our model trimming and its requirements on the viable sample to draw theoretical inferences, we followed recent theoretical recommendations and evaluated the *CPI*, *RPI* and *Sample* sizes[102] we could achieve with our more restrained construct. We estimated the Causal plausibility index (CPI)=0,048, while the Relational plausibility index (RPI)= 0,076; both estimates were within acceptable thresholds (Westland, 2007), thus we could finally proceed with a more "plausible" causal model.

---

[102] According to Westland (2007), we to consider the 'plausibility' of a particular causal model. The total number of possibilities between which we need to discriminate is 3 in the power of n*(n-1)/2, where n is the number of LVs. These measures tend to be exponentially large, hence it is recommended to rescale them, by taking the inverse natural logarithm of each, resulting in two measures of model complexity – a **causal plausibility index** (CPI) and a **relational plausibility index** (RPI) of a PLS model fit. Westland suggested that values of CPI≥0,01 and RPI≥0,02 are sufficient indicators of *plausible causation*, yet both indicators demand strong theoretical undepinnings of the a priori structural models, as well as a sufficient sample size. The heuristic of sample size would be Sample = 20/CPI for establishing causality in all elationships and Sample = 20/RPI for establishing correlation. If causality is seeked for the dependent LV then the causal LVs should be used. For our full construct, CPI=0,048, RPI=0,076, while for investigating causality on the dependent LV, the sample size should be 83-131.

7.7.4.5 Latent Variable Correlations and Factor Loadings of the Final PLS Model

Before engaging on studying the identified "final" model we followed the recommendations of Chin (2000). We evaluated the factor loadings of our reflective indicators on the latent variables with the heuristic that low factor scores (<0,45) indicate low alignment to the identified factors, or noise leading to non-concordance; if these conditions were present we could eliminate them, or transitioned into a new confirmatory latent factor. We choose elimination to be consistent with our original framework of concepts. The table below shows the final results. As an example we removed the indicator Q2.1: *Reduce product/service costs* from the Operational Objectives parameter as it produced low factor loads in its latent variable, which is not unnatural as most companies, both high and low performance are utilizing procurement and sourcing to constantly optimize cost structure for existing goods and services.

Table 35: Latent Variables with constituent Survey Parameters sorted by their Factor Loadings.

Final Parameter Options and PLS-based Latent Factors	Operational Objectives	Operational Efficiency	Operational Skills	Sourcing Criteria	Operational Initiatives	Strategic Initiatives	Objectives Measurement	Performance Monitoring	eProcurement Objectives	eProcurement Benefits
Q2.10_OperObj_Intr_eSourcingSys	0,74									
Q2.9_OperObj_Intro_eProcSys	0,70									
Q2.5_OperObj_SecurityAndResilience	0,65									
Q2.7_OperObj_FindGlobalSupplier	0,63									
Q2.4_OperObj_ResponsiveToDemand	0,51									
Q2.2_OperObj_Quality_ofProcured	0,48									
Q2.8_OperObj_Support_BPO	0,47									
Q3.9_OperEff_eProcurement		0,79								
Q3.8_OperEff_eSourcing		0,75								
Q3.5_OperEff_Supplier_Perf_Mgmt		0,72								
Q3.6_OperEff_of_Payment_process		0,58								
Q3.7_OperEff_ComplianceToPolicy		0,55								
Q3.4_OperEff_SupplierCollaborat		0,55								
Q3.2_OperEff_GlobIndirecSourcin		0,53								
Q3.3_OperEff_GlobDirectSourcing		0,48								
Q9.1_OperSkil_Glob_SourcDirects			0,64							
Q9.2_OperSkil_GlobSourcIndirect			0,62							
Q9.3_OperSkil_NonCoreOutsourcng			0,62							
Q9.4_OperSkil_CoreBProcsOutsour			0,62							
Q9.5_OperSkil_ContractComplianc			0,48							
Q12.10_SrcCrit_SupCollaboration				0,79						
Q12.7_SrcCrit_TechCompetency				0,68						
Q12.9_SrcCrit_AftermarkWarrCost				0,67						
Q12.6_SrcCrit_SupplFinStability				0,64						
Q12.8_SrcCrit_ProdServQuality				0,61						
Q12.2_SrcCrit_DelivLogistics				0,55						
Q12.3_SrcCrit_Environmental				0,54						
Q12.4_SrcCrit_TechEnablement				0,50						
Q15.3_ProcuEff_SupplCollabMngSC					0,75					
Q15.4_ProcuEff_SupplierPerfMgmt					0,74					
Q15.6_ProcuEff_DevTCOapproaches					0,70					
Q15.2_ProcuEff_SupplCollProdDev					0,64					
Q15.5_ProcuEff_RFIDusage					0,61					

Final Parameter Options and PLS-based Latent Factors	**Operational Objectives**	**Operational Efficiency**	**Operational Skills**	**Sourcing Criteria**	**Operational Initiatives**	**Strategic Initiatives**	**Objectives Measurement**	**Performance Monitoring**	**eProcurement Objectives**	**eProcurement Benefits**
Q16.7_ProcuStrat_TransfProcuOrg						0,73				
Q16.6_ProcuStrat_UpgradingSkill						0,67				
Q16.3_ProcuStrat_BPprocs_eSourc						0,66				
Q16.5_ProcuStrat_StaffTrainSkil						0,66				
Q16.2_ProcuStrat_BPRofPur2Pay						0,62				
Q16.1_ProcuStrat_ProcAutomation						0,54				
Q16.4_ProcuStrat_TalentRetentin						0,54				
Q16.8_ProcuStrat_ProcurOutsourc						0,52				
Q17.4_ProcuKPI_ProcurServicPerf							0,69			
Q17.8_ProcuKPI_TCO							0,65			
Q17.7_ProcuKPI_eProcBenefits							0,64			
Q17.6_ProcuKPI_SupplyResiliency							0,61			
Q17.1_ProcuKPI_ProcEfficie&Cost							0,61			
Q17.2_ProcuKPI_OrderCycleTimes							0,61			
Q17.3_ProcuKPI_SpendReduction							0,48			
Q17.5_ProcuKPI_Prod&ServQuality							0,48			
Q18.4_ProcuMon_DevInfSupplStrat								0,71		
Q18.5_ProcuMon_MeasuPerf_Buyers								0,69		
Q18.3_ProcuMon_IdentifimprvArea								0,64		
Q18.2_ProcuMon_ChallengBUdemand								0,63		
Q18.1_ProcuMon_SpendTransparncy								0,60		
Q19.8_eProcObj_ImproveCollabora									0,69	
Q19.6_eProcObj_DecrProcCycleTim									0,68	
Q19.7_eProcObj_ReductAdmWrkload									0,66	
Q19.9_eProcObj_ProvidTranspData									0,64	
Q19.3_eProcObj_SpendTransparncy									0,64	
Q19.4_eProcObj_RedTransactCosts									0,63	
Q19.5_eProcObj_ReducInventory									0,61	
Q19.2_eProcObj_RedMaverck&Compl									0,59	
Q20.8_eProcBen_ImproveCollabora										0,76
Q20.2_eProcBen_RedMaverck&Compl										0,71
Q20.4_eProcBen_RedTransactCosts										0,66
Q20.3_eProcBen_SpendTransparncy										0,66
Q20.5_eProcBen_ReduceInventory										0,65
Q20.7_eProcBen_ReductAdmWrkload										0,62
Q20.6_eProcBen_DecrProcCycleTim										0,61
Q20.9_eProcBen_ProvidTranspData										0,56
Q20.1_eProcBen_ReducePrices										0,54

The graphical depiction of the indicators' factor loadings was reproduced with SmartPLS as shown below. What is also noticeable is that this indicator pruning procedure led to a higher level of variance explained for our latent variables (as mentioned by Geffen et- al, 2000), with the dependent reaching a sufficient explanatory R^2 of 50,3%, quite close to the original full model's one, while the remaining intermediate ones are all around and above R^2 of 30%.

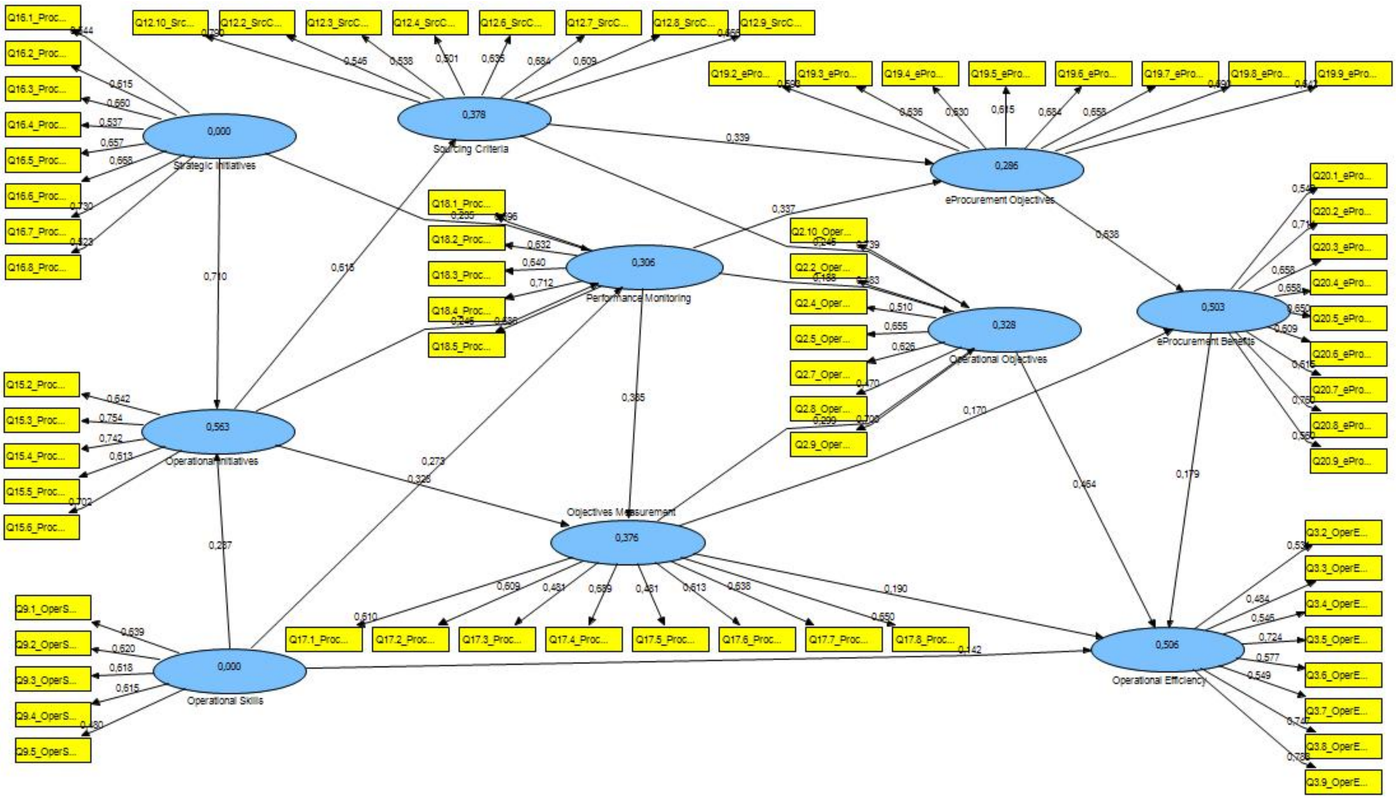


Figure 140: Final Nested PLS Model with *Path-Coefficients* and R^2 of the Reflective Indicators with their Factor Loadings.

7.7.5 Final PLS Model for SRM Adoption Factors

According to Cheng (2001) the best fitting SEM refers “to a model that is the best in achieving the goodness-of-fit indices among all tested structural models”. After pruning iterations and tests on the latent variables, and indicator variables amendments, we re-estimated the path relationships and all insignificant links were removed.

The entire hypothesized causal model structure, as shown in Figure 141 was estimated with Path coefficients and R^2 of the latent variables. What is also easy to review is that we did end up with fewer yet positively linked causal paths than originally hypothesized, which on the other side increases the model *causal plausibility* (Westland, 2007).

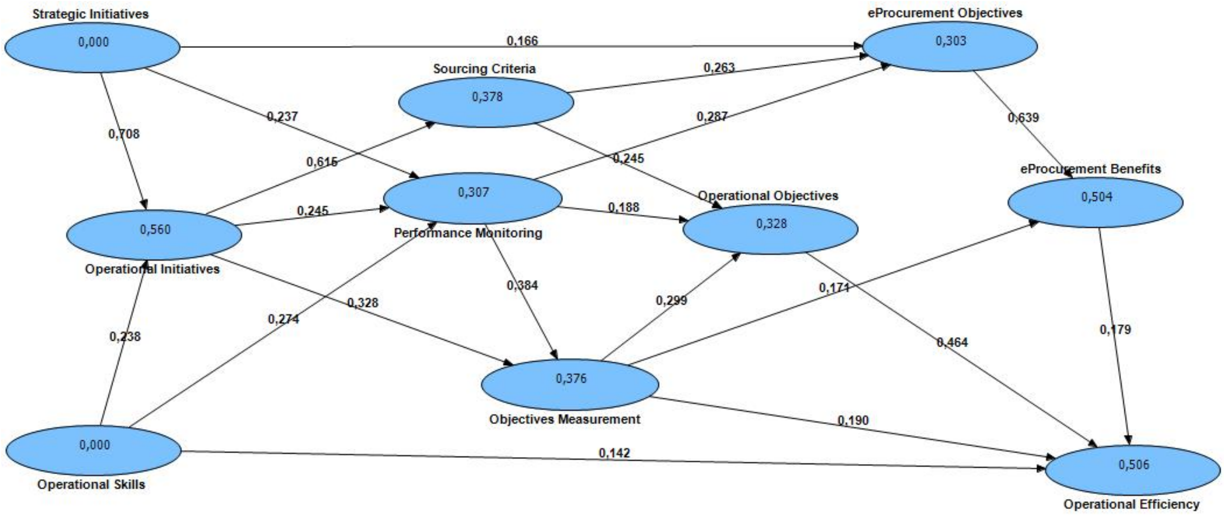


Figure 141: Final Nested PLS Model with Significant Path-Coefficients and R2 of the SRM Adoption Construct.

7.7.5.1 *Analysis of Path Coefficient Significance via T-statistic*

Second, we conducted a bootstrapping process to identify t-statistics providing the necessary information about the significance levels of the construct linkages – see figure below.

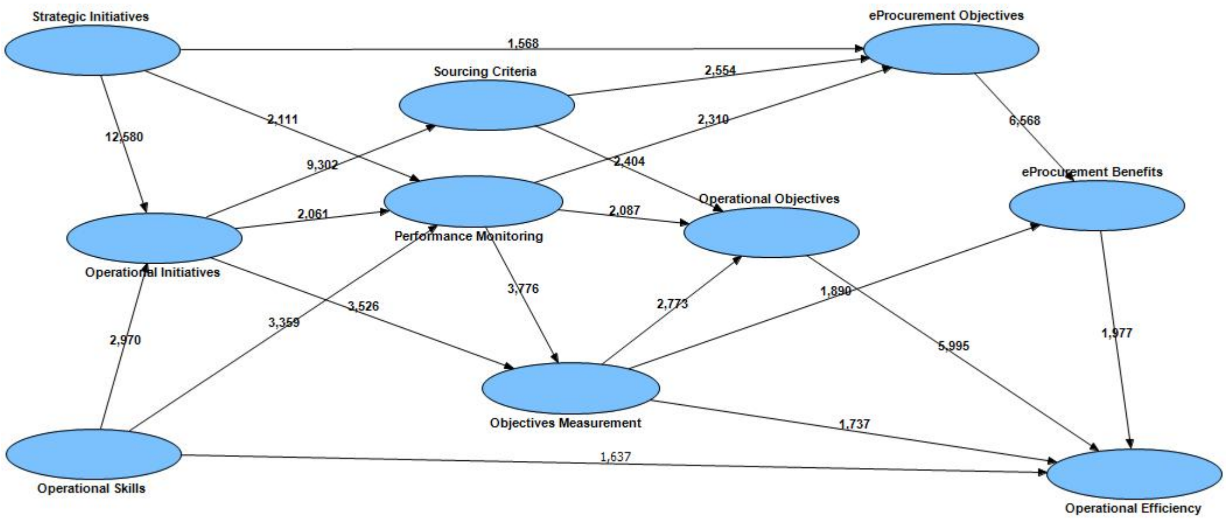


Figure 142: Final Nested PLS Model Significance Assessment with T-Statistics of the Path-coefficients of the SRM Technology Adoption Construct.

Most of the paths were shown significant at the $p<0.05$ level in 2-Tail T-values, while 2 paths between Strategic Initiatives and Operational Skills versus our dependent were significant at $p<0.05$; in 1-Tail test given our sample size.

From	To	Sample Mean (M)	Standard Deviation	Standard Error	T Statistics	Kendall τ	Prob>|τ|
Objectives Measurement	Operational Efficiency	0,1803	0,1093	0,1093	1,7372	0,351	0,000
Objectives Measurement	Operational Objectives	0,3146	0,108	0,108	2,7735	0,446	0,000
Objectives Measurement	eProcurement Benefits	0,1892	0,0903	0,0903	1,8904	0,281	0,000
Operational Initiatives	Objectives Measurement	0,3325	0,093	0,093	3,5261	0,343	0,000
Operational Initiatives	Performance Monitoring	0,2351	0,1189	0,1189	2,061	0,252	0,000
Operational Initiatives	Sourcing Criteria	0,6249	0,0661	0,0661	9,3021	0,271	0,000
Operational Objectives	Operational Efficiency	0,4714	0,0774	0,0774	5,9948	0,358	0,000
Operational Skills	Operational Efficiency	0,1442	0,0869	0,0869	1,6366	0,195	0,001
Operational Skills	Operational Initiatives	0,2427	0,0803	0,0803	2,9702	0,190	0,003
Operational Skills	Performance Monitoring	0,2884	0,0815	0,0815	3,3591	0,227	0,000
Performance Monitoring	Objectives Measurement	0,3888	0,1018	0,1018	3,7758	0,366	0,000
Performance Monitoring	Operational Objectives	0,1853	0,0901	0,0901	2,0868	0,265	0,000
Performance Monitoring	eProcurement Objectives	0,2862	0,1243	0,1243	2,3099	0,332	0,000
Sourcing Criteria	Operational Objectives	0,2484	0,1018	0,1018	2,4042	0,344	0,000
Sourcing Criteria	eProcurement Objectives	0,2753	0,1029	0,1029	2,554	0,398	0,000
Strategic Initiatives	Operational Initiatives	0,7056	0,0563	0,0563	12,5799	0,247	0,000
Strategic Initiatives	Performance Monitoring	0,242	0,1123	0,1123	2,1114	0,345	0,000
Strategic Initiatives	eProcurement Objectives	0,1783	0,106	0,106	1,5677	0,403	0,000
eProcurement Benefits	Operational Efficiency	0,1803	0,0904	0,0904	1,9767	0,290	0,000
eProcurement Objectives	eProcurement Benefits	0,6326	0,0972	0,0972	6,5675	0,483	0,000

Table 36: Path coefficients and respective significance levels of the various Latent Variables; remark we used the robust Kendall's T to confirm the t-statistic with non-parametric significance of the correlations.

The intermediate constructs that facilitate the achievement of above average operational performance in IT adoption like the one we are investigating was visibly proved. While we will elaborate on the results in the discussion it seems that our findings of transformation initiatives being indirectly effecting performance are confirming what other researchers have published (Subramanian & Shaw, 2004). Finally, the importance of IT enablement was also a predominant contributor to the overall variance explained.

Overall, our PLS model shows not only a sufficient R^2 value, but most of the postulated relationships are also supported through significant path coefficients. Before making any inferences on our final construct we will examine the quality of our measurement and structural model in the following section.

7.7.6 Component Reliability, Convergent & Discriminate Validity of Measurement Model

We elaborated in the previous section "Statistical Assessment of Partial Least Squares (PLS) models" on the statistical indices we will use to evaluate the measurement model. As mentioned, *convergent validity* is calculated slightly differently in PLS compared to the commonly used Cronbach's *alpha*, though they are closely related. The difference is that the PLS composite reliability measure considers item loadings obtained within the causal model. Generally, Cronbach's alpha is considered to be a conservative measure, representing the lower bound estimate of reliability (Hulland, 1999). The goodness of measurement model (reliability of latent variables) is evaluated by the amount of variance that a LV captures from its indicators (average communality) relative to the amount due to measurement error. Hence beyond alpha we will use the *Communality* to assess convergent validity as our indicator or manifest variables have been standardized (Vinzi & Tenenhaus, 2004).

Discriminant validity assesses whether: "the latent variables may be correlated, but they need to measure different concepts. It must be possible to discriminate between them." (Vinzi & Tenenhaus, 2004). As a guideline we will evaluate the correlations between latent variables - all should be significantly lower than 1. We will also use the *AVE* (average variance explained). In PLS, *Redundancy* is the same as *operational validity* that is the average variance of the indicator variables set, related to the endogenous latent ones, explained by the exogenous latent variables (Vinzi & Tenenhaus, 2004).

Latent Variable Correlations and AVE Squared reported on the Diagonal	Objectives Measurement	Operational Efficiency	Operational Initiatives	Operational Objectives	Operational Skills	Performance Monitoring	Sourcing Criteria	Strategic Initiatives	eProcurement Benefits	eProcurement Objectives	*Reliability & Validity Measures*	**Composite Reliability**	**R Square**	**Cronbach's Alpha**	**Communality**	**Redundancy**
Objectives Measurement	**0,60**											0,82	0,38	0,74	0,36	0,08
Operational Efficiency	0,52	**0,63**										0,83	0,51	0,77	0,39	0,06
Operational Initiatives	0,51	0,42	**0,69**									0,82	0,56	0,73	0,48	0,03
Operational Objectives	0,50	0,64	0,54	**0,61**								0,80	0,33	0,71	0,37	0,08
Operational Skills	0,23	0,28	0,24	0,20	**0,60**							0,73	0,00	0,58	0,36	0,00
Performance Monitoring	0,54	0,43	0,48	0,41	0,33	**0,65**						0,79	0,31	0,67	0,43	0,07
Sourcing Criteria	0,40	0,36	0,61	0,41	0,10	0,25	**0,63**					0,84	0,38	0,78	0,39	0,14
Strategic Initiatives	0,42	0,30	0,71	0,41	72,00	0,41	0,53	**0,62**				0,83	0,00	0,77	0,39	0,00
eProcurement Benefits	0,37	0,39	0,31	0,31	0,01	0,32	0,27	0,33	**0,64**			0,86	0,50	0,82	0,41	0,04
eProcurement Objectives	0,31	0,30	0,41	0,34	0,07	0,42	0,42	0,42	0,69	**0,64**		0,85	0,29	0,80	0,42	0,07

Table 37: Measurement Model Reliability, Discriminant-, Convergent- & Operational-Validity measures.

All these indices were estimated and are presented in Table 37. The correlation matrix for the model is shown with all squared correlation values were <1 and *AVE* of each latent variable on the diagonal were larger than the correlations. The results therefore confirm *Discriminant validity* of the constructs. On *composite reliability* of PLS most values fulfill the requirements of composite reliability greater than 0.75, Cronbach's alpha greater than 0.7 (except for Operational Skills). *Communalities* were >0,35 and *Redundancy* was found to hover around *Null* with the exception of Sourcing Criteria (i.e. it could be eliminated).

7.7.7 PLS Structural Model's Test of Structural Prediction and Predictive Relevance

The predictive power of a model was assessed by Stone and Geisser's Q^2. Since the developed PLS model represents a theoretical, causal model, the cross-validated redundancy measure was selected and an initial Q^2value of 0.218 was obtained for the overall model with subsequent values around 0,20, all confirming predictive relevance. We evaluated latent variables' impact on the dependent variable in the structural model, as f^2 values were estimated in conjunction to the q^2 index's effect on *Operational Efficiency* as shown in our summary table below:

Predictive Validity effect tests on Operational Efficiency by removing following Modeled Latent Variables	**Dependent R^2**	**$-R^2$ excluded**	**f^2**	**Q^2 test**	**q^2 index**
eProcurement Benefits	45,5%	-0,1%	0,00	0,20	0,019
Strategic Initiatives	47,4%	-0,1%	0,00	0,20	0,018
Operational Initiatives	47,2%	-0,2%	0,00	0,20	0,018
Sourcing Criteria	47,5%	-0,8%	0,02	0,20	0,018
Operational Skills	45,6%	**-1,6%**	0,03	0,20	0,021
Performance Monitoring	42,2%	**-3,3%**	0,06	0,20	0,018
Objectives Measurement	22,5%	**-5,7%**	0,08	0,20	0,015
eProcurement Objectives	28,1%	**-14,1%**	0,24	0,20	0,018
Operational Objectives	0,0%	**-22,5%**	0,29	0,21	0,007

Table 38: f^2 *and* Q^2 (Stone-Geisser) test with the q^2 index Effect on *Operational Efficiency* by LV removal

The q^2 index shows that all our independent latent variables have a positive effect on the overall predictive relevance of our model. Looking at the remaining R^2 and f^2 columns leads us to believe that the initial LVs are redundant. These latent variables in our nested model show little to no impact on our dependent variable, yer do have an impact on the other LVs as it was shown in Table 34. *Strategic Initiatives*, for example, show insignificant f^2 value for Efficiency, yet its removal as shown earlier has a substantial impact on latent variables like Operational Initiatives, Performance Monitoring, etc., leading to a stronger overall impact on their own R^2 and f^2 values. Also, removing *Sourcing Criteria* in itself shows no impact on overall R^2, but a rather high impact on other LVs like Operational Measurement. All this indicates that in nested models, indirect causation to the dependent LV should be evaluated with caution in that a low influence on explained variance on the ultimate dependent variable, does not necessarily translate into a negative impact on the predictive power of the model as shown by the q^2 index which is >0 indicating predictive validity. It is also noticeable that no single latent variable has a substantial q^2 index impact on the dependent variable, indicating that the model is relatively robust and well-balanced and that not a single construct dominates the others.

7.7.8 Refining the final PLS Construct – Exploring Interaction Effects

In this section of our PLS analysis, we followed the recommendations of Cheng (2001) and Chin (2000) to reach a set of alternative constructs. In effect, we questioned the current final model in that there might be alternative theoretical perspectives that might reverse or amend our subject of study. We commenced our exploratory study of alternative constructs by assessing the potential of interaction effects on our final dependent variable. Then we confirmed whether OLS regression could be used to study direct and indirect effects. Then we tested the hypothesis of recursive causal paths (Chin, 2000), in that our Operational Initiatives LVs might also receive a feedback from the LVs that they influence. Finally, we investigated how far we could "stretch" Cheng's (2001) recommendation of iterative construct development by searching for the minimum set of latent variables (LVs) that maximizes the model's variance explanatory power, i.e. affecting performance in relation to realization of an SRM collaborative enterprise architecture.

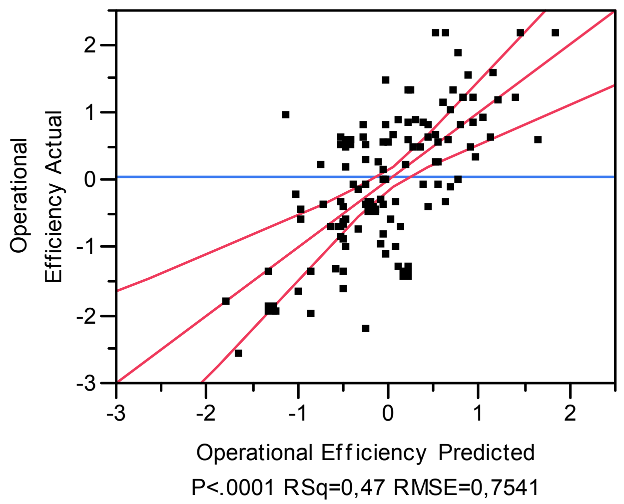
7.7.8.1 Analysis of Main & Interaction Effects - Background

Interaction effects are relevant to a number of research problems in management and especially MIS, as we are measuring effects that are not the sole causal effects to a dependent variable. When an interaction effect is present, the effect of one variable on the dependent variable is different for different values of another explanatory variable. In statistical terms, this effect is referred to as a moderated causal relationship in which an interaction effect is present. Interaction effects may be tested through moderated regression analysis, that is a regression analysis including the multiplicative term of the variables that interact as an additional variable (Gefen et al., 2000). If variables are measured without error, ordinary least squares (OLS) regression can be used to estimate and test interaction effects. If variables are measured with error, OLS lead to biased estimates. A number of researchers like Coenders et al. (2003: 16), states that "…since partial least squares do not correct for measurement error bias, one may wonder what the use is for a correct standard error around a biased point estimate….In the particular case of interaction effects, partial least squares have still one further disadvantage. Under this technique, the interaction term is built as a weighted sum of product indicators (e.g. item1 × item4, item2 × item5,...) that fails to be equal to y1y2, which compromises its interpretation as a proper interaction term." Hence, we decided to initially evaluate of the potential Direct and Interaction Effects with OLS regression.

7.7.8.2 Evaluation of PLS Latent Variables as Direct+Interaction Effects via OLS Regression

In comparison with PLS a standard OLS Regression with the produced Latent Variables as independent variables and direct effects on Operational Efficiency, the dependent one, showed similar results (R2=47%), further confirming that even with that technique there were a latent variables that did not directly influenced higher levels of performance – see the figure below.

While the eProcurement and Performance Monitoring LVs showed significance, most of the other variables were insignificant. What was clear to us was that in comparison to SEM based on PLS, standard multivariate techniques (e.g. OLSR, PCA, etc.) are sacrificing too much data richness and cannot unearth hidden patterns or causality.



OLR with Response Operational Efficiency: Summary of Fit

RSquare	0,471296
RSquare Adj	0,424184
Root Mean Square Error	0,754108
Mean of Response	0,029655
Observations (or Sum Wgts)	111

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	9	51,19988	5,68888	10,0037
Error	101	57,43650	0,56868	**Prob > F**
C. Total	110	108,63637		<,0001

Effect Tests

Source	Sum of Squares	F Ratio	Prob > F	
Operational Initiatives	1,2116901	2,1307	0,1475	
Objectives Measurement	0,4129107	0,7261	0,3962	
Operational Objectives	0,7541372	1,3261	0,2522	
Operational Skills	0,1551198	0,2728	0,6026	
Performance Monitoring	5,2900012	9,3023	0,0029	***
Sourcing Criteria	2,6800191	4,7127	0,0323	**
Strategic Initiatives	0,0028908	0,0051	0,9433	
eProcurement Benefits	2,3181237	4,0763	0,0461	**
eProcurement Objectives	1,7580174	3,0914	0,0817	*

Figure 143: Results of OLS Regression with the latent vars as direct effects (produced in SAS' JMP).

It is obvious that the direct effect OLS Regression model is not sufficient. Hence we continued with a factorial 3-way Interaction Effect investigation with OLS regression model.

7.7.8.3 3-way Interaction Effects analysis with Factorial OLS Regression

As shown our final PLS model, some LVs like *Operational Initiatives* do not directly influence the dependent variable, yet they causally linked to more than 2 other latent variables with significant path coefficients. Hence, in order to replicate our PLS model, we commenced with an OLS Regression where we created the full factorial set of independent LVs with up to 3-way interaction effects. Initially we pruned most alternative interaction effect combinations by using Forward-Stepwise regression in Sass's JMP, then generating the model and re-running the constrained model with OLS regression. The results are reported in the table below, which provides a truncated view of the direct and interaction effects that were found significant (p<0,1). We also provide the statistics for the parameters as to view the Confidence Intervals (lower & upper 95%), and especially the VIF[103]. We also confirmed no Auto-correlations via Durbin-Watson's indice (DW=2,20, Prob<DW = 0,872).

Effect Tests of 3-way Interaction Effects OLS Factorial Regression (R2=0,657)			Parameter Tests of 3-way factorial					
Source	**F Ratio**	**Prob > F**	**t Ratio**	**Prob>|t|**	**Low 95%**	**Up 95%**	**Std Beta**	**VIF**
Performance Monitoring	15,20	0,00	3,90	0,00	0,19	0,58	0,38	2,38
Operational Objectives*Operational Skills*Sourcing Criteria	5,98	0,02	-2,45	0,02	-0,66	-0,07	-0,33	4,48
Sourcing Criteria*eProcurement Benefits	5,80	0,02	-2,41	0,02	-0,65	-0,06	-0,35	5,08
Operational Initiatives*eProcurement Benefits*eProcurement Objectives	5,04	0,03	-2,24	0,03	-0,48	-0,03	-0,37	6,64
Sourcing Criteria	4,68	0,03	2,16	0,03	0,02	0,52	0,26	3,46
Objectives Measurement*Operational Skills	4,51	0,04	-2,12	0,04	-0,48	-0,02	-0,26	3,62
Sourcing Criteria*eProcurement Benefits*eProcurement Objectives	3,78	0,06	1,94	0,06	-0,01	0,52	0,35	8,10
Operational Objectives	3,42	0,07	1,85	0,07	-0,01	0,39	0,19	2,60
Operational Initiatives	3,26	0,07	1,80	0,07	-0,02	0,41	0,19	2,86
Operational Objectives*Operational Skills*Strategic Initiatives	3,12	0,08	1,77	0,08	-0,03	0,50	0,20	3,05
Operational Objectives*Sourcing Criteria	2,64	0,10	1,63	0,11	-0,04	0,41	0,17	2,75

Table 39: Truncated, significant OLSR results of the Factorial Model with up to 3-way Interaction Effects.

Our results confirmed that there were significant 3-way effects (which cannot be tested with the PLS algorithm!). Moreover many LVs are indirectly affecting our dependent variable by interacting with other LVs, which also provides statistical proof that there are intermediate LVs facilitate their effect on Operational Efficiency. Visible examples are Operational Skills, the eProcurement LVs and Objectives Measurement, where non are showing significant direct effects, but rather strong effects by interacting with other LVs. We believe that this analysis also affirms the importance of direct and indirect influence on the dependent based on interaction effects as raised by Chin, Marcolin, & Newsted (1996). Given the above results we then studied the effect of the 3 main direct effects on the remaining LVs. Here we used JMP's Prediction Profiler, to view the change in predicted response as we loaded these LVs to high values while holding the other at mean values.

[103] The resulting variance inflation factors (VIF) for these constructs are between VIF = 2 and 8. According to general rules of thumb (SAS JMP Help manual), values above VIF = 10 allude to a potentially severe problem of multi-collinearity.

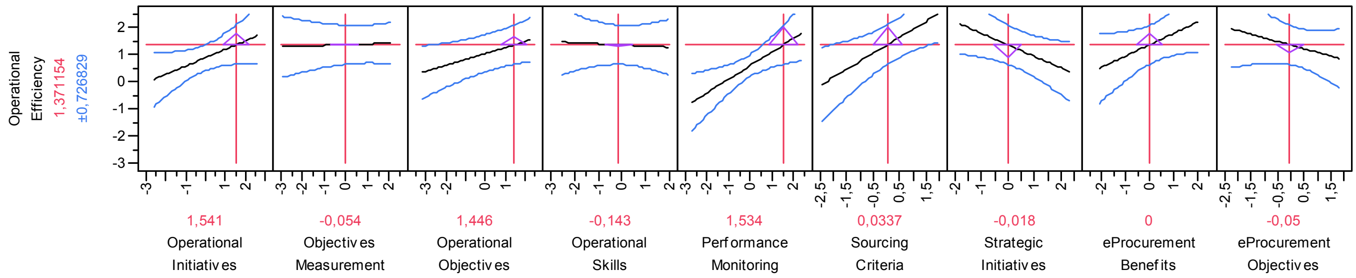


Figure 144: Prediction Profile of the 3-way Interaction Effect Factorial with High Direct Effects.

What is obvious is that high scores on our Operational Initiatives, Operational Objectives and Performance Monitoring LVs lead to higher Efficiency as the horizontal line denotes (score: 1,3). Further, higher scores in the direct ones, lead to lower scores in Strategic Initiatives and eProcurement Objectives, which makes sense given that there is a lower need to further upgrade the skills of resources that are capable of pursuing aggressive Operational Initiatives, setting clear targets and controlling them. What was also interesting is that these 3 main direct effects together with Sourcing criteria (as also shown by the "sensitivity" triangle) lead to higher eProcurement Benefits.

7.7.8.4 Investigating the importance of the 3-way Interaction Effects

The major question we had was whether these 3-way effects were proving that our original PLS model was incomplete. Thus we pursued an additional approach to resolve which effects were important – we computed posterior probabilities using a Bayesian approach[104].

The results shown in the Figure 145 proved that the 3-way effects were reaching appropriate posterior probabilities, yet at the lower end of the scale. On the other hand, 2-way effects were undoubtedtly having an earlier significant effect. Consequently, our current model should be amended to at least incorporate 2-way effects.

[104] This method, due to Box and Meyer (1986, refered from JMP help), assumes that the estimates are a mixture from two distributions. Some portion of the effects is assumed to come from pure random noise with a small variance. The remaining terms are assumed to come from a contaminating distribution that has a variance K times larger than the error variance. The prior probability for an effect is the chance you give that effect of being nonzero, (or being in the contaminating distribution). These priors are usually set to equal values for each effect, and 0.2 is a commonly recommended prior probability value. The K contamination coefficient is often set at 10, which says the contaminating distribution has a variance that is 10 times the error variance.The Bayes plot is done with respect to normalized estimates (JMP lists as Orthog t-Test), which have been transformed to be uncorrelated and have equal variance. Important effects receive high posterior prabadilities.

Term	Estimate	Prior	Posterior
Operational Initiatives	8,177186	0,2000	1,0000
Objectives Measurement	4,869114	0,2000	0,9922
Performance Monitoring	3,439177	0,2000	0,7086
(Operational Objectives-0,00366)*(Strategic Initiatives-0,07465)	-2,824297	0,2000	0,3752
(Sourcing Criteria-0,03372)*(eProcurement Benefits-0,0091)	-2,627194	0,2000	0,2840
(Objectives Measurement-0,06918)*(Operational Skills+0,00378)	-2,415835	0,2000	0,2065
(Operational Initiatives+0,00335)*(eProcurement Objectives-0,01813)	2,294816	0,2000	0,1716
Sourcing Criteria	2,066515	0,2000	0,1218
(eProcurement Benefits-0,0091)*(eProcurement Objectives-0,01813)	2,044605	0,2000	0,1180
eProcurement Objectives	-1,994917	0,2000	0,1098
(Sourcing Criteria-0,03372)*(eProcurement Benefits-0,0091)*(eProcurement Objectives-0,01813)	1,943027	0,2000	0,1020
(Operational Objectives-0,00366)*(Operational Skills+0,00378)*(Strategic Initiatives-0,07465)	1,785706	0,2000	0,0822
(Operational Objectives-0,00366)*(Operational Skills+0,00378)*(Sourcing Criteria-0,03372)	-1,697399	0,2000	0,0733
(Operational Skills+0,00378)*(Sourcing Criteria-0,03372)	1,623463	0,2000	0,0669
eProcurement Benefits	1,539615	0,2000	0,0605
Operational Objectives	1,440070	0,2000	0,0541
Operational Skills	0,894122	0,2000	0,0332
(Operational Initiatives+0,00335)*(eProcurement Benefits-0,0091)*(eProcurement Objectives-0,01813)	-0,834234	0,2000	0,0319
(Operational Objectives-0,00366)*(Sourcing Criteria-0,03372)	0,756946	0,2000	0,0304
(Operational Objectives-0,00366)*(Operational Skills+0,00378)	0,664316	0,2000	0,0289
(Sourcing Criteria-0,03372)*(eProcurement Objectives-0,01813)	0,576172	0,2000	0,0277
(Operational Initiatives+0,00335)*(eProcurement Benefits-0,0091)	-0,434888	0,2000	0,0262
(Operational Initiatives+0,00335)*(Performance Monitoring-0,01158)	0,285371	0,2000	0,0252
(Operational Skills+0,00378)*(Strategic Initiatives-0,07465)	0,256925	0,2000	0,0250
Strategic Initiatives	-0,082500	0,2000	0,0245

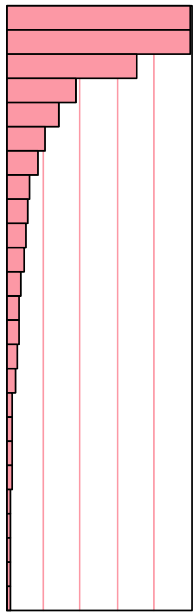


Figure 145: Bayes Posterior Probabilities JMP results with Bayes Plot (high prob's denote high effects).

While the results above are confirmatory, we might add some critical statements. To Gefen et. al.'s (2000) point, we would have problems replicating our PLS model with OLSR and studying the effects of LVs in a causal path-model, as the OLSR equations are created "locally" and then combined in a larger set of interacting OLSR equations, which of course will not allow for an unbiased generation of additional interaction effects across the original ones. This insight affirms our decision to pursue PLS, and is aligned with Gefen et al. (2000:6) stating that SEM techniques "also provide fuller information about the extent to which the research model is supported by the data than in regression techniques". Notwithstanding, OLSR does not have the error bias issues of PLS and also provided us with a view of 3-way effects not possible in the normal PLS interaction effect implementation in our tool SmartPLS.

7.7.9 Final PLS Construct Amendments with Main & Interaction Effects

Within the PLS method, Chin, Marcolin, & Newsted (1996) suggested a method to study Interaction Effects with Reflective Indicators that has been implemented in the SmartPLS tool . Following the recommendations of the authors, we initially standardized indicators for the main and moderating constructs, then created all pair-wise product indicators where each indicator from the main construct is multiplied with each indicator from the moderating construct. Then we executed approximately 30 iterations of the PLS algorithm and T-Statistics in order to prune the 12 interaction effects identified towards a revision valid and statistically significant PLS model. The only interaction effect that survived these test was the joint LV of Operational Measurement and Operational Objectives.

One final amendment we did after reading Chin (2000), was to also study the effect of *reverting* the measurement model of our dependent variable to *formative* indicators after studying the correlation matrix of Operational Efficiency that showed no significant correlations between its options, thus indicating formative attributes. The results of the final model with statistically significant path coefficients tested via T-stat values, is shown below, where the R^2 of the dependent variable (i.e. Operational Efficiency with formative indicators) reached 53,9% while the same model with reflective indicators was reaching 52,5 % of variance explained.

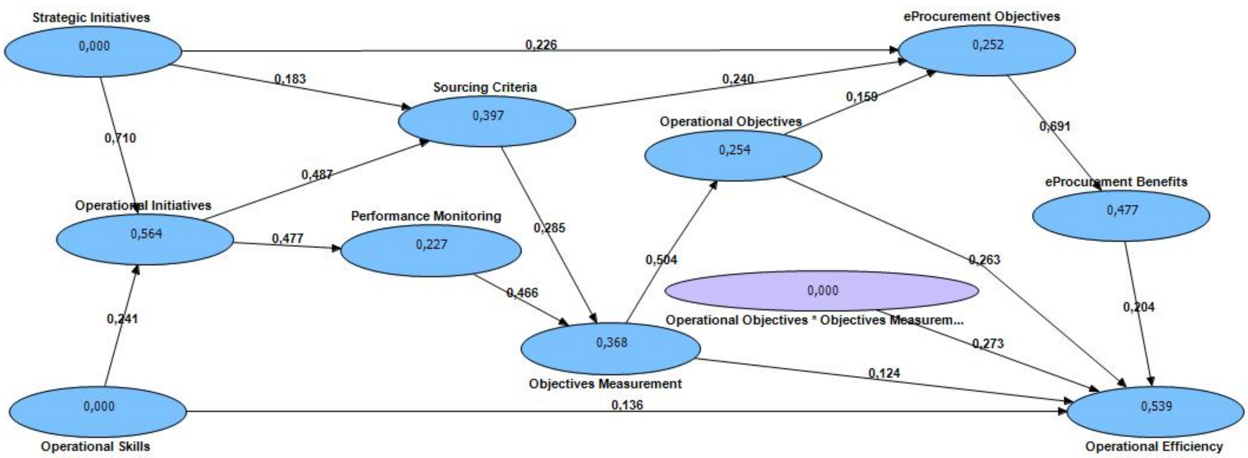


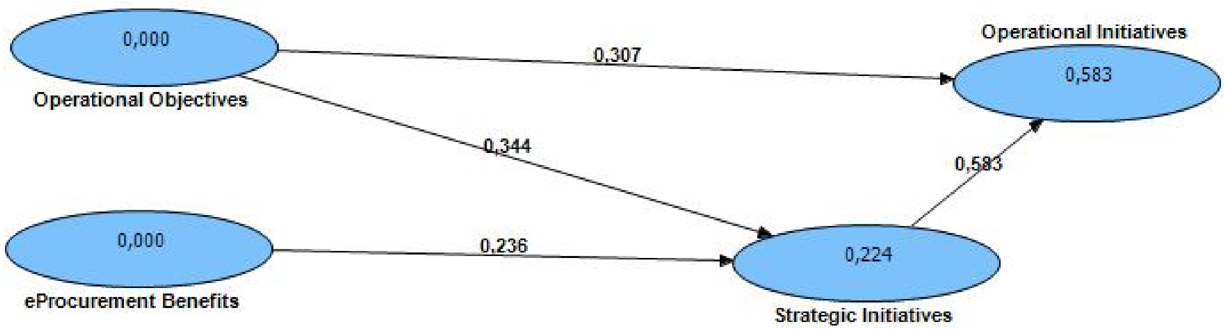
Figure 146: Expanded Final PLS Model with a significant Interaction Effect and revised Path-Coefficients reaching an R^2 of app. 54% (Note: Operational Efficiency uses Formative Indicators).

What is obvious from the above is that interactions *have* an important yet minor effect in our final model. What was also interesting was the revisions taken place among the existing path relationships given the iterations to optimize R^2 and q^2 index of the total model. Sourcing criteria was found to have a more significant relationship with Objectives Measurement, which is more in line with earlier research findings (Gadde & Håkansson, 2001). Moreover, Operational Objectives has a significant path to eProcurement Objectives. Overall the model was streamlined to fewer critical paths, which improved its "plausibility" (i.e. CPI and RPI indexes were higher), thus improving its upcoming interpretation.

7.7.10 Evaluating the "Feed-back" Proposition – Finding the Lead Contributors

One of the advantages of exploratory research is the option to question the direction of causality and then evaluate that. We assessed whether the rather obvious feed-back or "reverse" causality also generated a viable construct. Inspired by the debate of the 70's on whether structure follows strategy, subsequent research has proven that the relationship is bi-directional and recursive (Nøkkentved & Rosenø, 1998).

In the same spirit, we iterated through the reverse model and reached the model shown below. The R^2 of the dependent variable, *Operational Initiatives* of the reverse model was estimated to 58,3%, hence confirming that that reverse causality should be taken into consideration! It seems that Operational Objectives is the main contributor to the variance explained, yet that role was surprisingly shared by eProcurement Benefits, which also influence our dependent via Strategic Initiatives. Removing it halved the R^2 of the dependent.



7.7.11 Evaluating the Minimum PLS Construct of the SRM Adoption Factors

Our final exploration was to attempt to evaluate which of the intermediate latent variables played a significant role in determining efficiency. Hence, we removed all the upstream Strategic and Operational Initiatives LVs and continued pruning our PLS model based on the statistics provided in the previous Table 34.

The intermediate result shown below reverted most of our interdependent LVs in the intermediate layer into direct effects with only Performance Monitoring and Sourcing Criteria staying as background LVs. We then iterated further by removing the LVs with the lowest f^2 from the graph below. After around 80 iterations the result is shown in Figure 148.

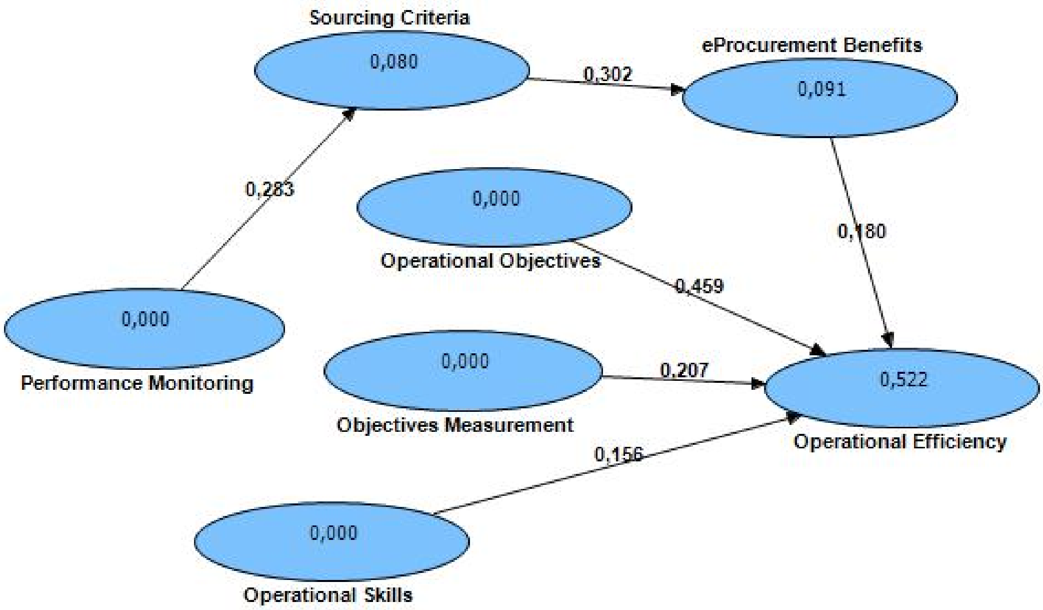


Figure 147: Maximizing R^2 PLS Model of LVs with Significant Paths vis-à-vis Efficiency

As depicted below, while it is evident that documentation and operationalization of unequivocal Objectives linked into SRM is the main determinant, it also seems that a successful realization of IT Enablement leading to recognizable benefits to the organization also positively explains why above than average levels of Operational Efficiency.

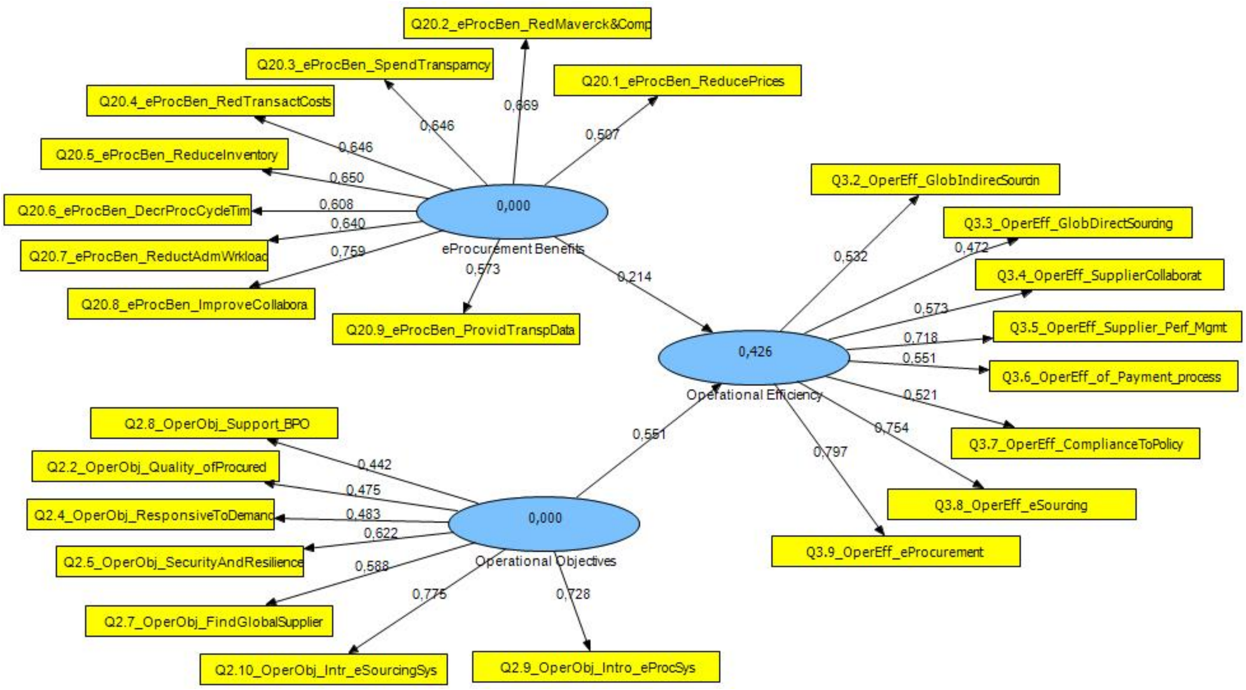


Figure 148: Minimal Effect PLS Model of LVs with Significant Paths vis-à-vis Performance

Given the actual factor loadings of these 2 latent variables in the table below, it is evident that companies that define clear objectives and bring them to fruition via eProcurement and eSourcing systems to pursue collaboration, improved contract compliance, lower transaction costs, improved spend visibility and lower inventory levels are achieving above average levels of operational efficiency. Even with reflective indicators the dependent reaches R^2>=42%, which is significant! No doubt that IT enablement of SRM leads to Benefits!

Q2: What are the main objectives for your procurement operation over the next 3 Ys?	Factor Loadings
Introduction of eSourcing system	***0,74***
Introduction of eProcurement system	***0,70***
Improve security and resilience of supply chain	***0,65***
Find better value suppliers globally	0,63
Make the supply chain more responsive to market demands	0,51
Manage quality of products/services procured	0,48
Support/facilitate business process outsourcing	0,47

Q20: Benefits of an implemented eProcurement Solution	Factor Loadings
Realize real-time collaboration	***0,76***
Reduce maverick buying and increase contract compliance	***0,71***
Reduce transaction costs	***0,66***
Improve spend control and transparency	***0,66***
Reduce stock and inventory	***0,65***
Reduction of administration workload	0,62
Decrease procurement cycle times through simpler or automated processes	0,61
Realize real-time collaboration	0,56
Reduce maverick buying and increase contract compliance	0,54

Table 40: Small Model Latent Variables Indicators with Final Loadings for Options – highlighted >0,65.

In summary, companies that aggressively pursue IT enablement of the SRM domain, in conjunction with being in control of where they are heading, seem to succeed. Such companies define effectiveness objectives such as scanning for quality product suppliers globally, in order to make their supply chain more responsive to customer demand, yet resilient to supplier risk.

Another interesting finding was that some of the objectives that were pruned from the Operational Objectives LV do re-appear as active ones in the eProcurement LV. For example, if companies have successfully introduced IT-enablement, then most of the "standard" SRM objectives like continuous Cost Optimization, reduction of functional and transactional costs, decrease of Inventory levels, improved Contract Compliance and implied reduction in maverick spending are defined and pursued with the help of the eProcurement and eSourcing systems, hence enhancing the productivity of the personnel, and increasing their ability to pursue more complex objectives like quality, global reach and minimized supplier risk (in line with the statements from Gadde & Håkansson, 2001). Finally, it is interesting that IT-enablement provides a better platform for increased real-time collaboration, which is in line with our overall theme.

7.8 Construct Discussion – SRM Adoption Model and Research Themes

After drawing inferences on the minimal model, we will review our Research Themes compared to our final PLS construct, and then reach some practical implications. This section will attempt to provide a summary and then elaborate on our conclusions.

7.8.1 Revisiting the Research Themes in the final SRM Adoption Model

As we mentioned during our analysis and given our previous experiences with the fallacies of conceptual classifications even though these were corroborated in literature or research, we made a decision early on to take the winding road of evaluating the model from the initial surveyed parameters. However we kept the subconstructs conceptualization for explanatory reasons. Hence, we followed Cheng's (2001) incremental approach SEM technique to attain a PLS model that explained most of the Operational Efficiency variance yet still descriptive and theoretical well-founded. Below we present the final model in our original representation. Path line-thickness depict the strength of the path causation, while all characters in *italics* mean that either that the factor was removed or the postulated theme was not proved.

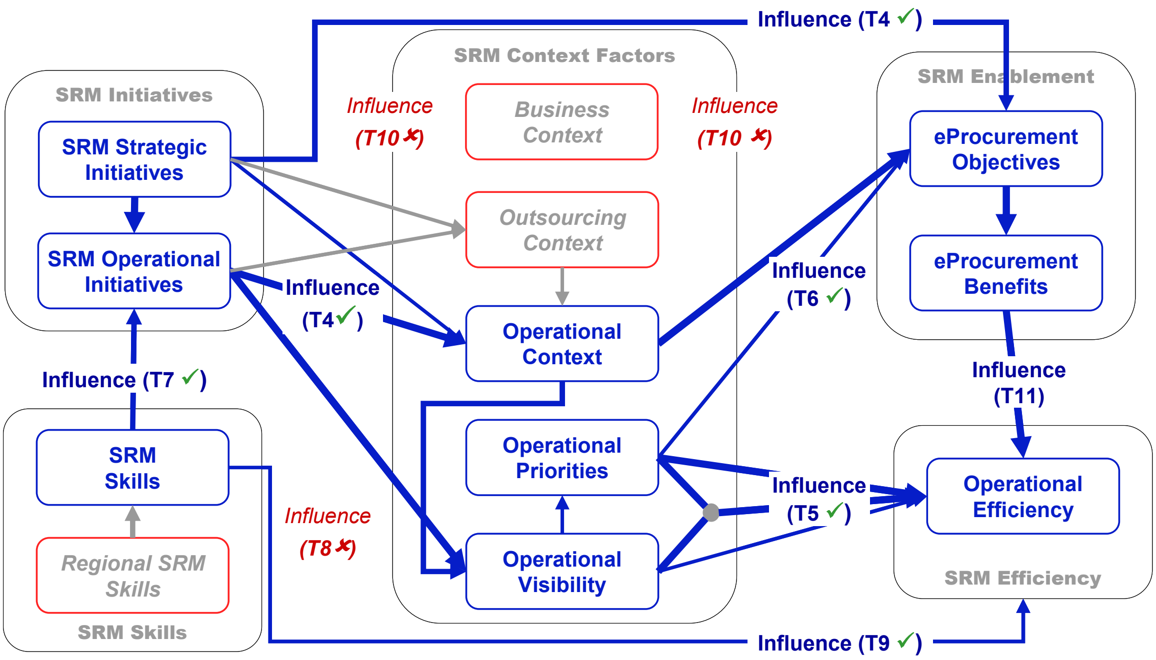


Figure 149: Final PLS Model with Plausible, Significant Subconstructs with Paths vs. Research Themes

It is evident that a number of subconstructs/factors were removed during our analysis. For example, *Regional Skills*, *Business Context* (i.e. Industry) and *Outsourcing Context* were neither statistically sufficient nor causal in our PLS model, while their removal didn't affect Operational Efficiency considerably. Hence they were not as significant as originally thought of or shown in our previous analyses (e.g. OLR). Now, if we look at our original list of Research Themes to be evaluated in this chapter we can deduce the following:

T3. *What are the SRM Contextual Factors that sufficiently characterize the SRM Domain?* No doubt that we proved that our SRM Context Factors do intervene between the SRM Initiatives and Performance, hence concluding that these initiatives only have indirect effect. From the above we can also conclude that the most substantiated factors are the Operational Context, Operational Priorities and Operational Visibility ones.

T4. *Which SRM Contextual factors are influenced by the SRM Adoption Initiatives?* This Theme seems sufficiently supported in our model in that there is significant causal path from both strategic and operational initiatives to our contextual factor. It is primarily our *Operational Initiatives* that significantly influence the Operational-Context and Visibility factors. Strategic Initiatives influence the SRM IT-Enablement's eProcurement Objectives and in a minor degree the Operational Context factor, while it has a substantial effect on its sibling, Operational Initiatives.

T5. *Which SRM Contextual factors influence SRM Domain's Operational Efficiency?* Again this theme is supported primarily by the Operational Priorities (i.e. Objectives) and the Operational Visibility factors (i.e. Measurement & Monitoring). There were numerous interesting findings: 1) Operational Context (i.e. Sourcing Criteria), has no direct effect on Operational Efficiency, and 2) we identified a significant interaction effect between the main effects (i.e. Operational Priorities and –Visibility), indicating that their simultaneous, mutual existence has additional effect on efficiency; 3) Outsourcing had no effect on efficiency, yet before its removal it displayed minor effects to the context and visibility parameters; 4) Business Context was not playing any significant role nether among the Context Factors nor vis-à-vis enablement or efficiency, a finding that was not that was surprised us given that we also investigated direct material sourcing and procurement activities. To summarize, there is a significant evidence to conclude that this theme is supported, yet only for 2 out of 5 factors..

T6. *How does SRM Contextual factors and Initiatives influence SRM IT-enablement?* Our initial formulation here was ambiguous, as we did investigate the state of SRM IT-enablement by the benefits reached and objectives set via implemented eProcurement and eSourcing applications. Yet both Operational Priorities and –Context and Strategic Initiatives influenced the eProcurement Objectives set, which had an indirect effect on Efficiency via its direct influence of eProcurement Benefits. So, from that perspective, our Theme was <u>supported</u>. However, it is important to notice that these contextual factors do not directly determine the benefits of an eProcurement solution, which means that there were other factors we didn't take into consideration. E.g. some of them like Content Mgmt, Supplier Enablement and Change Mgmt were identified in our Qualitative Survey, yet we didn't manage to incorporate them in the survey given size constraints. The CSFs that were in this survey had too few responses to be conclusive in any manner and were therefore not included in the PLS model. Consequently, we can state that the influence postulated is primarily *indirect*.

T7. *How does SRM Skills influence the SRM Strategic & Operational Initiatives?* Our postulated theme was <u>supported</u>, as the Causal Path was significant, but primarily towards the Operational Initiatives. There was no influence on the Strategic Initiatives, which does seem sensible as a closer review of the options in this parameter revealed that these initiatives focusing among other things in building people skills and capabilities. Hence the overall postulated theme has been substantiated and supported. Interestingly, Regional Skills were only affecting the current state of Operational Skills, yet had no direct effects on the SRM Initiatives; it is probably indicative that having or developing such sourcing skills is a prerequisite at least among the companies in our sample.

T8. *Which SRM Operational & Regional Skills influence the SRM Contextual factors?* This Theme was <u>not supported</u> at all, as Operational Skills were not found to have significant influences on the Contextual Factors with the exception of Monitoring in the Visibility factor which was subsequently removed given its borderline T-statistic level.

T9. *Are SRM Operational- & Regional Skills influencing the SRM Operational Efficiency?* Our final model here <u>partially supported</u> this theme, as Operational Skills did have a significant causal path to efficiency, yet its coefficient was not that high. The effect of removing Operational Skills did have a considerable negative effect on the variance we could obtain. It seems sensible that the SRM Capabilities are a prerequisite of successful operational transformation initiative, yet their existence does have an effect on performance

T10. *How does Other Contingencies as Industry, Geography and Size affect our Construct?* We described earlier that these otherwise important contextual factors, did not display any significant influences neither towards initiatives nor towards enablement or performance, hence the theme if not supported. This was a surprising result, which indicates that there might be some unqualified issues. If we can draw a preliminary conclusion that might be that the performance of the SRM domain (i.e. a support process) is less dependent on the industry dimension and more dependent on relationships and domain capabilities, which will naturally be the opposite if we were investigating the Supply Chain Execution domain. Similar results were reached by an earlier study in process infrastructures (Nøkkentved & Rosenø, 1998).

T11. *Does the state of SRM IT-Enablement influence SRM Operational Efficiency?* The state of, and especially the benefits achieved from, an implemented set of SRM applications (like eProcurement and eSourcing) were displaying significant causality with Operational Efficiency, hence proving that the theme was supported.

Our discussion of the results of the PLS Construct Analysis verses our Research Themes has been summarized in a simpler depiction below. The SRM domain's *Adoption Initiatives* and *Operational Skills* are the initial building blocks that transform and affect the current SRM *Context* and *IT-Enablement*, which lead into the higher level of *Operational Efficiency*.

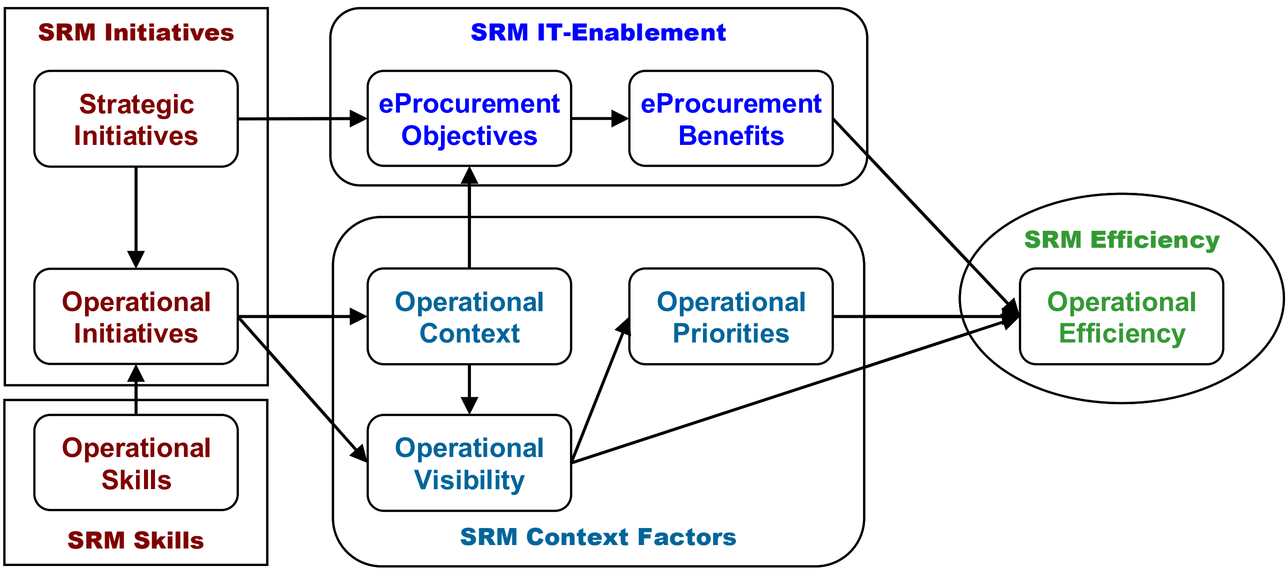


Figure 150: Summary of the Study Findings – The SRM Adoption and Transformation Framework.

7.8.2 Some Normative Recommendations based on the SRM Adoption model

Given the clear set of recommendations we have reached, we tried to describe our findings in the Mosaic below depicting SRM Performance levels versus the Significant Parameters.

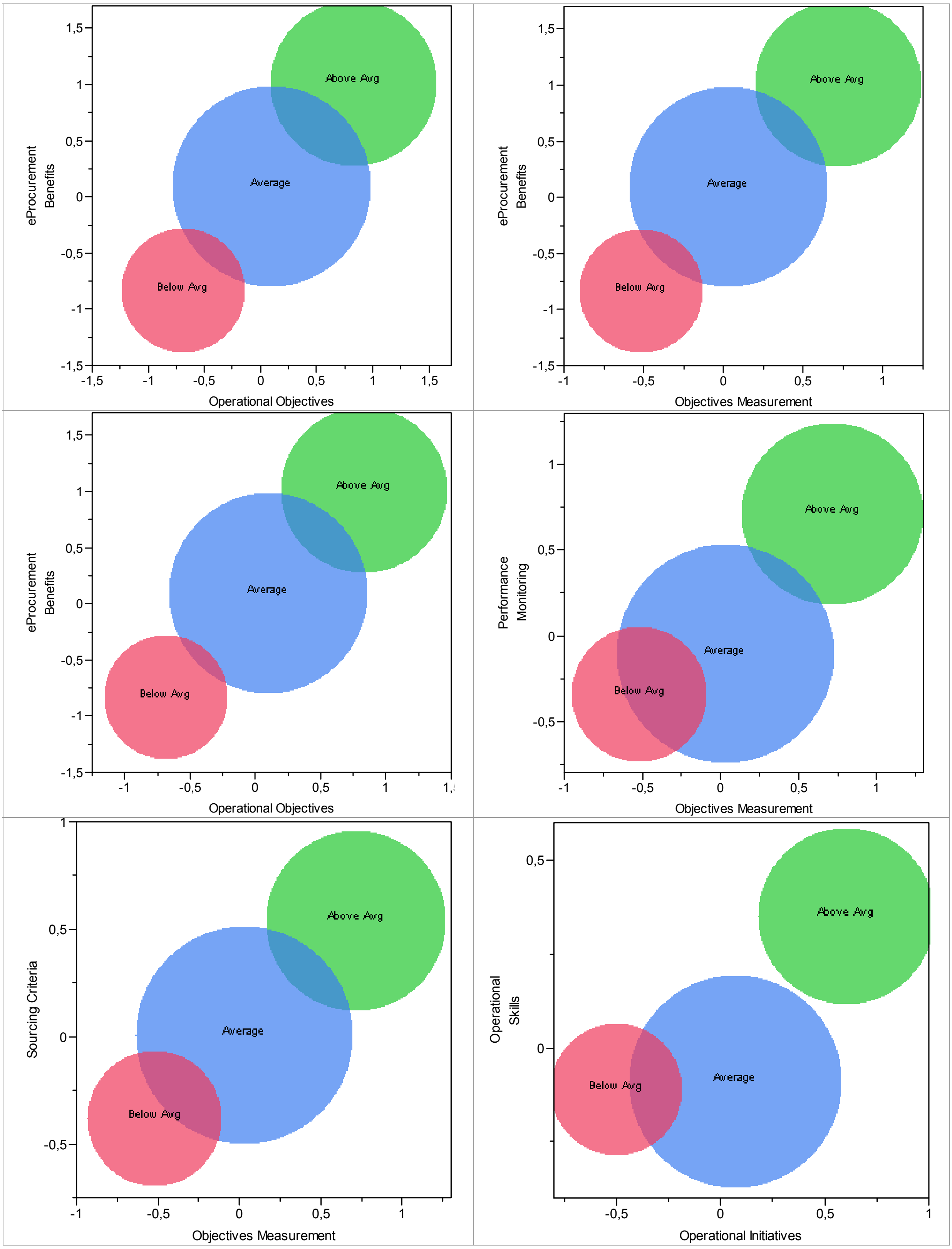


Figure 151: Operational Efficiency Clusters versus the main Latent Variables

I hope one can appreciate the clarity of the implied message in the mosaic – higer levels of Efficiency are related to higher scores of the main parameters! In the following graphs we attempted a 3-D visualization combining some parameters in our model. E.g. the top-left diagram depicts the 3 leading determinants of performance – *Operational Objectives*, *Operational Measurement* and *eProcurement Benefits*. Undoubtedtly, there is a visible separation between the *Above Average* and *Below Average* performers. These results are similar to earlier research findings on the effect of Collaboration on Efficiency of Supply Networks (Dyer & Singh, 1998; Carr & Smeltzer, 1999), and the importance of collaborative measurement based on "trusting" exchanges promoting responsiveness (Ellram & Carr, 1994; Ellram & Liu, B., 2002).

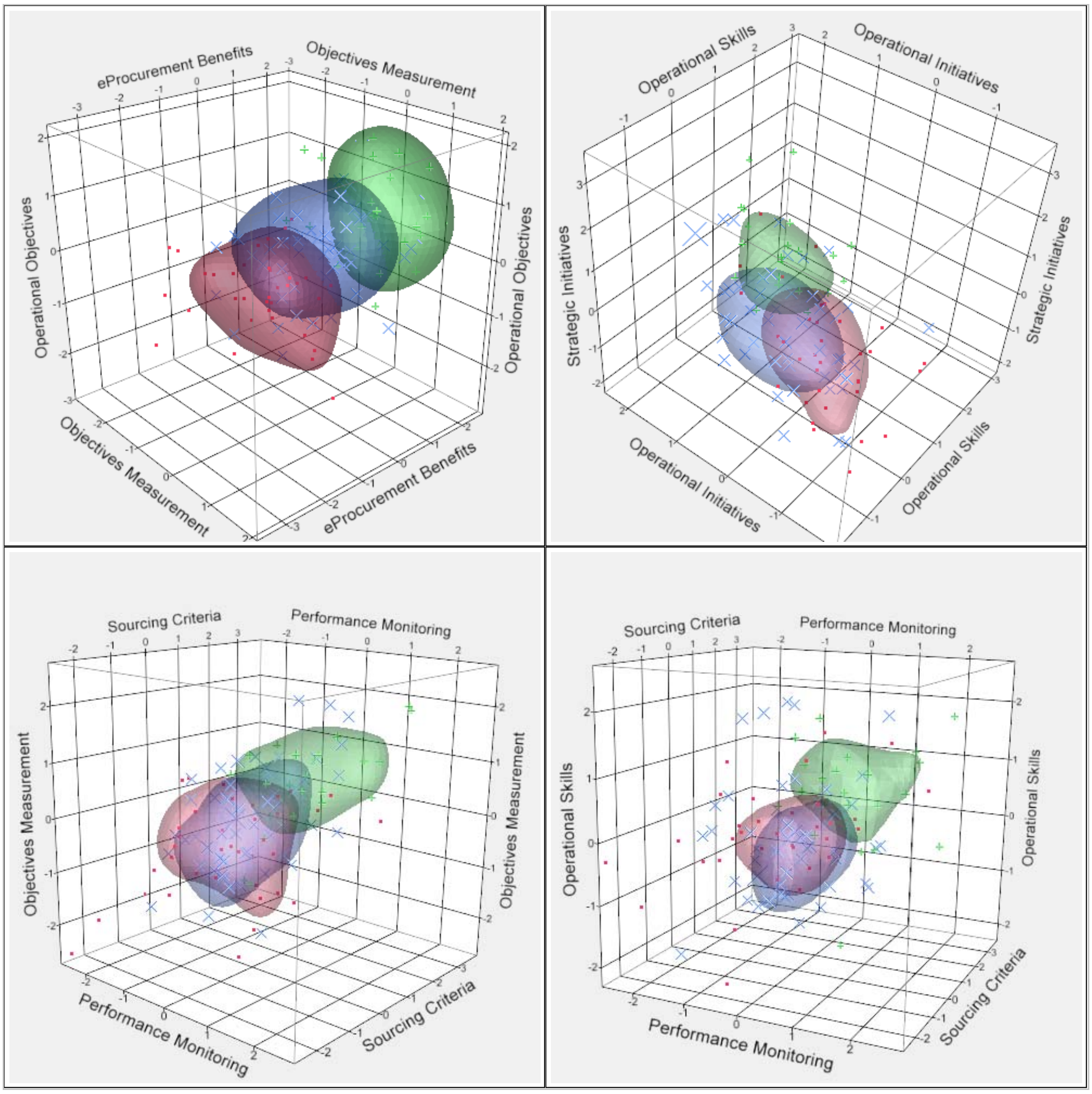


Figure 152: 3-D views on the Above- to Below Avg. Performers and Significant SRM Adoption Parameters.

These insights transition us to one of the themes that did prove difficult to prove. In T14 ("Are SRM Efficient Companies pursuing a broader set of SRM Contextual Factors?"), we took a holistic perspective. The Radar-plot below represents our final piece of evidence and provides an easy view on our verdict. Just as it was postulated by Venkatraman (1994), consolidated by Venkatesh et al. (2003) and Wheeler's NEBIC into perspectives of transformation theory, documented in our domain of procurement and sourcing by Hartmann (2002) and more recently by Angeles (2006), this is an unequivocal evidence that companies striving for higher levels of performance need to play on more "strings" with more commitment and dedication. Such resolution of aligning the business to technology inevitably brings the company to the higher echelons of efficiency and effectiveness as the actors involved become more productive, informed, collaborative, responsive and goal-oriented. We have shown an example and our toolset has moved far beyond the ones currently in the literature (e.g. De Boer, 2002).

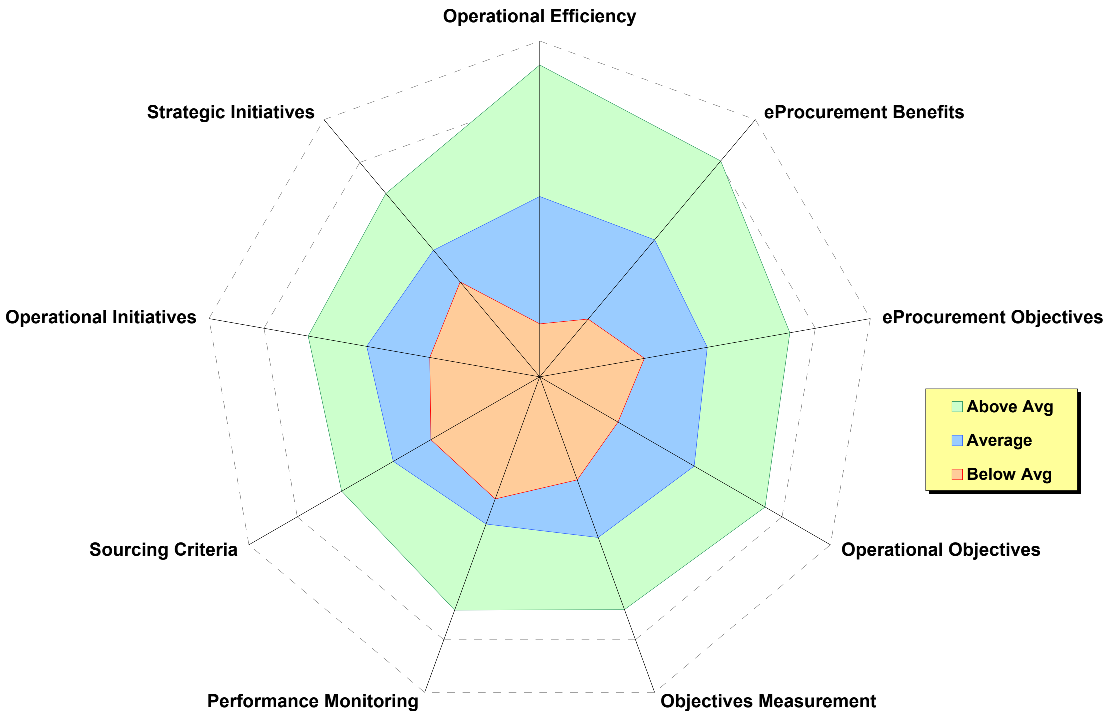


Figure 153: Getting the Full Picture of Multidimensional link of Performance and Context.

7.8.3 Critique of the Quantitative Analysis

After concluding on our analysis we will now backtrack and highlight some of the limitations of this study. Most of the a-priori weaknesses of our model, approach and techniques that were identified in the literature led to our extensive qualitative and quantitative iterations, while the utilized statistical toolsets (i.e. SNA and PLS) were appraised early on.

7.8.3.1 Critique of Statistical Techniques

The result of our constrained data set (in relation to our eProcurement responses N=127 cases) forced our choice of inferential methods like the two versions of PLS (in SmartPLS and JPM) and Neural Networks (Kohonen's Self-organizing Maps) for Clustering. Moreover, we took into consideration direct and indirect effects and interactions between them via Factorial OLR and in our PLS Models. We even used the non-linear PRESS residual estimations in SAS' JMP, to ensure that our model was taking into consideration errant residuals, checked for Suppressor Effects and Redundancy (recommended by Tenenhaus et al. 2005), and used SmartPLS' finite mixture routine (FIMIX) to review whether unobserved heterogeneity was expected in the data (McLachlan & Peel, 2000). A lot of these tests were not reported in this dissertation given space constraints. In all cases we did present multiple sides of our validation process of any construct proposed before reaching any conclusion. We do remind though that PLS – our main construct of hypotheses testing – still has some unresolved issues that surfaced during our study (Goodhue, Lewis & Thompson, 2006).

First, we still believe that the bootstrapping algorithm in SmartPLS used to test significance had a number of deficiencies. For example, SmartPLS uses the value 1 for all weights of a bootstrapped sample block. By performing mental "reverse coding" (Chin, 2000), the different solutions can be aligned. From a statistical point of view, sign changes are not seen an issue (Gefen et al. 2000), yet we became aware that signs of the relationships between the manifest/indicator and latent variables as well as the effects between the latent variables could be affected. While we did perform control runs in JMP, were able to fully validate the results. Further, even if PLS do not require very large sample sizes, bootstrapping methods are sensitive. Coenders et al. (2003:16) highlight that PLS also do not correct for measurement error bias, so "one may wonder what the use is for a correct standard error around a biased point estimate". As mentioned above, to accommodate this issue exacerbated by outliers (which may produce chance high correlation in PLS according to Goodhue, Lewis and

Thompson, 2006), we used JMP's PRESS and also removed extreme outliers among the identified LVs via SAS's JMP *Jackknife distance* metric, followed by a manual case deletion in SmartPLS. Yet that does not prove that we removed all our measurement model error biases.

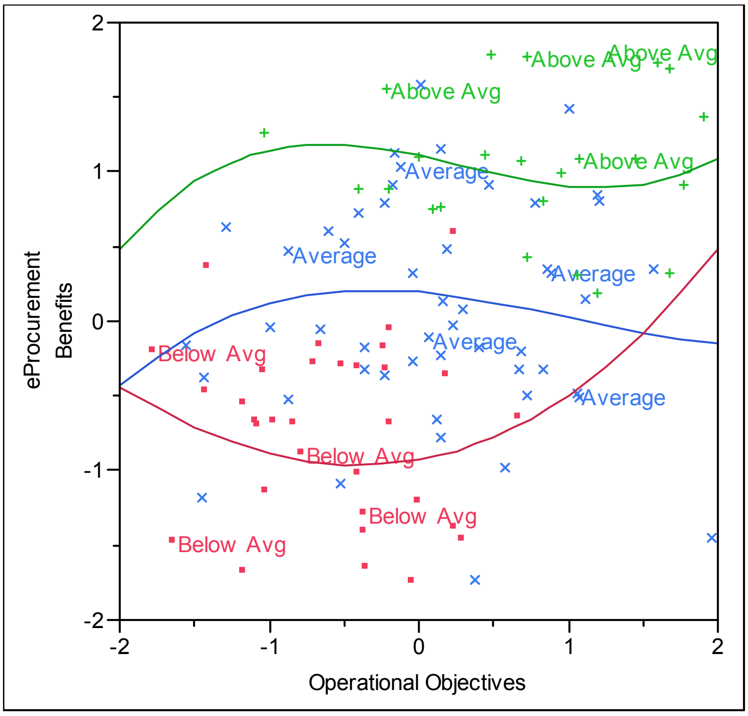


Figure 154: Issue with PLS – Performance Grouped Cubic-Polynomial Fit test of eProcurement Benefits By Operational Objectives

Another downturn of such patching procedures were that we had to reduce 4 cases from the 119 we had after SmartPLS applied case wise deletion! This is a major issue which indicates that we did loose some useful information leading to a inferior dataset. Hence, instead of the typical Null-Hypotheses testing we were only allowed to express plausibility statements (i.e. like the ones we do in our research themes). Marcoulides and Saunders (2006) argued about the issue of a small data-sets and the exacerbated and persisting effect of measurement biases. Even though we used PLS for non-predictive purposes the potential presence of measurement bias is a fundamental and unresolved issue. £

We could have replicated our analysis with LISREL, but our dataset was too small. Maximum-likelihood imputations could have been used to fill some of the missing values, yet the delta was too small to justify such a procedure (e.g. we did only have 127 responses on eProcurement, hence we could not impute values for the missing values).

Even among the extracted PLS model LVs, the regressions while being robust to non-normality, they still tend to favor linear relationships and are sensitive to non-equal variances. These issues were amended by removing the few extreme outliers via jackknifing the sample, yet as soon as we run bivariate regressions with our performance clusters as the grouping parameter and used cubic-polynomials, very vivid non-linear relationships emerged. Thus we should have run the PLS Model per Performance Cluster as a test, but that was not possible given the small set of cases per class/cluster. An ultimate pointer is that the non-linear relationships shown mean that there still might be substantial amounts of unexplained variance among our well-defined construct LVs.

7.8.3.2 Critique of Method and Measurement Models

The grounded theory mode of internalizing and structuring information might have led to an overly inward focus when it came to deployment. While phenomena like Supplier Adoption were identified in the original qualitative survey of the 50 eProcurement SMEs there was a sense that in the second qualitative survey the group, given that all were working with deploying these technologies among large MNCs, had an overly firm-centric perspective. We believe that was one of the reasons why so few discussions and constructs were made on outsourcing which is actually lacking proper initiative support (with the exception of Content Mgmt and Supplier Enablement).

Beyond these issues, a number of areas were not illustrated in our survey, given the need to satisfy multiple agendas in the host company (i.e. IBM) led to a lesser focus on some of the important, "soft" issues that pertain any supplier relationship. While we raised in the flag on trust, commitment as central antecedents of successful collaboration (Gadde & Håkansson, 2001; Dyer, 2000), we didn't manage to investigate these as independent parameters in the quantitative survey. Rather they were inserted as options within broader parameters – for example Collaboration was measured across different Parameters as options:

Q3.4: Collaboration with suppliers

Q12.10: Supplier's ability to collaborate and communicate

Q15.2: Supplier collaboration in product development

Q15.3: Supplier collaboration in managing the supply chain

Q19.8: Realize real-time collaboration

Q20.8: Realize real-time collaboration

We never really managed to reformat some of these into dimensions of Cooperation, Flexibility and Relationship Quality that have been recommended by previous studies (Angeles, 2006), thus we do believe that we invalidated some of our test by not been able to refer to similar studies (which is one of the biggest issues of "open coding" procedures in Grounded Theory procedures that we did follow). In extension to the aforementioned, the informal aspect of collaboration is one of the antecedents of success. Here we focused overly on the "formalized", or established routines of companies in our sample. Subramanian and Shaw (2002) discussed in detail the process characteristics (structured versus unstructured) versus utility of eProcurement. In their findings there are amble situations where unstructured processes are the ones benefiting the most. We did not manage to study these situations.

In general, we took the stance of treating previous research in these areas as sufficient, irrefutable proof, while we ventured into understanding the phenomena of transitions of transformation initiatives and skills into operational efficiency and IT enablement. This is certainly one of major deficiencies.

Another point pertains to the issue of differences between smaller and larger companies; it was not studied in sufficient detail given the time we have had. Moreover, we were lacking information on true volumes of transactional data beyond mere percentages of what was bought under contract. This parameter was omitted from the survey, hence disabling us to conduct objective comparisons of the requirements of SRM among smaller and larger firms. Ultimately, we have done no alignment to company Strategy, predisposition and dominant logic as we did in our previous study (Nøkkentved & Rosenø, 1997) that have evaluated the process infrastructure perspective from a number of strategic, business composition and industry structural issues like degree of diversification, degree of integration and others, which may have differentiated the sample and enriched our perspective of contingency. Even if Ciborra (2001) is overly critical of the IS Research and Strategy Alignment school, we still believe that it would have been a strength to create a more contingent approach rather than the "all for one – one for all" approach of High to Low performance

A final criticism can be made on our choice of theorizing on the premises of subjective efficiency measures. While there is amble support in the literature justifying our choices, it is nevertheless impossible to draw conclusive statements based on the subjective, and biased views on ones' own performance (even if anonymous). It is the destiny of most larger surveys that do promise anonymity as a entry premise.

8. Research Implications

Our research confirmed from multiple angles that procurement and sourcing is moving to center stage among most executives (see Figure 99), especially with their explicit wish and need for external collaboration in operations and innovation, as shown by IBM's CEO Survey 2006. Our research proved that companies around the world are counting on transformation initiatives like SRM to improve the business to technology alignment in order to keep their businesses favorably positioned in today's intensely competitive marketplace. This chapter has been set aside for this purpose[105] – to report our findings from a practical viewpoint of driving organizational transformation with technological enablement.

8.1 Transforming Supply Management[106] – An Executive Review

As a general set of guidelines from our survey results and subsequent analysis, we believe that CPOs can achieve success by focusing on five key areas:

- *From Buyers to Business Partners* – CPOs must overcome a pervasive buyer mentality and position procurement to identify and respond proactively to broader business goals.
- *Beyond Price Optimization - Exploring new value frontiers: It's not just about price* – CPOs need to reorient organizations that are historically biased toward buying raw materials and supplies and convert their thinking and actions to fit the very different demands of capability sourcing.
- *From Transactional to Collaborative Business Models: The best value chain wins* – Procurement organizations need to champion the *full* contribution potential of strategic suppliers, taking proactive steps to seek out value beyond the supply chain.

---

[105] Sections of this chapter are reproduced from an IBM Institute of Value (IBV) CPO 2005 report that the author reviewed and contributed to.

[106] While SRM as a term is providing us a correct term for a Collaborative Supply Network enabled by an Information Infrastructure, *Supply Management* (Dyer & Singh, 1998) is the more encompassing, or "strategic" variant of SRM. It may be defined as "Managing the integrated buying life cycle to proactively build and sustain supplier partnerships and track business benefits over time." (Leenders et al. 2002).

- *Sourcing Intelligence – A world worth exploring:* Procurement organizations have to be prepared to leap hurdles imposed by borders and geographic differences and tap into more cost-effective sources around the globe.
- *Filling the Continuous Capabilities Gap* – CPOs must equip their teams with the necessary skills and expertise to address all of these challenges – and, perhaps more importantly, they must do so in record time.
- *Enabling the SRM Transformation* – IT enablement of the optimized procurement and sourcing operation enables the teams to pursue effectiveness – new ways of adding value to the company. Companies that aggressively pursue the realization and adoption of SRM IT enablement have a higher propensity to differentiate themselves and reach higher levels of operational efficiency.

As procurement influence grows, performance in these key areas will dictate the position of industry leaders and laggards. Too often, procurement organizations focus on one aspect of their role while ignoring others. For instance, it is common for procurement organizations to concentrate so keenly on supplier management that they neglect stakeholder management; companies frequently end up with tremendous supply-side value that never gets realized because their internal customers decide not to leverage it.

To make the most of the limelight, procurement organizations will have to address *each* of these five key areas in a synchronized manner – and use their superior procurement performance to distance their companies from the competition.

8.2 Spotlight on Supply Management – From Efficiency to Effectiveness

For businesses worldwide, the steady beat of market pressures continues. Budget cuts are common. Deregulation and globalization are upsetting the competitive equilibrium. Companies are feeling the squeeze from rising materials costs and, yet, find it difficult to raise prices in a “zero inflation” world.

Meanwhile, the fundamental structure of the corporation is changing. Companies are spending more with third parties and, at the same time, are outsourcing many more functions that were historically performed in-house. Across the enterprise, the increased contribution of suppliers is adding more value – and more risk. Collectively, these factors have elevated the importance of procurement. Today, perhaps more than ever, procurement has a broad and direct impact on corporate performance. And consequently, procurement performance is prominently positioned on boardroom agendas worldwide.

Our survey results suggest that CPOs are beginning to feel the heat of the spotlight. The majority of those surveyed reported procurement savings as *much more* important in the near term (see left and in Figure 99).

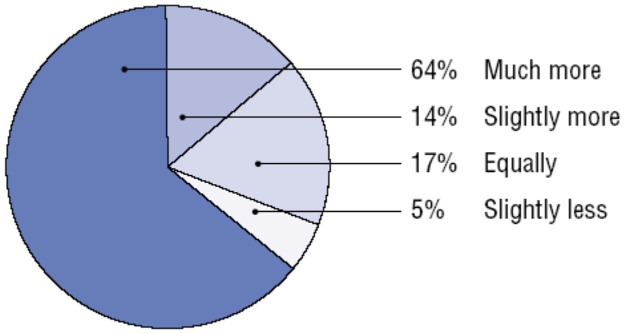


Figure 155: Importance of procurement savings over the next three years (Source: IBM 2005 CPO Survey).

And many of the ones who chose *equally* or *slightly more* offered their reasoning that procurement savings were already extremely important to their organizations.

But cost savings are only part of what procurement contributes to the bottom line. CPOs are beginning to wrestle with bigger, more strategic questions: How can procurement become a stronger competitive weapon? How can procurement contribute to increased shareholder value?

8.3 Transforming Operations towards a Collaborative Business Model

According to the CPOs surveyed, basic strategic sourcing competencies are relatively mature (see Figure 2). As business strategies evolve, procurement organizations are starting to look for ways to create additional value.

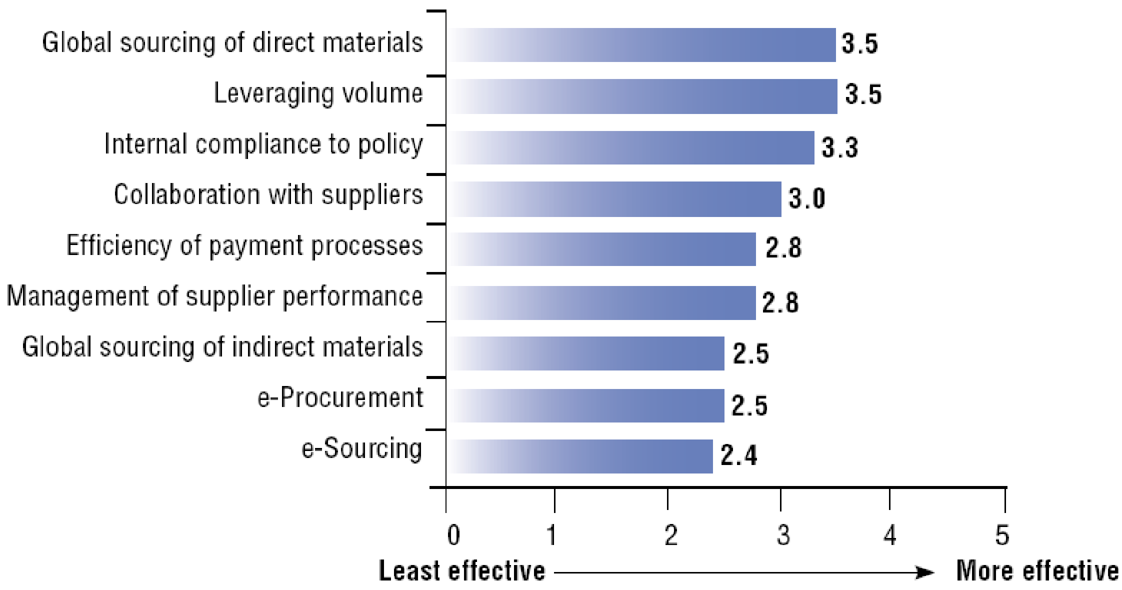


Figure 157: CPOs rank procurement effectiveness higher in historical focus areas (Source: IBM 2005 CPO Survey).

Global sourcing of direct materials Leveraging volume Internal compliance to policy Collaboration with suppliers Efficiency of payment processes Management of supplier. To give their companies a greater competitive edge, CPOs will need to focus on five key areas of change:

8.4 From Buyer to Business partners

To break out of the buyer mindset, procurement organizations have to focus on a bigger picture: the overall objectives of the business and how they can help their internal customers to meet these objectives. Procurement strategies need to be shaped by business strategies – and need the flexibility to adapt as those business strategies change.

Stakeholder engagement remains a constant challenge for procurement. The value procurement provides to the corporation is contingent upon the degree of buy-in from their internal customers throughout the organization. Misalignment between sourcing strategies and business needs leads to

Figure 156: Model better suited to future procurement demands(Source: IBV presentation, 2005).

maverick buying, causing companies to forfeit the value that procurement worked so hard to deliver.

Becoming a business partner involves a mindset shift for procurement – from price to value, products to solutions, inputs to outcomes. To make this transition, CPOs need to invert their traditional models, focusing more on relationship and category management where the opportunity for strategic impact is high (see Figure above). Procurement organizations must serve as the conduit for converting supply-side potential into broad, business value contributions. Shifting to such a model is not simple; procurement organizations will need deeper relationship management and customer service expertise – attributes that are not necessarily intuitive among existing procurement staff.

To stay focused on what matters, procurement organizations also need the right measurements. However, among the companies surveyed, comprehensive, balanced scorecards were the exception, not the rule. Performance measures were heavily skewed toward traditional external results – the price and quality buyers could negotiate – largely ignoring how the procurement organization itself was performing or how well it was serving internal customers. To produce superior results, procurement organizations have to balance both, identifying effectiveness and efficiency measures that are critical to their constituency and putting practices in place to track results.

8.5 Beyond Price Optimization - Exploring new value frontiers

Capability sourcing is totally different from traditional procurement – and it's a game which CPOs feel inadequately equipped to play. Instead of simply negotiating the price of a particular transaction, procurement personnel must understand the nuances of the capability in question, and have the ability to assess a broader variety of factors. With capability sourcing, the focus turns to overall business outcomes, total cost of ownership and the potential for long-term value creation.

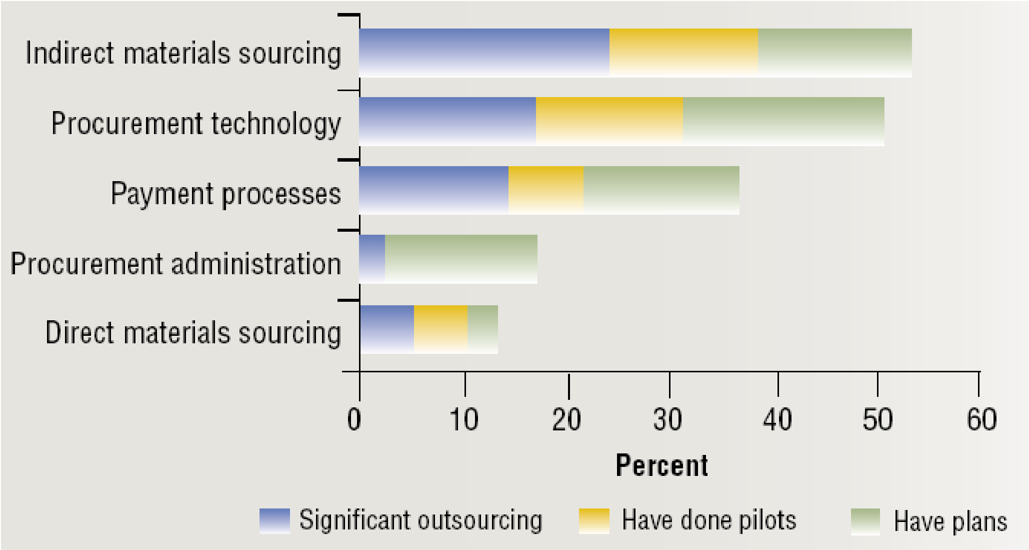


Figure 158: State of SRM Outsourcing (Source: Adopted from IBV presentation, 2005).

Our survey highlighted that CPO's attitude to outsourcing varies by process area, where indirect, accounts payable and procurement technology have been the typical candidates. Most companies still view Direct Materials/Services Sourcing as core to their business, thus still retaining these capabilities in-house.

Since capability outsourcing is new territory for many procurement organizations, the CPOs we surveyed reported difficulty in developing the skills and experience required for this sort of sourcing. Because of its long-term implications, capability sourcing involves a more holistic business perspective when evaluating and selecting vendors. With outsourcing, for example, procurement must carefully assess a potential partner's overall business health and marketplace longevity before entering what are typically multiyear agreements. As capability sourcing expands, procurement organizations must become more adept at forecasting the future – weighing a supplier's future capability, not simply what it offers today. Procurement needs to understand and compare strategies, discovering new areas where a strategic supplier can add value and become more integral to the company's operations. Equally important, it becomes procurement's responsibility to foresee conflicts of interest that might push the parties in different directions and derail long-term agreements.

8.6 From Transactional to Collaborative Business Models

During our interviews, CPOs spoke of continued supply-base consolidation, leading to fewer, deeper supplier relationships focused on long-term value creation. The emphasis on value creation is key. In today's business environment, suppliers do not just "supply" – they are participating in the full product lifecycle, moving upstream into product development and downstream all the way to disposal. Suppliers are becoming tightly integrated into the company's value chain.

The expanding influence of suppliers makes strategic supplier management even more critical. The interviewed CPOs agree – total cost of ownership (TCO) and management of preferred suppliers were considered the top two drivers for supplier value creation (see Figure below). Acknowledging the upstream progression, CPOs viewed product development collaboration with suppliers nearly as important to value creation as supply chain collaboration.

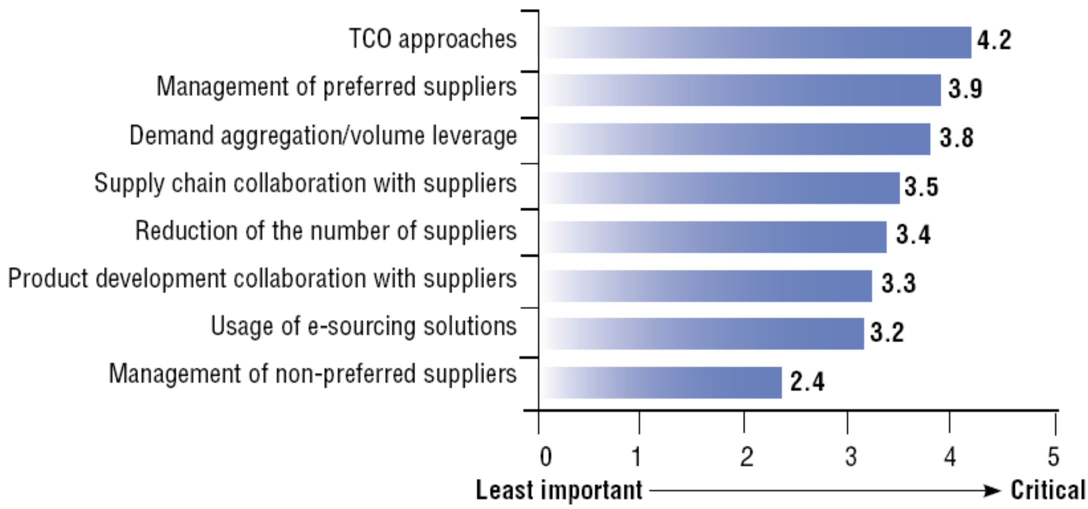


Figure 159: Key drivers for value creation with suppliers (Source: IBM 2005 CPO Survey).

Despite the perceived importance of strategic supplier management, 41% of those surveyed were actively managing less than half of their direct materials supplier base – and management reporting associated with indirect materials suppliers was even less common (see Figure below). Faced with complex relationships and sophisticated contracts, procurement organizations often find that they lack the skills needed to manage supplier performance.

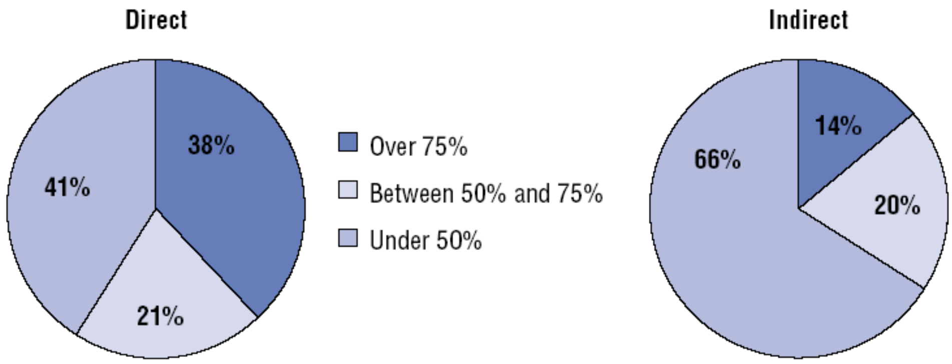


Figure 160: Percentage of supply base covered by regular performance reporting (Source: IBV, 2005)

As supply chain management becomes more digital, procurement organizations must become even more vigilant about nurturing supplier relationships. Engulfed in a world of electronic sourcing, companies have a tendency to slip into event management mode, focusing more on trade processes and less on supplier relationships. Confined to this narrow view, companies can easily miss all the additional layers of value suppliers could be contributing. To stem this trend, CPOs need to insist on a more inclusive approach to supplier management, overtly and purposefully involving strategic suppliers in decision-making processes and change initiatives ranging from new product launches to cost-reduction imperatives to supply chain reengineering.

8.7 Sourcing Intelligence: A world worth exploring

With technology bridging borders and enabling global commerce, the choice of suppliers today is truly worldwide. CPOs are taking advantage, seeking out viable suppliers in low-cost jurisdictions that can offer comparable quality and better price points.

According to our survey results, finding better-value suppliers globally was the number three strategic goal for CPOs (just behind the mainstays of cost and quality). And China was their top destination (see Figure below).

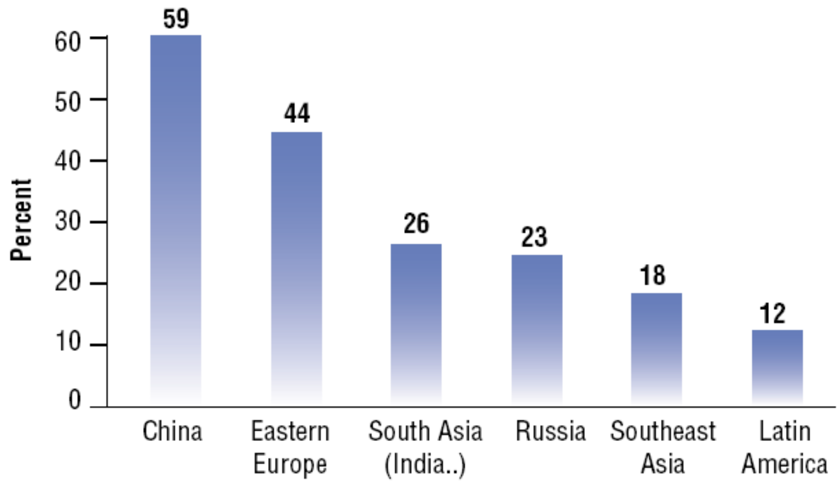


Figure 161: % of planning to increase procurement volumes and upgrade sourcing capabilities in specific regions

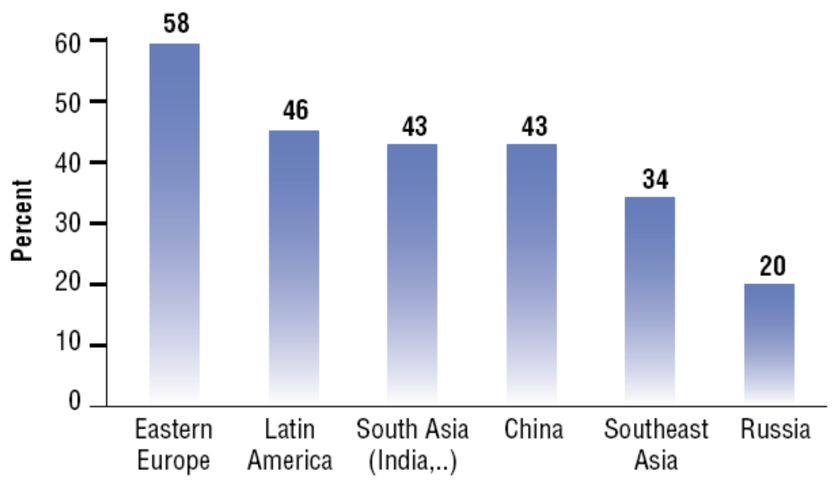


Figure 162: % currently equipped with the right knowledge and skills for procurement regions

With its financial potential, procuring globally also brings challenges and risk. Even if a company can overcome the language and cultural obstacles, the average procurement organization typically lacks the expertise required to establish and manage contracts in different countries – particularly emerging markets. CPOs recognize these shortcomings; while just over half believe their organizations have the right knowledge and skills to address sourcing in Eastern Europe, their shaky confidence dwindles even further when considering Southeast Asia or Russia (see Figure above).

Although CPOs' skill concern is justified, based on our experience with clients, a general, paralyzing fear of global sourcing is unfounded. In most geographies, pioneers have already tackled many of the anticipated issues, and effective risk mitigation and management approaches exist. For instance, because of their small size and relative obscurity in Asia, many large Western companies are adjusting their procurement approaches. Without the purchasing volume or reputation to command deep discounts individually, they are pooling their leverage and sourcing jointly. With such great potential for cost savings, CPOs owe it to their businesses to evaluate sourcing options outside of their traditional purview.

8.8 Filling the Continuous Capabilities Gap

While conducting interviews for this study, a persistent theme came across in nearly every discussion: *a fundamental need for new skills and expertise.* Greater use of outsourcing, more strategic supplier relationships, expanded sourcing in emerging markets, virtually every avenue that CPOs are counting on to boost procurement performance is pushing their personnel into unfamiliar territory. With the corporate role of procurement changing so rapidly, CPOs are scrambling to build enhanced skills and change behavior patterns across their organizations. In fact, the top three strategic improvement initiatives among the CPOs surveyed were all people-related – see figure below.

Figure 163: Top strategies for procurement performance improvement over the next 3 years (Source: IBM 2005 CPO Survey).

In the end, transforming procurement into a competitive advantage depends on winning the battle for talent. With the marketplace's shallow talent pool and internal financial constraints, companies cannot depend on hiring to fill all of the gaps; businesses have to develop expertise among their existing staff. And, with today's economic and competitive pressure bearing down, companies do not have time for traditional staff development approaches. The retrofitting of procurement personnel must happen in months, not years.

8.8.1 A brief Case: Building the Next-Generation Capabilities at BP[107]

As part of most companies' transition from inorganic to organic growth, procurement has been identified as a key value lever in delivering the business strategies. In order to capture this value, the focus has been on taking Procurement from a somewhat reactive, internally facing, service function to a proactive, market facing, business capability. As the organization and accountabilities have progressively moved toward market-facing lines, attention has shifted toward building the capabilities necessary to capture and deliver the increasingly complex sources of value. The first priority has been to build category strategies in support of the business strategies. These were developed in 2004 in consultation with stakeholders using a common framework. Performance management within the function is progressively shifting toward category lines as these strategies become operational.

The next priority has been to build both the skills (leadership, strategic, financial, program management, technical and communication) and the knowledge (business strategies and supply markets) within the organization necessary to capture complex sources of value. BP is using recruitment and coaching to achieve this objective. Recruitment covers sourcing commercial talent from within BP, expanding its graduate programs and finding experienced professionals from outside BP who can fill key gaps (for example, market knowledge/ experience or strategic process expertise). Coaching helps develop the key talent already existing within the organization. BP has taken an innovative, programmatic approach to capability development which it calls the "Capability Accelerator." The approach is designed to compress three years of development into six months through expert, on-the-job coaching. Individuals are independently assessed against "role model" job profiles, and receive a tailored, blended learning plan that covers the full set of skills required – not just technical ones. The program is being delivered in waves to 140 key members of the global procurement community between July 2004 and October 2005.

Program management is being driven internally by BP, with expert coaches coming from both internal (such as BP Finance) and external sources (such as IBM), depending on the module. The program's impact has been encouraging so far, and many of its features, including blended learning and expert coaches, are likely to form part of BP's ongoing learning program beyond this "Accelerator" phase.

---

[107] This section is from the IBM IBV report – it has been entered to exemplify some of the points above (Author: Marc Bourde, 2005).

8.9 Enabling the Supply Management Transformation with SRM

Our research into the best practices of Supply Management provided concrete evidence on whether the use of IT can help the company reach higher levels of performance. IT enablement of the optimized procurement and sourcing operation enables the teams to pursue operational efficiency and effectiveness – new ways of adding value to the company. Companies that aggressively pursue the realization and adoption of such IT-enablement have a higher propensity to differentiate themselves and reach higher levels of performance. In order to adopt such practices that merge business change and adoption of technology, we have identifies a set of proactive *initiatives* that will help and streamline the efforts of the team to reap the benefits of eProcurement and eSourcing applications (see figure below).

		Sourcing *Identify and manage sources of supply*	**Purchasing** *Purchase materials and services*
Strategic	*Development*	**Focus Sourcing Strategy** • Supplier Selection Efficiency • Supplier Rationalisation & Qualification • Right Price Determination	**Enforce Corporate Standards** • Demand (Spend) Consolidation • Compliance Enforcement • Contract Handling Efficiency
Strategic	*Collaboration*	**Improve Supply Visibility** • Product Development Acceleration • Supply Market Intelligence	**Improve Demand Visibility** • Supply Requirements Visibility • Procurement Risk Mgt • Inventory Cost Mgmt
Operational	*Execution*	**Optimal Supplier Management** • Parts Rationalisation • Quality Tracking	**Efficient Purchasing Processes** • Reporting & Communication • Capital Investment & TrackingY
Operational	*Enablement*	**Efficient Supplier Content Mgmt** • Supplier (Content) Enablement • Manage Sourcing Staff • Content Harmonization	**Efficient Enablement+Integration** • Procurement Automation • Manage Purchasing Staff • Supplier (B2B) Enablement

Figure 164: An overview of Supply Management Enablement Initiatives

Each of these management-led initiatives provides a structured guide of actions, metrics and aligned processes and application enablement to accelerate the adoption of technology.

IBM's CPO survey of Supply Management practices also identified that improvements and benefits attained with technology requires compatible changes in the practices, objectives, and performance metrics of the purchasing department.

8.10 Summary and Recommendations

As they reflect on current capabilities and the challenges ahead, CPOs have to ask themselves whether their procurement organizations will thrive or will be outsourced in the spotlight of increased corporate attention. Undoubtedly, procurement performance can have a significant impact on a company's bottom line and strategic positioning in the marketplace. As an organization, procurement must master each dimension of change – not just excel in one or two areas.

Key changes ahead – Speed is critical[108]

- *Becoming business partners, not just buyers*. Focus on business value contribution by enhancing customer service capabilities and category management skills and establishing measurements that track procurement efficiency and effectiveness.
- *Exploring new value frontiers*: It's not just about price. Explore additional capability sourcing options and develop the expertise to evaluate suppliers in a broader, future-state context.
- *Pulling suppliers inside*: The best value chain wins. Nurture supplier relationships to more actively manage supplier performance and seek broader value contributions from key suppliers.
- *Pursuing low-cost sources*: A world worth exploring. Gain the expertise required to evaluate sourcing options, establish agreements and manage contracts in different geographies and use co-sourcing or similar arrangements to reduce risk and increase buying power.
- *Conducting the ultimate talent search*. Equip the procurement organization with the new capabilities needed to achieve all of the above.

And most importantly, accelerate the development of more sophisticated procurement capabilities.

– *Establish an education program*. Develop a formal program to provide tailored education, training, coaching and knowledge transfer activities to staff and drive projects through a structured schedule.
– *Leverage specialized external expertise*. Draw on the strengths and experience of external partners to help the organization reach the desired level of performance more quickly.
– *Integrate the portfolio of capabilities*. Combine in-house and external capabilities to establish a procurement organization that differentiates your company in the market.
– *Capture value from the strategy*. Realize business value from procurement strategy, strategic sourcing and supplier management through the introduction of processes, tools, techniques and best practices that translate performance into financial results.

[108] This section has been adopted from the IBM IBV report to summarize some of the points above. Originally provided by the author.

In companies where procurement offers a true competitive edge, we expect to find CPOs that have won the talent contest, have turned buyers into business partners, consider capability sourcing routine, take suppliers deep inside their operations and who constantly explore low-cost sourcing options wherever they emerge – from Toyota's Supplier Associations to IBM's Supplier Implants (Dyer, 2000).

A strategy of transformation may look good on paper, but never materialize! What we do recommend is to take *action* – transformation must become a way of life in the corporation. Already by involving a cross section of people from your organization and your closest suppliers in the evolution of a Supply Management strategy, the ground work is made for acceptance and consensus.

However, that is not enough, the job of management is to constantly show, through actionable guidelines and measurable actions, that the strategy should be taken seriously, and that it is indeed the one sponsored. Indeed, management should constantly communicate and mobilize consensus within and across its supply network and let their company learn to "cope" with the necessary consensus in order to gain "insights" into its partners' priorities and "leverage" the advantages they may provide.

9. EPILOGUE – INFORMATION ORDER & ENTROPY SPIRALS

"Don't' Thou Despair – The Shore is Near – Just Watch out for them Birds!"
Cristobel Columbus (halfway to the New World) from Gavin Menzies: "1421".

9.1 Logbook – where are we heading?

What a journey this has been. What did we see and learn? For sure, enablement of complex, collaborative supply networks with information infrastructures may lead to a highly-probable, though slow, Lamarckian evolutionary mutation, rather than a revolutionary inflexion of current business practices in Supply Management among Industrial Organizations. Notwithstanding, the value of using information technology may not significantly improve until the company re-invents itself to embrace internal and external transformation – not an easy undertaking! That's what we found out – it is substantiated but simple.

In the course of this study we have encountered and puzzled over the issues faced by companies during their deployment of IT-based information infrastructures supporting management of their supplier relationship activities. We identified a number of business-level initiatives that affect actors, activities as well as resource adaptations in companies, yet are necessary to enable an organization with these technologies. These were then grouped into information technology enablers and a conceptual construct was presented defining their interdependencies. Based on the results of our investigation and the conceptual analysis, theoretical and practical implications were drawn and presented at length. While implications were supposedly self-explanatory based on the need of companies to structure their B2B efforts in a time & efficient manner, our recommendations regarding the former has wider repercussions for studying the role of technology within the setting of industrial networks[109].

[109] According to Latour (1987: 180): "The word *network* indicates that resources are concentrated in a few places—the knots and the nodes—which are connected with one another—the links and the mesh: these connections transform the scattered resources into a net that may seem to extend everywhere. Telephone lines, for instance, are minute and fragile, so minute that they are invisible on a map and so fragile that each may be easily cut: nevertheless, the telephone network 'covers' the whole world."

9.2 Dreamscapes and Actants – Technology to Business Alignment

Recalling our initial citing of Malone's Delphian perspective on the effect of the technology transformations and the parallel need to transform the organization, hence viewing transformation as a "synchronous hybrid" of Social and Technical, seems to have been corroborated by our research – it was shown as a plausible scenario.

Alas, our journey has followed a subjective trajectory of altruistic belief in the well-intendeness of both these entities in this socio-technical ecology. Actions and guidelines for the creation of hybrid-aligned view were sought in theory and practice, and we found what we desired. What we visualized of the unearthed was its shiny side – the constructivist view of engineering. We have forced a mesh of truth over our unearthed artifacts and used supposedly precise instruments to weigh and draw them, to reconstruct their hidden purpose and truth. It's all for the purpose of insight and good science. What we consciously ignored were the split sides of these artifacts – hence explaining the "monstrous" denomination. *Action* and *Inertia* – the first not thought of, while the second bypassed.

We did earlier explain that Information Technology enables infrastructures that resemble the business networks they are supposed to enable, thus replicating on a lot of the attributes of Human-to-Human networks. Hence, after our quantitative analysis we concluded that transformation in industrial networks need to consider information infrastructures as powerful actors or actants[110] containing powerful capabilities, resources and handling activities on their own, only emerging as large *leviathans* (Callon & Latour, 1981) to the surface for a playful interaction with these other beings. While it all sounds so Latour'ian in extreme sense, these same leviathans feeding on the same plankton, *information*, are currently affecting human activities and perceptions beyond their grip on the various resource constellations floating

[110] While 'actors' are normally understood as conscious beings, *actants* comprise all sorts of autonomous figures which make up our world. Actants can be anything endowed with the ability to act, including people and material objects: statements, inscriptions (anything written), technical artifacts, a human being, entities being studied, concepts, organizations, professions, skills, money etc. (see Callon 1991: 135–142; Law 1992: 381–384). "No actant is so weak that it cannot enlist another - then the two join together and become one for a third actant, which they can therefore move more easily. An eddy is formed, and it grows by becoming many others." (Latour 1988: 159)

within and among their *ecologies* (Håkansson & Snehota, 1995; Burgelman, 1991). What Malone urged us was to conduct an agile swim or synchronized underwater dance between these two "monstrous hybrids" of the human mind – organizations and technology.

Our naïveté though is obvious in that we conceive our dancing arrangement predefined – the human-to-resource roles seem solidified. In truth, we humans, the cells of the one ecosystem, took the vantage point of control even if our best theorist preach that we can only "cope not control" these ecologies of networks[111]. This dancing arrangement will shift in position and intensity as the roles are shifting – from lead to follower and back again, just as the reach of the polished floor appears. Hence, large information infrastructures[112], these other unintended leviathans, live in nomadic[113] ecologies[114] and have a role in acting too[115] - in other words they should be viewed as entities participating in actant[116] networks[117] that indirectly affect us – actors - being individuals, groups, companies or business networks.

We have to be cautious then when we fable about change, we have to account for the so-called *context* in the one entity while *installed base* on the other. Does this change when we perceive

---

[111] Ford, D. (ed.). (2002).

[112] An *Information Infrastructure* can be defined as a socio-technical construction containing actors, resources & activities enabled by ICT, yet extending beyond the boundaries of the focal firm's business network (Hanseth 1996). In information infrastructure, every conceivable form of variation in practice, culture, and norm is inscribed at the deepest levels of design. As Star and Ruhleder (1994, 253) characterise it it is "fundamentally and always a relation"! The larger the information infrastructure becomes, the more irreversible it turns.

[113] In the infrastructure is included technology, personnel with their basic education and competence, buildings, systems of transport, finance, laws, a market, and so on. Organizations are, of course, vitally dependent on such an infrastructure. As they grow in power, they will try to control it, to ensure its well functioning. They will incorporate aspects of the infrastructure within the organization, or build their own alternative infrastructure, rather than having to depend on public resources partly beyond their control. (Bo Dahlbom in Ciborra, 2000).

[114] Infrastructures are connected into ecologies of infrastructures and in that respect they are are layered - linking logical related networks - and integrating independent components, making them interdependent. (Renkema, 1998)

[115] "A Large Information Infrastructure is not just hard to change; it might also be a powerful actor influencing its own future life - its extension and size as well as its form." (Hanseth, 1996)

[116] Information Systems as Actants? Let's explain again – the concept of *actant* means an independent entity with the potential to <u>become</u> an actor in a given topology or multiple ones simultaneously, perhaps performing and behaving differently in various topologies depending on its relative position in the respective network. *Information Infrastructures* mobilize large networks of other *actants* (i.e. software, software vendors, hardware vendors and service providers) plus actants delivering a constant stream of renewed and tested knowledge, e.g. companies collaborating closely with the software vendors (Walsham, 1997).

[117] *Actant-networks* are associations of many different actants or actors which interact through what John Law has called 'heterogeneous engineering' (Law 1987: 113; see also Law 1992; 1994; Latour 1988). "An actor network is simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of." (Callon 1987: 93) "Nothing is, by itself, either knowable or unknowable, sayable or unsayable, near or far. Everything is translated." (Latour 1988: 167). As a result, heterogenous actant-networks emerge: within them every actant is connected with, depending on, influencing, and strengthening the position of every other.

these infrastructures of information as Actants? A number of theorists view these same Information Infrastructures as vehicles of organizational & relationship transformation[118]. In spite of that, resistance to change – or *inertia* is a shared anthropomorphic attribute of our leviathans – the mutually embedded organizations and information infrastructures. So we are rambling about Business Model innovations and transformation, all very radical, yet oft served as incremental, while on the same time what is certain is that such truisms will fail blatantly (Ciborra, 2001). What we really need is something to unlock inertia among these information[119] automata – and that is the opposite of what we learn, teach and sell – disorder!

9.3 Designing Business Model Innovation with Information Entropy

Claude Shannon, who was an engineer at AT&T's Bell Laboratories, introduced the term *information entropy*[120], but his theory, nevertheless, became known merely as a theory on information. He emphasized that his theory was not about communication but about transmitting information, Well, back to disorder! Our challenge in transforming or creating an information infrastructure is to ensure that actors get the most relevant, exact, timely information presented in a format that accelerates internalization. Such pertinent, quality information is the result of minimizing information entropy, since entropy is the degree of uncertainty or disorganization or even decay. Some of the leading actants, the enterprise application vendors (i.e. SAP, Oracle & Microsoft), promise that by integrating, harmonizing, and equalizing the multitudinous actant set on their information infrastructures – we reach the zenith of quality. Yet, order breeds equalization and the leviathans do not want that. Even by using the same standards like CPFR, one will certainly find the two transnational Cereal giants using the same standard Process, XML documents, SAP software, SCM application, IBM middleware to exchange, ordered information on the same products, categories and compatible

[118] An Enterprise System imposes its own logic on a company's strategy, culture and organization (Davenport, 1998). "Like any actor, the technology, playing the role as a powerful change agent, leads human actors or coalitions to build ever-shifting alliances with others … become instrumental in the journey of organizational transformation". (Hanseth, 1996).

[119] In the words of Bartlett and Ghoshal (1992:140): "In the information age, a company's survival depends on its ability to capture intelligence, transform it into usable knowledge, embed it as organizational learning, and diffuse it rapidly throughout the company. In short, information can no longer be abstracted and stored at the corporate level; it must be distributed and exploited as a source of competitive advantage."

brands talking to the same Retail giant's Outlet in the same country and same city to the same person or actor. Notwithstanding, one can presume that each giant will introduce tweaks or add to it (call it value-added services) in order to differentiate and provide a sense of higher quality of product, insight and information. Hence, when the standards wars on minimizing information entropy are over, then their actants often introduce such uncertainty for the sake of differentiation, or incremental innovation. Consequently, the information automata starts all over again never reaching the wanted equilibrium – reaching such a state will presume equalization (and industry consolidation).

So, while the advertised objectives of business process management and standards are usually to make processes more efficient by minimizing their time and cost, it is important that we use the same tools to do the reverse – entropy should not always be minimized to the degree that it becomes predictable and stale, creating boredom and perpetualizing past modes of behavior by providing "full visibility". Information as a discrete entity also needs to inspire the actors and actants of the ecosystem hence introducing wonderment and uncertainty screaming for more effort to fathom and treat. On the other hand, too much randomness and uncertainty, high entropy, renders processes and actants aimless in that there is no meaning; i.e., actions and information exchanges are unpredictable. With very low entropy, there is no surprise as everything is predictable, i.e., routine-type processes. Some will equate low entropy with transactional processes (like payroll in an ERP HR system), which could be true for some cases. Yet, even here we could dispute whether a process should not be questioned. If that is the case then we are talking about true utilities – who wants to understand how remote automated metering works – we just want to have a glass of water. If we apply the same argument to information technology, just as Carr (2003) attempted, then the whole dancing game falls apart. The other leviathan, or actant, dives into other hunting grounds. Or even worse it goes off to feed close to another competitor!

Information infrastructures need to be constantly questioned, awakened, pushed and stretched to make all dependent actants uncertain hence raising the bar of new thinking. If we don't, then they, like us, given their inertia tendencies, degenerate into stale immovable automata of "high quality" information. My point is that we need to design Information Infrastructures with an

---

[120] Shannon's *information entropy* is a measure of the average information content the recipient is missing when they do not know the value of the random variable. In information theory, Rényi's entropy, a generalisation of Shannon entropy, is one of a family of functionals for

element of *dynamic balance* that is optimal for the purpose of the organization or business domain. We need to introduce *entropy* (unpredictability) in the right places, to produce maximum effect: e.g. making a statement that people had not expected, but which rings a bell or is full of connotations and symbolism. Alternatively we could introduce entropy to enable innovation; i.e. new (and unpredictable) combinations of information, switching the information templates broadcasted to managers and introducing blank graphs: "sorry we don't have that information". But also predictable messages can be very effective, since people have seen them before, or at least in part, and are therefore adequately familiar with them to know how to act. So we need to balance stability with instability, breaking with building, controlling with letting loose, and steering with coping, deliberate with emergent. These are the terms that Ciborra (2001) so eloquently summarized under the banners of innovative transformations of the inertia-prone information infrastructures – *drifting, bricolage and cultivation*.

9.4 From Current to Future Research…

What can we learn from all that? Our analysis showed a deterministic link between performance outcomes, technology enablement and organizational context such as objectives, measurements and monitoring. We also proved that there is an intermediate context block of organization and technology before we reach operational efficiency as shown below.

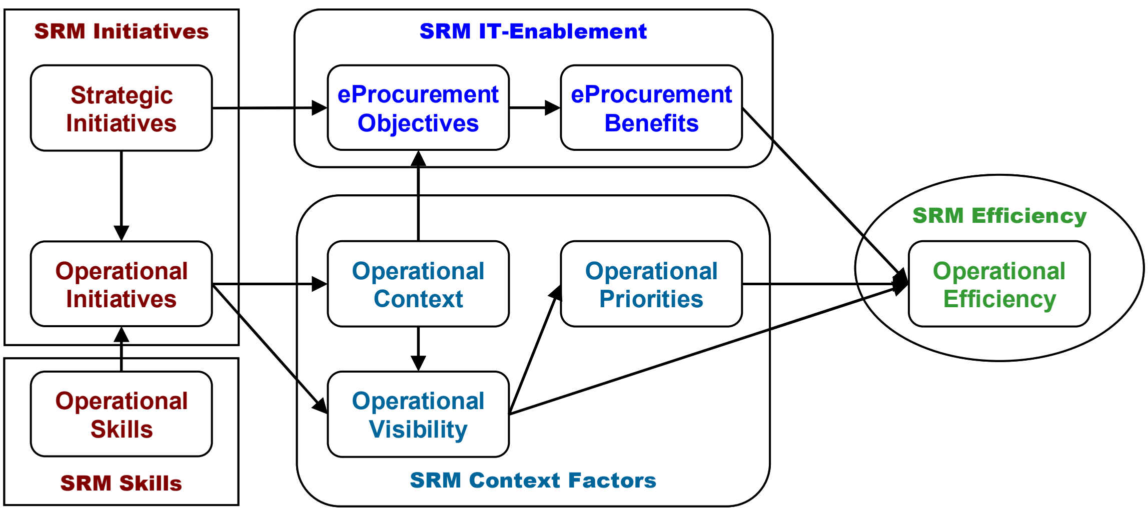


Figure 165: Summary of Findings: SRM Adoption and Transformation Framework

quantifying the diversity, uncertainty or randomness of a system. From: http://en.wikipedia.org/wiki/Information_entropy .

It is evident that great initiatives and well-defined capabilities do not by themselves lead to great performance. Moreover, we also concluded that we need to ensure some uncertainty in both of the intervening contextual domains of business operations and technology enablement to ensure that the automaton does not fall into decay, while everyone around blossoms.

What it also means is that we need to consider the effect of our insights into untraditional modes of research and into venues that will gain from the fruitful marriage of industrial networks and information infrastructures. Here we are thinking loud about cross-fertilizing these ideas and researching their effect on the latest paradigmatic shift in enterprise applications design and architecture – SOA or Service-oriented Architectures[121] – which will definitely be the vehicle for architecting more expansive and ubiquitous Supply Networks of the next decade….

[121] *Service-oriented Architecture* (SOA) as a recent paradigm - is currently advancing to the point where IT can achieve flexibility in building sustainable orchestration into business processes without affecting stable business processes. A service-oriented architecture (SOA) is an application framework that takes everyday business applications and breaks them down into individual business functions and processes, called services. SOA lets you build, deploy and integrate these services independent of applications and the computing platforms on which they run. The key change from the earlier Client/Server paradigm is that SOA requires that a business process originally inscribed into a packaged applications' logic layer, is detached from the code by orchestrating process steps based on "services" offered by the applications. SOA is thus driving the flexible management of business processes by using services with specific attributes . From the business viewpoint, SOA is a set of business/ organizational, process, governance, and technical guidelines/methods to enable an agile, business-driven IT environment for greater competitive advantage. It provides the flexibility to treat business processes as well as the underlying IT infrastructure as components that can be reused and recombined to address changing business priorities. Thus, in essence, SOA is the map that guides you down the road to competitive advantage. Here is a brief defintion: "A service-oriented architecture is a framework for integrating business processes and supporting IT infrastructure as secure, standardized components - services- that can be reused and combined to address changing business priorities". The main tenet of SOA is to achieve "loose coupling" among interacting software agents, where a Service is a unit of work done by a service provider to achieve desired results for a service consumer. What is unique about SOA is that a service becomes the new unit of measure for organizing software solutions. Services can come in many shapes and sizes, from simple function calls or APIs wrapped as Web services, to composite multi-step business processes like order-to-cash. In SOAs software functionality as loosely-coupled, business-oriented Services. It is important to remember that SOA is more about Architecture than Web Services! The key driver for Business Model transformation is Business Agility rather than technology . Actually,"there can be valid SOAs that do not define a single WebService and instead use existing technology such as mainframe, transactional or OO systems. Similarly, there are valuable Web services implementation projects that are not valid SOAs, because they do not address business value, componentization, true re-usability and flexibility that SOAs can and should provide" - e.g. integration initiatives can use web services for standards-based communication. So, SOA should be viewed as an architectural paradigm, which requires a translation of business vision and strategy into effective enterprise change by creating, communicating and improving the key principles and models that describe the enterprise's future state and enable its evolution.

9.4.1 Final Anthem…

This anthem should complete this journey – as a gift here is a favored poem, befitting journeys pursued by nomadic souls in search of a destiny…

"Ithaca" by C.P. Cavafy

As you set out for Ithaca
hope the voyage is a long one,
full of adventure, full of discovery.
Laistrygonians and Cyclops,
angry Poseidon—don't be afraid of them:
you'll never find things like that on your way
as long as you keep your thoughts raised high,
as long as a rare excitement
stirs your spirit and your body.
Laistrygonians and Cyclops,
wild Poseidon—you won't encounter them
unless you bring them along inside your soul,
unless your soul sets them up in front of you.

Hope the voyage is a long one.
May there be many a summer morning when,
with what pleasure, what joy,
you come into harbors seen for the first time;
may you stop at Phoenician trading stations
to buy fine things,
mother of pearl and coral, amber and ebony,
sensual perfume of every kind—
as many sensual perfumes as you can;
and may you visit many Egyptian cities
to gather stores of knowledge from their scholars.

Keep Ithaca always in your mind.
Arriving there is what you are destined for.
But do not hurry the journey at all.
Better if it lasts for years,
so you are old by the time you reach the island,
wealthy with all you have gained on the way,
not expecting Ithaca to make you rich.

Ithaca gave you the marvelous journey.
Without her you would not have set out.
She has nothing left to give you now.

And if you find her poor,
Ithaca won't have fooled you.
Wise as you will have become,
so full of experience,
you will have understood by then what these Ithaca's mean.

(Reproduced with permission from *Collected Poems*. Translated by Edmund Keeley and Philip Sherrard. Edited by George Savidis. Revised Edition. Princeton University Press, 1992)

10. TABLE OF FIGURES

11. Literature References

Afuah, A. & C. L. Tucci (2001), *Internet Business Models and Strategies: Text and Cases*, Boston, Mass.: McGraw-Hill Irwin.

Amor, D. (1999), *The E-business* (R)evolution, Prentice Hall.

Amoroso, D. L., P. H. Cheney (1991). *Testing a causal model of end-user application effectiveness*, in: Journal of Management Information Systems, Vol. 8 (1991), No. 1, Summer, p. 77.

Amoroso, D. L., Vannoy, S.(2006). *Translating the Adoption of B2B e-Business into Measurable Value for Organizations*, in: Proceedings of the 39th Hawaii International Conference on System Sciences – 2006.

Anderson J. and Gerbing D. 1988. "*Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach*," Psychological Bulletin, 103(3), pp. 411-423.

Angeles, R. (2006), *Business-To-Business E-Procurement Corporate Initiative: A Descriptive Empirical Study*, ICEC 2006 Conference, Fredericton, NB, Canada..

Atkinson, CJ. (2000). *The 'Soft Information Systems and Technologies Methodology' (SISTeM): an actor network contingency approach to integrated development*, European Journal of Information Systems (2000) 9, 104–123.

Bakos, J.Y. and Brynjolfsson, E. (1993), *Information Technology, Incentives, and the Optimal Number of Suppliers*, Journal of Management Information Systems, 10 (2), 37-53.

Bação F, Lobo V and Painho M. .(2005), *Self-organizing Maps as Substitutes for K-Means Clustering*, in V.S. Sunderam et al. (Eds.): ICCS 2005, LNCS 3516, pp. 476 – 483, 2005, Springer-Verlag, Berlin Heidelberg 2005

Bartlett, C. A. and Ghoshal S. (1992) "Transnational Management: Text, Cases, and Readings in Cross-Border Management," Irwing, Homewood, IL, 1992.

Bartlett, C. A. and Ghosha S. (1995),: "Rebuilding Behavioral Context: Turn Process Reengineering into People Rejuvena-tion," Sloan Management Review, Fall 1995, pp. 11-23.

Barua A., Pinnell J., Shutter J., and Whinston, A.B. (2001), *Measuring the Internet Economy: An Exploratory Study*, Research Report, Center for Research in Electronic Commerce, Graduate School of Business, The University of Texas at Austin.

Barua, A., C.H. Kriebel, and T. Mukhopadhyay, (1995), *Information Technologies and Business Value: An Analytic and Empirical Investigation*, Information Systems Research, Vol. 6 (1), pp. 3-23.

Barua, A., Konana, P., Whinston A. B., and Yin, F., (2004) "*An Empirical Investigation of Net Enabled Business Value*,"MIS Quarterly,Vol. 28, No. 4, 2004, pp. 585-620.

Baraldi, E., 2002, Making Sense of IT in Business Networks. A Conceptual Framework on Resources and Information with Empirical Illustrations from IKEA and Edsbyn. In: Proceedings of the inaugural meeting of the IMP Group in Asia, 11-13 December, 2002, Perth.

Baraldi, E., 2001, Using IT for Managing Resources in Business Networks. A Case Study from the Swedish Furniture Industry, Proceedings from the 17th Annual IMP conference, September, 2001.

Baskerville, R. and Pries-Heje, J. (1999). *Grounded action research: A method for understanding IT in practice*. In Accounting, Management and Information Technologies, 9:1-23.

Bendoly, E., and Schoenherr, T. (2005), *ERP system and implementation-process benefits: Implications for B2B e-procurement*. International Journal of Operations & Production Management, 25, 4 (2005), 304-319.

Bloomfield, B. P. and T. Vurdubakis (1994). "*Boundary disputes: Negotiating the boundary between the technical and the social in the development of IT systems*." Information Technology & People 7(1): 9-24

Bowker and S. L. Star (1996). *How things (actor-net)work: Classification, magic and the ubiquity of standards, from* : http://alexia.lis.uiuc.edu/~bowker/actnet.html.

Borgatti, S. P., Everett M. G. and L. C. Freeman, (1999). *Ucinet 5 for Windows: Software for Social Network Analysis*. Natick: Analytic Technologies.

Broadbent, M., P. Weill, & B. S. Neo (1999), *Strategic context and patterns of IT infrastructure capability*. Journal of Strategic Information Systems, Elsevier, vol. 8, no. 2, pp. 157-187.

Brown, C., Brennan, R., Frame, P. (1999). *Participatory Action Research and its Relevance to Inter-organizational Learning*, Industrial Marketing & Purchasing Group, 15th Annual Conference, IMP 99, Dublin, Ireland, Sept 1999.

Brynjolfson E. (1993), *The productivity paradox of information technology*, Comm ACM 36, No 12, 67-77.

Brynjolfsson, E. & L. M., Hitt (1993): *Paradox Lost? Firm-Level evidence on the returns to Information Systems spending*. Center for Coordination Science Working Paper, MIT Boston.

Brynjolfsson, E., & L. M., Hitt, (2000), *Beyond Computation: Information Technology, Organizational Transformation and Business Performance*, Journal of Economic Perspectives, Vol. 14 No. 4, pp. 23-48.

Brynjolfson E. and H. Mendelson (1993), *Information Systems and the Organization of Modern Enterprise*, Journal of Organizational Computing, 3, 245-255, 1993.

Brynjolfsson E., Malone T.W., Gurbaxani V., and A. Kambil (1991)., "*Does Information Technology Lead to Smaller Firms*?", Technical Report 123, Cambridge MA: Center for Coordination Science, MIT, 1991,

Burgelman, R. (1991). *Intraorganizational ecology of strategy making and organizational adaptation: Theory and field research*, Organiza-tion Science, vol. 2(3).

Burt, R., (1992) *The Social Structure of Competition*, in *Networks and Organizations: Structure, Form and Action*, Nohria, N. and Eccles, R. (eds), Harvard Business School Press, Boston, 57-91.

Byrd T. A. and D. E. Turner (2001), *An exploratory examination of the relationship between flexible IT infrastructure and competitive advantage*, Information & Management 39, Issue 1, 41-52.

Callon, M. (1991). *Techno-economic networks and irreversibility*. From "A Sociology of Monsters: Essays on Power, Technology and Domination". J. Law. London, Routledge.

Callon, M. (1993). *Variety and irreversibility in networks of technique conception and adoption*. In D. Foray and C. Freeman (Eds.) Technology and the Wealth of Nations: The Dynamics of Constructed Advantage. London, Pinter Publishers: 232-268.

Callon, M. (1997). Michel Callon's Keynote Speech: *Actor-Network Theory -The Market Test*. 'Actor Network and After' Workshop., Centre for Social Theory and Technology (CSTT)., Department of Sociology and Social Anthropology Keele University.

Callon, M. (1998), "Introduction", in Callon, M. (Ed.), The Laws of the Market, Blackwells, London.

Callon, M. and Latour, B. (1981). *Unscrewing the big Leviathan: how actors macrostructure reality and how sociologists help them to do so*. In Knorr-Cetina, K.D. and Cicourel A.V. (eds), *Advances in Social Theory and Methodology: Toward and Integration of Micro- and Macro-Sociologies*, Routledge and Kegan Paul, Boston, Mass.

Carr, G. N.(2003): *IT Doesn't Matter*. Harvard Business Review, vol. 81, no. 5

Carr, A.S. and Smeltzer L.R. (2002), *The Relationship Between Information Technology Use and Buyer-Supplier Relationships: An Exploratory Analysis of the Buying Firm's Perspective*, IEEE Transactions on Engineering Management, 49 (3), 293-304.

Chakravarthy, B. S. (1986). *Measuring Strategic Performance*, Strategic Management Journal, vol 7.

Chakravarthy B. S. and Perlmutter H.V. (1985). *Strategic Planning for a Global Business*, Columbia Journal of World Business.

Chan, K. and Liebowitz, J. (2006) '*The synergy of social network analysis and knowledge mapping: a case study'*, Int. J. Management and Decision Making, Vol. 7.

Charmaz, K. (2000) *Grounded Theory: Objectivist and Constructivist Methods*, in Denzin, N. and Lincoln, Y. (Eds.), The Handbook of Qualitative Research, (vol. 2), Sage Publications, NY, pp 509-535.

Cheng, E. (2001), "*SEM Being More Effective than Multiple Regression in Parsimonious Model Testing for Management Development Research*", Journal of Management Development, 20(7), pp. 650-667.

Chin W., Marcolin B., Newsted P. (1996). "*A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and Voice Mail Emotion/Adoption Study*", 17th International Conference on Information Systems, Cleveland, pp. 21-41.

Chin W. (1998). "*The Partial Least Squares Approach to Structural Equatio n Modeling*", modern Methods for Business Research, G. Marcoulides (ed.), Erlbaum Associates.

Chin W., Newsted, P. (1999). "*Structural Equation Modeling Analysis with Small Samples Using Partial Least Squares*", in Rick Hoyle (Ed.), Statistical Strategies for Small Sample Research, Sage Publications, pp. 307-341.

Chin W. (2000). "*Partial Least Squares for Researchers: An Overview and Presentation of Recent Advances Using the PLS Approach*", http://disc-nt.cba.uh.edu/chin/indx.html

Chin, W. and Todd, P. A. (1995). *On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution*, in: MIS Quarterly, Vol. 19 (1995), June, pp. 239-240.

Chin, W., Marcolin, B.L and P. R. Newsted (2003). *A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion / adoption study*, in: Information Systems Research, Vol. 14 (2003), No. 2, June, pp. 189-217.

Chisholm, R.F. (1998). *Developing Network Organizations: Learning from Practice and Theory*, Addison Wesley Longman.

Chopra S. and P. Meindl, (2004), *Supply chain management: Strategy, planning, and operation*, 2nd ed., Upper Saddle River 2004,

Christopher, M. (1994). *New directions in Logistics, Logistics and Distribution Planning – strategies for management*; edited by James Cooper, Kogan Page Limited, 2nd edition.

Christopher, M. (1994). *New directions in Logistics, Logistics and Distribution Planning – strategies for management*; edited by James Cooper, Kogan Page Limited, 2nd edition.

Christopher, Martin (2005), *Logistics and supply chain management: Creating valueadding networks*, 3rd ed., Harlow 2005.

Ciborra, C., (2001), *From Control to Drift – The Dynamics of Corporate Information Infrastructures*, Oxford: Oxford University Press.

Ciborra, C., (2002), *The Labyrinths of Information – Challenging the Wisdom of systems*, Oxford: Oxford University Press.

Ciborra, C.U. (1997). *Deconstructing strategic alignment*, Scandinavian Journal of Information Systems, Vol. 9, No. 1, 1997: 76-82.

Coenders G., Bisbe J., Saris W. E., Batista-Foguet, J. M. (2003), *Moderating Effects of Management Control Systems and Innovation on Performance. Simple Methods for Correcting the Effects of Measurement Error for Interaction Effects in Small Samples*, White Paper, Departament d'Economia, Universitat de Girona, Girona, June 2003.

Cooper, M. C., D. M. Lambert and J. D. Pagh (1997), *Supply chain management: More than a new name for logistics*, in: The International Journal of Logistics Management, Vol. 8 (1997), No. 1, pp. 1-14.

Cooper R., Madden G., Lloyd A. and M. Schipp (2006), *The Economics of Online Markets and ICT Networks*, Physica-Verlag HD, 2006.

Corsten, D. and Hofstetter, J.S. (2001) „*Supplier Relationship Management*" in: Belz, C. Mühlmeyer, J., (Hrsg.): Key Supplier Management, Thesis: St. Gallen, 2001.

Corsten, D. and Hofstetter, J.S. (2001) „*Supplier Relationship Management*" in: Belz, C. Mühlmeyer, J., (Hrsg.): Key Supplier Management, Thesis: St. Gallen, 2001.

Cox, A., Lonsdale, A., Sanderson, J. and G. Watson (2004), *Business relationships for competitive advantage – Managing Alignment and Misalignment in Buyer Supplier Transactions*, Palgrave Macmillan, 2004.

Cox, A. (2004), *The art of the possible: Relationship management in power regimes and supply chains, in: Supply Chain Management*: An International Journal,Vol. 9 (2004), No. 5, pp. 346-356.

Cox, A. (2001), *The power perspective in procurement and supply management*, in: The Journal of Supply Chain Management, Vol. 37, 2001, No. 2, Spring, pp. 4-7.

CPFR Guidelines, (1998), *CPFR Collaborative Planning, Forecasting, and Replenishment*, VICS - Voluntary Interindustry Commerce Standards, http://www. cpfr.org

CPFR Roadmap, (1999), *Roadmap to CPFR: The Case Studies*, VICS - Voluntary Interindustry Commerce Standards, http://www.cpfr.org

Cross, R. and Parker, A. (2004) *The Hidden Power of Social Networks*, Boston, MA: Harvard Business School Publishing.

Cross, R., Borgatti, S. and Parker, A. (2003). *Making Invisible Work Visible. Networks in the Knowledge Economy*. Cross, R, Parker, A. and Sasson, L. (Eds). New York. Oxford Press. 261-282.

Curran, T. A., Ladd, A. (1999). *SAP R/3 Business Blueprint: Understanding Enterprise Supply Chain Management*, Prentice Hall.

Curry B., F. Davies, P. Phillips, M. Evans, L. Moutinho (2001), *The Kohonen self-organizing map: an application to the study of strategic groups in the UK hotel industry*, Expert Systems 18 (1), 19–31.

De Boer, L., H, J. and G. Heijboer, (2002), *A conceptual model for assessing the impact of electronic procurement*. European Journal of Purchasing & Supply Management, 2002, 8, 25-33.

Davenport, T.H., (1993), *Process Innovation: Reengineering Work Through Information Technology*. Boston, Harvard Business Press.

Davenport, T.H. (1998). *Putting the Enterprise into the Enterprise System*, Harvard Business Review, July-August, p.121-130.

Davenport, T.H. (2000). *Mission Critical: Realizing the Promise of Enterprise Systems*, Boston, Harvard Business School Press.

Davenport, T. and Markus, M. L. (1999), "*Rigor vs. Relevance Revisited: Response to Benbasat and Zmud*," MIS Quarterly, 23(1), pp. 19-23.

De Burca, S., and Fynes, B. (2001), *Relationships and Technology: Combining ERP and Internet Technologies*, Conference Paper, IMP Annual Conference 2002.

Dellarocas C. and Klein M. (2000), *A Knowledge-Based Approach for Handling Exceptions in Business Processes*, Working paper, Center for Coordination Science, Sloan School of Management, Massachusetts Institute of Technology.

Dubois, A; Hulthén, K and Pedersen, A.-C. 2003. *Interdependence within and among supply chains*, Proceeding from the 12th International IPSERA Conference, April 2003, Budapest, Hungary: 65-76.

Dyer, J. H. (2000), *Collaborative Advantage: Winning Through Extended Enterprise Networks*, Oxford University Press, 2000.

Dyer, J. H. and Singh H. (1998), *The relational view: Cooperative strategy and sources of interorganizational competitive advantage*, in: Academy of Management Review, Vol. 23 (1998), No. 4, pp. 660-679.

Easton, G and Araujo, L. (2003), *Evaluating the impact of B2B e-commerce - a contingent approach*, Industrial Marketing Management, Volume 32, Issue 5 , July 2003, Pages 431-439.

Edwards, P; Peters, M and Sharman, G (2001). *The effectiveness of Information Systems in Supporting the Extended Supply Chain*, Journal of Business Logistics, Vol 22 No. 1, pp.1-27.

Egelhoff, W. G. (1991). *Information-processing theory and the Multinational enterprise*, Journal of International Business Studies, Vol 4, 3rd Quarter 1991.

Elie E., Lefebvre L.A., and E. Lefebvre (2004), *Typology of B-to-B E-Commerce Initiatives and Related Benefits in Manufacturing SMEs*, Proceedings of the 37th Hawaii International Conference on System Sciences – 2004.

Eisenhardt, K.M., and Martin, J.A. (2000), Dynamic capabilities: what are they? Strategic Management Journal 21 (10–11), 1105–1121.

Ellram, L.M., and Carr, A.S. (1994), *Strategic purchasing: a history and review of the literature*. International Journal of Purchasing and Materials Management 30 (2), 10–18.

Ellram, L.M., and Liu, B. (2002), *The financial impact of supply management*. Supply Chain Management Review 6 (6), 30–37.

Ford, D. (ed.). (1997). *Understanding Business Markets*, 2nd edition, Dryden Press.

Ford, D. (ed.). (2002). *Understanding Business Marketing and Purchasing*, 3rd edition, Thomson Learning.

Ford, D. and Håkansson, H., (1999), *How should companies interact?*, Conference paper, IMP 1999, Dublin.

Ford, D., Gadde L., Håkansson H., Lundgren A. (1998). *Managing Business Relationships*, John Wiley.

Freeman, L. C. (2000), *Visualizing Social Networks*. Journal of Social Structure, 1.

Freeman, L. C., Webster C. M. and D. M. Kirke. (1998). *Exploring social structure using dynamic three-dimensional color images*. Social Networks, 20:109-118.

Gadde, L. and Håkansson, H., (2000), *Supply Network Strategies*, Conference paper, IMP 1999, Dublin.

Gadde, L. and Håkansson, H., (2001), *Supply Network Strategies*, John Wiley.

Gadde. L. E., Håkansson, H. Jahre, M. & Persson, G. (2002). *More instead of less: Strategies for use of logistics resources*, Journal on Chain and Network Science, 2: 81-91.

Gefen, D., Straub, D. W., and Boudreau, M. (2000), Structural Equation Modeling And Regression - Guidelines For Research Practice, Volume 4, Article 7, October 2000, Communications of the Association for Information Systems,

Gelinas U. J., and Markus M. L. (2005), *The Standards Lens on IS Innovations—The Case of CPFR*, Proceedings of the 38th Hawaii International Conference on System Sciences - 2005.

Ghoshal, S. and Gratton L. (2002). *Integrating the Enterprise*, MIT Sloan Management Review, Fall 2002.

Glaser, B.G. and Struass, A.L. (1999). *The discovery of Grounded Theory: Strategies for qualitative research*. Paperback Ed. New York: Aldine de Gruyter.

Glaser, B.G. (1992). *Basics of Grounded Theory Analysis: Emergence vs. Forcing*, Mill Valley, CA: Sociology Press.

Goedde and De Villiers (1997) *The Applicability of Grounded Theory as Research Methodology in studies on the use of Methodologies in IS Practices*, Proceedings of SAICSIT 2003, Pages 208 –217.

Goldman-Sachs (1999), *B2B:2B or Not 2B?*, Goldman Sachs Investment Research, 09/1999.

Goodhue, D, Lewis, W., and R. Thompson (2006). *PLS, Small Sample Size, and Statistical Power in MIS Research*, Proceedings of the 39th Hawaii International Conference on System Sciences, 2006.

Goold, M. and A. Campbell (1987). *Strategies and Styles: The Role of the Centre in Managing Diversified Corporations*, Basil Blackwell, London.

Gordijn, J., J. Akkermans, and J. van Vliet (2001). *Designing and Evaluating E-Business Models*, IEEE, Intelligent Systems, July/August 2001, Vol. 16, No. 4, pp. 11-17

Grant, R.M. (1995) *Contemporary Strategy Analysis*, Malden MA: Blackwell.

Gribbins, M.L., Subramanian, C. and M.J. Shaw, (2006), Process-Technology Fit: Extending Task-Technology Fit to Assess Enterprise Information Technologies, 27th International Conference on Information Systems, Milwaukee, 2006

Gulati, R., Nohria, N., and A. Zaheer (2000). *Strategic Networks*, Strategic Management Journal, 21: pp. 203-215.

Haig, B. (1995) *Grounded Theory as Scientific Method*, Philosophy of Education Society, Illinois, http://www.ed.uiuc.edu/EPS/PES-Yearbook/95_docs/haig.html

Håkansson, H. and Snehota I. (1995). *Developing Relationships in Business Networks*, International Thomson Business Press, London.

Håkansson, H. and Waluszewski. A. (2002) *Managing Technological Development*. Routledge. London.

Hammer, M. (2001), *The superefficient company*, in: Harvard Business Review, Vol. 79 (2001), September, pp. 82-91.

Hanneman, R.A. and Riddle M. (2005). *Introduction to social network methods*. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/)

Hansen, G.S. & B. Wernerfeldt (1989). *Determinants of firm performance: the relative importance of economic and organizational factors*. Strategic Management Journal 10: 399-411.

Hanseth, O (1996). *Information Technology as Infrastructure*, Ph.D. Thesis, University of Gothenburg, 1996.

Hanseth, O, Ciborra, C.U., and Braa, K. (2001). *The Control Devolution: ERP and the Side Effects of Globalization*, The DATA BASE for Advances in Information Systems - Fall 2001 (Vol. 32, No. 4).

Hanseth, O. and Braa, K. (1996). *Technology as traitor: Emergent SAP Infrastructure in a Global Organization*. Proceedings from ICIS '98, 19th International Conference on Information Systems, Helsinki, Finland, December 13-16, 1998.

Hanseth, O. and Braa, K. (2001). *Hunting for the Treasure at the End of the Rainbow: Standardizing Corporate IT Infrastructure*, Computer Supported Cooperative Work 10: 261–292, 2001.

Hanseth, O., Monteiro, E. and Hatling, M. (1996). *Developing information infrastructure standards: the tension between standardization and flexibility*, Science Technology and Human Values, Vol. 21 No. 4, Fall 1996, 407-426.

Hansmann, K. and C. M. Ringle (2006), *SmartPLS Benutzerhandbuch*, 2004, http://www.smartpls.de, retrieved on: January 17, 2007

Harrigan, Kathryn Rudie (1985). An application of Clustering for Strategic Group Analysis, Strategic Management Journal, Vol 6.

Harland, C.M.(1996). *Supply Chain Management: Relationships, Chains and Networks*, British Journal of Management, Vol. 7, Special Issue, pp. 63-S80.

Harland C, Zheng J, Johnsen T, and R. Lamming (2004), *A conceptual model for researching the creation and operation of supply networks*, British Journal of Management, Vol. 15, No. 1, pp. 1-21, March

Hart, S. L. and C. Banbury (1994), *How Strategy-Making Process Can Make a Difference*, Strategic Management Journal 15 (May): 251-70.

Hartmann, E., Ritter T. and Gemuenden, G.E. (2002), *The Fit between Purchase Situation and B2B E-Marketplaces and its Impact on Relationship Success*, Conference Paper, IMP Annual Conference 2002.

Hassan, N.R. Richards, T.C. Becker, J.D. (2006), Using Social Network Analysis to Test an IT-Enabled Business Process Reengineering Theory, System Sciences, 2006. HICSS '06. Proceedings of the 39th Annual Hawaii International Conference, Jan. 2006, Volume: 8..

Hassan, N. R. (2006). *The relationship of IT to IS: An inquiry into the technoscientific nature of the IS field*. Paper presented at the Americas Conference on Information Systems, 4-6th August, 2006, Acapulco, Mexico.

Hassan, N. R., and Will, H. J. (2006). *Synthesizing diversity and pluralism in information systems: Forging a unique disciplinary subject matter for the information systems field*. Communications of the AIS, 17(7), 152-180.

Hedaa, L. (1998). *Atoms of Interaction – Demigraphic analysis of business networks*, MPP Working Paper, 1998.

Hedaa, L., and Törnroos, J. (1997). *Understanding Event-based Business Networks*, MPP Working Paper, 1997.

Hedberg, B., Dahlgren, G., Hansson, J., Olve, N. (Ed.) (1997). *Virtual Organizations and Beyond: Discover Imaginary Systems*, Series in Practical Strategy, John Wiley.

Henderson, J.C., Venkatraman, N. and Oldach, S. *Aligning Business and IT strategies*, in J. Luftman op.cit., 1996.

Henderson, J.C., Venkatraman, N. and Oldach, S. *Aligning Business and IT strategies*, in J. Luftman op.cit., 1996.

Hewitt, D and Boeke, J. (2001). *The 2001 eProcurement Project Survey*, PwC Consulting Survey, 2001.

Hulland, J. (1999): Use of partial least squares (PLS) in strategic management research: A review of four recent studies, in: Strategic Management Journal, Vol. 20 (1999), No. 2, pp. 195-204.

Huxham, C. ed. (1996), *Creating Collaborative Advantage*, Sage Publishers, London.

Johnsen T., Wynstra F., and Zheng J., Harland C. and Lamming R. (2000) *Networking activities in supply networks*, Journal Of Strategic Marketing, 8 161–181 (2000)

Johnston, S.J. (2002) *ERP: Payoffs and pitfalls*. @hbsworkingknowledge.hbs.edu/pubitem.jhtml?id=3141&sid=0&pid=0&t=operations (14 October).

Kalakota, R., and Robinson, M. (1999), *E-Business: Roadmap for Success*, Addison-Wesley Information Technology Series, Addison-Wesley.

Kalakota, R. and Robinson, M., (2001):"*E-business 2.0: Road-map for Success*", Addison-Wesley, Harlow

Klein, S. (1996), *The Configuration of Inter-organizational Relations*, in: European Journal of Information Systems, 5 (1996) 5, pp. 92-102

Klein, H.K & Myers, M.D. (1999). *A set of principles for conducting and evaluating interpretive field studies in information systems*. MIS Quarterly, 23(1): 67-94

Kling, R. and Lamb, R (1999), *IT and Organizational Change in Digital Economies: A Socio-Technical Approach*, Computers and Society, September 1999.

Kohonen T. (2001). Self Organizing Maps, 3rd edition, Springer-Verlag.

Lamming, R., Johnsen, T., Zheng, J., & Harland, C. (2000). *An initial classification of supply networks*. International Journal of Operations & Production Management. 20(6): 675-691.

Latour, B, (1986). *The powers of association*. In Law J. (ed.), *Power, Action and Belief. A New Sociology of Knowledge?* Routledge and Kegan Paul, London.

Latour, B. (1987). *Science in Action: How to Follow Scientists and Engineers Through Society*, Open University Press, Milton Keynes.

Latour, B. (1988a). *The Pasteurization of France*. Harvard University Press, Cambridge, Mass.

Latour, B. (1988b). *The Prince for machines as well as for machinations*. In Elliott, B. (ed.), *Technology and Social Process*, Edinburgh University Press, Edinburgh.

Latour, B. (1992). *Where are the Missing Masses? Sociology of a Few Mundane Artifacts*. In W. Bijker and J. Law (Eds.) Shaping Technology, Building Society: Studies in Sociotechnical Change. Cambridge, Mass, MIT Press: 225-258.

Latour, B. (1996) "*Social Theory and the Study of Computerized Work Sites*" in Orlikowski, Wanda J., Walsham, Geoff, Jones, Matthew R. and DeGross, Janice I. (Eds) Information Technology and Changes in Organizational Work Chapman & Hall, London.

Latour, B. (1999). *On Recalling ANT*. In J. Law and J. Hassard (Eds.) Actor Network and After. Oxford., Blackwell and the Sociological Review: 15-25.

Latour, B., P. Mauguin, et al. (1992). "*A Note on Socio-Technical Graphs*." Social Studies of Science 22: 33-57.

Law, J. (1999) `*After ANT: Complexity, Naming and Topology'*, in J. Law and J. Hassard (eds) Actor Network Theory and After, pp. 1-14. Oxford: Blackwell.

Law, J., and Hassard, J. (1999) *Actor Network Theory and After*. Oxford: Blackwell.

Lawrence, P.R. and Lorsch, J.W (1967). *Organization and Environment: Managing Differentiation and Integration*, Homewood

Lawrence, P.R. and Lorsch, J.W (1967). *Organization and Environment: Managing Differentiation and Integration*, Homewood

Leenders, M.R., Fearon, H.E., Flynn, A.E., Johnson, P.F. (2002), *Purchasing and Supply Management*, McGraw-Hill/Irwin, NewYork, NY.

Liebowitz, J. (2000) *Building Organizational Intelligence: a Knowledge Management Primer*, Boca Raton, FL: CRC Press.

Linder, J. and S. Cantrell (2000). "*Changing Business Models: Surveying the Landscape*" Accenture Institute for Strategic Change.

Luftman, J., (ed.) (1996). *Strategic Alignment*, Oxford University Press, 1996.

Magretta, J. (1998). *The power of virtual integration: an interview with Dell Computer's Michael Dell*, Harvard Business Review, Vol. 76, March-April 1998, pp. 72-84.

Magretta, J. (2002), "*Why Business Models Matter*", Harvard Business Review, May 2002, 86-92.

Mahadevan, B. (2000), "*Business Models for Internet-Based E-Commerce: An Anatomy*", California Management Review, 42, 4, Summer, 55-69.

Malone, T. (1987). *Modeling Coordination in Organizations and Markets*, Management Science, 33, 1317-1332.

Malone, T. W., Crowston, K., Lee, J. and Pentland, B. (1993). *Tools for inventing organizations: Toward a handbook of organizational processes*. In Proceedings of the 2nd IEEE Workshop on Enabling Technologies Infrastructure for Collaborative Enterprises. Morgantown, WV, April 20-22.

Malone, T. W., Crowston, K., Lee, J. and Pentland, B. (1993). *Tools for inventing organizations: Toward a handbook of organizational processes*. In Proceedings of the 2nd IEEE Workshop on Enabling Technologies Infrastructure for Collaborative Enterprises. Morgantown, WV, April 20-22.

Malone, T.W., and Crowston, K. (1994), *The Interdisciplinary Study of Coordination*, in: ACM Computing Surveys, 26 (1994) 1, pp. 87-119.

Malone, T.W., and Crowston, K. (1994), *The Interdisciplinary Study of Coordination*, in: ACM Computing Surveys, 26 (1994) 1, pp. 87-119.

Markus, M. L. (2004), "*Technochage Management: Using ITto Drive OrganizationalChange*,"in Journal of Information Technology,Vol. 19, 2004, pp. 319.

Marcoulides, G. A. and C. Saunders(2006), "*PLS: A Silver Bullet?*, Editors Comments"in MIS Quarterly Vol. 30 No. 2, pp. iii-ix/June 2006.

Mattsson, L. G. (2003). Understanding market dynamics: potential contributions to market(ing) studies from actor-network theory. IMP Group 2003 conference paper, Lugano.

McLachlan, J. and Peel, D. (2000). *Finite Mixture Models*. Wiley, New York.

Miles, R. and C. Snow (1978). *Organizational Strategy, Structure and Process*, McGraw-Hill, NY.

Miles, R., and C. Snow (1986). *Network Organizations: New Concepts for New Forms*, California Management Review, 1986.

Miles, G., C. Snow, and M. P. Sharfman (1993). Industry variety and performance, Strategic Management Journal, Vol 14.

Miller, D. and P. Friesen (1984). Organizations: AQuantum View, Prentice Hall, Englewood Cliffs, NJ.

Mouritsen, J., Larsen, H., & Bukh, P.N.D. (2001). *Intellectual capital and the 'capable firm': narrating, visualizing and numbering for managing knowledge*. Accounting, Organizations and Society, 26, 735-762.

Mueller T.A., Hölzle K., Gemuenden H.G. (2003), *The Impact of IT-based Cooperation on Industrial Relationship Management*, Conference Paper, 19th Annual IMP Conference at the University of Lugano.

Murtagh F. and Hernández-Pajares M. (1995). *The Kohonen Self-Organizing Map Method: An Assesment*. Journal of Classification, 12, 165-190.

Nahapiet, J. and Ghoshal, S. (1998), *Social Capital, Intellectual Capital, and the Organizational Advantage*. Academy of Management Review, vol. 23 no. 2, pg. 242-266.)

Naman, J. L. and D. P. Slevin. (1993), *Entrepreneurship and the Concept of Fit: A Model and Empirical Tests*. Strategic Management Journal 14 (February): 137-54.

Nelson, R. R. & S. G. Winter (1982), *An Evolutionary Theory of Economic Change*, Harvard University Press, Cambridge, MA.

Nohria, N. and Eccles, R. G. (1992), *Network and Organizations*, Harvard University Press, Boston, MA.

Nøkkentved, C. (2003), *Implementing Supplier Relationship Management: A Conceptual Framework Of Value Creation In Collaborative Supply Networks,* IBM BCS Institute of Business Value, Research Note, EMEA, 2003.

Nøkkentved, C. (2004), *Collaboration in eSupply Networks*, Chapter in Hansjoerg, F. and Chae An (2004), *Advances in Supply Chain Management*, IBM Research, Springer Verlag, 2004 (forthcoming).

Nøkkentved, C. and Hedaa, L. (2000), *Collaborative Processes in e-Supply Networks*, Conference Paper, IMP Annual Conference 2000.

Nøkkentved, C. and Hedaa, L. (2001), *Collaborative Planning Processes in e-Markets*, Conference Paper, IMP Annual Conference 2001.

Nøkkentved, C. and Rosenø, A. (1998), *Management Process Archetypes in Scandinavia and their relationship to Performance, Diversification and Environment*, Conference Paper, Strategic Management Society Annual Conference 1998.

Nøkkentved, C. and Rosenø, A. (1997), *Analyzing Management Process in MNCs*, 2nd Edition, Copenhagen, CBS Press, 1997.

Normann R. (1984, 1991), Service management, strategy and leadership in service business, Wiley, Chichester.

Orlikowski W.J. and D. Robey (1991), *Information technology and the structuring of organizations*, Information Systems Research 2, No 2, 143-169.

Orlikowski, W. J. (1992). *The Duality of Technology - Rethinking the Concept of Technology in Organizations*. In: Organization Science, 3 , 398-427.

Orlikowski, W.J., (1996). *Improvising organizational transformation over time: a situated change perspective*. Information Systems Research 7, pp. 63–92.

Orton, J. D. (1997), "*From Inductive to Iterative Grounded Theory: Zipping the Gap between Process Theory and Process Data*," Scandinavian Journal of Management, 13 (December), 419-38.

Österle, H., Fleisch, E., Alt, R. (1999). *Business Networking - Shaping Enterprise Relationships on the Internet*, 1999, Springer Verlag.

Österle, H., Fleisch, E., Alt, R. (1999). *Business Networking - Shaping Enterprise Relationships on the Internet*, 1999, Springer Verlag.

Osterwalder, A. (2004). *The Business Model Ontology: A Proposition in a Design Sciemce Approach*. Swiitzerland, University of Lausanne: 173.

Osterwalder, A. and Y. Pigneur (2002). *An e-Business Ontology for Modeling eBusiness*. 15th Bled Electronic Commerce Conference, Bled Slovenia.

Osterwalder, A., Y. Pigneur and C. Tucci (2005). "*Clarifying Business Models: Origins, Present and Future of the Concept*." CAIS 15.

Pateli, A. and G. Giaglis (2004). "*A Research Framework for Analysing eBusiness models*", European Journal of Information Systems 13: 302-314.

Peppard, J., W., and Ward, J. (2004). *Beyond Strategic Information Systems: Towards an IS Capability*, Journal of Strategic Information Systems (13) 2004.

Poirier, C. (1999). *Advanced Supply Chain Management : How to Build a Sustained Competition*, Publishers' Group West.

Porter, M. E. (2001) *Strategy and the Internet*, Harvard Business Review, March, pp. 63–78

Porter, M. E.(1985). *Competitive Advantage. Creating and Sustaining Superior Performance*. The Free Press, New York.

Porter, M. E.(1980). *Competitive Strategy*, Free Press, New York.

Prahalad, C.K. and G. Hamel (1990), *The core competence of the corporation*, in: Harvard Business Review, Vol. 68 (1990), May/June, pp. 79-91.

Quinn, J. B. and F. G. Hilmer: (1994), *Strategic outsourcing*, in: Sloan Management Review, Vol. 35 (1994), No. 4, Summer, pp. 43-55.

Rauber A., E. Pampalk, and J. Paralic (2000). *Empirical evaluation of clustering algorithms*. Journal of Information and Organizational Sciences (JIOS), 24(2):195--209, 2000.

Renkema, Theo J.W. (1998). *The Four Ps Revisited: Business Value Assessment Of The Infrastructure Impact Of IT Investments*, Journal of Information Technology, 13, 181-190.

Ringle, C.M., Wende, S., Will, A. (2005), SmartPLS 2.0 (M3) beta, www.smartpls.de.

Roberts, B. and Mackay, M. (1998): *IT supporting supplier relationships: The role of electronic commerce*, in: European Journal of Purchasing and Supply Management, 4, 175-184.

Rosson, P. (2000), *Electronic Trading Hubs: Review and Research Questions*, 16th IMP conference, Bath.

Sanders, N. R. and R. Premus (2005), *Modeling the relationship between firm IT capability, collaboration, and performance*, in: Journal of Business Logistics, Vol. 26 (2005), No. 1, pp. 1-23.

SAP APO (1998), *Advanced Planner & Optimizer*, Product Whitepaper, SAP AG, Walldorf, 1998.

Scheer, A.-W., (1998), *ARIS - Business Process Frameworks*, Springer Verlag, Berlin.

SCOR - *Supply-Chain Operations Reference-model* (1998), Version 3, Supply-Chain Council, Pittsburgh, PA, September 1998.

Scully, A., and Woods, W., (1999), *B2B Exchanges: The Killer Application in the Business-to-Business Internet Revolution*, ISI 1999.

Segev, E. (1987) *'Strategy, strategy making, and performance in a business game'*, Strategic Management Journal, 8, 1987, pp. 565-577.

Seifert, D. (2003), *Collaborative Planning Forecasting and Replenishment - How to create a Supply Chain Advantage*, New York: AMACOM, 2003.

Sethi, Vijay and William R. King. 1994. "*Development of Measures to Assess the Extent to Which an Information Technology Application Provides Competitive Advantage*." Management Science 40 (12): 1601-1627.

Shapiro, C., and Varian, H.R. (1998). *Information Rules: A Strategic Guide to the Network Economy*, Boston, Harvard Business School Press.

Shaw, M.J., Subramanian, C., and Gebauer (2006), J. *Process-Technology Fit: Model, Analysis, Application, and Validation*, Working Paper, Center for IT and e-Business Management, University of Illinois at Urbana-Champaign, 2006.

Skjoett-Larsen, T., Thernøe, C., and Andresen, C. (2003), *Supply chain collaboration: Theoretical perspectives and empirical evidence*, International Journal of Physical Distribution & Logistics Management, Vol. 33, No. 6, pp. 531-549.

Sidorova, A. and Sarker, S (2000) "*Unearthing Some Causes of BPR Failure: An Actor-Network Theory Perspective*" Proceedings 2000 Americas Conference in Information Systems ed H.M.Chung, Long Beach California

Simchi-Levi, D., Philip Kaminsky, P., Simchi-Levi, E. (1999), (2003). *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies*, 1st and 2nd editions, Irwin/McGraw-Hill.

Simon, Herbert A. (1997). *Administrative Behavior*, Free Press, 4th Edition, (1st Edition: 1945), NY.

Snow, C. C., Miles, R. E., and Coleman, H. J. (1992). *Managing 21st Century Network Organizations*. Organizational Dynamics, 20(3), 5-20.

Stank, T. P., Keller S. B. and P. J. Daugherty (2001), *Supply chain collaboration and logistical service performance*, in: Journal of Business Logistics, Vol. 22 (2001), No. 1, pp. 29-48.

Star, S. L. (1999). *The ethnography of infrastructure*, The American Behavioral Scientist. Thousand Oaks: Nov/Dec 1999. Vol. 43, Iss. 3; pg. 377, 17 pgs

Star, S. L., & Ruhleder, K. (1996). *Steps toward an ecology of infrastructure: Design and access for large information spaces*, Information Systems Research, 7, 1, 111-134.

Stewart, G. (1997) *Supply-chain operations reference model (SCOR)*, Logistics Information Management, Vol.10-2, · 1997 , pp.62–67

Strauss, A. and Corbin J. (1994) *Grounded Theory Methodology: An Overview*, in N. Denzin and Y. Lincoln (Eds.), Handbook of Qualitative Research, Thousand Oaks, Sage Publications, California, USA.

Subramanian, C. and M.J. Shaw, (2001), *Exploring the Role of Process and Organizational Factors in B2B E-commerce Impact: An Economic Perspective of Buyer-side B2B System*, Sixth INFORMS Conference on Information Systems, November 3-4, Miami, FL.

Subramanian, C. and Shaw, M. J. (2002), "*A Study of the Value and Impact of B2B E-Commerce: The Case of Web-Based Procurement*" International Journal of Electronic Commerce, Summer 2002, (6:4), pp. 19-40.

Subramanian, C. and M.J. Shaw, (2004), *The Effects of Process Characteristics on the Value of B2B E-Procurement, Information Technology and Management*, Volume 5, Numbers 1-2 / January, 2004.

Subramani, M. (2004). *How do suppliers benefit from information technology use in supply chain relationships?* in: MIS Quarterly, Vol. 28 (2004), No. 1, pp. 45-73.

Swanson, E. B. (1994), "*Information Systems Innovation among Organizations*,"Management Science,Vol. 40, No. 9, 1994..

Tapscott, D. (1995). *The Digital Economy*, McGraw-Hill, New York, NY.

Tapscott, D., Ticoll, D. and Lowy, A. (2000). *Digital Capital: Harnessing the power of business webs*, NB Publishing, London.

Tatnall A. And Gilding, A. (1999), *Actor-Network Theory and Information Systems Research*, Conference Paper, Proc. 10th Australasian Conference on Information Systems, 1999

Teece, D. J., Pisano, G., and Shuen, A. (1997), "Dynamic Capabilities and Strategic Management,"Strategic Management Journal,Vol. 18 No. 7, 1997, pp. 509-533.

Tenenhaus, M., Vinzi, V. E., Chatelin, Y.-M., and Lauro, C. (2005). *PLS path modeling*. Computational Statistics and Data Analysis, 48(1):159–205.

Thompson, G. (2003), *Between Hierarchies and Markets – The Logic and Limits of Network Forms of Organization*, Oxford University Press, London.

Timmers, P. (2000), *Electronic Commerce – Strategies and Models for B2B Trading*, Wiley, London.

Turban, E., King, D., Viehland, D., and Lee, J. (2006), *Electronic Commerce: A Managerial Perspective* 2006. Pearson-Prentice Hall, Upper Saddle River, NJ, 2006.

Wagner, E.L., and Scott, S.V. (2001). *Unfolding new times: The implementation of ERP into an Academic Administration*, Working Paper, Department of Information Systems, London School of Economics and Political Science.

Walsham, G. (1995). '*Interpretive case studies in IS research: nature and method'*. European Journal of Information Systems(4): 74-91.

Walsham, G. (1997) *'Actor-network Theory and IS Research: Current Status and Future Prospects'*, in A. Lee, J. Liebenau and J. DeGross (eds) Information Systems and Qualitative Research, pp. 466-80. London: Chapman Hall.

Walsham, G. (2001). *Making a world of difference: IT in a global context*. Chichester, john Wiley & Sons.

Wasserman, S., and Faust, K., (1994), *Social network analysis: Methods and applications*. Cambridge/New York/Melbourne: Cambridge University Press.

Watson, R. T., Pitt L. F.,Berthon, P., and Zinkhan,G. M., (2002), "*U-Commerce: Extending the Universe of Marketing*,"Journal of the Academy of Marketing Science, Vol. 30, No. 4,2002, pp. 329343.

Weill, P & Vitale, M.(2002) : *What IT Infrastructure Capabilities Are Needed to Implement E-Business Models*. MISQ Executive, vol. 1, no. 1, pp. 17-34

Weill, P., and Broadbent, M. (1998). *Leveraging the New Infrastructure*, Boston, Mass. Harvard Business School Press, 1998.

Weisfelder, C. J. (2001), "*Internationalization and the Multinational Enterprise: Development of a Research Tradition*," Advances in international marketing, 11, 13-46.

Westland, C. J. (2007), *Confirmatory Analysis with Partial Least Squares*, White Paper, University of Science & Technology, HK, Clearwater Bay, Kowloon, Hong Kong.

Wheeler, C. (2002), "*NEBIC: A Dynamic Capabilities Theory for Assessing Net Enablement*,"Information Systems Research,Vol. 13 No. 2, 2002, pp.125-146.

Wilkinson, I. and Young, L. (2002) *On cooperating firms, relations and networks*, Journal of Business Research, 55, 123-132.

Wold H. (1989). "*Introduction to the Second Generation of Multivariate Analysis*," in H. Wold (Ed.), Theoretical Empiricism. New York: Paragon House, vii-xl.

Venkatraman, N. (1997): *Beyond Outsourcing: Managing IT Resources as a Value Center*. Sloan Management Review, vol. 38, no. 3, pp. 51-64.

Venkatraman, N. (1994), "*IT-Enabled Business Transformation: From Automation to Business Scope Redefinition*," Sloan Management Review (35:2), 1994, pp. 73-87.

Venkatraman, N. and V. Ramanujam (1986). *Measurement of business performance in strategy research: Acomparison of approaches*, Management Science, vol. 11.

Vinzi E. V., and Tenenhaus, M. (2004), The PLS (Partial Least Squares) Approach to SEM, Presentation, Department SIAD - Groupe HEC, Jouy en Josas – France, 2004.

Zheng, J., Johnsen, T.E., Harland, C.M., Lamming, R. (1998). *Initial Conceptual Framework for Creation and Operation of Supply Networks*, IMP Group, 14th Annual Conference, IMP 98, Turku, Finland, Sept 1998.

PhD. Abstrakt	Understøttelse af Forsyningsnetværk med Kollaborative informations infrastrukturer.
Forfatter:	**Chris Nøkkentved**
Email:	chris.nokkentved@dk.ibm.com
Tel:	(+45) 27 13 72 32
Akademisk Institut	**Copenhagen Business School, Institut for Ledelse, Politik og Filosofi (LPF)**
PhD. Vejleder:	**Niels Bjoern-Andersen**
Email:	nba@cbs.dk
Universitet:	Copenhagen Business School (CBS)
Center:	Applied Information and Communication Technology (CAICT)
Institut:	Institute of Informatics
Adresse:	Howitzvej 60, DK-2000, Frederiksberg, Denmark
Phone::	(+45) 38 15 24 24
Virksomhed	**IBM Global Business Services**
Vejleder:	**Mogens Rødbro**
Email:	mogens_roedbro@dk.ibm.com
Afdeling:	IBM GBS Nordics
Adresse:	Nymøllevej 91, 4, DK-2800 Lyngby, Denmark
Phone:	(+45) 45 23 34 66

PhD. Abstrakt: Understøttelse af Forsyningsnetværk med Kollaborative informations infrastrukturer.

Denne afhandling præsenterer et analyse af IT-støttede transformationsinitiativer og deres effekt på operationel efficiens. Udgangspunktet for forskningsprojektet var den omfattende litteratur om relationen mellem IT og finansielle resultater, samt en række undersøgelser foretaget af IBM igennem en årrække af topledelses prioriteringer i forbindelse med innovation. Begge disse synes at indikere, at kontinuerlig forandring og kollaborative relationer i virksomhedernes forretningsmodeller understøttet af informationssystemer er nødvendige for at få succes med innovative produkter/ydelser. Denne afhandling har således forsøgt ud fra en konstruktiv vinkel at undersøge disse påstande om den gensidige afhængighed imellem forretningsmodeller og IT i samarbejdsbaserede forretningsnetværk.

Målsætningen med denne eksplorative forskning var at identificere de forretnings-transformerende initiativer samt de organisations- og omgivelsesmæssige faktorer, som understøtter succesrige innovation i forretningsmodellerne understøttet af informationssystemer. Analyserne afgrænsede sig til indkøbs-, leverandør- og/eller forsyningsnetværket (også kaldt Supply Network eller Supplier Relationship Mgmt – forkortet til SRM). Denne mangeårige forskningsindsats var unik i sin adgang til erfaringer og data, da den fandt sted i IBM's løsningsorienterede konsulentafdelinger med adgang til de primære empiriske analyser.

Forskningsprojektets fundament var baseret på teorierne omkring informationsinfrastrukturer, industrielle netværk og forsyningskæder (eller SCM). En række forskningshypoteser blev formuleret efter en dybdegående litteraturstudie og tilsvarende forskningsundersøgelser indenfor transformationsinitiativer understøttet af kollaborative informationsinfrastrukturer.
Ved at følge en multidimensionel forskningstilgang og- metode, er emnet belyst ud fra en række kvalitative samt kvantitative anskuelsesvinkler. En eksplorativ, interview-baseret undersøgelse af IBMs SRM eksperter forsøgte at afdække de kritiske succesfaktorer bagved IT understøttelse af sådanne processer. Dernæst evaluerede en særligt udvalgt gruppe medarbejdere disse værdiskabende initiativer og klassificerede deres vigtighed og gensidige afhængigheder. Hertil anvendtes SNA (Social Network Analysis). Baseret herpå udvikledes et spørgeskema, som i en emailbaseret undersøgelse af IBMs klienter, med støtte fra IBMs SCM afdeling. 340 svar blev modtaget og blev verificeret vha. 60 telefoninterviews. Indenfor studiets specifikke domæne var der kun 130 brugbare besvarelser som blev anvendt i en omfattende statistik undersøgelse af forskingshypoteserne. Den overordnede kausale netværksmodel blev skabt vha. en strukturalligningsmodel (Partial Least Squares) som muliggjorde en multidimensionel analyse af SRM initiativerne, organisatoriske og omgivelsesmæssige faktorer, samt eProcurementsystemer, og deres effekt på den operationelle efficiens.

Forskningsresultaterne fremviste en signifikant og kausal relation mellem ydeevne, den teknologiske understøttelse samt domænespecifikke kontekstuelle faktorer som operationelle målsætninger, overvågning og kontrol. Det blev påvist, at IT understøttelse alene ikke nødvendigvis leder til højere efficiens. Det er kombinationen af realisering af transformations-initiativer og målrettede organisatoriske forandringer, som muliggør, at informationssystemer er med til at understøtte en forbedret operationel efficiens. Dog viste sig, at en række faktorer som industritype ikke havde en signifikant effekt på relationen mellem transformationsinitiativer og operationel efficiens. Indenfor SRM domænet er dette understøttet af det faktum at de fleste SW leverandør som SAP og Oracle, ikke har særlige industriløsninger med undtagelse indenfor den offentlige sektor. Forskningsprojektet konkluderere, at virksomhederne skal forsøge at forbedre de organisatoriske rammer før informationssystemer kan levere de ønskede produktivitets-forbedringer.

PhD. Dissertation Abstract:
Enabling Supply Networks with Collaborative Information Infrastructures

This thesis presents research on IT-enabled transformation initiatives and their effect on operational efficiency. Previous research on information infrastructures, supply networks, and IBM's CEO surveys identified that continuous transformation enabled by IT and external collaboration are indispensable to Business Model Innovation, an inimitable vehicle to realize product/service innovations. This exploratory study examined the apparent interdependency of business and technology in collaborative environments within companies' supply networks, with the objective to identify the initiatives and contextual factors driving successful business model innovation enabled by the IT Information Infrastructures. The study was delimited to the Supply Networks domain (i.e. Supplier Relationship Mgmt/SRM), and was undertaken within IBM's Business Consulting Division.

Based on a detailed review of the theoretical background, a number of research propositions were outlined and aligned to a contextual construct of transformation initiatives enabled by information infrastructures. After establishing a multi-stage research method, an exploratory qualitative survey was carried out among IBM's SRM professionals, followed by a qualitative evaluation process that refined these initiatives. Based on these findings a confirmatory quantitative survey questionnaire was created and sent to IBM's business database. 340 responses were validated and a statistical analysis was undertaken to test the research propositions. A structural equation model (i.e. PLS) was created to study the significance of the proposed construct on operational efficiency.

The research analysis showed a siginificant causal relationship between transformation initiatives and performance, mediated by IT-enablement and organizational contextual factors such as objectives, measurements and monitoring. While we did prove support for most of our propositions a number of factors were removed during our analysis, like Regional Skills, Industry and Outsourcing, as they proved neither significant nor causal in the PLS model.

Finally, we elaborated on the need for continuous transformation as companies should pursue stability and uncertainty in designing their business operations and IT-enablement.

TITLER I PH.D.SERIEN:

2004

1. Martin Grieger
Internet-based Electronic Marketplaces and Supply Chain Management

2. Thomas Basbøll
LIKENESS
A Philosophical Investigation

3. Morten Knudsen
Beslutningens vaklen
En systemteoretisk analyse of moderniseringen af et amtskommunalt sundhedsvæsen 1980-2000

4. Lars Bo Jeppesen
Organizing Consumer Innovation
A product development strategy that is based on online communities and allows some firms to benefit from a distributed process of innovation by consumers

5. Barbara Dragsted
SEGMENTATION IN TRANSLATION AND TRANSLATION MEMORY SYSTEMS
An empirical investigation of cognitive segmentation and effects of integrating a TM system into the translation process

6. Jeanet Hardis
Sociale partnerskaber
Et socialkonstruktivistisk casestudie af partnerskabsaktørers virkelighedsopfattelse mellem identitet og legitimitet

7. Henriette Hallberg Thygesen
System Dynamics in Action

8. Carsten Mejer Plath
Strategisk Økonomistyring

9. Annemette Kjærgaard
Knowledge Management as Internal Corporate Venturing
– a Field Study of the Rise and Fall of a Bottom-Up Process

10. Knut Arne Hovdal
De profesjonelle i endring
Norsk ph.d., ej til salg gennem Samfundslitteratur

11. Søren Jeppesen
Environmental Practices and Greening Strategies in Small Manufacturing Enterprises in South Africa
– A Critical Realist Approach

12. Lars Frode Frederiksen
Industriel forskningsledelse
– på sporet af mønstre og samarbejde i danske forskningsintensive virksomheder

13. Martin Jes Iversen
The Governance of GN Great Nordic
– in an age of strategic and structural transitions 1939-1988

14. Lars Pynt Andersen
The Rhetorical Strategies of Danish TV Advertising
A study of the first fifteen years with special emphasis on genre and irony

15. Jakob Rasmussen
Business Perspectives on E-learning

16. Sof Thrane
The Social and Economic Dynamics of Networks
– a Weberian Analysis of Three Formalised Horizontal Networks

17. Lene Nielsen
Engaging Personas and Narrative Scenarios – a study on how a user-centered approach influenced the perception of the design process in the e-business group at AstraZeneca

18. S.J Valstad
Organisationsidentitet
Norsk ph.d., ej til salg gennem Samfundslitteratur

19. Thomas Lyse Hansen
Six Essays on Pricing and Weather risk in Energy Markets

20. Sabine Madsen
Emerging Methods – An Interpretive Study of ISD Methods in Practice

21. Evis Sinani
The Impact of Foreign Direct Investment on Efficiency, Productivity Growth and Trade: An Empirical Investigation

22. Bent Meier Sørensen
Making Events Work Or, How to Multiply Your Crisis

23. Pernille Schnoor
Brand Ethos
Om troværdige brand- og virksomhedsidentiteter i et retorisk og diskursteoretisk perspektiv

24. Sidsel Fabech
Von welchem Österreich ist hier die Rede?
Diskursive forhandlinger og magtkampe mellem rivaliserende nationale identitetskonstruktioner i østrigske pressediskurser

25. Klavs Odgaard Christensen
Sprogpolitik og identitetsdannelse i flersprogede forbundsstater
Et komparativt studie af Schweiz og Canada

26. Dana B. Minbaeva
Human Resource Practices and Knowledge Transfer in Multinational Corporations

27. Holger Højlund
Markedets politiske fornuft
Et studie af velfærdens organisering i perioden 1990-2003

28. Christine Mølgaard Frandsen
A.s erfaring
Om mellemværendets praktik i en transformation af mennesket og subjektiviteten

29. Sine Nørholm Just
The Constitution of Meaning
– A Meaningful Constitution?
Legitimacy, identity, and public opinion in the debate on the future of Europe

2005

1. Claus J. Varnes
Managing product innovation through rules – The role of formal and structured methods in product development

2. Helle Hedegaard Hein
Mellem konflikt og konsensus
– Dialogudvikling på hospitalsklinikker

3. Axel Rosenø
Customer Value Driven Product Innovation – A Study of Market Learning in New Product Development

4. Søren Buhl Pedersen
Making space
An outline of place branding

5. Camilla Funck Ellehave
Differences that Matter
An analysis of practices of gender and organizing in contemporary workplaces

6. Rigmor Madeleine Lond
Styring af kommunale forvaltninger

7. Mette Aagaard Andreassen
Supply Chain versus Supply Chain
Benchmarking as a Means to Managing Supply Chains

8. Caroline Aggestam-Pontoppidan
From an idea to a standard
The UN and the global governance of accountants' competence

9. Norsk ph.d.

10. Vivienne Heng Ker-ni
An Experimental Field Study on the

Effectiveness of Grocer Media Advertising
Measuring Ad Recall and Recognition, Purchase Intentions and Short-Term Sales

11. Allan Mortensen
Essays on the Pricing of Corporate Bonds and Credit Derivatives

12. Remo Stefano Chiari
Figure che fanno conoscere
Itinerario sull'idea del valore cognitivo e espressivo della metafora e di altri tropi da Aristotele e da Vico fino al cognitivismo contemporaneo

13. Anders McIlquham-Schmidt
Strategic Planning and Corporate Performance
An integrative research review and a meta-analysis of the strategic planning and corporate performance literature from 1956 to 2003

14. Jens Geersbro
The TDF – PMI Case
Making Sense of the Dynamics of Business Relationships and Networks

15 Mette Andersen
Corporate Social Responsibility in Global Supply Chains
Understanding the uniqueness of firm behaviour

16. Eva Boxenbaum
Institutional Genesis: Micro – Dynamic Foundations of Institutional Change

17. Peter Lund-Thomsen
Capacity Development, Environmental Justice NGOs, and Governance: The Case of South Africa

18. Signe Jarlov
Konstruktioner af offentlig ledelse

19. Lars Stæhr Jensen
Vocabulary Knowledge and Listening Comprehension in English as a Foreign Language
An empirical study employing data elicited from Danish EFL learners

20. Christian Nielsen
Essays on Business Reporting
Production and consumption of strategic information in the market for information

21. Marianne Thejls Fischer
Egos and Ethics of Management Consultants

22. Annie Bekke Kjær
Performance management i Proces-innovation
– belyst i et social-konstruktivistisk perspektiv

23. Suzanne Dee Pedersen
GENTAGELSENS METAMORFOSE
Om organisering af den kreative gøren i den kunstneriske arbejdspraksis

24. Benedikte Dorte Rosenbrink
Revenue Management
Økonomiske, konkurrencemæssige & organisatoriske konsekvenser

25. Thomas Riise Johansen
Written Accounts and Verbal Accounts
The Danish Case of Accounting and Accountability to Employees

26. Ann Fogelgren-Pedersen
The Mobile Internet: Pioneering Users' Adoption Decisions

27. Birgitte Rasmussen
Ledelse i fællesskab – de tillidsvalgtes fornyende rolle

28. Gitte Thit Nielsen
Remerger
– skabende ledelseskræfter i fusion og opkøb

29. Carmine Gioia
A MICROECONOMETRIC ANALYSIS OF MERGERS AND ACQUISITIONS

30. Ole Hinz
Den effektive forandringsleder: pilot, pædagog eller politiker?
Et studie i arbejdslederes meningstilskrivninger i forbindelse med vellykket gennemførelse af ledelsesinitierede forandringsprojekter

31. Kjell-Åge Gotvassli
Et praksisbasert perspektiv på dynamiske
læringsnettverk i toppidretten
Norsk ph.d., ej til salg gennem Samfundslitteratur

32. Henriette Langstrup Nielsen
Linking Healthcare
An inquiry into the changing performances of web-based technology for asthma monitoring

33. Karin Tweddell Levinsen
Virtuel Uddannelsespraksis
Master i IKT og Læring – et casestudie i hvordan proaktiv proceshåndtering kan forbedre praksis i virtuelle læringsmiljøer

34. Anika Liversage
Finding a Path
Labour Market Life Stories of Immigrant Professionals

35. Kasper Elmquist Jørgensen
Studier i samspillet mellem stat og erhvervsliv i Danmark under 1. verdenskrig

36. Finn Janning
A DIFFERENT STORY
Seduction, Conquest and Discovery

37. Patricia Ann Plackett
Strategic Management of the Radical Innovation Process
Leveraging Social Capital for Market Uncertainty Management

2006

1. Christian Vintergaard
Early Phases of Corporate Venturing

2. Niels Rom-Poulsen
Essays in Computational Finance

3. Tina Brandt Husman
Organisational Capabilities, Competitive Advantage & Project-Based Organisations
The Case of Advertising and Creative Good Production

4. Mette Rosenkrands Johansen
Practice at the top
– how top managers mobilise and use non-financial performance measures

5. Eva Parum
Corporate governance som strategisk kommunikations- og ledelsesværktøj

6. Susan Aagaard Petersen
Culture's Influence on Performance Management: The Case of a Danish Company in China

7. Thomas Nicolai Pedersen
The Discursive Constitution of Organizational Governance – Between unity and differentiation
The Case of the governance of environmental risks by World Bank environmental staff

8. Cynthia Selin
Volatile Visions: Transactons in Anticipatory Knowledge

9. Jesper Banghøj
Financial Accounting Information and Compensation in Danish Companies

10. Mikkel Lucas Overby
Strategic Alliances in Emerging High-Tech Markets: What's the Difference and does it Matter?

11. Tine Aage
External Information Acquisition of Industrial Districts and the Impact of Different Knowledge Creation Dimensions

A case study of the Fashion and Design Branch of the Industrial District of Montebelluna, NE Italy

12. Mikkel Flyverbom
Making the Global Information Society Governable
On the Governmentality of Multi-Stakeholder Networks

13. Anette Grønning
Personen bag
Tilstedevær i e-mail som inter-aktionsform mellem kunde og med-arbejder i dansk forsikringskontekst

14. Jørn Helder
One Company – One Language?
The NN-case

15. Lars Bjerregaard Mikkelsen
Differing perceptions of customer value
Development and application of a tool for mapping perceptions of customer value at both ends of customer-supplier dyads in industrial markets

16. Lise Granerud
Exploring Learning
Technological learning within small manufacturers in South Africa

17. Esben Rahbek Pedersen
Between Hopes and Realities: Reflections on the Promises and Practices of Corporate Social Responsibility (CSR)

18. Ramona Samson
The Cultural Integration Model and European Transformation.
The Case of Romania

2007

1. Jakob Vestergaard
Discipline in The Global Economy
Panopticism and the Post-Washington Consensus

2. Heidi Lund Hansen
Spaces for learning and working
A qualitative study of change of work, management, vehicles of power and social practices in open offices

3. Sudhanshu Rai
Exploring the internal dynamics of software development teams during user analysis
A tension enabled Institutionalization Model; "Where process becomes the objective"

4. Norsk ph.d.
Ej til salg gennem Samfundslitteratur

5. Serden Ozcan
EXPLORING HETEROGENEITY IN ORGANIZATIONAL ACTIONS AND OUTCOMES
A Behavioural Perspective

6. Kim Sundtoft Hald
Inter-organizational Performance Measurement and Management in Action
– An Ethnography on the Construction of Management, Identity and Relationships

7. Tobias Lindeberg
Evaluative Technologies
Quality and the Multiplicity of Performance

8. Merete Wedell-Wedellsborg
Den globale soldat
Identitetsdannelse og identitetsledelse i multinationale militære organisationer

9. Lars Frederiksen
Open Innovation Business Models
Innovation in firm-hosted online user communities and inter-firm project ventures in the music industry
– A collection of essays

10. Jonas Gabrielsen
Retorisk toposlære – fra statisk 'sted' til persuasiv aktivitet

11. Christian Moldt-Jørgensen
Fra meningsløs til meningsfuld evaluering.
Anvendelsen af studentertilfredshedsmålinger på de korte og mellemlange videregående uddannelser set fra et psykodynamisk systemperspektiv

12. Ping Gao
Extending the application of actor-network theory
Cases of innovation in the telecommunications industry

13. Peter Mejlby
Frihed og fængsel, en del af den samme drøm?
Et phronetisk baseret casestudie af frigørelsens og kontrollens sameksistens i værdibaseret ledelse!

14. Kristina Birch
Statistical Modelling in Marketing

15. Signe Poulsen
Sense and sensibility:
The language of emotional appeals in insurance marketing

16. Anders Bjerre Trolle
Essays on derivatives pricing and dynamic asset allocation

17. Peter Feldhütter
Empirical Studies of Bond and Credit Markets

18. Jens Henrik Eggert Christensen
Default and Recovery Risk Modeling and Estimation

19. Maria Theresa Larsen
Academic Enterprise: A New Mission for Universities or a Contradiction in Terms?
Four papers on the long-term implications of increasing industry involvement and commercialization in academia

20. Morten Wellendorf
Postimplementering af teknologi i den offentlige forvaltning
Analyser af en organisations kontinuerlige arbejde med informationsteknologi

21. Ekaterina Mhaanna
Concept Relations for Terminological Process Analysis

22. Stefan Ring Thorbjørnsen
Forsvaret i forandring
Et studie i officerers kapabiliteter under påvirkning af omverdenens forandringspres mod øget styring og læring

23. Christa Breum Amhøj
Det selvskabte medlemskab om managementstaten, dens styringsteknologier og indbyggere

24. Karoline Bromose
Between Technological Turbulence and Operational Stability
– An empirical case study of corporate venturing in TDC

25. Susanne Justesen
Navigating the Paradoxes of Diversity in Innovation Practice
– A Longitudinal study of six very different innovation processes – in practice

26. Luise Noring Henler
Conceptualising successful supply chain partnerships
– Viewing supply chain partnerships from an organisational culture perspective

27. Mark Mau
Kampen om telefonen
Det danske telefonvæsen under den tyske besættelse 1940-45

28. Jakob Halskov
The semiautomatic expansion of existing terminological ontologies using knowledge patterns discovered

on the WWW – an implementation and evaluation

29. Gergana Koleva
European Policy Instruments Beyond Networks and Structure: The Innovative Medicines Initiative

30. Christian Geisler Asmussen
Global Strategy and International Diversity: A Double-Edged Sword?

31. Christina Holm-Petersen
Stolthed og fordom
Kultur- og identitetsarbejde ved skabelsen af en ny sengeafdeling gennem fusion

32. Hans Peter Olsen
Hybrid Governance of Standardized States
Causes and Contours of the Global Regulation of Government Auditing

33. Lars Bøge Sørensen
Risk Management in the Supply Chain

34. Peter Aagaard
Det unikkes dynamikker
De institutionelle mulighedsbetingelser bag den individuelle udforskning i professionelt og frivilligt arbejde

35. Yun Mi Antorini
Brand Community Innovation
An Intrinsic Case Study of the Adult Fans of LEGO Community

36. Joachim Lynggaard Boll
Labor Related Corporate Social Performance in Denmark
Organizational and Institutional Perspectives

2008

1. Frederik Christian Vinten
Essays on Private Equity

2. Jesper Clement
Visual Influence of Packaging Design on In-Store Buying Decisions

3. Marius Brostrøm Kousgaard
Tid til kvalitetsmåling?
– Studier af indrulleringsprocesser i forbindelse med introduktionen af kliniske kvalitetsdatabaser i speciallægepraksissektoren

4. Irene Skovgaard Smith
Management Consulting in Action
Value creation and ambiguity in client-consultant relations

5. Anders Rom
Management accounting and integrated information systems
How to exploit the potential for management accounting of information technology

6. Marina Candi
Aesthetic Design as an Element of Service Innovation in New Technology-based Firms

7. Morten Schnack
Teknologi og tværfaglighed
– en analyse af diskussionen omkring indførelse af EPJ på en hospitalsafdeling

8. Helene Balslev Clausen
Juntos pero no revueltos – un estudio sobre emigrantes norteamericanos en un pueblo mexicano

9. Lise Justesen
Kunsten at skrive revisionsrapporter.
En beretning om forvaltningsrevisionens beretninger

10. Michael E. Hansen
The politics of corporate responsibility: CSR and the governance of child labor and core labor rights in the 1990s

11. Anne Roepstorff
Holdning for handling – en etnologisk undersøgelse af Virksomheders Sociale Ansvar/CSR

12. Claus Bajlum
Essays on Credit Risk and Credit Derivatives

13. Anders Bojesen
The Performative Power of Competence – an Inquiry into Subjectivity and Social Technologies at Work

14. Satu Reijonen
Green and Fragile
A Study on Markets and the Natural Environment

15. Ilduara Busta
Corporate Governance in Banking
A European Study

16. Kristian Anders Hvass
A Boolean Analysis Predicting Industry Change: Innovation, Imitation & Business Models
The Winning Hybrid: A case study of isomorphism in the airline industry

17. Trine Paludan
De uvidende og de udviklingsparate
Identitet som mulighed og restriktion blandt fabriksarbejdere på det aftayloriserede fabriksgulv

18. Kristian Jakobsen
Foreign market entry in transition economies: Entry timing and mode choice

19. Jakob Elming
Syntactic reordering in statistical machine translation

20. Lars Brømsøe Termansen
Regional Computable General Equilibrium Models for Denmark
Three papers laying the foundation for regional CGE models with agglomeration characteristics

21. Mia Reinholt
The Motivational Foundations of Knowledge Sharing

22. Frederikke Krogh-Meibom
The Co-Evolution of Institutions and Technology
– A Neo-Institutional Understanding of Change Processes within the Business Press – the Case Study of Financial Times

23. Peter D. Ørberg Jensen
OFFSHORING OF ADVANCED AND HIGH-VALUE TECHNICAL SERVICES: ANTECEDENTS, PROCESS DYNAMICS AND FIRMLEVEL IMPACTS

24. Pham Thi Song Hanh
Functional Upgrading, Relational Capability and Export Performance of Vietnamese Wood Furniture Producers

25. Mads Vangkilde
Why wait?
An Exploration of first-mover advantages among Danish e-grocers through a resource perspective

26. Hubert Buch-Hansen
Rethinking the History of European Level Merger Control
A Critical Political Economy Perspective

2009

1. Vivian Lindhardsen
From Independent Ratings to Communal Ratings: A Study of CWA Raters' Decision-Making Behaviours

2. Guðrið Weihe
Public-Private Partnerships: Meaning and Practice

3. Chris Nøkkentved
Enabling Supply Networks with Collaborative Information Infrastructures
An Empirical Investigation of Business Model Innovation in Supplier Relationship Management

TITLER I ATV PH.D.-SERIEN

1992

1. Niels Kornum
Servicesamkørsel – organisation, økonomi og planlægningsmetoder

1995

2. Verner Worm
Nordiske virksomheder i Kina
Kulturspecifikke interaktionsrelationer ved nordiske virksomhedsetableringer i Kina

1999

3. Mogens Bjerre
Key Account Management of Complex Strategic Relationships
An Empirical Study of the Fast Moving Consumer Goods Industry

2000

4. Lotte Darsø
Innovation in the Making
Interaction Research with heterogeneous Groups of Knowledge Workers creating new Knowledge and new Leads

2001

5. Peter Hobolt Jensen
Managing Strategic Design Identities
The case of the Lego Developer Network

2002

6. Peter Lohmann
The Deleuzian Other of Organizational Change – Moving Perspectives of the Human

7. Anne Marie Jess Hansen
To lead from a distance: The dynamic interplay between strategy and strategizing – A case study of the strategic management process

2003

8. Lotte Henriksen
Videndeling
– om organisatoriske og ledelsesmæssige udfordringer ved videndeling i praksis

9. Niels Christian Nickelsen
Arrangements of Knowing: Coordinating Procedures Tools and Bodies in Industrial Production – a case study of the collective making of new products

2005

10. Carsten Ørts Hansen
Konstruktion af ledelsesteknologier og effektivitet

TITLER I DBA PH.D.-SERIEN

2007

1. Peter Kastrup-Misir
Endeavoring to Understand Market Orientation – and the concomitant co-mutation of the researched, the researcher, the research itself and the truth