Analysis of Current Supplier Relationship Management Practices: A Solution Proposal

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Contents

List of Abbreviations

B2B	Business to Business
B2C	Business to Customer
B2G	Business to Government
BI	Business Intelligence
BPO	Business Process Outsourcing
CDM	Central Data Management
DPS	Desktop Purchasing System
DQM	Data Quality Management
DSS	Decision Support System
e-Auction	Electronic Auction
e-Business	Electronic Business
e-Catalogue	Electronic Catalogue
e-Commerce	Electronic Commerce
EDI	Electronic Data Interchange
e-Procurement	Electronic Procurement
ERP	Enterprise Resource Planning
e-Sourcing	Electronic Sourcing
ETL	Extraction, Transform, Load
ICT	Information and Communication Technology
IT	Information Technology
KPI	Key Performance Indicator
MRO	Maintenance, Repair and Operations
MRP	Material Requirements Planning
OLTP	Online Transaction Processing System
ORM	Operating Resource Management
PDA	Personal Digital Assistant
RFP	Request for Proposal
RFQ	Request for Quotation
ROI	Return on Investment
SCM	Supply Chain Management
SMEs	Small-and-Medium Size Enterprise
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SRM	Supplier Relationship Management
TCP/IP	Transmission Control Protocol / Internet Protocol
TQM	Total Quality Management
XML	Extensible Markup Language

List of Figures

List of Tables

1 Introduction

The modern economical environment has been gaining sweeping complexity and competition. Organizations from all market segments are facing continuous changes in their marketplaces due to the entrance of new competitors and the growing access to market information.

The globalization process and the use of innovative communication meanings have made companies rethink the way they do business. The new developments in business have created a new world in which traditional management practices are no longer applicable and information has become crucial for companies to succeed.

Therefore, the application of information technology to support business processes and to facilitate the management of companies' supply chain has turn out to be an essential element of modern management practices.

In order to cope with this new business scenario, companies are forced to invest great sums of capital to improve their communication technology infrastructure and to be ahead on this market trend.

Indeed, with the increase of importance of the purchasing department and the boost in interest for supplier relationship management practices, organizations are seeking to manage and integrate their inter-organizational business processes by means of applying supplier relationship management solutions.

Supplier relationship management is the part of the supply chain management which deals with all aspects of the business relationship between companies and their suppliers.

It is a broad concept and describes the business structures and processes required by companies to communicate and execute commercial transactions with their suppliers, while providing methods, processes and tools to support the different phases of a supplier relationship [EyKM02, 66-76].

It is notorious that the deployment of supplier relationship management (SRM) solutions has become a key element of the modern business strategy and the transfer of electronic information between commercial partners is absolutely needful.

Diverse market studies have shown that SRM solutions have been for a relative long time implemented in organizations, and it is perceived by most enterprises' managers as a critical success-factor for company's competitive advantage [Gart04], [Bart05], [Aberd06].

In view of SRM's acknowledge importance to organization's strategy, it is continuously required the further development of this technology as well as the analysis of its deployment in companies.

Nonetheless, the available literature on this topic focus, in most cases, on the management aspect of this technology, leaving the technical development of those solutions to software provides, which seldom apply a systematic research approach toward this subject.

For this reason a systematic research dealing with all aspects of this subject, organizational as well as technological, is still missing. Therefore, due to the lack of a bigger picture concerning this issue key aspects are forgotten or neglected.

This statement is especially true in the field of indirect material supplier relationship management practices and solutions, in which barely research has been carried out and relative few software vendors are active.

In this specific area, the electronic catalogue system has been successfully applied along the years to manage the exchange of electronic information between organizations and their business partners [Gran99], [PWC02], [IDC03].

When we look at the B2B e-Commerce literature and practice, it can be seen that electronic catalogue has gained an important place in the SRM environment. e-Catalogue is defined by Segev as electronic representations of information about the products and/or services of an organization [SeWB95].

In other words, electronic catalogue is the tool, which enables buyers to view electronically and interact automatically with their suppliers' product information, simplifying for those buyers the search, management, evaluation and acquisition of this data.

As it can be noted by the description above, companies can profit from the deployment of e-catalogue solutions in two main ways: reducing the material costs and/or streamlining the requisition process.

Nevertheless, due to the dynamic characteristic of the actual economical environment, the scope of e-catalogue that was just described above is no longer appropriate to deal with the new business challenges.

Nowadays, e-catalogue vendors and researchers are challenged to increase the range of functionalities and advantages that these systems provide to companies beyond their actual borders, i.e. exchange of electronic product information and their respective search inside a database.

In this work, the focus of the analysis is on the information technology aspect of the supplier relationship management, which embraces the flow of information between the purchase function, their internal customers and suppliers.

Here are included transaction systems such as electronic sourcing, electronic procurement, supplier enablement and the content management infrastructure as well as the analytical solutions, which in combination creates an information system environment to support the source-to-order process of indirect goods and services.

The research contributes with the existing literature by investigating the current German supplier relationship management practices with the focus on the management of the indirect material purchasing process in a business information perspective.

According to these findings, the study designs an information system framework concept based on the electronic catalogue technology in which new relevant functionalities have been incorporated into the current system architecture.

The developed SRM solution concept should be able to be implemented in company's practical purchase activities, increasing from one side the current application area of the available e-catalogue solutions, and from the other side, providing companies with an innovative and competitive framework to manage their indirect material management processes.

The concept implementation is though not in the scope of the research. By way of innovative approach of the study, it is expected that the knowledge gained from the empirical survey provides the research with the required subsides to develop a concept that corresponds with the organization's business requirements and the technological pretensions of SRM system developers.

The fundamentals to the concept design are originated from the literature review, the empirical study as well as the research project "Content Supply Chain Management", which had as the main goal the analysis of existing standards for the exchange of business data between enterprises as well as they representation and harmonization with the aim of enabling the exchange of content in different market sectors, countries and languages.

Due to the dual objective of the research, the work has been divided into two main parts: The empirical study and the e-Catalogue based SRM framework, see figure 1.1 for more detail about the research structure.
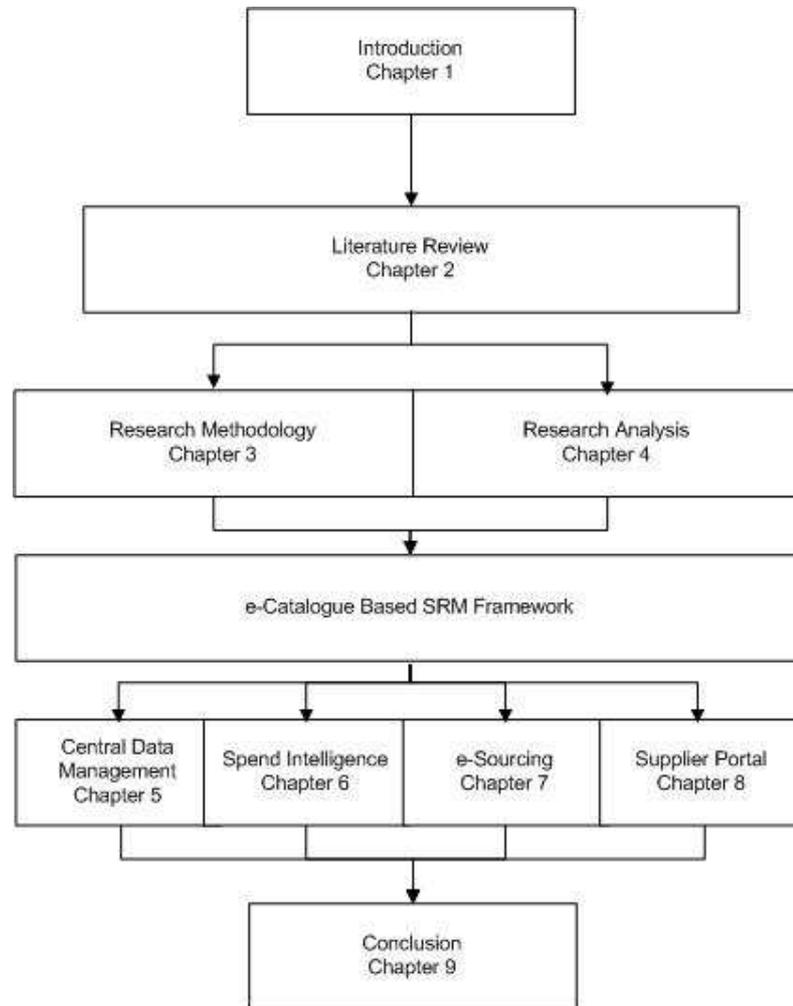
Figure 1.1 The Research Structure

First of all, the study undertakes an empirical research among large German organizations with the goal of defining the state-of-the-art of the supplier relationship management solutions as well as to elucidate potential trends in the indirect good purchasing area.

The main research questions of the study can be defined as follows:

- Usage of supplier relationship management solutions;
- Main benefits, obstacles and key-drivers of SRM programs;
- Extension of SRM projects;
- Methods and systems implementation.

Besides the analysis of general supplier relationship management practices, the empirical research has focused on issues concerning the application of e-catalogue platforms in company's purchasing process.

Therefore, the research has been concerned also about obtaining crucial information in relation to this solution with the purpose of creating a concept, which can be deployed to expand the capacity of those systems to communicate with other solutions and to manage a wider scope of functions within company's supply chain.

The main research questions in this area have been divided into:

- Usage of e-Catalogue systems;
- e-Catalogue management;
- Integration issues;
- Technical developments;
- e-Catalogue Standards.

In the second part of the work, the author has designed three new features to be integrated into the e-catalogue platform, i.e. central data management, business intelligence and the e-Sourcing tool, as well as the concept of a specialized e-catalogue supplier portal to facilitate the communication between the involved business partners.

Hence, the concept design for the e-catalogue based SRM solution applied a mix of general supplier relationship management concepts and new specific concepts designed specifically to the proposed framework.

The design description starts in chapter five with the design of a central data management solution. The chapter portrays the central master data management module, including its architecture, data model, data enrichment and classification processes, while it introduces a data quality management approach with the purpose of illustrating the managerial procedures necessary to guarantee a high data quality in companies.

In chapter six, the spend intelligence tool is introduced, applying therefore a general business intelligence concept to design a specialized indirect material business intelligence environment, including but not limited to its ETL process, data model construction and its logical and reporting design.

Chapter seven looks at the indirect goods sourcing functionality that is provided by the framework. The main focus of this chapter is the e-catalogue based sourcing features and the ideal sourcing process designed to support buyers during their negotiation activities with their actual and potential suppliers.

In chapter eight, the supplier portal concept used to facilitate the electronic communication between two or more business partners is described. The proposed

portal intends to create a devoted environment in which indirect product and supplier information can be exchanged and the above mentioned framework can be accessed, increasing the interoperability of the diverse SRM modules available in the framework.

Finally, in the end of the work it is provided a short discussion concerning the research results and the framework proposed, including the potential enhancements and limitations of the e-Catalogue based SRM concept design as well as a discussion about further research in the area.

2 Literature Review

The literature review discusses concepts and theories from different study areas, e.g. business administration, economics, informatics, supply chain management, etc. Nonetheless, this chapter intends to provide just a superficial background of these research fields without getting involved in an exhaustive discussion of each of these topics.

The theoretical analysis is crucial to give the author the information necessary to develop and carry out the empirical research, at the same time that it provides readers with the background required to understand the contributions of the study.

In this chapter, it is discussed the influence of the recent changes in corporate strategy on the buyer-supplier relationship theory and their impact on the procurement function (section 2.1).

With this review, the basic conditions are provided to describe the late information technology developments with the focus on the web-based applications that support the purchase processes in companies (section 2.2 and 2.3).

In a next step, the author draws some market trends, adopting therefore a practical approach through the analysis of numerous market researches of different research institutes and authors (section 2.4), which will constitute the basis for the empirical study construction.

2.1 Corporate Strategy

Organizations are facing an era of enormous competition and extraordinary market changes. The later innovations in the information technology, e.g. internet, mobile services, etc., and the globalization process have created a business environment in which companies have to continuously improve their managerial processes and their technical infrastructure to keep competitive in the marketplace.

This new business environment and the trade liberalization are changing the competition behavior in most economical sectors. These changes are leading to a revolution in business strategy that has been suggested by several strategic researchers [HmPc94].

This business revolution can be partially explained by the challenges that companies are encountering during the last decades, i.e. pressure on costs and prices, shorter product lifecycle, reduction of the supplier-base, higher customization, innovation and market fragmentation.

Organizations had to rethink their way of doing business, based solely on their internal resources toward a more dynamic strategy, benefiting from their internal improved operations and closer relations with their business partners to overcome those challenges.

In resume, as Ohmae (1994) has foreseen, the information system technology is making conventional borders obsolete. Not only between countries, but especially between enterprises, creating a "global village".

2.1.1 Supply Chain Management

This phenomenon has created a new economical environment in which organizations compete in the market no longer as a single legal entity, but as supply chains [Chrs97, 204], and information has become the most valuable asset for companies, which has to be managed and distributed to their "stakeholders", i.e. investors, suppliers, customers, employees, government, with the intention of managing their business relations efficiently and compete in the global market.

Therefore, the application of information technology and the formation of electronic networks have become an important part of corporate strategy. This statement is also true in the management of organization's value chain, which consists the range of processes that a product or service must undergo from raw material to the end consumer [Port85].

These new market forces have demanded organizations to concentrate their efforts on few core activities, in which they can attain and sustain a long-term competitive advantage. All other activities which companies are unable to achieve a distinctive performance should be outsourced [Quin92].

The concentration strategy on few core competencies, which has been adopted by many leading organizations, has leaded the evolution of company's purchase function from an administrative and short-term driving job to a strategic department in which companies found numerous possibilities to improve their long-term business performance [AnKa98].

Analyzing the cost structure of an organization, it becomes clear the importance of procurement to company's performance. Spending on materials and services in an organization may report for between 30 to 75% of the total costs. Storage and distribution costs may account for further 10 to 20% of the total costs, while stocks can account for between 30 to 50% of the total investment [Quay06]. This shows the potential impact of the procurement function on costs and profits of an organization.

Consequently, supply chain management and purchasing performance are increasingly recognized as an important determinant of a firm's competitiveness. The term "supply chain management" has its origins in the early eighties, when Oliver and Weber [Harl96, 63-80] argued about the potential benefits of integrating the diverse business functions of an organization, e.g. procurement, manufacturing, logistic and sales.

Since then, supply chain management is a hot topic in company's strategy and in the scientific community. However, there is little consistency in the definition of this term in the literature.

This work applies the supply chain management definition provided by the global supply chain forum, which says that "supply chain management is the integration of key business processes from end user through original suppliers that provides products, services, and information that add value for customers and other stakeholders" [LaCP98, 1].

These business processes can be grouped in: Customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, procurement, product development and commercialization, and returns [Quay06]. According to this approach supplier relationship management constitutes an essential part of the procurement activities in companies' supply chain.

The objective of the above listed processes is to provide organizations with high-quality information on the right time in order to improve their process's performance and enable suppliers to provide an uninterrupted and precisely timed flow of products and services.

2.1.2 Buyer/Supplier Relationship Theory

The customer/supplier relationship is an essential part of corporate strategy, which has been gaining an increasing attention from management researches because of its potential to influence decisively companies' financial results.

The literature on buyer-supplier relationships used to focus on a single sort of business relationship, ignoring or sub-estimating the differences and interdependencies between dissimilar business relations and the important task of allocating various resources between all enterprises' relationships [OlEl95].

Nonetheless, due to the increasing competition, organizations are focusing more and more on their strategic stakeholders, moving from the traditional relationship approach which is mainly based on a simple buy-sell relation without any collaborative character,

to adopt a more long-term driving cooperative relationship with their business partners [BoCl96].

This trend may be explained, from one side, by the impossibility of companies to control their complete supply chain and their strategic focus on core competences, e.g. technical and know-how advantages.

From the other side, the introduction of modern management practices, e.g. Just in Time, lean manufacturing, electronic commerce, integrated supply chain, Total Quality Management (TQM), has increased the necessity to establish closer long-term customer-supplier relationship with key suppliers with the purpose of increasing product and service quality and enhancing organizational competitiveness.

This new business environment invites us to rethink the traditional management models and organization structures of the industrial era. Organizations are moving towards a strategic network model, dealing simultaneously with different issues, e.g. global competition, internal organizational complexity, innovation, market fragmentation and process diversity.

In this scenario, the supply chain management theory has been established to deal with the new challenges. The Supply Chain Management (SCM) deals with the integration of businesses processes through the value chain within and across company's boarders [CoLP97, 1-14].

Therefore, companies participating in a supply chain have to be willing to cooperate between each other in order to achieve an effective flow of product and information. Furthermore, the institutional economics postulates the importance of trust on the supply chain to cultivate business relationships and achieve competitive advantage [GrMa03, 457-473].

In this context, two widely differing supplier management models have emerged from both practices as well as academic research on the issue of how to optimize companies' supply chains.

The traditional view of supplier relationship management argues on the necessity to minimize the dependence on suppliers, while maximizing bargaining power. This approach was acknowledged as the most effective way to manage suppliers in the western world until the success of Japanese supplier management practices, which is based on a partnership model of supplier management [DyCC98, 55-77].

However, nowadays because of the high costs of building up and maintaining strategic partnerships, we see in the practices the coexistence of these two models in

company's strategy with the intention to allocate in the best way possible their resources through their supply chain.

The idea is to foster close relationships with a small number of key suppliers, which possess high technological and add-value know-how and resources, and maintain traditional arm's length relationships with the others.

Indeed, the relationship theory is a relative new discipline of business economics and its importance can be seen in the numerous discussions on the topic coming from different academic research areas in the last decades: marketing management [KoLe69, 10-15], developing theory of exchange [Bago75, 32-39], network interaction [HaSh95], institutional economics [Will96, 448], etc.

As an important part of organization's business strategy, the supplier-buyer relationship has become one of the most studied fields of the management theory, and the procurement function, as one of its enablers in companies, stays in the middle point of these discussions.

2.1.3 The Role of Procurement in Corporate Strategy

All companies consist of a group of activities, resources and infrastructure to enable their value chains to perform key activities, functions and business processes, e.g. product design, production, marketing, deliver, to support their end-customers in the best way possible [Quay06].

It is important to note that any company's value chain is directly or indirectly connected up with the preceding and subsequent value chains of their suppliers and customers. Together these business connections constitute the entire value chain of a product, market or sector [ECC00].

The management of a company's value chain is the focus of many business strategies, and its long term high performance is a key factor to achieve and keep up a distinctive competitive advantage.

The value chain is composed of nine generic activities, which can be sub-divided into primary activities and support activities: primary activities are those which are directly involved on the physical transformation and handling of companies' final products, while the support activities enable and support the execution of the primary activities [Port85], see Figure. 2.1.

Porter includes the procurement activity in the support activities group. However, he noted that often the procurement process has a great impact in company's total costs and its market differentiation.
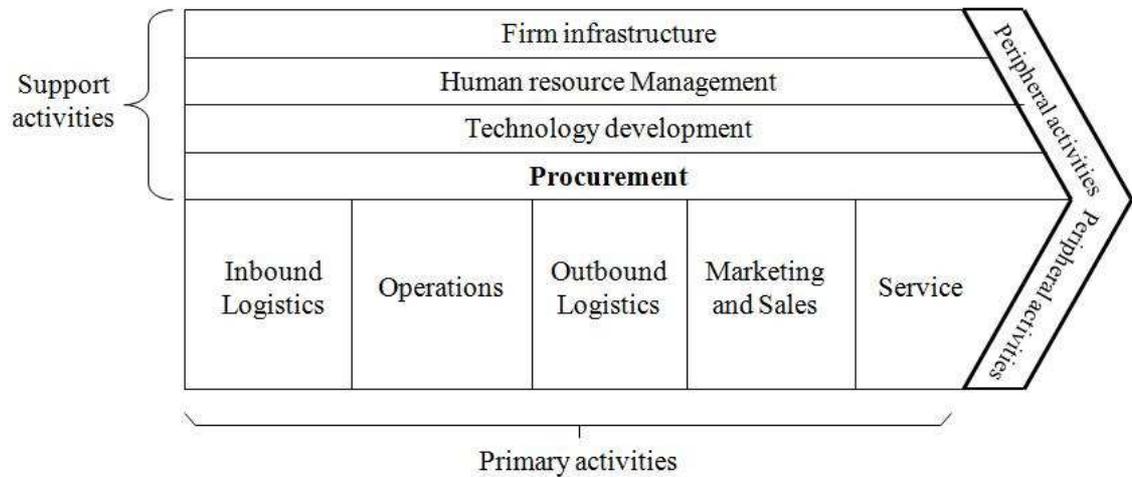
Figure 2.1 Procurement and the Value Chain (adapted from [Port85])

Procurement or purchasing encompasses all activities involved in obtaining material and services and managing their inflow into an organization toward company's internal customers. It includes the acquisition of direct materials for an assembly line as well as obtaining office materials for an organization [HoAs92, ZeTh94].

The purchasing business processes take place at the beginning of the value chain, including activities such as development and realisation of purchasing strategy, supplier analysis and selection, purchasing negotiation as well as the ordering, disposition and payment politics and operation.

In other words, the procurement department operates as an interface between an organization and its suppliers; hence its performance has a great influence on company's business results.

Lambert & Cooper structural model concerning the management of suppliers' relations and activities illustrates the numerous advantages to integrate business activities and purchasing processes, including services and information, to add value to company's relationships, cf. [CoLP97].

2.1.4 Purchasing Function Evolution

Nonetheless, the purchasing function was seen until the eighties as a secondary function that supported the daily operation of other departments and did not get much attention from the top management, its personnel were mainly employees without high education,

who realized simple operational and administrative activities, leading to high inefficiency of its activities and loose relationship with company's suppliers.

In the eighties, because of the increase of companies' specialization on their core competences [HmPc94], procurement has become a strategic function with its focus on the support of companies' primary activities, dealing with the acquisition of complex and added value supplies.

The purchase department had changed its image from a cost center, in which mainly operative activities were done, to a strategic function of key importance to company's performance.

In order to cope with this new scenario, the procurement department had to change their traditionally oriented transaction approach to a supply chain approach with the respective reorganization and improvement of its structures and processes, becoming a market oriented department in which the contact and the collaboration with company's suppliers and their internal customers should emerge in first place.

The purchasing activities can be sub-divided into strategic, tactical and operative. The strategic level deals with the product segmentation, standardization of the purchasing process, make-or-buy decision as well as the procurement controlling.

The demand analysis, the supplier selection and its respective contract negotiation are responsibilities of the tactical purchasing. On the other hand, the operative purchase is responsible for tenders organization & execution, and the complete ordering process cycle, including the activities and services around it, see figure 2.2.
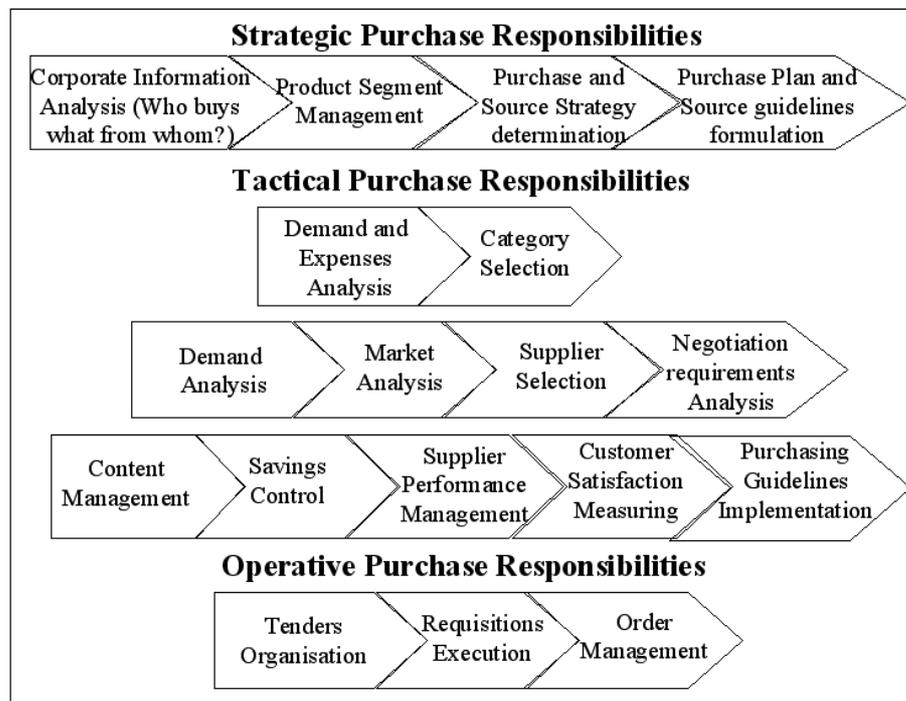
Figure 2.2 The Procurement Responsibilities (adapted from [Dolm00])

The reorganization of the procurement department and its new responsibilities have forced "buyers" to change their attitude towards their functions. The employees of this department had to start to deal with crucial and strategic responsibilities, leaving the operative activities in a second plan, often realized automatically by information systems.

In order to cope with this new reality, buyers had to increase their education and qualification backgrounds to be able to apply information systems and process oriented methods to improve the procurement function performance.

The application of inter-organizational information systems in the purchasing process has enabled buyers to use their "new free resources" to deal and to communicate better with their suppliers, while controlling enterprise's commercial contracts and its execution. Operative activities were redesigned and have started to be performed by information systems automatically.

Aspects such as strategic supplier selection, shorter sourcing cycle time, more responsive supplier network and reduced selection costs and process errors, could also be in the center of the procurement strategy [TaSF00, 457-478].

2.2 Information Technology

Most organizations seek to manage their purchasing activities in the most efficient way possible with the goal of reducing their materials costs and intra business processes,

while ensuring the quality of their services and products to their internal and external customers, avoiding the misallocation of capital, and contributing to improve their organization's market position.

With buying processes generally involving a large amount of information and communication procedures, purchasing is well suited for information technology support and automation [GeBS98, 167-184].

Hence, inter-organizational information systems have become an important enabler of this strategy and the application of the internet to do business a crucial factor in modern business relationships.

2.2.1 Information Management Systems

For decades, economics and information technology researchers have postulated that organizations should link their internal and external activities through a coordinate flow of information from raw materials to end-customers. By that means, a number of information systems have been developed to rationalize the flow and use of information by companies to facilitate their business activities.

2.2.1.1 Intra-Organizational Information Systems

Since late forties, extensive research has been carried out in the area of information and communication technology to develop information systems capable to manage and improve the flow of information within a company.

Information and communication technology (ICT) is the infrastructure that makes it possible to search, filter, store, view, retrieve, copy, manipulate, transmit and receive data [ShVa98, 8].

The deployment of information technology (IT) allows the acquisition, management and distribution of information in different activities of a company, increasing company's efficiency and performance.

The first steps made by the ICT to systematize the information flow around the manufacturing process were taken in the sixties, when materials requirement planning (MRP), which were information systems applied to plan materials acquisition and production, were developed [Norr00].

Since then, research has been made to improve MRP systems performance and capabilities, leading to the development of a new generation of materials requirement planning that included various operational functions. This new generation of MRP systems was termed closed loop MRP.

Later on, it came to the market the MRP II with the extension of master production scheduling to deal with the support of business planning in production terms and the addition of financial features to the closed loop MRP [BrHS88].

Over the years new functionalities have been included into these systems from capacity planning models to financial resources, until recent developments in the field shaped the Enterprise Resource Planning (ERP) solution, which has been designed to support multiple business processes of an organization, while integrating companies information and business units.

These systems bring into focus the flow of information within an organization to support their internal business processes, e.g. finance/controlling, production, human resources, etc.

It collects data and distributes content throughout the entire enterprise with the aim of integrating functions, procedures and information in a single information system. Carroll argues that ERP is the best approach for supply-chain and logistics data and information collaboration [Carr08].

The organization's business processes can be reproduced in an ERP solution for the purpose of producing an electronic environment, which supports a smooth workflow of information to aggregate all departments' functions.

This capability provides enterprise resource planning solutions with their main advantage, which is the capacity to standardize processes, while enabling them to be performed automatically.

A business process is defined as a "multistep activity that supports an organization's mission such as manufacturing a product and processing insurance claims" [Buss01, 3-11]. Nowadays, there are diverse business process modeling techniques, which are applied to describe, plan and improve companies' processes.

The main objective of these methods is to illustrate organizations' business processes to companies' employees as well as their IT personnel in an understandable and standard approach. The notations and workflow illustrations should be though transparent and comprehensible to all team members.

The detailed analysis and simplification of organization's business processes have to be performed previously to the implementation of any information system in an organization. Without a process reengineering, bad designed processes could reduce the benefits of these technologies to an organization, cf. [HaCa98].

The business process modeling is an essential part of the business process reengineering and a key point in any IT implementation project. Currently, most enterprises apply informal and semi-formal modeling languages to represent and create the basis for discussions about their business process standardization and improvement plans. The most applied business process modeling languages are: Petri-Net, cf. [PrWi08] and ARIS, cf. [Sche03].

Hence, a systematic view of organization's business processes is crucial to improve company's processes and finally choose and implement the most adequate information system for a company.

2.2.1.2 Inter-Organizational Information Systems

This is also true for the business processes related with the flow of products and services between companies and their business partners which are based heavily on the exchange of information.

Therefore, since the sixties organizations are applying information technology to support transactions with their trade partners via the integration of suppliers and customers in private commercial networks.

The technology adopted to allow the inter-organizational communication between suppliers and their customers was the Electronic Data Interchange (EDI) which has as the main goal the transaction data transfer between two companies' information systems without any human interaction.

The literature provides a vast range of definitions for EDI which focus on different features and other related technologies. The one which the National Computing Centre has adopted is: "The transfer of structured data, by agreed message standards, from one computer system to another, by electronic means" [Parf92].

The necessity to adopt common standards, e.g. UN/EDIFACT, ANSI, which normally involved an agreement with each trade partner, as there was no universal standard for the inter-organizational data exchange and the high implementation costs involved in creating, maintaining and integrating EDI networks [Rain00], have restricted the adoption of this technology to big organizations and their key business partners.

Only after the introduction of the internet in business, which has established open and more flexible standards, platforms and interfaces, companies from all industries and sizes could take advantage of web based solutions, e.g. web-EDI, to communicate and perform business transactions with a relative low cost with their trade partners.

The TCP-/IP basis allowed the development of flexible and user friendly solutions, which applied improved technological concepts, standards and a vast range of functionalities [NeLa02], which have fostered further the business process automation.

This new information technology systems based on the internet technology permitted companies to develop new and more effective ways to communicate with their business partners and enable the creation of virtual supply chain networks.

However, organizations must restructure their business processes and / or their entire business models, if they intend to achieve the full dividends of their internet application' investment [JaHE03].

2.2.2 Internet

The internet started as a research project of the United States Department of Defense in the sixties as a decentralized telecommunication network to connect regionally dispersed institutions in the country that should guarantee the integrity of strategic information even in extreme situations as a war by the communication among different computers and rapid transfer of high volume of information.

It was only after the development of the World Wide Web (WWW) as a public available standard interface between user and applications that the internet was available to the general households and for commercial use.

Today, the Internet is a set of networks, "net of the nets", controlled by a number of actors, private organizations, government entities and universities. Not all those networks are public, though there are many private networks whose access is limited to few authorized actors through the use of login-names and passwords.

In the literature, many classifications of private networks can be found. This work restricts the discussion to the following two classifications of private networks:

Intranet

Private network based on the internet, which can be either connected with the internet or be completely isolated. The intranet is based on http:// protocol, and other internet technologies, e.g. web servers, browser, firewalls, which is used to manage and make available some applications exclusively within company's boarders [Etno99].

Extranet

The extranet is an expansion of the intranet or in other words, it is the connection of several intranets using a secure network, which connects a company with its business

partners, creating a private network based on internet technology, which allows the communication process between partner organizations.

It enables authorized business partners to have access to a defined portion of a company's intranet and it is the backbone of the electronic business (e-business), in which business-to-business solutions are integrated.

2.2.3 Electronic Business

The constant technological innovation and the present transition to network economy are changing the market structures from an industrial society toward an information society, in which information has overtaken the production as the main economical factor.

Nowadays, most of the enterprises are using the internet to improve their business processes and communicate with their trade partners, which leads us to the term electronic business.

Since the introduction of the internet in business the terms electronic business (e-business) and electronic commerce (e-commerce) are often used in the practices and by the academy. Even today, e-business is still a relatively new and constantly changing field of business management and information technology [Tass03].

However, the literature does not provide a unique and definitive definition of these terminologies, creating a situation in which there are many overlapping and sometimes confusing definitions of those terms.

In this work e-business is about conducting business both internally and/or externally by electronic means over the internet, intranet or extranet. It involves not only buying and selling, but also operating automated, efficient internal business processes, serving customers and collaborating with the suppliers and business partners.

In this context, e-business is meant in the broadest sense of using Internet-based information technology along the whole value chain of businesses [BrHH03], see figure 2.3.
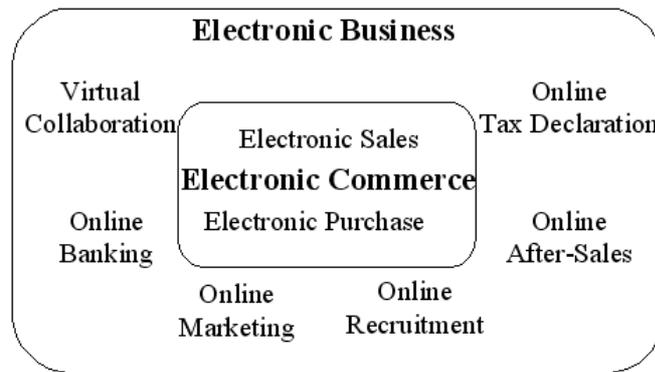
Figure 2.3 e-Business Environment

E-business can be classified according to its user groups as following:

Business-to-Customers (B2C)

Business-to-Customer e-business is often used as a synonym for e-commerce. However, B2C is restricted to the segment of e-business that deals with the relationship between a company and its end-customers, e.g. Amazon.com

Business-to-Government (B2G) or Business-to-Administration (B2A)

B2G or B2A describe the electronic connection and the application of web-based technology to support the inter-relations between companies and government agencies.

Customers-to-Administration (C2A)

It concerns the use of electronic technology by government agencies, but also Non-Governmental Organizations (NGOs) to offer information and interact with the citizens, e.g. online tax declaration.

Customer-to-Customer (C2C)

The use of the internet as a platform to interact and realize transactions directly with other private customers is called customer-to-customer e-business, e.g. e-bay.

Business-to-Business (B2B)

All electronic procedures done between two or more business partners in an internet platform is described as business-to-business. And although the B2C is more present in the media, the interactions between organizations represent more than 90% of the total of the e-commerce transactions [Vulk05].

The work has its focus on the B2B environment, in which e-business methods and procedures are applied to support companies' inter-organizational business processes, e.g. supplier relationship management, via the adoption of internet based information technology applications.

In special, the e-commerce applications which make possible the commercialization of products and services and it represents around one third of the potential benefits that e-business can provide to organizations [MöBP01].

In the internet era, several "purchasing management" technologies have been developed to support e-commerce processes. The emergence of this technological infrastructure has changed the traditional trade structures, and it has forced companies to adequate their purchasing processes, which take place in practices in many different forms, depending on the nature of the information flow and the different products groups, which require different purchase strategies and operative processes.

Therefore, the effective selection of an information system to support companies' procurement activities has to start with a detailed classification of company's purchased goods.

Product Classification

The identification and classification of enterprise's procurement portfolio, regarding their buying processes, volume, product standardization, complexity and automation potential are the starting point for the design of an efficient purchasing information system strategy, since the product groups define the requirements for a B2B e-commerce solution.

An often applied product classification analysis is based on the material usage within a company. The direct / indirect analysis model, in which direct products are characterized by all supplies and raw material that are used in the production process of finished products, such as metal, semiconductors, and motors [Lamm95], products that are of strategic interest and normally viewed by business as critical.

Whereas indirect goods and services include ORM-goods (Operating Resource Management), e.g. computers, office supplies, hygienic materials and MRO-goods (Maintenance, Repair and Operations), e.g. spare parts, tools, as well as services.

Those goods support business operations and are not part of the finished products, they are viewed as important to companies, but not crucial as they do not directly contribute to company's competitive advantage.

Other schema based on the strategic importance of a product group is the traditional ABC-model, which classifies the product portfolio relating to its (value x quantity) relationship [Prei02].

A: High value and low purchase volume; relevant part of the end-product,

B: Middle value and middle purchase volume; not relevant part of the end-product;

C: Low value and high purchase volume; it is not a part of the end-product

In this model the A-articles represent most of the costs in the procurement portfolio, but constitute just a small part of the total transaction volume, whereas the C-articles represent a great part of the transaction volume, while responding for a small part of company's procurement costs.

Nonetheless, the previous product classification schemas are not detailed enough to support the selection of the most appropriate IT solution to apply in a purchasing strategy.

Therefore, a more descriptive product portfolio classification schema was required to develop an adequate information technology strategy to deal with the different purchase processes, derived from the innumerous product groups in company's procurement portfolio.

This work applies the product portfolio analysis method developed by the consultant firm KPMG, which analyzes the product portfolio regarding its strategic meaning as well as its automation potential, having the ABC-model as basis, see figure 2.4.
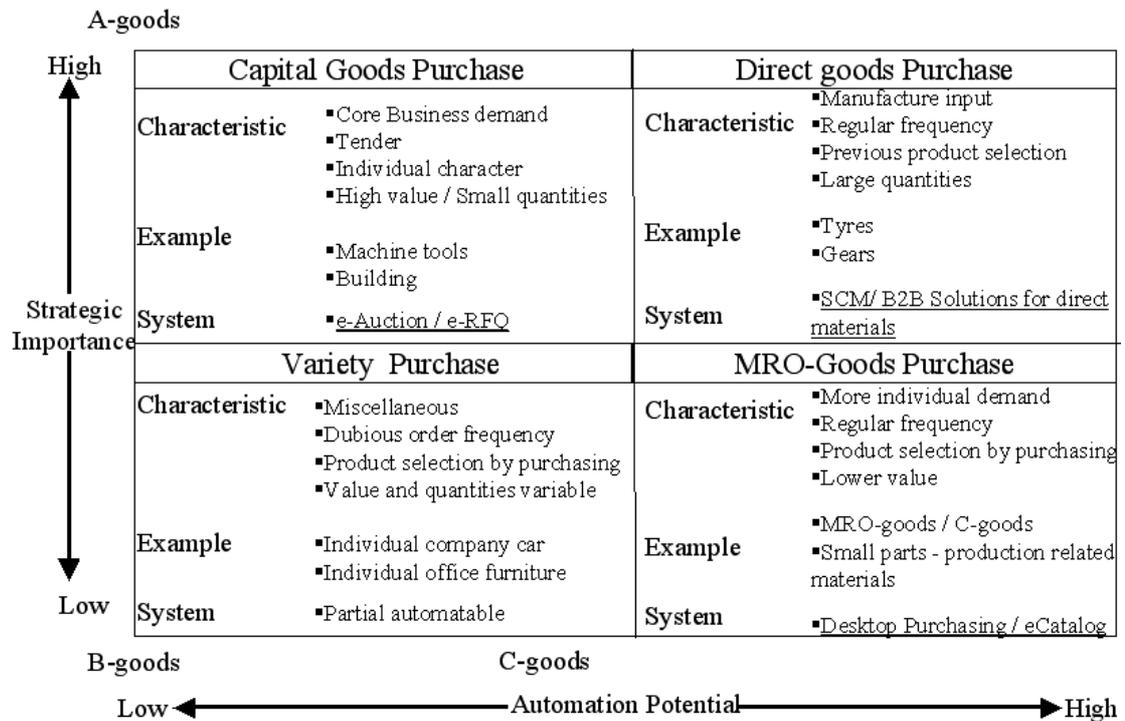
Figure 2.4 Product Classification [KPMG01]

2.3 Supplier Relationship Management System

In order to support the great variety of product and services purchasing processes and to integrate different business partners in an electronic network, supplier relationship management systems (SRM) have been developed to coordinate and automate the process concerned with the supplier integration and communication.

Supplier relationship management is the part of the supply chain management which deals with all aspects of the business relationship between companies and their suppliers.

It is a broad concept and describes the business structures and processes required by companies to communicate and execute commercial transactions with their suppliers, while providing methods, processes and tools to support the different phases of a supplier relationship [EyKM02, 66-76].

In this work, the focus of the analysis is on the information technology aspect of the supplier relationship management field, which embraces the flow of information between the purchase function, their internal customers and suppliers.

Here are included transaction systems such as electronic sourcing, electronic procurement, supplier enablement, e.g. supplier portal as well as the e-catalogue management infrastructure, which compose the main technologies in focus on this work, see figure 2.5.
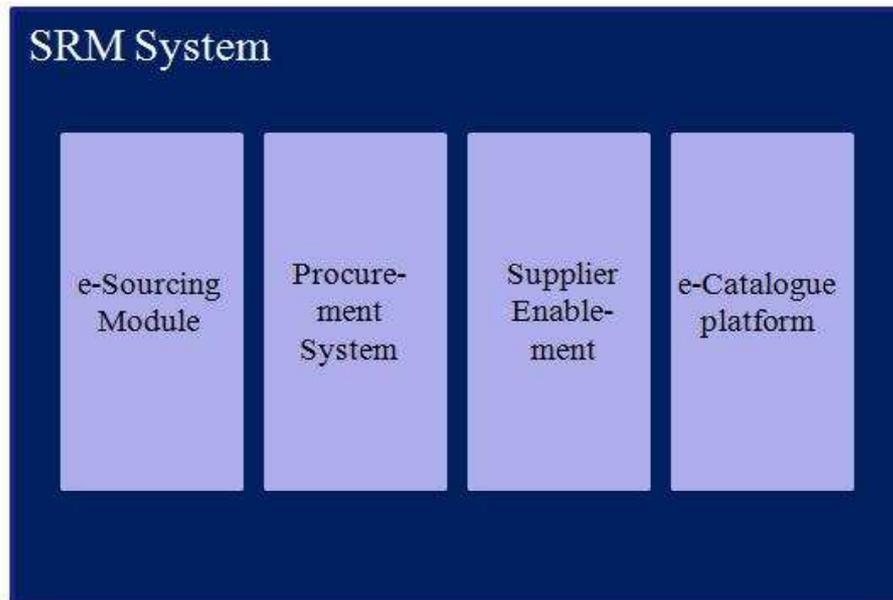
Figure 2.5 Supplier Relationship Management System

The work treats SRM as a combination of stand-alone modules/suites specialized in part of the purchasing process, building a set of functionalities that enable the communication and integration of multiple channels and the automation of electronic business processes between two or more independent organisations.

2.3.1 E-Sourcing

The sourcing activities take place at the beginning of the purchasing process prior to any transaction, it has its main focus on the supplier search / selection and negotiation process of goods, and it is a critical element of the strategic purchasing. In addition, sourcing is a process to develop supplier strategy and subsequently support its execution.

The main goal of the e-sourcing systems is to support buyers to find the most appropriate supplier for a good, and the foreground is the negotiation phase of the purchasing process in which professional buyers search for the most appropriate product source for a company based on price or any other defined criterion.

First of all, buying organizations must search for potential suppliers and gather information about them and their products. The internet has facilitated the search and selection process by supporting buyers to look for sellers in virtual yellow pages, e-marketplaces, shopping malls, etc.

Search service providers, from the other side, make available for companies search engines to investigate the entire internet or a fraction of the net, e.g. virtual marketplaces, via the matching of particular search criterion.

Nonetheless, the search results, derived from the search engines, are alone not sufficient for the decision-making process, thus enterprises have to investigate the potential suppliers further with the purpose of appraising accurately their information and their products and services quality level.

Collaborative filtering techniques are a possible method to support organizations during the supplier evaluation process. This method collects and stores users' opinions and ratings about a business partner in a database, which are then used by other users, e.g. buyers to judge the reliability of the information and commercial practices of a supplier.

Once the potential suppliers are found and their reliability is checked. Buying organizations have to decide either for a purchase contract or the further negotiation of the contract conditions with a single suppliers or a group of potential sellers.

Electronic auctions and electronic request for quotation (RFQ) are at this time the two most well-know negotiation form applied in e-Sourcing and are often used in the practices as a synonym of these terms.

Auction is a form of bid that has been used since the antiquity to establish the sell price through a transparent selling process of goods. The two main auction models applied in the market are the reverse auction, in which bidders submit their bids until the lowest one wins the auction, and the forward auction in which the highest bid wins the auction.

This sourcing mechanism has been applied traditionally by government organizations. Nonetheless, after the introduction of internet based e-auctions solutions, which has drastically reduced the cost of setting up and conducting auctions [BiKa02], the use of auctions in corporate purchase has increased significantly.

At the beginning, e-auction systems had their focus exclusively on price negotiation, leaving out of their scope all other relevant negotiation factors, e.g. quantity, quality, delivery time.

However, this approach leads to numerous disadvantages to suppliers, e.g. dramatically margins reduction, product commoditization, and to buyers, e.g. reduction in product quality and loose of their quality suppliers.

These disadvantages have made purchasing departments change from a price based supplier selection to a broader selection model, in which suppliers are no longer selected based solely on prices, but also in aspects such as product quality and warranty [CaSt06, 207-212].

Nowadays, a new generation of auctions systems based on business intelligence technology allows the negotiation of multi-attribute criteria during the online auction and the continuous control of supplier performance.

Therefore, a number of analytical approaches are applied to support the multi-criterion supplier evaluation, e.g. categorical method, matrix or weight approaches, multiple objective programming, analytical hierarchy process, etc.

These multi-attribute criteria are used to evaluate submitted bids and to select the most adequate supplier by the computation of the total bid scores, according to buyer's specification and needs. Consequently, this approach has the advantage to increase the total value of an online negotiation compared to price auctions.

However, the criterion's selection is critical for the success of the application of any multi-attribute auction, as any factor can be considered during the bidding process in order to establish the enterprise's measures.

Therefore, subjectivity should be avoided and organisational overall resources, e.g. time, personnel, purchase value, market expertise, should be considered in the formulation of the analytical model.

The RFQ process is to some extend similar to the auction process. Therefore, what is true for e-auctions can be applied also for e-RFQ. The main difference between RFQs and auctions is the lack of formal specifications concerning the process regulations and the exactly workflow of the RFQ process [BeWe03, 1529-1545].

E-RFQ has been applied traditionally during the negotiation process of complex products and services, in which extensive technical descriptions and complex calculations are required, e.g. construction project, facility management services [NeLa01]. On the other hand, e-auctions are appropriate for products which have a great demand in a high volatile market with a large number of suppliers, e.g. commodity.

The deployment of e-auction systems in corporate procurement provides companies with some advantages, being the most relevant ones the process time and price reduction, which in some product segments leads to a price reduction up to 30%, which is in average between 2-6% lower than other negotiation methods [NeLa02].

In addition to negotiation and supplier evaluation functionalities, organizations should integrate contract management and spend analysis tools to provide companies with a precise overview of their contracts and commercial agreements, and include the possibility to continuously evaluate their suppliers and spending performance.

The main function of these tools is the centralization of contractual content and the compliance of established commercial arrangements; and the material spending controlling and its respective business performance.

2.3.2 E-Procurement

The focus of e-Sourcing systems, EDI, ERP lies basically on the direct materials purchasing process, leaving the purchasing process of indirect materials and services in a second plan. Until the end of the nineties, the purchase of indirect products and services has received much less attention by corporate purchase department [KaGu97, 21-31].

Only with the application of the internet as an inter-organization communication medium and the consequent decrease of the implementation and management costs of inter-organization information systems that supported the electronic transactions of these material groups, e.g. Desktop Purchasing System (DPS), the procurement of indirect materials got a central position in company's purchasing strategy due to its high potential to improve procurement processes and reduce costs [Matt99].

The definition of e-procurement is a reason for evident confusion in the literature and in the practices. A number of definitions describe e-procurement as a general technology that allows the purchase of supplies using the internet.

This work shortens this general view of e-procurement to "a software that enables organizations to purchase indirect and MRO goods online, automates the buying processes and centralizes all spending data. The technology has progressed from enabling simple transactions to cover broader categories such as services procurement, as well as the post-procurement stages, such as invoicing, reconciliation and settlement." [Comp02].

This solution has its focus on the reduction of the purchase department's administrative process costs, by the electronic support and automation of operative purchasing processes.

In opposite to e-Auction and e-RFQ systems, which have their major benefit on product's price reduction, e-Procurement system or Desktop Purchasing System has as

its main benefit the process efficiency improvement through the redesign of the procurement processes as well as the automation of the operative purchasing tasks, leaving time for buyers to focus on the strategy purchase activities as the negotiation and management of long term contracts, which according to the economist magazine, they cover between 80 to 90 percent of all business transactions of goods and services [Vulk05].

This technology enabled companies to change their traditional centralized structures to a more decentralized one, allowing employees to realize their requisitions directly from their workplaces applying web applications, whereas companies could establish specific rights and budgets to their internal customers to place orders, their supervisors to authorize the requisition, the warehouse to acknowledge the delivery and the finance department to emit and pay the invoice.

e-Procurement solutions are adequate to support the purchase of indirect, low value and standard products. These products represent around 5% of the purchasing volume, but generate up to 80% of the total purchasing process costs of a company, 60% of the orders and 70% of the suppliers [Pepe02].

On the other hand, service and complex products are either currently not appropriately supported by those systems, or their electronic purchase is possible just with a high level of system customization.

The core component of a desktop purchasing system is the electronic catalogue, and in case the organization applies a multi supplier e-catalogue approach, the content management system to create and maintain the catalogue data [Gron04].

The system is a web-application, based on business rules and authorization mechanisms to support organizations directives and specific purchase processes. Business rules are flexibly configurable and can be easily combined to design and customize the business process, especially in what is concerned to the system and user administration, approval workflow as well as the process automation.

Furthermore, another important feature of e-Procurement solutions is the system integration, which generally provides numerous interface possibilities with different Online Transaction Processing systems (OLTP), e.g. ERP, Web-Shops, to facilitate the support and control of the entire purchasing cycle.

The integration of those systems is supported by the application of standards as the Extensible Markup Language (XML). Currently, there are several data exchange formats based on XML, e.g. xCBL, cXML, BMEcat, cf. [MaPü02].

On the other hand, to facilitate the electronic product information transfer, companies rely on material classification standards as eCl@ss and UNSPSC to increase transparency and to reduce the communication costs.

2.3.3 Supplier Enablement

Enterprise integration is undeniably a critical issue for organizations in all business sectors attempting to maintain a competitive advantage [Holi99, 30-36]. Most of the key business players have realized that the success in their e-business activities depends on the business processes synchronization with their trade partners, by connecting their organizations directly or indirectly with the back- and front-end systems of both organizations, using an appropriate gateway to exchange information.

Supplier enablement is the channel that enterprises use to integrate with their trade partners and carry out their e-sourcing and e-procurement activities. The word "channel" has two main meanings: In the media sector, a channel is a branded carrier of entertainment or information to an audience; in marketing, channel means any permanent route to a group of customers [Rowl02].

In the supplier relationship management perspective, supplier enablement should provide a mix of these two definitions, bringing organizations and their suppliers together with the intention of exchanging commercial information and doing business.

The two main ways via which supplier enablement takes place in companies are through the application of supplier portals and e-marketplaces. It is important that these channels provide users, besides the transaction functionalities, rich, actual and interesting content, a range of services as well as interactive elements in order to increase and maintain the access/visit rate.

A company's portal is defined as a web based application that makes available personalized content as well as the rights to operate specific collaboration processes between heterogeneous groups [Frau05].

In the case of supplier portals, they create the basis to connect suppliers with their buyers, with the focus on purchasing processes and the exchange of transactions data. They offer a structured and customized gateway to improve the business relations between two or more business partners.

On the other side, e-marketplace is described as a virtual online market in which buyers, suppliers, distributors and sellers find and exchange information, conduct trade, and collaborate with each other via an aggregation of information portals, trading exchanges and collaboration tools [ECEC02].

It is crucial for an efficient purchase strategy that these channels are not isolated in the enterprise's intranet, but rather they should be integrated with companies' front-end and back-end systems in order to integrate the inter-processes and automate the data exchange.

At the same time, it is recommend that their users have the possibility to access them anywhere, at any time, regardless of the distance and the sort of device they are using, e.g. computer, laptop, Personal Digital Assistant (PDA).

In addition, supplier portals and e-marketplaces should include in their functionality spectrum, a number of features to facilitate and secure their use by company's employees, e.g. navigation and search tools, reporting and notification functions, etc. Since the acknowledgment and success of those channels depend on the willingness of these employees to use these channels in their daily purchase activities.

2.3.4 e-Catalogue Management

e-Catalogue systems have been developed to support the indirect goods purchasing process, gathering, storing and distributing information that are of interest to buying and selling organizations.

They have been applied, along the years, to perform e-commerce activities, allowing buying organizations to browse, search for products and suppliers, place orders and track them on-line.

This solution combines and extends many functionalities of traditional channels, such as the rich content of print catalogues, the convenience and intimacy of on-line shopping, and the sophisticated searching capability of CD-ROM catalogues. They also let suppliers customize content and views to different buyers, and allow all parties to immediate track orders electronically [MaHe97, 118-151, Perl90].

In other words, electronic catalogue helps to streamline and reduce the costs of purchasing. Such systems allow regular employees to execute their purchases from their workplaces to specific suppliers and a limited set of products and services of those suppliers.

By funneling these autonomous purchase actions to a target list of suppliers, management can negotiate discounted prices, implement on-demand supplies replenishment, and obtain process efficiencies in the purchasing cycle [Gran99].

Electronic catalogue is a front-end system database specialized on product and supplier information, e.g. description, multimedia data, price, etc; which is often acquired from back-end systems, usually the ERP solution that in general contains just core product information, which must be completed with supplemental content in the e-catalogue platform in a way that can be used easily by suppliers and customers applying the internet.

As it can be noted, companies can profit from the deployment of e-catalogue in two main ways: reducing the cost of material and improving their purchasing process. Three main e-Catalogue strategies can be found in the practice to enable these benefits [Pusc05, 122-133].

- e-Catalogue hosting on supplier's web-page, which buying organizations have access through a punch-out mechanism;
- e-Catalogue hosting on electronic marketplaces (e-Marketplace), in which e-marketplace works as a central hub to increase synergy across several organizations;
- e-Catalogue hosting on company's extranet, considered as the most successful e-catalogue hosting strategy for buying organizations due to the higher control and data quality.

e-Catalogue Technology

e-Catalogue has its focus on the exchange of product information between business partners and the functionalities that facilitate company's employees to find and transact with enterprise's authorized suppliers.

This technology has been adopted mainly to improve indirect goods transactions in e-Marketplace and large organization scenarios, where thousands of transactions take place between hundreds of organizations. However, they support multiple business functions such as purchasing, marketing, sales, etc.

As a result, there are several types of e-catalogue solutions in the market, which can be characterized according to their operational levels, e.g. computer language, content presentation, business representation, functions, etc; which provide a multiplicity and

effectiveness of services that exceeds the capability of any competing application [BaSB00].

In order to overcome the challenges incurred in electronic commerce, e.g. difference of data format, dynamic product information, complex company's structure, etc, e-Catalogue researchers and vendors have developed a number of functionalities to enable the exchange of product information in a multi-supplier / multi-buyer environment, thus maximizing e-Catalogue's benefits.

Below, some of these functions and their respective benefits to companies are shortly described:

- Catalogue integration: Nowadays companies use different file formats and media to exchange product information with their business partners. Therefore, e-Catalogue systems should provide both possibilities: First, the possibility to receive catalogues per e-mail or CD-ROM in different data formats, e.g. excel, PDF; and second, to allow suppliers to interact directly with their buying organization's systems to export their catalogues, while decreasing buyer's content management costs.

- Communication mechanisms: to enable employees' to communicate through the on-line notification of their tasks per e-mail or directly in the system, collaborating for a more dynamic process workflow.

- Workflow systems: the catalogue life cycle is supported by workflow applications to establish catalogue verification roles, approval criteria, release processes, user responsibilities as well as a visual support for users to track in real time their catalogue's status.

- User domain and privilege control: This functionality is especially designed for large organizations, which have multiple business units and user groups. These domains allow business units and different user groups to have an exclusive working area for their relevant catalogues, increasing system's performance, usability and privacy.

- Management of Multimedia files: to enable companies to handle multimedia files with the purpose of facilitating their correct attachment and visualization within a catalogue, improving the data quality and marketing effectiveness.

- System integration: A key requirement for product information systems is the integration with other front and back-end systems. e-Catalogue developers have created diverse integration rules and adopters to facilitate multiple

systems communication, thus transforming e-Catalogue in one of the most integrated systems in the e-Commerce area.

- Dynamic Database repository: Once the content is stored in a catalogue repository, users can re-use, share, edit and publish this content in different media, e.g. print catalogue, CD-ROM, web site, to support companies' activities.

Given the functionalities described above, it may be stated that e-catalogue systems have given a great contribution to the electronic exchange and management of product and supplier information. Nonetheless, e-Catalog researchers and vendors continue to be challenged to expand this technology within and across organizations boarders.

2.4 The Supplier Relationship Management Market

The SRM market, which is consisted by the systems described in the previous sections, is in constant growth. Most of the market researches in this area, e.g. [Gart04], [Bart05], [Aberd06] shows a growth rate greater than 10% per year between the main vendors, who can be divided into two distinct classes:

- The ERP vendors, who offer their SRM systems as a module of their product portfolio, which have as the main advantage the high integration capacity with the other modules of the same vendor, reducing the implementation cost and time.

- The best-of-breed providers, who are specialists on SRM solutions or part of the system, e.g. e-Procurement, e-Sourcing, Supplier Enablement, who offer their products to the market as an alternative to ERP providers or concentrate their efforts in niche markets.

Nonetheless, a detailed analysis of the SRM functionalities shows that the market has different maturity grades and growth potential while comparing different features, i.e. e-Procurement functions are in average much more mature than e-Sourcing functions. The following sub-sections provide a short discussion on this issue.

2.4.1 e-Procurement Functionalities

The e-procurement applications of the main providers have achieved already their technical maturity and their functions can be hardly differentiated from their competitors in the market.

This finding has been shown by the later studies from the most important research institutes of the area [Bart05], [Aber06], [ABGG05], [Aberd05], [VaVi06], [Aberd07].

In fact, Forrester research (2005) found that the average scores for goods procurement, settlement, and process configuration are consistently strong across all vendors, averaging close to 4 (on scale of 1 to 5) with a standard deviation of less than 1.

The same research institutes found that the most competitive e-procurement providers are SAP, Oracle and Ariba, although none of them reached the highest technological level/rate, suggesting that there are still areas, which require further developments.

One of those areas is the support of more complex material groups and services, as the current protocols and standard formats, e.g. BMEcat provides a solution just for a limited number of material groups, and in the case of service due to its variety and differentiated data model, a new protocol based either on configuration rules or references has to be developed to enable the description and price formation of service.

Furthermore, the compliance management is an issue that has not been properly addressed by e-procurement vendors, and it is a top theme on the procurement executive agenda.

Therefore, a higher integration level has to be achieved with other systems in the organization in order to integrate the purchasing data and even to eliminate redundant systems amongst the enterprise.

2.4.2 e-Sourcing Functionalities

In contrast to the e-procurement functionalities, most of the e-sourcing functionalities have still not achieved its maturity, and there is not a single vendor that can be classified as a leader [KyEW05].

The market is characterized by the presence of a number of best-of-breed providers that are classified by the research institutes as specialist in their area, e.g. FreeMarktes (auctions), Emptoris (complex bid processes), I2 (Spend Management), Contracto (Contract management).

It is in this area of the supplier relationship management that most investments in research and development have been done in the last years and the consolidation process is more present.

For the next couple of years, it is expected that the new developments will still concentrate on this area, improving the current functionalities as spend and contract management.

At the same time, a higher integration between the current technologies available is foreseen, especially as a result of the consolidation process through merger and acquisition as well as strategic partnerships.

At the moment, the e-Sourcing market has a huge growth potential, which can be explained by the high company's expectations on these solutions. A study from the BME & Siemens [BME06] showed that the majority of the enterprises expect a 10-25% process costs reduction and a 5-10% material costs reduction through the application of SRM solutions.

And according to ARM Research (2005) and IDC Research (2005) there is an evidence to suggest that the growth of the SRM market is leaded by the e-Sourcing applications rather than the relative mature e-Procurement solutions.

2.4.3 The Supplier Relationship Management Trends

The universal trend in the area of supplier relationship management goes towards the process cost reduction and compliance. Nowadays, the interest of the organizations is to build flexible electronic processes that support and customize their business processes, at the same time that they are able to adapt the enterprise to the constant market changes.

Therefore, for the next couple of years it is unlikely that SRM will move outside its current basis: e-Procurement, e-Sourcing and Supplier Enablement. Instead, what is expected is the consolidation of the current functionalities and practices, especially the ones that have still not achieved its maturity: business process outsourcing, contract management, service procurement, spend and supplier intelligence, process integration, among others.

Business Process Outsourcing (BPO)

During the last years, there was a wave towards the application of service providers in the supplier relationship management market, although earlier utilization of those services leaded to a reduction in process improvement benefits due to workflow and integration issues.

Currently, a study from Gartner [Gart06] showed that 42% of the European respondent and 36% of the American respondents are already using some form of procurement BPO.

BPO is the delegation of IT-intensive purchasing processes to an external provider that owns, administers and manages selected processes, based on defined and measurable performance metrics.

The factors in favor of business process outsourcing, e.g. rapid deployment, lack of IT resources, access to new technology/skills and cost, are convincing supply chain managers to outsource part of their procurement activities, despite the relative higher integration cost of this approach [Aberd06, 2].

Contract Management

The benefits of contract management is gaining more and more attention, due to the amount of manual processes currently involved during a contract negotiation and its future control, there is no reason that contract management applications cannot double or triple their installations over the next few years [Pang05].

The contract management providers can offer their systems in two ways: As a part of their Sourcing-Suite or as a Standalone solution. Since companies have different requirements and processes regarding contract management, there are opportunities for both business models.

Technically speaking, contract management system has started its deployment on the buy-side with the management of supplier contracts. Nonetheless, the market should start a convergence between sell-side and buy-side contract management solutions that should provide to companies a central document database and compliance rules, based on a unique master data [CeDa05].

Enterprises are also starting to enhance the integration between contract management solutions and other inter-organizational applications, such as CRM, SRM, and ERP in order to gain visibility and to prevent revenue leakage and lengthy processes [Aberd06].

Service Procurement

Service procurement processes are still a source of high costs to companies, and due to its complex and heterogeneous purchasing processes, few companies up to now have tried to support those processes via the application of web-based information systems.

Nonetheless, this scenario is changing, the survey "eBusiness-Barometer 2006/2007" have shown that around 70% of the industrial enterprises in Germany rated service procurement as a high or very high relevant aspect of their SRM activities.

Different from the MRO (Maintenance, Repair and Operations) materials, service procurement processes have hardly data transfer standards, and few IT vendors provide specialized tools to support this business process.

Hence, there is a need to develop electronic data transfer models and standards to foster the development and application of web-based information systems during a service negotiation and buying process between companies and their suppliers.

Some initiatives in this direction have already taken place in Germany with the research projects Services Standardization and AIR-CRAFT. Nevertheless, further developments have to be done by IT vendors in order to build appropriate tools and interfaces to facilitate the management of service procurement, since companies are seen this area as the next frontier in their SRM projects.

Spend and Supplier Intelligence

The transparence of the purchasing process and data is a key factor for a SRM program success. However, currently only one in every five companies applies spend management solutions to control their purchase activities [HoNe06, 27].

The utilization of business intelligence technology to extract and analyze possible cost savings and support the design of supplier selection/evaluation and spend saving programs in a company is a major goal of modern purchase departments.

Since most studies suggest that those systems are still in its infancy and most companies have still not deployed this technology, the market of spend and supplier intelligence applications should continue its high growth rate in the next years.

The near future developments in this area should focus on reporting and analytical features as well as Key Performance Indication (KPI) definition models. In the long run reporting tools with automatic commutation with end-user are expected.

Process Integration

All the trends listed above and any other development in the area of supplier relationship management should have as the main goal the complete integration of company's business processes.

It has to be noted that during the development of any suite, module or a standalone solution, the main focus should not rely on the features conception, but rather on the entire business process.

Service Oriented Architecture (SOA) is an option to facilitate this approach by supplying an environment in which different information systems can be provided and integrated as services, increasing systems functionalities and process compliance.

Mr. Shai Agassi, the former CEO from SAP, goes even further and related as his and SAP's vision, the deployment of a unique and integrated business process platform in which the entire supply chain, from the purchase to sales, will take place.

"The days of buying point products are long behind us. Five years from now, customers will only buy suites. You won't purchase individual point products such as ERP, CRM, Supply Chain Management or HR applications that will ship to you as separate entities and that will end up as a collection of services that you need to manage. Customers are looking to drive a higher level of value out of their industry flavored enterprise software solutions and they are doing this through deploying application suites." [SAP06].

Market Overview

The SRM market is constantly growing. The ERP providers, e.g. SAP and Oracle, but also the "Best-of-Breed" vendors, e.g. Ariba, are strongly developing their functionalities in order to be able to survive in this competitive market.

Especially in the area of strategic sourcing much investment has been done with the purpose of improving or reinforcing the current developments in the area of contract management, service procurement, spend and supplier intelligence and process integration, among others.

On the other side, in the area of e-Procurement, the growth potential seems to be exhausted, and the growth expectations relatively low, when compared with the booming e-Sourcing segment of the market.

Other important trend in the SRM market is the application of business process outsourcing and SRM On-Demand, which gives software vendors the possibility to offer their systems as a service. First to middle size enterprises, which cannot afford the acquisition of license software, and second to big organizations, which are looking for innovative products and skills without the need to invest huge amount of capital in implementation and roll out projects.

3   Research Methodology

The main goal of the following chapter is to describe the empirical study constructed with the purpose of exposing useful information for the design of an innovative e-catalogue based tool to support companies' indirect material supplier relationship management (section 3.1).

Therefore, it is introduced firstly the research typology applied in the study (section 3.1.1), followed by the data gathering tool design (sections 3.1.2 and 3.1.3) as well as the sample delimitation process (section 3.1.4).

Afterwards, the chapter carries on describing the conceptualization of the research questions, as neither the literature review nor previous researches could have provided enough subsides to the further development of the study, the author has decided for the application of an empirical study (section 3.2). Furthermore, the chapter explains the data analysis methodology used to interpret the survey results (section 3.3).

3.1 Empirical Study

Based on previous studies and the literature review, the empirical research was designed and conducted from October-2007 to February-2008 to analyze the adoption of supplier relationship management tools by large German enterprises in order to describe the state-of-the-art of these systems in the German market and to confirm and to draw trends that will be used to develop a new solution to support current and future e-business needs.

3.1.1 Research Typology

The survey applies two research methods. First, an exploratory approach is used to expand the current knowledge and believes on the area, helping to break up some paradigms that may exist.

This method is often applied in fields which have not been much researched and there is a lack of qualified information, which is the case of the research field in question, i.e. SRM and e-Catalogue.

Supplier relationship management and e-catalogue systems, although they are considered relative mature systems, there are no much applied market studies on these topics, especially in what is regarding their technical aspects, e.g. technological trends, integration issues, standards, etc.

And secondly, a descriptive methodology is applied with the purpose of describing the current practices through the collection of characteristics and opinions, and the further correlations of these facts and other variables.

The later approach, in contrast, is used in areas that have already been enough studied, thus the survey intends to verify the results of previous similar researches concerning the practical application of these solutions in companies, e.g. system benefits, obstacles, key-drivers, etc.

Most studies apply a hypothesis based methodology, which is tested against previous ideas of the authors using diverse gathering tools and experiments. Although this technique is reasonable in numerous situations, its application is more appropriate in confirmative studies than in exploratory researches.

New research areas in which there are either few or no consolidated common knowledge, e.g. supplier relationship management, should avoid the solely application of hypothesis based studies with the purpose of reducing the risk of limiting the research results.

According to Vergara [Verg98], exploratory research is applied in areas in which there are few common knowledge, while descriptive research are used to analyze specific populations with the aim of describing facts and phenomenon extracted from their experienced reality.

The chapter two has provided readers with the required SRM background, explaining terms and solutions through an exhaustive literature review of the area. On the other side, the main objective of the empirical study is to gather sufficient data from the relevant population: first to define the state-of-the-art of these systems, and next and more important to collect and to classify information in order to foresee new trends and future behaviors based on observation and database analysis of this population.

Berry [BeLi97] emphasizes the use of data mining as a bottom-up approach to extract new knowledge, previously not known, cf. [Shap00]. The data mining process applies a series of tools and techniques to allow the generation of knowledge from diverse databases.

This work applies some of these techniques with the purpose of getting a better understanding of the research participants' current reality and draw new technological trends on this market.

On the other hand, the application of descriptive methods is required both to delimitate and describe the practices on the market and to establish relationships between variables and facts [Mart94, 116].

Therefore, it was applied a quantitative research, which is characterized by the employment of quantifications on either the data gathering process and their treatment using statistical methods, which can vary from simple indicators such as mean, percentage, maximum-minimum, etc., to more complex ones such as correlations, regressions and trust levels, etc [Rich99]. This method seeks to guarantee the precision on the results description to avoid the generation of misinterpretations and false trends.

The research data was gathered from a number of large German organizations, applying the internet as the main communication channel between the parts. Regarding the nature of the study, the work has a quantitative approach applying a questionnaire to collect the data.

However, there was a preliminary issue that must be addressed before starting with the data collection, the decision about the appropriate communication channel, i.e. the internet, which was selected to be used due to its advantage regarding cost, speed and access to participants.

After the decision to use the internet, there was the necessity to check the participant access to the Web and the penetration of this media in the population. This analysis was though relative simple considering the profile of the potential participants, i.e. most of them high managers of important German organizations with high internet literacy.

Taylor [Tayl00] argues that the use of the internet to apply questionnaire represents an important revolution, which reduces drastically the research costs and allow researchers to address much bigger populations, obtaining a faster response than traditional ways, e.g. the post.

The application of a written interview form was selected, because of the necessity to achieve a high anonymity grade of the respondents, who probably would not feel congenial to answer questions about their project details and future developments, if a face-to-face oral interview model had been chosen.

Furthermore, the specific terms and definitions of the area are in most cases confusing, because of the existence of diverse interpretation for the same term in the practice, thus to avoid possible misunderstanding a pretest phase was necessary to increase and secure the questionnaire understanding level by the potential respondents.

Other important issue was the selection of the gathering tool, in other words, the decision about the use of an off-line or an on-line questionnaire. The off-line questionnaire had the benefit that the participants did not need to be connected to the internet to respond the survey.

However, its application requires either a file download, which would incur the risk to the e-mail be blocked by the organization`s firewall, or the necessity to create a web-page to store the questionnaire which could be downloaded from a link available in the invitation e-mail, creating discomfort to the respondent.

After a pros and cons analysis, it was decided for the utilization of the on-line questionnaire tool of a professional survey software provider (2ask), cf. www.2ask.de, which was available through a link on the presentation e-mail.

The main reasons for this decision were:

- The possibility to use interactive questionnaires;
- Increase the professionalism feeling and the trust on the survey;
- Maintain the participants anonymity, while tracking possible duplications by the use of cookies;
- Application of an on-time follow-up mechanism;
- Avoid firewall matters.

3.1.2 Data Gathering Tool

The next step was the development of a questionnaire, which is an investigation technique consisting of a number of written questions presented to people with the purpose of gathering opinions, believes, interest, feelings, expectations, etc. [Gil87, 206].

The questionnaire was designed based on the literature review with the goal of facilitating the collection of relevant primary data, which could be analyzed using data mining techniques to build correlations, trends and the impact of supplier relationship management systems on the German Market.

The author developed an elaborated questionnaire in German, which was e-mailed to the potential participants. The questionnaire was divided into three parts for didactical and practical reasons, see appendix C it the end of this work for more details:

- The first part of the questionnaire addresses company's and participant characteristics; the respondent was asked about general questions concerning

their organization, e.g. size, sector and their position in the enterprise to give an overview of the research sample.

- The second part deals with company's supplier relationship management strategy and competences. A number of questions were formulated regarding the SRM strategy situation in which the participant could rate a variety of statements by importance. At a later time, the respondent was asked about the system landscape of their organizations, given details on their information system architecture and competence.

- The third part covers the e-catalogue strategy of the enterprise, providing information about the current status of their programs and discussing their goals in the near future, regarding different aspects of their strategy, e.g. system features, system integration, project scope, etc.

Indeed, the questionnaire is consisted of a group of objective questions, which could be answered by a mouse click by the utilization of check boxes and radio buttons techniques, in addition in some questions a text free option has been included to take the maximum advantage of the exploratory nature of the research.

The questions were designed in the simplest way possible to increase the response rate of the survey, thus most of the questions were of multiple choice. However, for some questions the participant was asked for his agreement or disagreement using a five point rating scale based on the Likert scale, and in some other questions, respondents have been asked about the current situation of their program and their future expectations in a two columns question layout.

A limited point scale has the advantage to facilitate the statistical analysis of the research, while it provides researchers with a satisfactory number of options without submitting participants to the stress of an excessive range of possibilities. According to Mattar [Matt99; 204] more than seven options confuses the respondent and less than three make unviable any reliable analysis.

The questionnaire was stored in the database of a professional survey tool at the internet from the company 2Ask, which allowed a comfortable response of the questions and the prompt export of the final result to the database, and then to the statistical analysis software.

The use of an individualized presentation letter, i.e. e-mail, even though it is recommended by many authors, was unpractical due to the fact that the questionnaire was sent to hundreds of organizations.

Nonetheless, to reduce the unwillingness of the potential participants and increase the credibility on the research, a semi-individualized e-mail was prepared and sent from the University Karlsruhe e-mail system, what the author believes increased the interest of potential respondents, avoided the possibility that the e-mail was perceived as a spam, at the same time that it increased the trust level on the survey, for more detail, please see the appendix A and B at the end of the work.

In order to increase the response rate, the potential participants were contacted many times, approximately every 20 days after the previous contact was done. After four months realizing this procedure the gathering process was closed with a satisfactory response quote of 21%.

3.1.3 Pretest

After the conceptualization of the questionnaire and the decision for the most appropriate communication channel, a pretest was executed. The data gathering tool was verified regarding its appropriateness and answerability. The pretest has as its main objective the instrument evaluation in order to guarantee that the gathering tool measures exactly what is supposed to analyze [Gil89, 159].

A version of the pretest was discussed with software experts and system users, who were selected from specialized software houses and from the purchase department of large German multinationals. The duration of the pretest interviews were around one hour, during which terms / questions comprehension, completeness and redundancy were tested and improved.

The pretest phase was also important to analyze the necessity to introduce further questions and indicators, which may had been forgotten during the questionnaire design, and to prove the efficiency of the tool.

The result of the pretest was very positive, requiring just minor changes concerning some technical terms, the inclusion of a new question, and one or another change in the order of the questions.

Another goal of this phase was to check the duration of the questionnaire response process, which should not be longer than 10 minutes, and the usability of the on-line questionnaire software interface.

Thanks to the relative simple questions construction and the available software resources, the proposed response timing has been achieved without any software usability problems.

Parallel to the design and the test of the data gathering tool, the sample selection was carried out and as soon as these processes had been done, the survey was applied to collect the data and proceed with the research analysis.

3.1.4 Sample Delimitation

The work intended to gather data mainly from purchase departments or other related departments, e.g. SCM, logistics, etc. Therefore, it can be said that more than organizations, the purchase departments were the highlight of the survey.

On the other hand, in the macro-economical sense, the population target of the research is the group of large enterprises in the German market, which according to the classification of the European Union are companies with an annual turnover greater than 50 million Euros [DiHL03, 45]. The work has adopted this classification and introduced the term very large enterprises for companies with an annual turnover greater than one billion Euros.

In the next step the sample has been delimitated through the contact of several organizations which possess the information about key employees of some large German companies.

This process is characterized by a process of not-probabilistic sample due convenience [Matt99], which is often seen in other scientific researches and in many cases is the unique or most efficient way to study a specific issue [Wint02].

Basis of the sample was: the Ecl@ss e.V. members, who have a strong focus on purchase department IT issues; addresses from specialized direct marketing companies' database as well as organizations, which have participated recently on fairs and events in the area such as e-Procure in Nuremberg, Germany.

Besides these sources, personal contacts have also been included, generating a database with a total of 445 organizations, which according to the statistical analysis more than 97% were large enterprises.

The potential respondents consisted basically of the high-management of the purchase department or other related activities, e.g. supply chain, IT, Business Process Management, etc.

Due to the specificity and strategic nature of the questions, it was discarded the possibility to apply the questionnaire on the C-levels of large organizations, e.g. CEO, CFO, CIO, because those employees may did not have the detailed knowledge about the supplier relationship management programs.

Thanks to the good quality of the generated list, which consisted mainly of high executives of the second and third hierarchical level, the author did not need to contact per telephone the companies to identify the appropriate contact person, although some telephone calls have been made to convince some potential respondents to participate in the survey. Nevertheless, as previously mentioned the main contact channel was the e-mail.

Out of the 445 organizations listed, 92 firms participated successfully in the survey; other 3 did not complete the questionnaire and for this reason, they were out of the research analysis. The reasons for the nonparticipation on the survey are unknown, but it can range from time constraints to lack of interest.

The goal of the minimum required participation quote had been established in 70 respondents based on previous researches in the area and the necessity to achieve a statistical significant population.

The advantages and disadvantages of a subjective data collection had to be accepted, because of the limitation to collect the information just from one employee per organization, although it was expected that the participant gives the organization`s point-of-view about their SRM programs, instead of their own personal opinions.

The data collected from the survey has been automatically stored in the database of the on-line questionnaire tool, thus the risk of errors was minimized. Furthermore, the tool allowed the data transformation into SPSS format, facilitating so the data transfer to the statistical tool and the data analysis.

Despite the lack of more formal probabilistic approach, the sample can be considered as a good representation of the German market with companies coming from all sectors of the economy such as: automobile, mechanical engineering, services, electronics, etc.

The sample provides also a very good representation of the large and very large German business sector, having the majority of the firms that participated on the research a turnover greater than one billion Euros per year.

3.2 Research Questions

This section introduces the research questions designed based on the literature review and the available market studies on the supplier relationship management topic. The research instrument has been formulated basically by the construction of some research questions, which from one side collect descriptive data, e.g. system applied, use grade, company's revenue, etc.; and from the other side, it explores facts and indicators correlations to draw new trends and opportunities in the SRM market.

The survey is consisted of the following research questions:

Population Characterization

- What is the annual revenue of your firm?

- In which sector of the economy is your company?

- What is your function within your company?

Supplier Relationship Management Program

- Does your company have a SRM program (indirect goods)?

- What are the expected benefits of your SRM program (indirect goods)?

- What are the main obstacles to your SRM program (indirect goods)?

- In your opinion, which are the key business practices that support a successful SRM program (indirect goods)?

- Which systems does your enterprise apply to support its indirect material purchasing processes?

- How many percent of your indirect material spending are currently supported electronically (purchase volume)?

- How many percent of your indirect material spending are currently supported electronically (contract quantity)?

- How many percent of your service spending are currently supported electronically?

- Does your company perform spend analysis of its indirect purchasing? If yes, which are the criteria?

- Based on what do you negotiate contract with your indirect material suppliers?

- Does your company apply other criteria besides price in its indirect purchasing? If yes, which ones?

- Does your company deploy a contract management system?

e-Catalogue Systems

- Does your company deploy e-Catalogue solutions?

- How many suppliers does your e-catalogue platform currently support?

- Who implements and maintains your catalogue content?

- Which systems is your e-catalogue solution currently integrated with?

- Which systems would you like to see your e-catalogue solution integrated with in the future?

- Which Product Groups are supported electronically in your organization?

- Is your company planning to expand these material groups in the next 24 months? If yes, which material groups?

- What are the current value-added functionalities of an e-Catalogue system?

- What are the future value-added functionalities of an e-Catalogue system?

- If your company applies e-catalogue solutions from a specialist provider, what are the main benefits of those solutions to your company?

- What kind of information should be available in an e-catalogue based procurement portal?

- How many languages does your company acquire product information in?

- Which format does your enterprise apply to support its electronic product data exchange?

- Which product classification system does your company support?

3.3 Data Analysis Methodology

In the first part of this work the author has introduced some concepts concerning the supplier relationship management technology and market, which provided the required background to the research and gave readers the necessary knowledge to understand the study results.

This theoretical framework has been represented by various objects in a questionnaire for the purpose of evaluating the current situation of SRM projects with the focus on indirect material management in large German organizations, at the same time that it has explored new technological areas to be developed in this field.

In order to investigate these issues, variables and indicators must be created to test the practical application of this technology. The data analysis of these objects consists first of a descriptive analysis [Viei98] of data by means and standard errors, in cases of quantitative variables; and by means of absolute frequencies and percentages for the case of qualitative indicators.

It has been also included in the work, charts and tables with the intention to improve the visualization and interpretation of the survey results. These data presentation mechanisms have included just the valid values of the study and their statistical interpretation to facilitate the right interpretation of the results by the readers.

Furthermore, an inferential analysis was made consisting of two parts: An analysis of internal consistency and an association analysis.

The inferential analysis applied in the study has considered a significance level of 10% ($\alpha = 0.10$), which is less conservative than the usual significance level of 5% ($\alpha = 0.05$) adopted in other similar researches.

The reason being that the author has decided for a broader investigation, considering that the research seeks to identify the most representative characteristics of the projects studied, and to recognize technological trends, which a more conservative analysis would probably not uncover.

The questionnaire made use also of quantitative questions, which were represented by a Likert scale, hence to verify their reliability a statistical analysis has been conducted item by item using an internal consistency tests based on the Cronbach's Alpha, means and standard deviations of the scale [Nunn78].

These reliability tests were conducted to check the probability of errors concerning the research results as well as to identify possible items that would decrease the information consistency.

In addition, associations between the variables representing companies` and the project characteristics, i.e. companies' size and sector as well as the SRM and e-Catalogue projects maturity; and the other indicators of the survey have been verified by the Fisher exact Test [MaLi00], which was the statistical methodology selected due to its effectiveness and its appropriateness to deal with the sort of data collected in the survey.

The Fisher's exact test is used to demonstrate statistically significant association between different variables, and it is characterized by the calculation of p-values that indicate the association between two distinct indicators once the p-value is lower than $\alpha = 0.10$, level of significance; see the appendix D in the end of the work for more information about this analysis.

In order to measure the effect size of the associations the V Cramer test [Agre96] was applied. This test is commonly used to measure nominal qualitative variables like the ones adopted in the questionnaire.

The measure of association V Cramer range from 0 to 1 or (0% to 100%) where 0 means no association and 1 means perfect combination. Hence, the measures illustrated in the last two columns of the appendix D represent the strength of association between the variables and their respective p-values.

Once the association between two variables had been confirmed by the statistical analysis, the objects were submitted to a Residual Analysis in Contingency Tables [Pere99] to identify the association profile and their representation intensity.

And to conclude, after the reliability and the association analysis had been done, the results were further examined by means of comparisons against the literature review and the expert experiences with the aim of providing the statistical analysis with the practical aspect of companies' operations.

4 Research Analysis

The next chapter describes the results of the empirical study conducted from October 2007 to February 2008 among different sectors of the German economy in an attempt to understand the current German supplier relationship management practices and the future issues that companies are planning to address in their SRM projects.

The response of 92 participants, the majority of which were multinational enterprises with an annual turnover greater than one billion Euros, were analyzed to identify leading SRM practices by gathering relevant information about organizational business factors, enabling technologies and planning investments.

The survey consists of 24 questions with the primary objective to explore companies' strategy and recognize significant trends in the SRM and e-Catalogue area. However, the e-catalogue approach adopted is wide, including technological factors, which should support the future development of this system's functional features towards more sophisticated SRM functionalities.

4.1 Internal Consistency Analysis

The questions consisted of responses based on the Likert scale were proved applying the Cronbach's Alpha to measure their internal consistency in order to assess the capacity of the scale and the questionnaire to collect the data necessary to measure the information, which should be definitely measured. This indicator is represented in percentage (%) and it is resumed in the table 4.1, consisting a total of 31 items.

Nonetheless, eight items were identified due to its potential to diminish the Cronbach's Alpha level. In fact, the Cronbach's Alpha value would increase at most 2.8%, in the case that the item 8.5 (Alpha = 0,803) of the table 4.1 would be removed. The item 8.5 is the item with the greatest negative impact on the internal consistency level.

Furthermore, it has been taken into consideration that from one side the exclusion of the questionnaire does not lead to a considerable gain in terms of the information consistency, and from the other side the information lost could not be measured under the research circumstances.

The author has decided to keep all items of the questionnaire to deepen the survey results, although occurring in a certain loose of the information consistency in the statistical findings.

Variables	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
6.1 - Automate the purchasing process	102,23	121,945	0,359	0,766
6.2 - Reduce the transaction costs	102,62	120,326	0,388	0,764
6.3 - Centralize the purchasing process	103,12	115,466	0,482	0,757
6.4 - Improve spend visibility	102,81	114,962	0,610	0,752
6.5 - Free up the procurement team for value added activities	102,62	115,766	0,677	0,751
6.6 - Promote collaboration with suppliers	102,88	128,586	0,120	0,775
6.7 - Increase control over company's spending	103,12	117,306	0,440	0,760
7.1 – Lack of e-business standards	104,12	121,946	0,420	0,764
7.2 - Internal end-user resistance	103,69	124,302	0,242	0,771
7.3 - Limited systems functionality	**103,42**	**126,334**	**0,122**	**0,778**
7.4 - Resistance and immaturity of suppliers	**104,12**	**129,466**	**0,018**	**0,780**
7.5 - Enabling and managing suppliers catalogues	**103,54**	**130,018**	**-0,021**	**0,784**
7.6 - Managing complex material categories	**103,15**	**130,135**	**-0,032**	**0,786**
7.7 - System integration	**103,81**	**138,562**	**-0,343**	**0,801**
8.1 - Consolidate the suppliers' base	102,65	119,755	0,635	0,757
8.2 - Centralize the purchase activities	102,69	122,062	0,473	0,763
8.3 - Purchasing process reengineering/standardization	102,23	124,105	0,310	0,768
8.4 - Improve purchasing/performance analysis	103,27	120,205	0,471	0,761
8.5 - Outsource supplier enablement and catalogue management	**103,69**	**138,702**	**-0,328**	**0,803**
8.6 - High integration with other SRM technologies	**103,58**	**129,614**	**0,012**	**0,780**
8.7 - Use of supplier networks	104,23	124,985	0,229	0,772
14.1 - Single products	**103,65**	**124,315**	**0,149**	**0,778**
14.2 - Total portfolio	103,19	118,402	0,342	0,766
14.3 - Material group	102,73	123,885	0,211	0,773
14.4 - Product with highest and lowest purchase volume	103,27	119,325	0,343	0,766
15.2 - Product/Service quality	102,38	124,166	0,355	0,767
15.3 - Delivery time	102,62	124,006	0,421	0,766
15.4 - Supplier assortment	103,04	120,678	0,436	0,762
15.5 - Technological capacities	103,08	114,314	0,694	0,749
15.6 – Services	102,81	120,962	0,503	0,761
15.7 – Implementation	102,96	116,998	0,662	0,753

Table 4-1 Cronbach's Alpha if Item Deleted Analysis

The Cronbach's Alpha value of the questionnaire was calculated on 0,775 (77.5%), which indicates a high ability of the questions and their variables to portray information, see the results on the table 4.2.

The appendix E, in the end of this work gives a summary of the item per item analysis, in case more detail about the reliability test is required.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0,775	0,800	31

Table 4-2 Cronbach's Alpha Test

4.2 Organizations Profile

The Organizations profile provides the characteristics of the survey participants which allow the relationship of the research results with these organizations as well as the construction of deeper analysis concerning supplier relationship management practices within specific target groups.

The population consists of enterprises from diverse market segments and sizes, though including a broad spectrum of large organizations, whereas the majority of the respondents are large German enterprises with an annual turnover greater than one billion Euros.

Company Size

The company size, according to their annual revenues, is represented in the figure 4.1. The sample represents well the large sector of the German economy, coming around 97% of the participants from this market segment and with the majority of the population (60%) being very large enterprises with an annual turnover greater than one billion Euros, and 15% consisting of companies with annual revenues varying between 250 million and one billion Euros.

The work adopts the European Union classification, which considers large enterprises, companies with an annual revenue greater than 50 million Euros. Thus there is just a minority of the sample (3%) representing the small and medium size enterprise sector.

This population representation was already expected as the survey has as its main goal the analysis of SRM projects, which the author believes are more common and mature in the large organizations segment. Therefore, the attention on refining the sample selection procedure in order to collect the contact data of potential participants that come from this market segment.

Nonetheless, the survey has further divided the sample into different company's sizes to allow deeper analyses of organizations coming from different sub-segment of the large enterprise sector. The figure 4.1 shows this further segmentation and their representation in the total population.
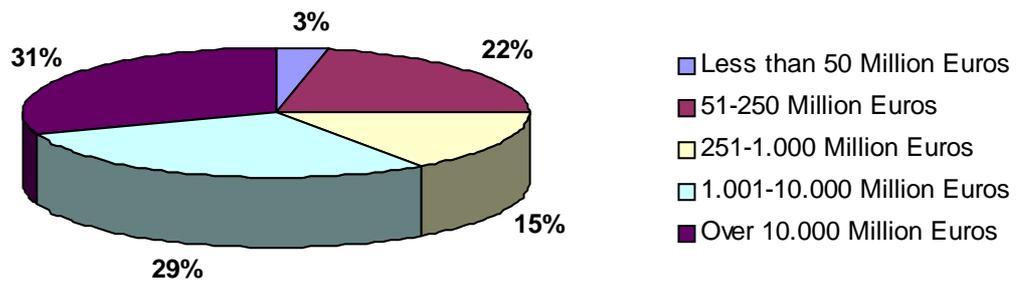
Figure 4.1 Company Size

Organization Sectors

The companies' sectors are sub-divided into seven specific segments and a further option to represent the other segments not specified in the survey, see figure 4.2. The division was made based on previous researches in the area, cf. chapter 2.4, which demonstrated that sectors that have a higher competitive rate, stimulated by strong cost pressures and low margins, tend to look more for innovative ways to improve their competitive advantage against their competitors than do other market sectors. And often they have found in supplier relationship management programs a good instrument to leverage efficiency and their competitiveness.

The population represents different business areas of the German economy, with a relative strong concentration on three main sectors: Automobile with 20% of the total participants, Services with 13% and Mechanical Engineering counting with 11%; followed by chemical / pharma (7%), electronic and technology both with 5% and wholesaler / retailer (4%). However, unfortunately a great number of the respondents (35%) come from other sectors of the economy, which could not be identified in the survey.

The literature on this topic suggests that these seven sectors, which were clearly identified on the survey, have the most profound knowledge and experience in SRM projects. Hence, the idea to concentrate the analysis on these sectors and to have the other sectors grouped in a single set to simplify the analysis, and confirm previous findings, which indicate that SRM practices are less present and mature in these other sectors.
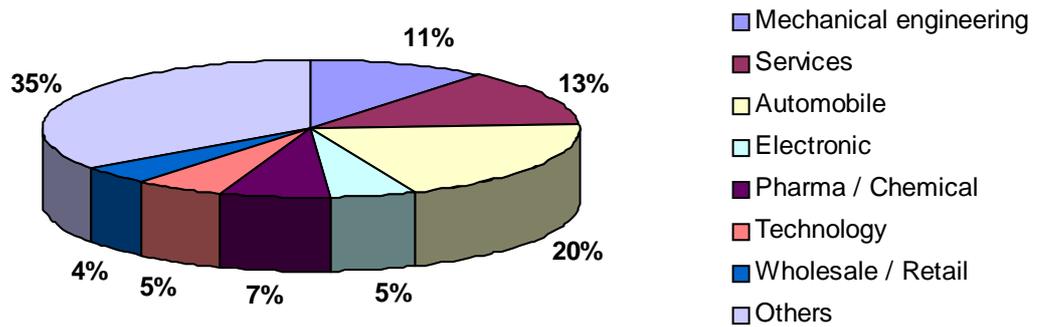
Figure 4.2 Organizations Sectors

Function within the Enterprise

Regarding the participants' position in the organization, the table 4.3 shows that most of the respondents are employed in departments related with the purchasing activities. Looking in more detail at their functions, 82,6% of the participants are employed at the purchasing / supply chain department.

IT counts with the second largest group with 7,6% of the participants, followed by Business Process Management (4,30%) and logistic with 1,1%. The remaining 4,3% come from other unidentified company's departments.

The concentration of the respondents on SRM related functions provides the work with a more refined and practices oriented view on the issues investigated by the survey. This fact increases the accuracy of the responses and assures the quality of the research findings and their practical application in future works and technological developments.

Variables	Frequency (N)	Percent (%)
Purchasing / Supply Chain	76	82,6
Logistic	1	1,1
Business Process Management	4	4,3
IT	7	7,6
Others	4	4,3
Total	92	100,0

Table 4-3 Participant Function within an organization

4.3   Supplier Relationship Management

The survey confirms that supplier relationship management activities are on the agenda of most large German organizations with more than 80% of the participants having SRM programs for indirect goods in place.

Given that SRM started with the implementation of e-procurement applications, which has as its focus the indirect goods purchasing process, it is not surprising that the majority of the respondents (54,9%) have begun their programs for a relative long time, over three years, see figure 4.3.

Nonetheless, approximately 14,3% of the participants still planning to implement SRM programs in the next 12 months and another 6,6% have just implemented their SRM solutions.

Indeed, most German organizations have understood the value proposition of such programs and are willing to invest on information technology and better processes to improve their SRM operations.

As companies advance in their business and in their purchasing processes, they recognize new supply chain demands and as a consequence the necessity to manage their purchasing processes electronically.

Later adopters realize the market pressure and are pressured by the market forces to move from paper / manual based processes to more sophisticated information technology based ones. And the organizations which have already recognized this demand and have implemented SRM solutions will most likely either invest in extended supplier relationship management solutions or will carry out Rollouts projects throughout diverse Business Units.
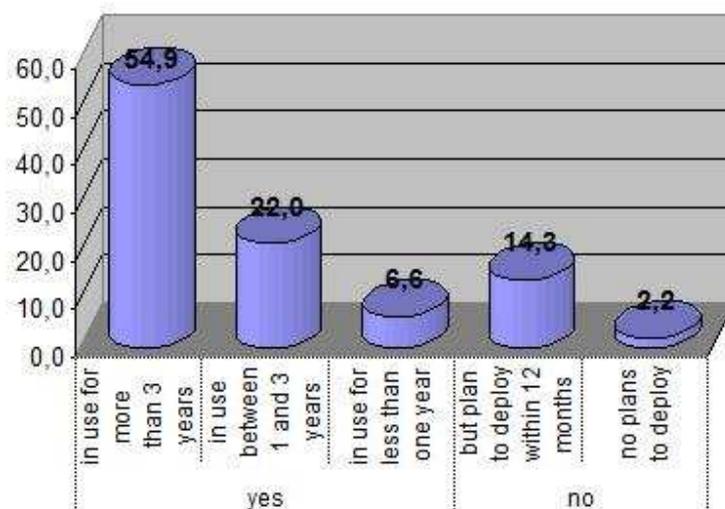
Figure 4.3 SRM Implementation

4.3.1 SRM Benefits

The survey results demonstrate that the three most consequential benefits of a supplier relationship management program for indirect goods are:

1. Automate the purchasing process;
2. Free-up the procurement team for value added activities;
3. Reduce transaction costs.

In this question, participants were asked to rank benefits on a Likert scale ranging from 1 to 5, in which five indicates the greatest importance.

Since SRM projects are directly linked up with the implementation of information systems to improve supplier management processes, it is not astounding that the automation of the purchasing process has been selected as the most important motivation that enterprises seek while adopting a SRM program. This fact scores a mean of 4,48 and a standard error of just 0,105 among the participants.

The free-up of the purchasing department to perform strategic activities was prioritized by most respondents, mean 4,22 and standard error of 0,103. After the automation of the purchasing process, this item has been selected as the highest ranked benefit.

This result suggests that organizations are moving from short-term, cost-driving reasons to implement SRM projects to a more strategic and long-term approach, avoiding the risk and high expectations that were common in the beginning of the internet applications.

Cost reduction issues, which used to be the primary reason for organizations to implement SRM programs, are still ahead of most objectives, mean 4,11 / std. error 0,110, but it no longer ranks as the most important benefit, as often seen in previous studies.

	N	Mean	
Variables	Statistic	Statistic	Std. Error
Automate the purchasing process	89	4,48	0,105
Reduce the transaction costs	89	4,11	0,110
Centralize the purchasing process	88	3,74	0,129
Improve spend visibility	89	3,60	0,117
Free up the procurement team for value added activities	89	4,22	0,103
Promote collaboration with suppliers	88	3,65	0,090
Increase control over company's spending	89	3,48	0,134

Table 4-4 SRM Benefits

The topics centralize the purchasing process, promote collaboration with suppliers, improve spend visibility and increase control over company's spending have scored about the same on the survey, see table 4.4.

These factors have scored a mean around 3,6 and a relative small standard error, indicating that all of them are relevant for companies and that control and compliance continues to rise in importance at the purchasing department, whilst they seek to improve their relations with suppliers.

While having a closer look at the benefits of implementing SRM programs, the study shows that basically the main reasons to employ such a solution almost do not change their importance level in companies, regardless of the maturity of the SRM project.

As it can be seen in the table 4.5, the three main benefits, i.e. automate the purchase process, free-up resources and reduce transaction costs, are present in all different maturity grades, having just minor differences, mainly on the weight that each group gives to these factors.

This result indicates that managers started to prioritize strategic and process issues over cost reductions; hence there is an increasing awareness of the importance of value added reasons to deploy SRM solutions, regardless of the program maturity.

Descriptive Statistics	in use for more than 3 years			in use between 1 and 3 years			in use for less than one year			plan to deploy within 12 months		
	N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error
Automate the purchasing process	50	4,60	0,131	19	4,00	0,306	6	5,00	0,000	12	4,58	0,149
Reduce the transaction costs	50	4,24	0,136	19	3,95	0,281	6	4,00	0,447	12	3,83	0,322
Centralize the purchasing process	49	3,78	0,190	19	3,58	0,289	6	3,67	0,494	12	3,83	0,207
Improve spend visibility	50	3,52	0,162	19	3,74	0,285	6	4,33	0,211	12	3,33	0,256
Free up the procurement team for value added activities	50	4,34	0,123	19	3,74	0,285	6	4,33	0,494	12	4,50	0,195
Promote collaboration with suppliers	49	3,71	0,109	19	3,58	0,221	6	3,67	0,422	12	3,50	0,230
Increase control over company's spending	50	3,60	0,167	19	3,05	0,354	6	4,17	0,401	12	3,42	0,358

Table 4-5 SRM Benefits according to Project's Maturity

4.3.2 SRM Obstacles

As it is shown in the table 4.6, the major challenge for companies' SRM programs is the management of complex material categories, given that the respondents rank this matter with a mean of 3,19 and a standard error of 0,131.

Complex products demand often special attention from purchasing managers and systems due to their configuration and customization requirements, which generally go far beyond the functionalities of standard SRM solutions.

It is not infrequently that the management of complex material categories requires specific professional expertise and processes, which include extra information technology infrastructure and purchase experts to manage their buying process.

In order to attend this market demand, various best-of-breed providers are developing niche solutions to support diverse complex products categories. Nonetheless, this approach brings extra costs to companies as these solutions are offered often as add-on functionalities to other SRM systems, requiring tailored business processes and new e-business standards to handle specific processes.

Although the later developments in the supplier relationship management field are significant, the other three major challenges mentioned in the survey are well-known from early days.

They are in this order: the limited systems functionality (mean 2,91, std. error 0,134), the capability to enable and manage suppliers' catalogues (mean 2,84, std. error 0,134) and the system integration capability (mean 2,83, std. error 0,129).

This finding indicates either the necessity for companies to further invest on new IT infrastructure or that SRM solutions still have plenty of room to be developed, and while doing that vendors should increase the integration flexibility of their solutions to enable a bigger return on investment (ROI) for companies' IT investments.

On the other hand, e-catalogue vendors have to design uncomplicated and user-friendly solutions to facilitate the enabling and managing process of suppliers' catalogues without the necessity for companies to spend on internal e-catalogue expertise.

| | N | Mean | |
Variables	Statistic	Statistic	Std. Error
Lack of e-business standards	81	2,74	0,135
Internal end-user resistance	81	2,77	0,127
Limited systems functionality	81	2,91	0,134
Resistance and immaturity of suppliers	79	2,44	0,121
Enabling and managing suppliers catalogues	79	2,84	0,134
Managing complex material categories	80	3,19	0,131
System integration	80	2,83	0,129

Table 4-6 SRM Obstacles

Indeed, the results sign to a future increase on the adoption of business process outsourcing providers for companies to guarantee new system's functionalities and e-catalogue knowhow without incurring in high fix costs.

Other obstacles perceived as critical by the respondents include internal end-user resistance (mean 2,77) and lack of e-business standards (mean 2,74), see table 4.6. At the bottom of the list of key challenges by adopting a SRM program is the resistance and immaturity of suppliers, scoring a mean of just 2,44 and a standard error of 0,121.

It should be noted though that except by the management of complex material categories, all other perceived obstacles had a remarkable low score, smaller than 3 in the Likert scale.

These findings suggest that the confidence on SRM programs is growing again after years of disbelief subsequent to the internet bubble and the disappointment with the return on investment of former internet applications.

On the other hand, the table 4.7 shows that earlier adopters indicate as one of the most significant obstacles the system integration, in opposite to new adopters that consider the lack of e-business standards one of their major challenges.

In fact, the early obstacles in implementing a SRM program are still remaining. However mature projects are facing more sophisticated challenges such as limitation of their systems' functionality and integration matters.

Notably, all groups recognize that the management of complex products is one of their two major challenges. This fact confirms the importance of these products and services to current companies' e-business strategy, while it reinforces the necessity for further developments in this area.

Descriptive Statistics	in use for more than 3 years			in use between 1 and 3 years			in use for less than one year			plan to deploy within 12 months		
	N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error
Lack of e-business standards	48	2,77	0,177	20	2,45	0,285	6	2,83	0,477	6	3,50	0,342
Internal end-user resistance	48	2,58	0,154	20	3,15	0,284	6	2,33	0,494	6	3,50	0,342
Limited systems functionality	48	2,94	0,169	20	2,95	0,285	6	2,50	0,619	6	3,17	0,477
Resistance and immaturity of suppliers	47	2,45	0,160	19	2,32	0,254	6	2,33	0,333	6	3,00	0,447
Enabling and managing suppliers catalogues	48	3,00	0,179	19	2,42	0,233	6	3,33	0,615	5	2,40	0,245
Managing complex material categories	48	3,21	0,174	19	3,00	0,296	6	3,67	0,211	6	3,33	0,422
System integration	48	3,02	0,167	19	2,47	0,280	6	2,50	0,428	6	2,83	0,401

Table 4-7 SRM Obstacles according to the Project's Maturity

Finally, it should be noted that new adopters should select their system providers not just based on their immediate needs, but also based on the different challenges faced by experienced enterprises.

And while implementing their projects, they have to prepare themselves from the beginning for more advanced matters faced by organizations, which have more mature and sophisticated projects.

4.3.3 Success Factors

The participants' views regarding the critical factors to the success of SRM programs indicate a move from the naive perception of the earlier days of the Internet, when organizations saw in the single implementation of information systems to manage the purchasing processes the answer for their bottom-line cost problems.

Nowadays, enterprises understood that the critical success factor of a SRM program is not the IT infrastructure itself, instead the success of SRM projects is closer correlated to the organization's approach to process standardization, supplier management and change management (see table 4.8), while the information system adoption should just support these managerial changes in companies.

With the implementation of improved and "centralized" processes, companies can easily consolidate their suppliers' base and introduce electronic processes to improve their communication with suppliers and consequently consolidate their business relationship, which lead to the reduction of purchasing process and material costs, and the increase of enterprises spend visibility and compliance.

Other factors have been identified in the study to have impact on the success of SRM programs, they are: improve purchasing/performance analysis (mean 3,43), high

integration with other SRM technologies (mean 3,09), outsource supplier enablement and e-catalogue management (mean 3,06) and use of supplier networks (mean 2,62).

Variables	N Statistic	Mean Statistic	Std. Error
Consolidate the suppliers' base	90	3,93	0,088
Centralize the purchase activities	90	3,91	0,096
Purchasing process reengineering/standardization	90	4,22	0,090
Improve purchasing/performance analysis	89	3,43	0,102
Outsource supplier enablement and catalogue management	90	3,06	0,135
High integration with other SRM technologies	89	3,09	0,110
Use of supplier networks	86	2,62	0,117

Table 4-8 SRM Success Factors

While organizations are focused on the strategic impact of their supplier relationship activities, it is comprehensible that a key issue is the improvement of their purchasing process analysis, which embraces as a decisive component the utilization of information technology to automate their processes and place more spend under management.

The expansion of the adoption of complementary, integrated supplier relationship management technologies such as spend intelligence and contract management, collaborates to achieve this company's goal and it is also perceived as it is shown in table 4.8 as a critical success factor by organizations.

Analyzing the different success-factors that drive current German SRM projects in different maturity stages, it was clear that all of them achieve the greatest value from their SRM programs by focusing on process issues, i.e. process standardization, centralize activities and consolidating the supplier's base.

Indeed, it seems that the younger is the project phase, the bigger is the focus on the process reengineering and standardizations aspects, what suggests that new adopters have learned from the mistakes of earlier users and are trying to avoid them by preparing first their organizations to subsequently implement SRM systems to support and ensure the continuity of the business improvements.

Descriptive Statistics	in use for more than 3 years			in use between 1 and 3 years			in use for less than one year			plan to deploy within 12 months		
	N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error
Consolidate the suppliers' base	50	4,00	0,114	19	3,79	0,224	6	4,17	0,167	13	3,77	0,257
Centralize the purchase activities	50	3,92	0,124	19	3,68	0,254	6	4,17	0,307	13	4,00	0,226
Purchasing process reengineering/standardization	50	4,20	0,134	19	4,21	0,164	6	4,33	0,333	13	4,46	0,144
Improve purchasing/performance analysis	49	3,43	0,140	19	3,16	0,245	6	4,00	0,365	13	3,54	0,215
Outsource supplier enablement and catalogue management	50	3,06	0,188	19	2,47	0,246	6	3,83	0,543	13	3,38	0,311
High integration with other SRM technologies	49	3,22	0,152	19	2,74	0,252	6	3,33	0,494	13	2,85	0,191
Use of supplier networks	48	2,67	0,174	18	2,17	0,185	6	3,00	0,516	12	2,75	0,218

Table 4-9 SRM Success Factors according to the Project's Maturity

In other words, the research results confirm the high correlation between supplier relationship management accomplishments and the companies' focus on process issues, which indicates that companies are more aware of their supplier management needs and imbalances and try to find in enabling information system technologies just the tools to optimize and integrate their supply relationship management processes.

4.3.4 Systems' Deployment

In the nineties with the introduction of the internet applications to manage suppliers, companies started to boost their investments on information technology to support these processes. One of the main responsible for this wave of internet application deployments were the e-procurement system and the electronic catalogue.

Therefore, it is not surprising that the survey demonstrates that those solutions continue to be one of the most deployed systems in the area of SRM applications with the current deployment rate of 69,6% and 70,7% respectively, see figure 4.4.

Although, companies are still heavily relying on EDI (51,1%) to connect suppliers to their organizations. EDI appears to lose momentum and plans of future investments on this technology is rare these days in companies (6,5%), instead enterprises are looking forward to adopting low-priced, flexible and more efficient technologies.

ERP as one of the backbones of any SRM project has achieved its maturity with most of the enterprises having this system currently in place (81,5%). ERP systems are far the most deployed solution in large German organizations, however, with a low market expansion rate expected for the next two years (3,3%).

Perhaps because of this fact, most ERP providers are moving their activities either to new technology fields, e.g. SRM, CRM or to new market segments, e.g. Small-and-Medium size enterprises.

In the last years, the business focus on control, visibility and compliance have become more apparent. And companies have started to invest on complementary technologies to fulfill and aggregate the complete source-to-payment process.

e-Procurement and e-catalogue, although are considered as mature technologies, still being part of the implementation plans of approximately 13% of the companies appraised.

However, it has to be noted that the study did not have a deep analysis to identify possible Rollout and up-grade projects of these systems in the future, which the author believes will be the main source of future investment in the area.
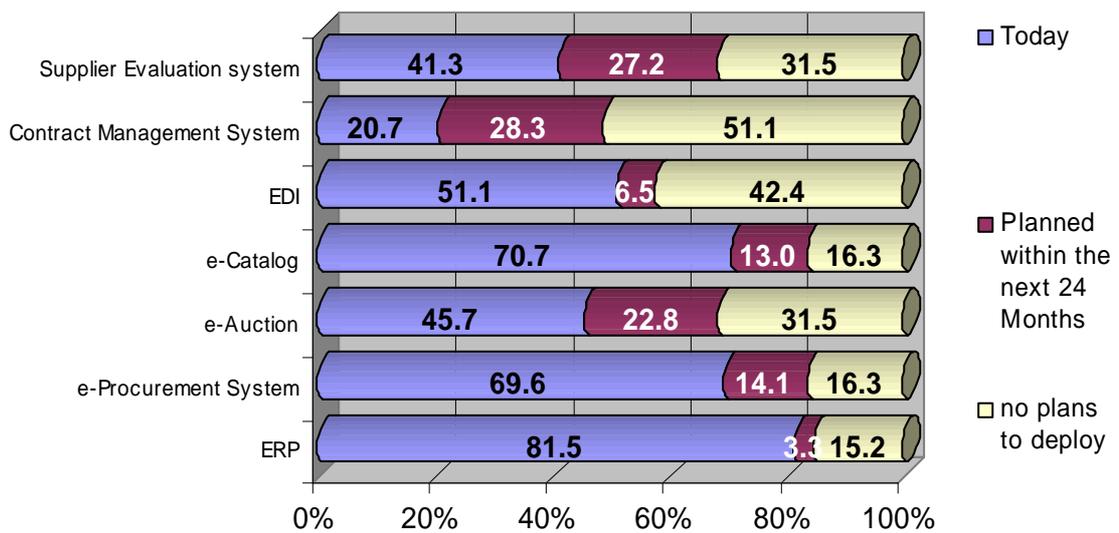
Figure 4.4 System Deployment

On the other hand, e-auction and supplier evaluation systems even though have a relative high presence in companies, 45,7% and 41,3% respectively. The survey indicates that they are going to experience an implementation rate greater than 20% in the next couple of years, suggesting that companies are still seeking for larger material savings and searching for key suppliers to build closer relationships.

This scenario implies the necessity of better supplier integration and in consequence the increase on the level of information exchange and improved performance measures,

which should be supported by a new generation of e-auction and supplier evaluation systems that should include on their functionalities new and more refined assessment methods to support these procedures.

Furthermore, the growing pressure on visibility and compliance have forced enterprises to invest on contract management solutions, which are responsible for the transfer of contract information from/to other operational systems in order to enable the electronic control over business agreements, purchase quote, supplier follow-up, etc.; and finally to guarantee the realization of the savings initiated during the negotiation process.

This relative new system environment is currently deployed by just 20,7% of the participants and it is expected a future adoption rate of around 28% in the next twenty four months.

This finding is also in line with other trends found in the study that suggest a growing requirement on system integration and the inclusion of add-on functionalities in current SRM systems to cover the complete purchasing process, while boosting business performance and increasing the level of the spend under management and compliance.

The survey results have reinforced the idea that very large enterprises are the pioneers in applying information systems to support their purchase processes, having deployed most mature solutions and many of them are currently investing in more sophisticated technologies to electronic connect and manage their supplier base.

4.3.5 Indirect material spending supported electronically (purchase volume)

While the study indicates that companies have heavily invested in supplier relationship management technologies and have to a certain extend overcome most obstacles to succeed in this area. The level of total indirect spend under management has given a completely paradoxical vision of the current status of a large part of the SRM projects.

With 46,7% of the respondents stating that their total indirect spend under management represents less than 15% of their total purchase volume, and approximately 80% of the enterprises having less than 50% of their total indirect material purchase volume under management, suggest a dramatic situation, which is hard to be explained through the survey analysis alone, see figure 4.5.
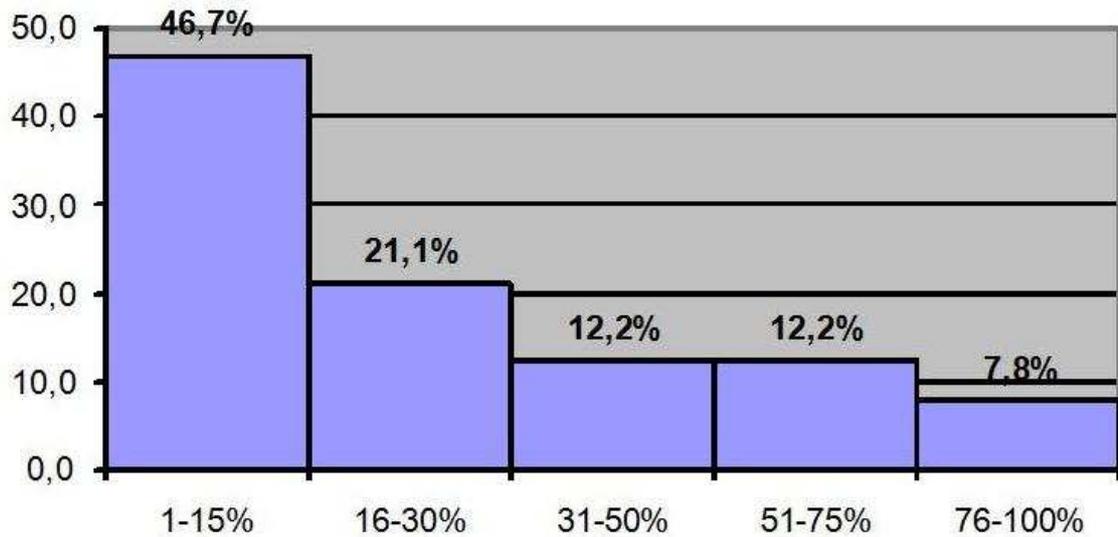
Figure 4.5 Indirect Material Spending (purchase volume)

From one side, the survey has shown that the majority of companies have e-procurement as well as e-catalogue solutions currently deployed, at the same time that they stated that their SRM projects face relative low end-users and suppliers resistance.

It is hard to understand the reason why companies are struggling so barely to increase the level of spend under management in their SRM projects. Therefore, further in depth researches based on case studies are required to explain this paradoxical situation in large German companies SRM projects.

In spite of the previous results of the survey, it appears that internal users' as well as suppliers' adoption resistance have not been given the required attention by organizations, and perhaps although not shown on the research, they remain one of the most challenging aspect of a SRM program, indicating that organizations have to give closer attention to change management matters and user training programs, if they want truly to succeed on their SRM projects.

Other assumption which can be made is that companies still are targeting just a reduced number of suppliers and material groups in their SRM programs, thus reducing drastically the potential benefits that their projects could achieve and increasing so the total cost of ownership.

In order to solve this problem, organizations have to invest on new technologies and set aggressive supplier as well as material group coverage targets and their deadlines. This goal may be facilitated by the exploitation of company's systems providers' expertise during the deployment as well as training of their employees and suppliers.

A detailed look at the survey results has indicated that there are differences between the indirect material spend under management level according to the company's sector.

The Fisher's Exact Test has identified an association between the companies' sectors and the level of their purchase volume supported electronically, represented by a p-value of 0,031, i.e. less than 0,10 of significance level.

In order to identify which sectors are in advantage in this subject, a residual analysis has been made and it has shown that service is the sector with the highest level of spend under management, followed by technology, electronic and wholesale/retail, all of these sectors having scored an adjusted residue greater than 1,3 for purchase volume bigger than 30% of the total spending.

Automobile which is often presented in other studies as pioneer in information systems projects, in this survey, its adjusted residue of 1,4 for purchase volume between 16-30% indicates that they tend to cover less than 30% of their indirect material spending electronically, see the table 4.10.

Other compelling finding was that the study confirmed, in this item, the previous researches' assumption that the "other sectors", not specified on the survey, lye behind the other specified sectors, according to the residual analysis these sectors concentrate their purchase volume supported electronically level between 1-15% of their total spending.

Companies Sector	N		How many percent of your indirect material spending (i.e. purchase volume) is currently supported electronically?					Total
			1-15%	16-30%	31-50%	51-75%	76-100%	
Services	12	% within % purchase volume	7.1%	21.1%	18.2%	0.0%	42.9%	13.3%
		Adjusted Residual	-1.6	1.1	0.5	-1	**2**	
Automobile	18	% within % purchase volume	16.7%	31.6%	18.2%	9.1%	28.6%	20.0%
		Adjusted Residual	-0.7	**1.4**	-0.2	-1	1	
Electronic	5	% within % purchase volume	4.8%	0.0%	18.2%	9.1%	0.0%	5.6%
		Adjusted Residual	-0.3	-1.2	**2.0**	1	-1	
Technology	5	% within % purchase volume	4,8%	0,0%	0,0%	27,3%	0,0%	5,6%
		Adjusted Residual	-0,3	-1,2	-0,9	**3**	-1	
Wholesale/ Retail	4	% within % purchase volume	0.0%	10.5%	18.2%	0.0%	0.0%	4.4%
		Adjusted Residual	-1.9	1.4	**2.4**	-1	-1	
Others	30	% within % purchase volume	42.9%	21.1%	9.1%	45.5%	28.6%	33.3%
		Adjusted Residual	**1.8**	-1.3	-1.8	1	0	
Total		Count	42	19	11	11	7	90
		% within Sectors	46.7%	21.1%	12.2%	12.2%	7.8%	100%

Table 4-10 % of Purchase Volume Supported Electronically per Sector

These observations lead to a variety of possible interpretations, which must be investigated to provide a more precise view of the market. At one end, it is possible that

the sample covers a big number of organizations which have not a well designed indirect material procurement strategy in place. At the other extreme, it may be that existing studies of the SRM market overestimate how efficient are these systems employed in companies.

4.3.6 Indirect material spending supported electronically (contract quantity)

Considering the aspect of total spend under management measured based on contract quantity, the situation is slightly different as shown in the figure 4.6. More than 35% of the companies have more than 50% of their contracts under management and just 25,6% of the respondents have less than 15% of their total contracts under management.

What proved to be even more confusing, since it was expected that companies apply a 20%-80% approach while dealing with their purchasing contracts. This means that it would be expected that companies cover a great part of their purchase volume electronically through the negotiation of a limited number of contracts with key suppliers.
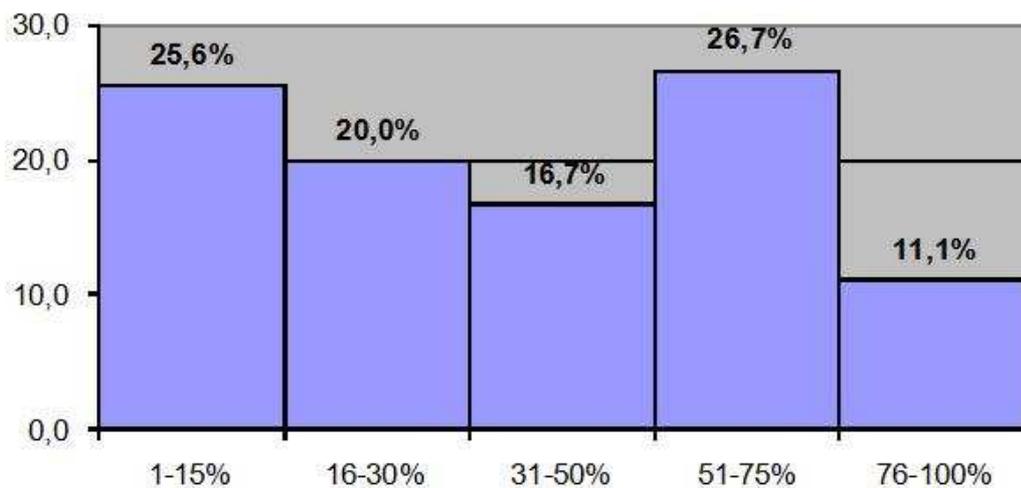
Figure 4.6 Indirect Material Spending (contract quantity)

Despite of the confusing or better said not expected results of the last two research questions, the imposition of high levels of spend under management is a critical aspect for the long-term success of supplier relationship management programs.

In view of that organizations have to pursue the continuous improvement of this success factor, at the same time that companies have to be aware of the real impact of this issue on their operational and financial performance.

4.3.7 Service spending supported electronically

The first generation of internet applications systems focused on the purchasing process of direct and indirect goods, leaving service to a second plan in companies' purchasing departments.

After managers started to realize the benefits that the electronic management of service spend could bring to organizations, they have started also to use their e-procurement systems to handle the purchase of service.

Nonetheless, although some of the available tools in the market have been adapted by the inclusion of new functionalities to cover the purchase process of service electronically, these solutions still limited concerning the effective support of this business process.

Nowadays, there are two sorts of information systems, which support the electronic purchase of service in the market:

- Systems that have extended their features, often by customizing templates and adding sophisticated functionalities specialized in service, and it runs in parallel with the core product purchasing features.

- Service provider specialists that have developed solutions specially designed for service, covering tailored processes of a bigger range of these items, and treating them as a separate spend category.

Moreover, there is the problem of the lack of appropriate e-business standards to support the purchase of service. At the moment, there is no established classification standard which supports satisfactorily the electronic exchange of service information between companies.

Even though, many standard organizations urge to have service as a discrete material group, these classifications model are not enough structured to properly handle this kind of material.

The classification standard eCl@ss noticing this weakness of its classification system has joined a consortium headed by the University of Karlsruhe and financed by the German federal ministry of economics and technology (BMWI), which has the goal to develop specific processes, tools and standards to support the electronic purchase of service, q.v. http://ebusinstand.de.

Having this in mind, it was not unexpected that most organizations still in their infancy in what is concerned to service procurement. As shown in the figure 4.7 the

majority of the participants (67,5%) cover less than ten percent of their services purchasing volume electronically.
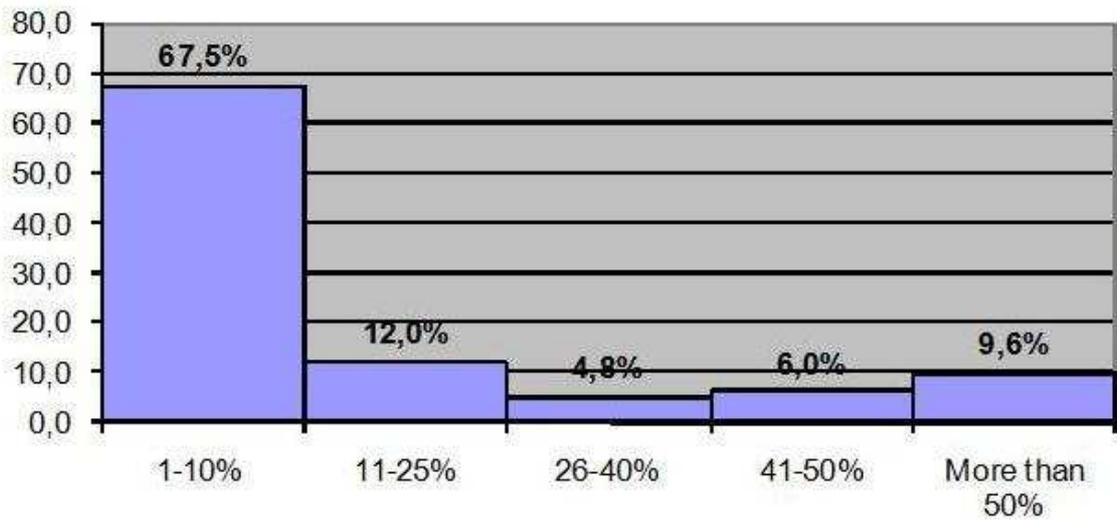
Figure 4.7 Services Spending Supported Electronically

The Fischer's exact test has proven an association between the company's sector and the level of service supported electronically, p-value 0,028. Again the sector that is leading the electronic management of service according to the residual analysis is the service sector with an adjusted residue of 2 for the factor over 50%, see table 4.14.

Other sectors that are investing in the electronic purchase of services are electronic, followed by wholesale/retail and pharma/chemical. On the other hand, the sectors with the smallest level of service supported electronically, according to the survey, are the mechanical engineering with an adjusted residue of 1,3 on the factor less than 10% of the total service spending volume.

Companies` Sector	N		1-10%	11-25%	26-40%	41-50%	Over 50%	Total
					is currently supported electronically?			
Mechanical engineering	8	within % service	12,5%	10,0%	0,0%	0,0%	0,0%	9,6%
		Adjusted Residual	**1,3**	0,0	-0,7	-1	-1	
Services	11	% within % service	12,5%	10,0%	0,0%	0,0%	37,5%	13,3%
		Adjusted Residual	-0,3	-0,3	-0,8	-1	**2**	
Automobile	17	% within % service	19,6%	40,0%	0,0%	20,0%	12,5%	20,5%
		Adjusted Residual	-0,3	**1,6**	-1,0	0	-1	
Electronic	5	% within % service	3,6%	10,0%	50,0%	0,0%	0,0%	6,0%
		Adjusted Residual	**-1,4**	0,6	**3,8**	-1	-1	
Pharma / Chemical	6	% within % service	5,4%	10,0%	25,0%	20,0%	0,0%	7,2%
		Adjusted Residual	-0,9	0,4	**1,4**	1	-1	
Technology	5	% within % service	5,4%	0,0%	0,0%	20,0%	12,5%	6,0%
		Adjusted Residual	-0,4	-0,9	-0,5	1	1	
Wholesale / Retail	4	% within % service	3,6%	10,0%	25,0%	0,0%	0,0%	4,8%
		Adjusted Residual	-0,8	0,8	**1,9**	-1	-1	
Others	27	% within % service	37,5%	10,0%	0,0%	40,0%	37,5%	32,5%
		Adjusted Residual	**1,4**	**-1,6**	**-1,4**	0	0	
Total		Count	56	10	4	5	8	83
		% within Sectors	67,5%	12,0%	4,8%	6,0%	9,6%	100%

(Header spanning note: "How many percent of your services spending (i.e. purchase volume) is currently supported electronically?")

Table 4-11 % Services Spending Supported Electronically per Sector

The study has shown that although indirect materials are still the most common items supported electronically by companies, service is also being increasable addressed by large German organizations.

The rising developments on information systems to support the electronic purchase of service as well as the growing interest of companies and e-business standard organizations in this material group reflect the trend in the adoption of electronic means to support service purchase processes.

4.3.8 Spend Analysis

Purchase department is responsible both for the quality of company's acquired products and services, and for their purchasing decisions on where, what and when to buy those materials.

Indeed, spend analysis is the tool that can support buyers to successfully analyze and manage their spend data, while seeking opportunities to improve processes and increase future cost savings.

Since the survey results point out that those systems are still in the early stage of development and roughly half of the participating organizations have still not deployed

this technology, see figure 4.8. This finding indicates that the market of business intelligence applications should continue to grow in the next couple of years.
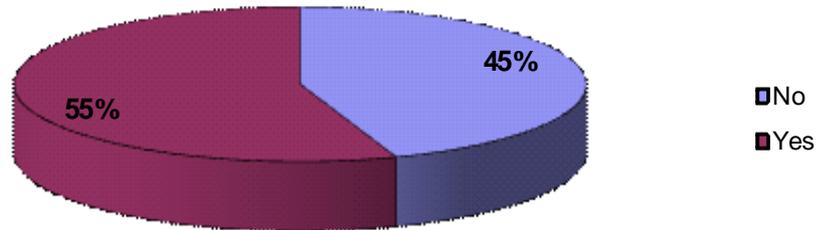
Figure 4.8 Spend Analysis Application

Most organizations still performing their spend analysis activities manually without the deployment of spend analysis solutions to automate the extraction, aggregation and analysis of their spend data.

Unfortunately, the spend data are stored in diverse transaction systems, which are not integrated with each other, and do not support reporting and analytical functions. These systems frequently accumulate redundant data across different regions and company's subsidiaries, making harder the analysis of this data.

The explanation for the poor usage of spend analysis tools by companies, it may be that many organizations either have not started to invest on this technology or have not opened the mind of their buyers for the necessity to use these solutions to increase spend visibility and create opportunities of future cost savings.

Given that organizations while deploying a spend analysis tool should first of all design a strategy to adopt business intelligence technology in a way that satisfy their business requirements. The study has evaluated the main spend analysis approaches adopted by large German enterprises.

The figure 4.9 shows that companies which currently apply this technology has the most interest in the analysis of their spend data on material group basis (45,7%), followed by suppliers coming up to 34,8%, region (19,6%), product with highest and lowest purchase volume (17,4%), and single products (15,2%).

However, these criteria are commonly combined between each other to give a global view of companies spend performance, in view of the fact that managers often require

different information perspectives to decide for the best approach to apply in their purchase strategy.
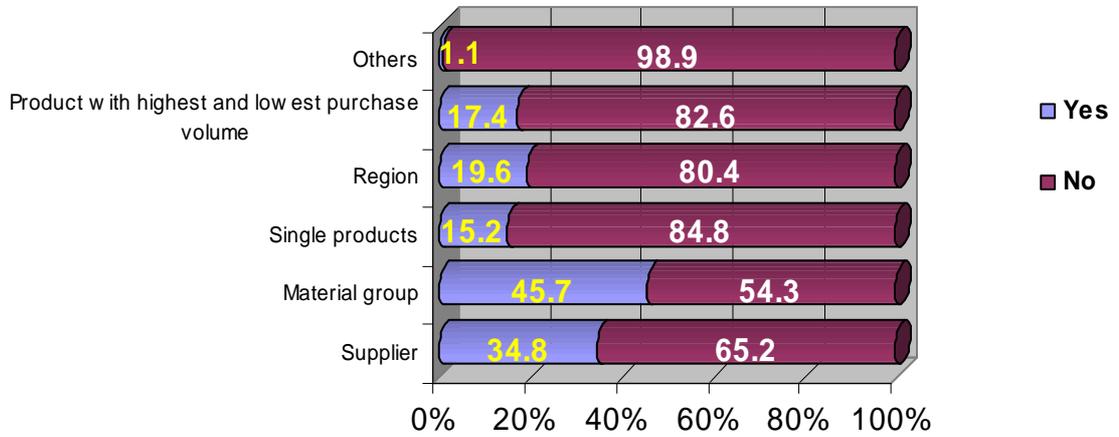
Figure 4.9 Spend Analysis Approaches

4.3.9 Supplier Evaluation

Most organizations' purchase departments have as their main goal, process and material savings. Therefore, enterprises used to obtain business benefits only over price and volume discounts in products that are not of critical interest for them such as indirect materials and services.

It is well known, that suppliers offer discounts to gain high business volumes with a specific organization to achieve economy of scale. Consequently, the easiest way of achieving savings is to increase the purchase volume with a restricted number of suppliers and acquiring from them a limit set of standard products and services to pressure further price discounts and volume targets.

Having this in mind, it was postulated that suppliers of indirect goods should be all handled in the same way, in a zero-sum game. Nowadays, the study demonstrates that this approach still been used by fifty-five percent of the respondents, although lately diverse researchers postulate the application of multiple criteria to evaluate indirect material suppliers besides the price, see figure 4.10.
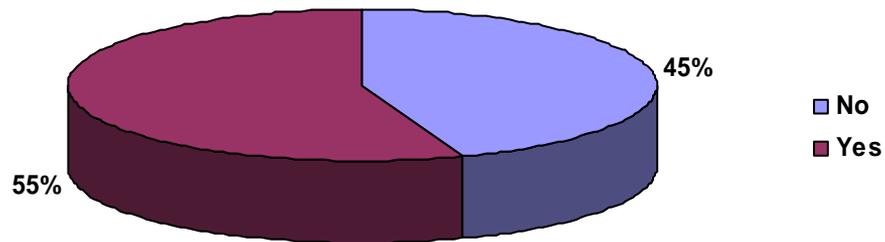
Figure 4.10 Supplier Evaluation based solely on Price

It is clear that relationships based only on price terms would not lead to advantageous returns neither for buyers nor suppliers. In the same case, companies should not handle all their suppliers in the same way, since this approach would not lead to an optimal relationship management.

In other words, the right supplier strategy should be a mix of diverse approaches according to the importance of a supplier and its products to a company with the purpose of increasing the buying organizations' material management performance.

In the field of indirect goods and services supplier management is not different. The table 4.12 demonstrates that a great number of companies are currently adopting diverse criteria besides price to evaluate their suppliers.

When analyzing the criteria used by organizations to evaluate their indirect goods suppliers, a great variety of criteria comes up. Concerning this issue, the respondents who apply diverse criteria besides price to analyze their indirect material suppliers classify as the most important criterion the product and services quality with a mean of 4,26 and a standard error of 0,112. Being the range of services provided (mean 3,95, std. error 0,136) also a key factor for companies while evaluating their business partners.

The reason is that buyers tend to expect a superior level of products and services quality from their strategic providers due to the extra motivation that they believe larger contracts grant to suppliers.

Along with products and services quality, delivery time punctuality with a mean of 4,00 and standard error of 0,122 is considered the second most critical criterion by most respondents.

Undeniably, when buyers purchase a product, they suppose that their suppliers give especial attention to their orders, and in case the product is in short of supply, their providers should offer what is available to them first, within the agreed delivery time frame.

Besides these criteria, the participants have considered also implementation (mean 3,80, std. error 0,153), followed by technological capacities (mean 3,64, std. error 0,156) and supplier assortment (mean 3,61, std. error 0,139) as important.

Variables	N	Mean (Std. Error)
Product/Service quality	47	4,26 (0,112)
Delivery time	47	4,00 (0,122)
Supplier assortment	41	3,61 (0,139)
Technological capacities	42	3,64 (0,156)
Services	42	3,95 (0,136)
Implementation	41	3,80 (0,153)

Table 4-12 Supplier Evaluation Criteria

In view of the fact that sourcing strategy has grown in complexity, e-auctions solutions have expanded their functionalities to enable a more complete bid process with the goal of identifying the most appropriate supplier for an organization.

Although it was not possible to verify in the survey by the application of the Fisher's exact test., the author believes that organizations, which deploy e-auction tools capable to perform multi-attribute analysis tend to use a bigger number of criteria to evaluate their indirect material suppliers, what would positively impact companies' supplier relationship management operations.

Indeed, recent studies show that the application of more complex and complete supplier evaluation techniques implies in increased savings, and what is more important, this approach enables the identification of the most appropriate suppliers for each group of commodities, recompensing the high-value suppliers, while improving the business relationship with them.

Nonetheless, supplier evaluation systems as well as e-auction systems should not eliminate the personal interaction between buyers and suppliers, instead they should serve as tools to complement the quality and the efficiency of companies' purchasing processes.

4.3.10 Contract Negotiation

While selecting new suppliers or renewing contracts, organizations should not only focus on the seller's characteristics to choose the most adequate supplier, instead companies should also consider the most suitable product portfolio to acquire from a certain provider, at the same time it should chose an appropriate method to evaluate a supplier portfolio, since in most cases it is not required to analyze all products and/or services of a seller to assess its performance.

Looking at the research results at the table 4.13, it becomes clear, that despite the fact that companies not always need to analyze the total supplier portfolio, this criterion is the favorite among large German enterprises having ranked a mean of 3,88 and a standard error of just 0,128.

One of the possible reasons for this result is the lack of spend analysis solutions in many organizations which reduces the transparency of organization's spending and limit the possibilities for enterprises to opt for other analysis approaches.

Furthermore, it was identified other methods applied when negotiating a contract with a supplier. Besides the total portfolio the survey shows that the most popular method is the material group (mean 3,77, std. error 0,137), followed by Product with highest and lowest purchase volume (mean 3,49, std. error 0,145) and single products (mean 3,06, std. error 0,146).

Variables	N	Mean (Std. Error)
Single products	83	3,06 (0,146)
Total portfolio	87	3,80 (0,128)
Material group	83	3,77 (0,137)
Product with highest and lowest purchase volume	80	3,49 (0,145)

Table 4-13 Negotiation Criteria

The findings indicate that the usage of material group as a criterion for contract negotiation has almost become as widely spread as the total portfolio analysis, increasing the need for a proper commodity management strategy and the employment of hierarchical classification systems.

It has to be noted though that many organizations spread their analysis in more than one criterion to increase the quality of the analysis and create a portfolio and a supplier mix that best fit with companies' strategy.

Nonetheless, one of the biggest challenges with contract management is not the negotiation process, but their life cycle management. With the purpose of handling this

issue, many enterprises are applying proprietary systems, e.g. Access databases, and they are struggling to transfer their contract data into electronic format.

Contract management is a critical factor of managing suppliers and purchase performance, since it allows contract execution monitoring and it assists to bring more spend under management, while optimizing business relationships through the control of off-contract purchasing, meet of discount targets and uncover of transactional errors and inconsistent pricing.

As shown already in this research, contract management system has become a clear field of investment for many companies. However, these stand-alone solutions have to be integrated with other relevant SRM applications, e.g. e-auction, e-procurement, e-catalogue, to build a smooth environment to cover the entire contract lifecycle process.

4.4 e-Catalogue

Electronic catalogue systems have been deployed in companies over thirty years from proprietary solutions to today's web based applications. At the beginning, e-catalogue was designed as a computer-based ordering system, which was connected via telephone to a supplier. Using the system, buyers could browse, select indirect products/services and generate orders.

In the mid nineties, the Internet has allowed a wider e-catalogue application in diverse companies from small enterprises to large organizations. The exchange of products and services information between sellers and buyers could be then made using standard electronic languages through a universal user interface, helping to streamline and reduce the buying and selling process.

There are several ranges of electronic catalogue systems in the market, which basically differ from means of purpose and user's functionality. The differences determine the system characteristics and the kind of information available.

The utilization of electronic catalogue in business-to-business purchase processes has been supported by the development of new internet technologies such as e-procurement that gave an innovative platform to deploy those solutions.

Having this in mind, it is not surprising that currently more than 70% of the participants have an e-catalogue system in place. In fact, it should be noted that around half of the respondents have implemented their systems over three years, suggesting that this technology is already well established in today´s large German company's system landscape, see figure 4.11.

Nonetheless, the survey also indicates a relative high implementation rate of these solutions within the next 12 months (18,5%), which could be motivated either by new developments in the area or more aggressive companies' e-business strategies. Whether the reason is based on technological aspects or organizational issues could be a subject of further research.
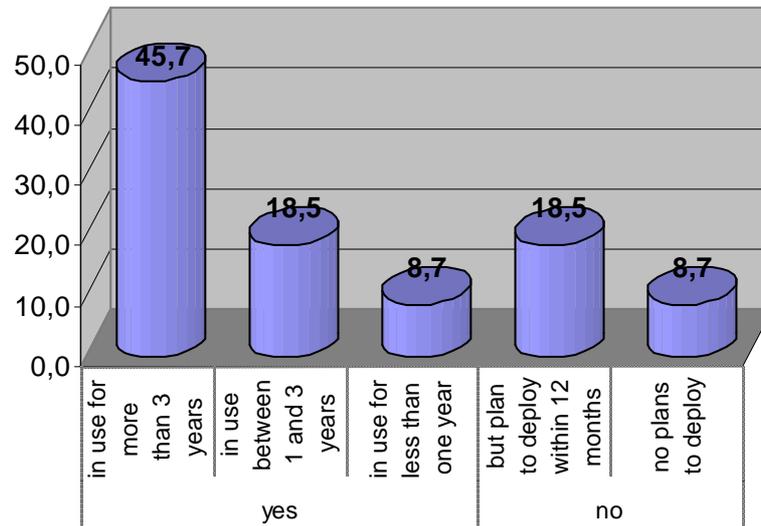
Figure 4.11 e-Catalogue Deployment

In order to evaluate the relationship between the annual turnover of an organization and their e-catalogue strategy, it was applied the Fisher's Exact Test, which indicated that these two dimensions have an association between them identified by a p-value of 0,028 with a significance level less than 0,10.

After a detailed Residual Analysis some findings came out from the survey, which demonstrate some trends concerning companies' e-catalogue deployment plans. It seems that very large enterprises have already deployed their e-catalogue platforms, in fact their projects can be considered relative mature with a great part of them being life longer than three years, see table 4.14.

Yet, the new wave of e-catalogue implementation takes place in companies with an annual turnover between 51 and 250 million Euros, which the adjusted residue of 2,2 indicates that these companies are concentrating their implementation plans within the next 12 months.

At the same time, although the Small and Medium size sector is scarcely represented in the study, the adjusted residue (3,6) indicates that those companies do not have any plans to deploy an e-catalogue solution in the medium term.

In other words, e-catalogue providers should focus their commercial strategy either on "small" large enterprises or on rollout and update projects of very large enterprises, which already have e-catalogue in place and may seek for more sophisticated and innovative platforms.

Companies' Size	N		Longer than 3 years	between 1 and 3 years	less than one year	plan to deploy within 12 months	No Plans	Total
						Deploy e-Catalogue		
< 50 Million Euros	3	% within e-catalogue	0,0%	0,0%	0,0%	5,9%	25,0%	3,3%
		Adjusted Residual	-1,6	-0,8	-0,5	0,7	**3,6**	
51-250 Million Euros	20	% within e-catalogue	16,7%	5,9%	25,0%	41,2%	37,5%	21,7%
		Adjusted Residual	-1,1	-1,8	0,2	**2,2**	1,1	
251-1.000 Million Euros	14	% within (e-catalogue	9,5%	23,5%	25,0%	23,5%	0,0%	15,2%
		Adjusted Residual	-1,4	1,1	0,8	1,1	-1,3	
1.001-10.000 Million Euros	27	% within e-catalogue	35,7%	35,3%	12,5%	17,6%	25,0%	29,3%
		Adjusted Residual	1,2	0,6	-1,1	-1,2	-0,3	
Over 10.000 Million Euros	28	% within e-catalogue	38,1%	35,3%	37,5%	11,8%	12,5%	30,4%
		Adjusted Residual	**1,5**	0,5	0,5	-1,9	-1,2	
Total		Count	42	17	8	17	8	92
		% within Annual Revenue	45,7%	18,5%	8,7%	18,5%	8,7%	100,0%

Table 4-14 e-Catalogue Usage per Company's Size

4.4.1 Number of Enabled Suppliers

Although e-catalogue is considered as a mature technology, the survey results show that most organizations (67,50%) still have connected less than 50 suppliers to their e-catalogue platform, and just 15,6% of all respondents have connected more than 100 suppliers via an e-catalogue solution, see figure 4.12 .

Yet, it is critical that organizations finally understand that they must expand their electronic supplier connectivity level in order to achieve the full benefits of their e-business strategy.

Moving beyond the enablement of just few key suppliers into a broader range of partners will generate higher returns on investment and reduce the cost of ownership of their applications.
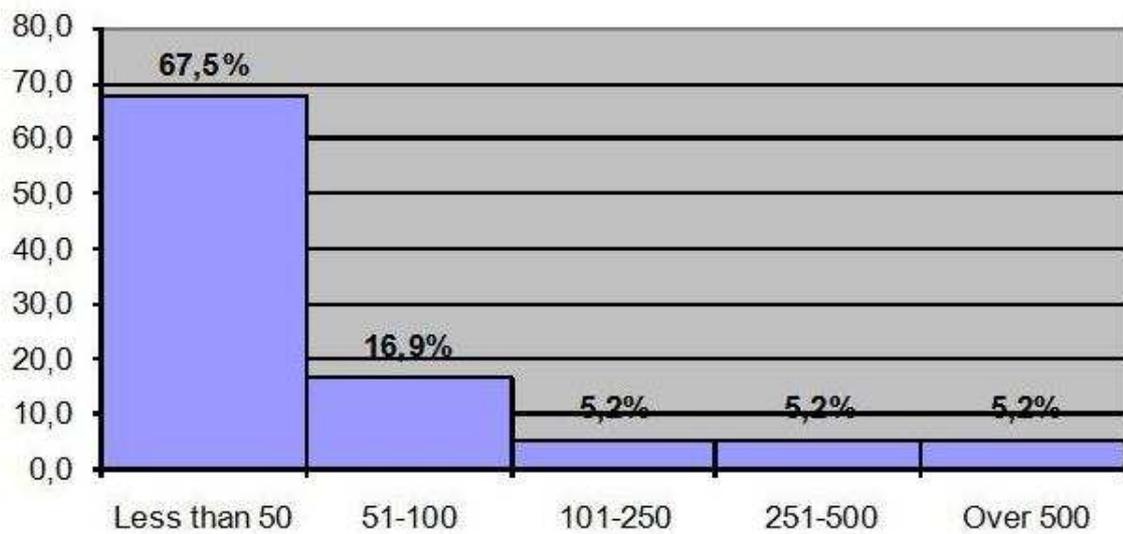
Figure 4.12 Number of Enabled Suppliers

Over the years, it has been postulated that the key to success was to apply the strategy of enabling 20% of organization's suppliers which involve 80% of company's total purchase volume.

However, this e-business strategy is no longer adequate for nowadays aggressive business environment, and the remaining 80% of the supplier base that is managed manually and represents the majority of the problems concerning operational efficiency, must be addressed and enabled.

In terms of supplier connectivity, the automobile sector leads the way. Already pioneer in a number of supply chain issues, the automobile industry scores high concerning the number of enabled suppliers in their e-catalogue platforms, the residual analysis shows that in this sector there is a concentration of projects that have between 251 and 500 suppliers connected, adjusted residue of 1,5.

Surprisingly, it was the results of the residual analysis for the "other sectors", which indicates that at this point the industries that normally have not ranked well in previous researches as regards their supplier relationship management activities, have the highest connective rate with most of their projects enabling more than 100 suppliers, see table 4.15.

The mechanical engineering was the sector that connected the lowest number of suppliers within their e-catalogue projects. The adjusted residue of 1,5 indicates that most of the e-catalogue projects in this industry enable less than 50 suppliers.

Companies' Sector	N		How many suppliers does your e-catalogue system currently support?					Total
			Less than 50	51-100	101-250	251-500	Over 500	
Mechanical engineering	9	% within N° Suppliers	15,4%	0,0%	0,0%	25,0%	0,0%	11,7%
		Adjusted Residual	**1,5**	-1,4	-0,7	0,9	-0,7	
Services	9	% within N° Suppliers	7,7%	38,5%	0,0%	0,0%	0,0%	11,7%
		Adjusted Residual	-1,6	**3,3**	-0,7	-0,7	-0,7	
Automobile	16	% within N° Suppliers	21,2%	7,7%	25,0%	50,0%	25,0%	20,8%
		Adjusted Residual	0,1	-1,3	0,2	**1,5**	0,2	
Pharma / Chemical	5	% within N° Suppliers	3,8%	23,1%	0,0%	0,0%	0,0%	6,5%
		Adjusted Residual	-1,4	**2,7**	-0,5	-0,5	-0,5	
Technology	5	% within N° Suppliers	5,8%	15,4%	0,0%	0,0%	0,0%	6,5%
		Adjusted Residual	-0,4	**1,4**	-0,5	-0,5	-0,5	
Others	27	% within N° Suppliers	38,5%	0,0%	75,0%	25,0%	75,0%	35,1%
		Adjusted Residual	0,9	-2,9	**1,7**	-0,4	**1,7**	
Total		Count	52	13	4	4	4	77
		% within Sectors	67,5%	16,9%	5,2%	5,2%	5,2%	100,0%

Table 4-15 Supplier Enablement per Sector

The results above bolster up the survey findings, which show that the level of purchase under management and the number of enabled suppliers are still a huge challenge for company's e-business strategy.

Enterprises, if they want truly succeed in this area, must aggressively expand across a wider range of suppliers and material categories. It is highly recommended the execution of further researches to identify the reasons for this e-business pitfall in companies and design an effective business case for these matters.

4.4.2 e-Catalogue Management

Organizations which want to communicate with their business partners electronically must manage and integrate the content required to fulfill this process. Information management and integration were and still are a problem that takes place within company's boarders, and it has been addressed applying data warehouse techniques as well as master data management methods.

Nonetheless, in cross-company environments, organizations must manage information from different suppliers, integrating their content in diverse ways and of individual catalogues from each of their business partners.

The execution of this process is a critical part of an e-business process, in which data accuracy and availability is a must and the design of a well-structured process is extremely important to mitigate problems in this area.

Hence, the creation of a proper strategy around the issues of data creation, versioning, storing and distribution of structured and unstructured content across companies is a key success factor in any e-catalogue project.

The study indicates that most enterprises apply a strategy in which suppliers are responsible for their own content, see figure 4.13. This can be done essentially in two ways:

- Organizations deploy an e-catalogue platform that provide suppliers with self-service functionalities to manage their data creation, maintenance and distribution processes, including automated workflows and intelligent wizards to facilitate their tasks;

- Or they apply punch-out capabilities to allow the data acquisition from external catalogues, using a temporal communication gateway to their supplier's portal and the additional capacity to import the information required to generate an order.
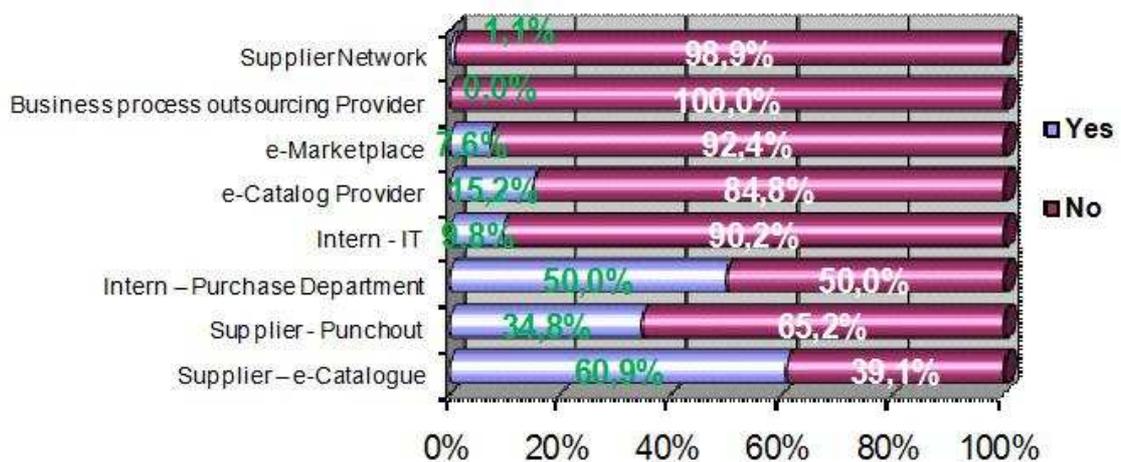
Figure 4.13 e-Catalogue Management

The management of catalogue information by the purchase department is other way that enterprises use (50%) to support their content creation and management process. Nonetheless, it seems that the utilization of this approach depends strongly on the company's size, as it can be seen in the table 4.16.

Indeed, the Fisher's exact test has demonstrated that there is an association between the company size and the e-catalogue management practices, represented by a p-value of 0,018 with less than 0,10 of significance level.

A detailed residual analysis indicates that the utilization of the purchase department to perform the catalogue management process is a characteristic essentially of very large enterprises with an annual revenue over one billion Euros.

On the other side, smaller organizations tend not to adopt this approach. The adjusted residue greater than 1,5 in companies with an annual turnover smaller than one billion Euros shows this tendency, which may be caused because of the lack of expertise or man power in the purchase department of these organizations.

In fact, the employment of the purchase department to carry out the content management process enhances drastically the data maintenance costs, which represents a large part of e-catalogue project efforts. The main advantage of this strategy is the increase in control over suppliers' content, which very large enterprises seem to prioritize comparing to other cost issues.

Companies' Size	N		Purchase Department		Total
			No	Purchase Department	
Less than 50 Million Euros	3	% within Purchase Department	6,5%	0,0%	3,3%
		Adjusted Residual	**1,8**	-1,8	
51-250 Million Euros	20	% within Purchase Department	28,3%	15,2%	21,7%
		Adjusted Residual	**1,5**	-1,5	
251-1.000 Million Euros	14	% within Purchase Department	21,7%	8,7%	15,2%
		Adjusted Residual	**1,7**	-1,7	
1.001-10.000 Million Euros	27	% within Purchase Department	21,7%	37,0%	29,3%
		Adjusted Residual	-1,6	**1,6**	
Over 10.000 Million Euros	28	% within Purchase Department	21,7%	39,1%	30,4%
		Adjusted Residual	-1,8	**1,8**	
Total		Count	46	46	92
		% within Annual Revenue	50,0%	50,0%	100,0%

Table 4-16 e-Catalogue Management per Company's Size

The utilization of third party service providers such as e-catalogue providers (15,2%), e-Marketplaces (7,6%) and supplier networks (1,1%) are other strategies adopted by the participants to manage their e-catalogue content.

In fact, the author expects an increase use of third part service providers due to its cost-effectiveness and their high flexibility. Service providers may include also in their service package, software as a service, reducing the cost of ownership of companies', which no longer will have to invest on license and constant software upgrades.

Nonetheless, software houses, e.g. ERP have to provide greater integration possibilities in their future releases to enable an easier integration with other software modules and increase the return on investment of companies' previous IT projects.

The relative high utilization of e-catalogue providers to support the content management process compared to other service providers, which has been indicated by the study, was unanticipated due to the relative new entrance of these vendors in this market segment and the supposed established business-model of the others service providers.

On the other hand, the high expertise of the e-catalogue providers in the area and their long-term relationship with their customers may facilitate their entrance in the market, characteristics that may shore up this trend in future researches in the field.

Again, the residual analysis has shown that the pioneer on this trend are the very large enterprises, especially the ones with an annual revenue between one and ten billion Euros, which the adjusted residue of 3,1 suggests their strong predisposition to deploy electronic catalogue providers to manage their e-catalogue platforms and content.

The companies with an annual turnover varying between 51 and 250 million Euros appear not to use e-catalogue providers to manage their catalogue content, see the table 4.17.

| Companies' Size | N | | e-Catalogue Provider | | Total |
			No	e-Catalogue Provider	
51-250 Million Euros	20	% within e-Catalog Provider	25,6%	0,0%	21,7%
		Adjusted Residual	**2,1**	-2,1	
1.001-10.000 Million Euros	27	% within e-Catalog Provider	23,1%	64,3%	29,3%
		Adjusted Residual	-3,1	**3,1**	
Total		Count	78	14	92
		% within Annual Revenue	84,8%	15,2%	100,0%

Table 4-17 e-Catalogue Management by e-Catalogue Providers

Comparing this analysis with other previous analysis within this survey, it can be argued that the utilization of e-catalogue providers to manage suppliers' content is a practice more present in mature e-catalogue projects, while new projects tend to manage their e-catalogue in other ways, e.g. suppliers and punch out.

Nonetheless, it must be noted that an organization cannot effectively manage all aspects of an e-catalogue creation and maintenance processes. Suppliers have to be included in the routine to manage their own e-catalogues, thus self-service tools are currently the most appropriate approach to effectively combine different content management practices to maintain e-catalogue data.

4.4.3 e-Catalogue Integration

Integration issues are a major topic in current supplier relationship management projects and it could be not different in the e-catalogue field. The survey results have shown that the majority of the respondents do not have a high integration level between their different modules.

In effect, besides the e-procurement systems (52,2%), which many vendors include an e-catalogue module in their solutions, and since the beginning they have been well integrated with other e-catalogue platforms, all other SRM modules have an integration rate smaller than 50% with the e-catalogue platform, despite the well-know benefits of this practice to companies, e.g. reduce data redundancy, cross-module workflow, data consistency, etc.

The ERP (39,1%) and the SRM (34,8%) solutions, which often incorporate e-catalogue integration gateways to their modules to increase the integration flexibility of their systems, rank also high concerning integration matters.

Even though, theses three mentioned solutions have the greatest current level of integration with the e-catalogue technology, the study suggests that it will be in these areas the focus on integration projects in the next 24 months.
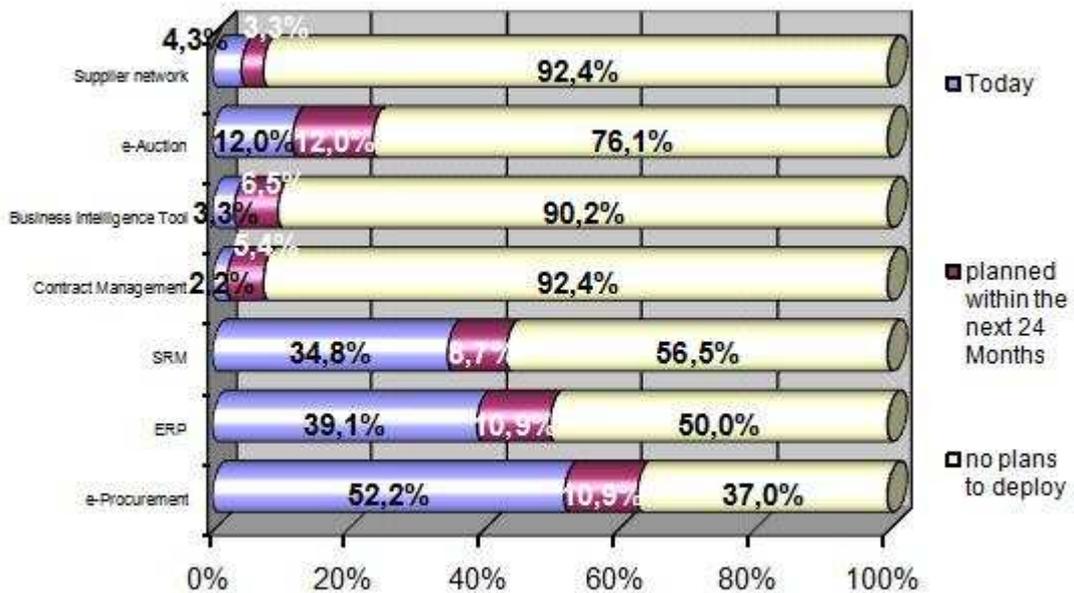
Figure 4.14 Systems Integration

Besides these three systems mentioned above, only e-auction solutions (12%) have a current representative integration level and it expects a relative high implementation grow of another 12% in the next 2 years.

All other systems have less than 5% of current integration rate, but this situation is about to change in the near future, as it can be seen in the figure 4.14, as companies are starting to invest heavier on integration projects to increase their efficiency regarding their supplier relationship management procedures.

Supplier information should be available across all company's departments from purchase through logistic to finance. Integration into these departments is a decisive fact to promote faster, smoother and easier process across the entire enterprise.

Nowadays, the integration of all relevant modules is equally important as the implementation of these systems in companies. After all, a product catalogue should be available directly through an e-procurement tool, which should represent the negotiated terms achieved by the e-auction application that generated a contract which should be respected and controlled by a contract management system. Furthermore, all these source-to-order processes should be supported by an ERP module, which should have the full access to all pertinent information described above.

Nevertheless, a deeper analysis of the survey results using the Fisher's exact test to establish associations between the e-catalogue integration level and the effective deployment of other SRM solutions have shown an interesting result.

The Fisher's exact test together with the residual analysis have demonstrated that enterprises which have already implemented an e-procurement, an e-auction and/or a contract management system tend also to integrate or are willing to integrate those systems with their electronic catalogue solutions in the next twenty-four months, as it can be seen in the table 4.18.

These different results of the same issue can be explained due to the methodology used to analyze the matter in different perspectives. The first looks at the problem regardless of the system's implementation level in companies, while the second approach analyzes just the companies which have effectively the system in place, e.g. e-procurement, SRM, e-auction, etc., providing so a different perception of the subject.

e-Procurement Implemented			e-Procurement Integration			Total
Time	N		No current plan	Today	Next 24 Months	
Today	64	% within e-Procurement	47,1%	91,7%	40,0%	69,6%
		Adjusted Residual	-3,6	**4,8**	-2	
Next 24 Months	13	% within e-Procurement	20,6%	2,1%	50,0%	14,1%
		Adjusted Residual	1,4	-3,5	**3**	
Total		Count	34	48	10	92
		% within e-Procurement	37,0%	52,2%	10,9%	100,0%

e-Auction Implemented			e-Auction Integration			Total
Time	N		No current plan	Today	Next 24 Months	
Today	42	% within e-Auction	42,9%	72,7%	36,4%	45,7%
		Adjusted Residual	-1,0	**1,9**	-1	
Next 24 Months	21	% within e-Auction)	20,0%	0,0%	63,6%	22,8%
		Adjusted Residual	-1,2	-1,9	**3**	
Total		Count	70	11	11	92
		% within e-Auction	76,1%	12,0%	12,0%	100,0%

Contract Mngt. Implemented			Contract Management Integration			Total
Time	N		No current plan	Today	Next 24 Months	
Today	19	% within Cont Mngt.	20,0%	100,0%	0,0%	20,7%
		Adjusted Residual	-0,5	**2,8**	-1	
Next 24 Months	26	% within Cont Mngt.	24,7%	0,0%	100,0%	28,3%
		Adjusted Residual	-2,6	-0,9	**4**	
Total		Count	85	2	5	92
		% within Cont Mngt.	92,4%	2,2%	5,4%	100,0%

Table 4-18 e-Catalogue Integrations Plan

In any case, organizations seem to be moving from the core e-procurement framework, which supports basically the "requisition-to-order" process towards a more complex and complete business cycle that includes no longer only e-procurement functionalities, but also sourcing, contract management and other more refined features.

They have realized that the process improvements and savings achieved by the implementation of isolated solutions are not materializing on the extension that they had planned.

Therefore, these organizations, which have already invested in a number of isolated solutions, seek now to extend the capabilities of the systems available to rearrange the

way they communicate with each other in order to achieve a new frontier concerning their supplier relationship management automation and integrated processes.

4.4.4 Material Group

The application of e-business tools to support the purchasing process has urged the classification of products and services to facilitate the data exchange between companies, thus the division of these products and services into distinct material groups coding has become crucial.

Classifying company's purchased products in granular, classification schema enables the identification of individual products and services by buying organizations as well as by their business partners, assisting the search and grouping of products into families to build more generic groups to negotiate with suppliers.

A material group classification schema should divide products and services into distinctive classes and families, creating a hierarchical structure to provide companies with a common coding system to communicate with their suppliers in a transparent fashion way, which allows a greater visibility for enterprises to design their e-business expansion strategy through the application of material group management techniques.

Although companies can create their own classification systems, there are some obvious advantages to adopt a universal classification code from established classification organizations like eCl@ss and UNSPSC.

This research has employed the eCl@ss classification system to support the analysis of the current situation of material group management in large German companies as well as the future expansion plans of their usage in those organizations.

The table 4.19 indicates that there are three major categories, which companies are currently massively involving in their e-business programs. Office Products (73,9%) and Tools (64,1%) are the most traditional areas for the utilization of e-catalogue systems to support the electronic buying process of companies, together with electric engineering, automation (53,3%).

These material groups represent the main product categories that companies are currently adopting in their e-business projects. Nevertheless, participants have indicated a further increase of approximately 11% on their employment in the next 24 months.

The survey results have shown that although these three product groups are still the most adopted material categories in companies' e-catalogue projects, other categories are also been implemented: Marketing (31,5%), Home Economics (31,5%), Media

Technology (30,4%), Service (29,3%), Machine (26,1%), Construction Technology (26,1%) and Automotive Technology (21,7%).

Material Group	Today		planned within the next 24 Months		no plans to deploy		Total
	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)	
Machine	24	26.1	7	7.6	61	66.3	92
Media Technology	28	30.4	7	7.6	57	62.0	92
Tool	59	64.1	11	12.0	22	23.9	92
Construction Technology	24	26.1	8	8.7	60	65.2	92
Office Products	68	73.9	10	10.9	14	15.2	92
Service	27	29.3	17	18.5	48	52.2	92
Energy	4	4.3	7	7.6	81	88.0	92
Electric engineering, automation	49	53.3	10	10.9	33	35.9	92
Automotive Technology	20	21.7	5	5.4	67	72.8	92
Home Economics	29	31.5	6	6.5	57	62.0	92
Marketing	29	31.5	11	12.0	52	56.5	92
Others	6	6.5	2	2.2	84	91.3	92

Table 4-19 Material Group Employment

The table 4.19 also suggests that respondents see Service (18,5%) and Marketing (12%) as the fields with the largest medium-term opportunities to progress. The increase implementation of other material categories within e-catalogue platforms was a predictable phenomenon and it is actually a prudent development.

However, the implementation of more complex product groups is not trivial, especially in the case of service, which has a number of singularities to be addressed, thus from the technical point of view, it is surprising that organizations have chosen service as their main material group to be implemented in the near future in their e-catalogue platform.

Although, it is on the other side understandable that companies attempt to increase this material group visibility and electronic coverage due to its high representativeness in companies' total spending volume and the consequent necessity to trace and control its operations.

The survey has shown that the majority of the organizations have either initiatives underway or plan to expand the application of e-catalogue technology to support a larger number of material groups.

Indeed, the definition of expansion targets and the implementation of more complex product group's electronic business processes are the only way to pursue an efficient material group management strategy in companies.

4.4.5 e-Catalogue Functionalities

Electronic catalogues are used by different business users. They encompass different functionalities to attend their demands and business objectives. To evaluate the value that some of these features deliver to companies, the research has analyzed the significance of each of these functions in a chronological approach.

Since e-catalogue solutions offer a broad range of functionalities, the study has limited them just to thirteen with the aim of carrying out the investigation. As shown in the table 4.20.

The features can be divided into three different groups. The top four current features embrace: sophisticated / user-friendly search (68,5%), simple modification overview (62%), workflow with notifications (59,8%) and integration with ERP (54,3%), which also represent the most mature features and are present in the majority of the e-catalogue applications available in the market. These features tend to increase in importance for around 20% of the participants in the future.

After examining the major functionalities mentioned above, the table 4.20 demonstrates other group of functionalities that respondents perceive as important to current e-catalogue projects, they are: decision support through statistics / reports (43,5%), automated data cleansing (39,1%) and automated quality assurance (33,7%),

These features are present in many e-catalogue applications, but in nearly all of them with a limited performance. Moreover, participants see specially on the automated data cleansing (33,7%) and the decision support through statistics / reports (28,3%) an increase in importance in the next years.

e-Catalogue Functionalities	Today		Future		None		Total
	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)	Frequency (N)	Percent (%)	
Simple modification Overview	57	62.0	16	17.4	19	20.7	92
Automated Quality Assurance	31	33.7	32	34.8	29	31.5	92
Decision support through Statistics + Reports	40	43.5	26	28.3	26	28.3	92
Automated Data Cleansing, e.g. Supplier self-service	36	39.1	31	33.7	25	27.2	92
Sophisticated + user-friendly search	63	68.5	20	21.7	9	9.8	92
Workflow with notifications	55	59.8	20	21.7	17	18.5	92
Spend Analysis Support	23	25.0	34	37.0	35	38.0	92
Bid based on e-Catalogue	19	20.7	33	35.9	40	43.5	92
Integration with e-Auction	21	22.8	33	35.9	38	41.3	92
Integration with Contract Management	10	10.9	35	38.0	47	51.1	92
Integration with Supplier Portal	16	17.4	34	37.0	42	45.7	92
Integration with ERP	50	54.3	19	20.7	23	25.0	92
Integration with Material Management System	26	28.3	24	26.1	42	45.7	92
Others	1	1.1	0	0.0	91	98.9	92

Table 4-20 e-Catalogue Functionalities

Furthermore, there is a group of features which are in the majority of the cases neither available in current e-catalogue solutions nor are in their infancy. These features are not recognized currently as crucial, but all of them are pointed out having a great potential and increase in importance in the future, with roughly 36% of the respondents expecting an increase of significance of these functionalities:

- Integration with Material Management System;
- Spend Analysis Support;
- Integration with e-Auction;
- Bid based on e-Catalogue;
- Integration with Supplier Portal;
- Integration with Contract Management.

Indeed, the group of very large enterprises with an annual turnover greater than ten billion Euros is the main driver of these trends. The residual analysis points out that the companies of this segment see on these functionalities the future of e-catalogue development and innovation.

The adjusted residues over 2,8 in all the four functionalities listed on the table 4.21 demonstrate clearly that these features will be a hot topic in future electronic catalogue projects.

As already discussed in this study, organizations are hunting for expansion of their current systems functionalities towards more complex features, which facilitate the

operation of large processes, while integrating them to enable the easy flow and control of information across all enterprise.

Companies' Size	N		Bid based on e-Catalogue - Future		Total
			Not relevant	Future	
Over 10.000 Million Euros	28	% within e-Catalogue Bid	20,3%	48,5%	30,4%
		Adjusted Residual	-2,8	**2,8**	
Total		Count	59	33	92
		% within Anual Revenue	64,1%	35,9%	100,0%

Companies' Size	N		Spend Analysis Support - Future		Total
			Not relevant	Future	
Over 10.000 Million Euros	28	% within Spend Analysis	19,0%	50,0%	30,4%
		Adjusted Residual	-3,1	3,1	
Total		Count	58	34	92
		% within Anual Revenue	63,0%	37,0%	100,0%

Companies' Size	N		Integration with e-Auction – Future		Total
			Not relevant	Future	
Over 10.000 Million Euros	28	% within Integration e-Auction	18,6%	51,5%	30,4%
		Adjusted Residual	-3,3	**3,3**	
Total		Count	59	33	92
		% within Anual Revenue	64,1%	35,9%	100,0%

Companies' Size	N		Integration with Contract Management - Future		Total
			Not relevant	Future	
Over 10.000 Million Euros	28	% within Integration Cont Mngt	15,8%	54,3%	30,4%
		Adjusted Residual	-3,9	**3,9**	
Total		Count	57	35	92
		% within Anual Revenue	62,0%	38,0%	100,0%

Table 4-21 e-Catalogue Functionalities / Very Large Enterprises Perspective

Nonetheless, companies before investing huge amounts on new and innovative functionalities have to firstly analyze their human resources to ensure that their employees can assimilate all new technical elements without being overloaded.

The survey results show that these innovations are sought mostly by very large enterprises, which it was expected and in point of fact appropriate, as this market

segment has in average the most mature e-catalogue projects in place and consequently the most experienced personnel to carry out these innovations.

These organizations can achieve a higher technological acceptance by their employees, engaging them in an early stage of the innovative process, i.e. informing, training and persuading them about the benefits of the system to their daily work.

A change management program is also crucial to analyze and develop the necessary human capabilities to succeed in this task, or to decide for a later implementation of some features to avoid the overwhelming of the employees affected, thus creating the basis for a long-term supplier relationship management program.

4.4.6 e-Catalogue Providers

Electronic catalogue systems can be found in the market in two distinct ways:

- Solutions which are incorporated to a bigger system, e.g. SRM, ERP and it is acquired together with those solutions;
- And stand-alone applications which are specialized on this function and are offered by best-of-breed providers.

The survey has investigated the opinion of large German companies regarding the advantages of an e-catalogue platform provided by a best-of-breed provider against the solutions offered by a no e-catalogue specialist.

The study found that 85% of the participants perceive some benefits to apply a "specialized" solution from a best-of-breed- provider, instead to use an e-catalogue platform of a large software, see figure 4.15.
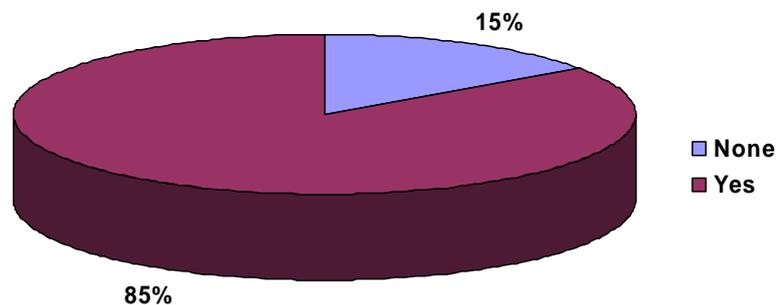
Figure 4.15 e-Catalogue Provider Benefit Perception

Having a look at the reasons for companies to select an e-catalogue specialist provider, the study came out with being the specialized e-catalogue skills the primary

reason for a German organization to deploy a specialist vendor, with 50% of the participants seeing it as important, see the figure 4.16.

This finding suggests that enterprises are seeking specialized suppliers as source of expertise that are hard to develop internally, thus e-catalogue providers must increase their level of services and capabilities to provide organizations with the knowhow needed to succeed in their e-catalogue initiatives through training and on-demand knowledge transfer.
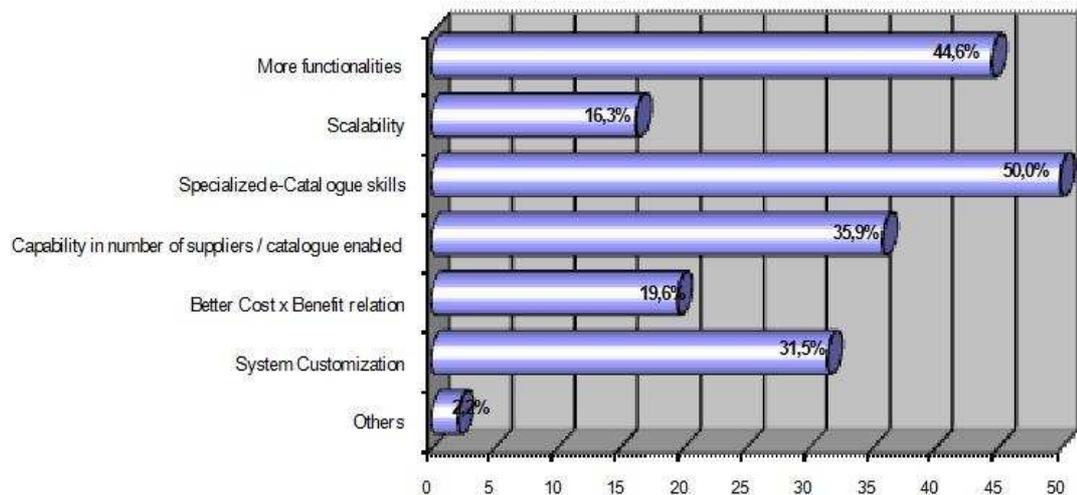
Figure 4.16 e-Catalogue Provider Benefits

Nonetheless, besides the fact that smaller enterprises often lack e-procurement expertise in house, the residual analysis has suggested that companies with an annual turnover smaller than 250 million Euros do not perceive the specialized e-catalogue capabilities offered by those vendors as a key benefit, see table 4.22.

On the other hand, the study points out that very large enterprises have an adjusted residue of 1,8 on this item, confirming the importance of external e-catalogue skills to support their projects.

The reason for this apparently ambiguous result may be from one side the complexity of the e-catalogue projects performed by very large enterprises, and from the other side, the naive judgment from the part of smaller enterprises, which believe that e-catalogue processes require a limited set of IT and content management knowledge.

Companies' Size	N		Specialized e-Catalogue skills		Total
			No	Yes	
Less than 50 Million Euros	3	% within e-Catalogue skills	6,5%	0,0%	3,3%
		Adjusted Residual	**1,8**	-1,8	
51-250 Million Euros	20	% within e-Catalogue skills	34,8%	8,7%	21,7%
		Adjusted Residual	**3,0**	-3,0	
Over 10.000 Million Euros	28	% within e-Catalogue skills	21,7%	39,1%	30,4%
		Adjusted Residual	-1,8	**1,8**	
Total		Count Companies' Size	46	46	92
		% within (a)	50,0%	50,0%	100,0%

Table 4-22 Specialized e-Catalogue Skills

The study found also that the second most important aspect is the greater number of functionalities available (44,6%), followed by the system capability concerning the number of enabled suppliers and e-catalogue (35,9%).

Taking into account that the majority of the organizations which deployed specialized systems are very large enterprises, it is understandable their necessity to move into new solutions, which are able to support more complex business environments as well as greater business relationships volume.

The two issues led to the necessity to customize the system to different business and process models, which is the fourth factor that respondents has indicated to choose such a system.

However, the Fisher's exact test did not give enough instruments to confirm these assumptions. Instead, the test brought up the relationship between those variables and the maturity of the e-catalogue project.

Looking at these results and the findings of the residual analysis, it became clear that the necessity to have a system with a higher supplier and e-catalogue capability grows according to the maturity of the project, see table 4.23.

According also to the residual analysis, companies that have started their e-catalogue programs no longer than three years seem to require the specialized vendor's capability to customize their solutions according to company's processes, due to the fact that probably those organizations are still involved in a considerable amount of customization projects.

Project Maturity	N		Capability in number of enabled suppliers / e-catalogue		Total
			No	Yes	
Longer than 3 years	42	% within Capability	32,2%	69,7%	45,7%
		Adjusted Residual	-3,5	**3,5**	
Plan to deploy within 12 months	17	% within Capability	25,4%	6,1%	18,5%
		Adjusted Residual	**2,3**	-2,3	
No plans to deploy	8	% within Capability	11,9%	3,0%	8,7%
		Adjusted Residual	**1,4**	-1,4	
Total		Count	59	33	92
		% within Project Maturity	64,1%	35,9%	100%

Project Maturity	N		System Customization		Total
			No	Yes	
Between 1 and 3 years	17	% within Customization	14,3%	27,6%	18,5%
		Adjusted Residual	-1,5	1,5	
Less than one year	8	% within Customization	4,8%	17,2%	8,7%
		Adjusted Residual	-2,0	2,0	
No plans to deploy	8	% within Customization	12,7%	0,0%	8,7%
		Adjusted Residual	2,0	-2,0	
Total		Count	63	29	92
		% within Project Maturity	68,5%	31,5%	100,0%

Table 4-23 e-Catalogue Providers Benefits according to Company's Maturity

The cost-benefit relationship (19,6%) and the system scalability (16,3%) appear to have little importance to the respondents of the survey. One interpretation for this fact may be that companies which decide for these systems are typically enhancing their projects, moving from legacy / standard applications to more sophisticated ones, and as a result they are more aware of their high performance as they are with their acquisition costs.

4.4.7 Multilingual Catalogues

Global sourcing is a new trend for companies that are willing to reduce material costs and increase profits. Therefore, enterprises are deploying internet applications to support this process.

Nonetheless, throughout the application of internet to support their international business transactions, organizations have been facing different challenges that threaten

their global sourcing strategies, being multilingualism one of the main matters to be addressed by those enterprises.

Multilingualism is for a long time a concern among European companies, especially while exchanging product and services information across their countries borders, organizations have the problem of handling different languages.

Nowadays, the majority of the respondents (85%) apply German to exchange product information, followed by English (48,9%), French (19,6%), Spanish (12%), Italian (7,6) and Chinese (2,2%), see figure 4.17.
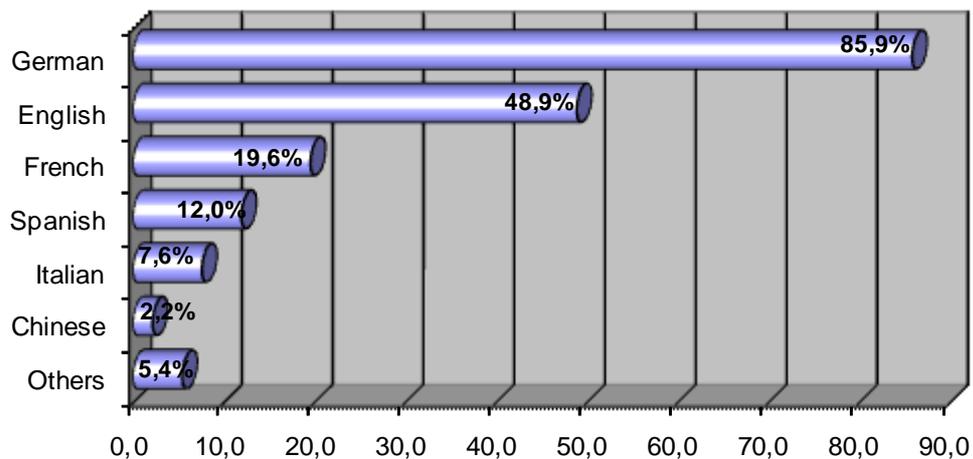
Figure 4.17 e-Catalogue Languages

Indeed, it is expected that in many cases companies apply more than one language to communicate with their buyers and suppliers. In this case, companies should be able to apply convenient solutions to support the product information management and exchange process in different languages.

Nevertheless, the majority of the organizations are incurring in high costs to prepare and store their multilingual content due to the costly manual process that they have to proceed and the necessity to store redundant data in their databases.

The primary reason for it is that current e-catalogue standards generally do not support properly more than one language in a single e-catalogue and the multilingual mapping techniques are still not adequate to solve this matter.

Yet some format standards, e.g. BMEcat, have noticed this pitfall and are including new features to facilitate the management of more than one language in a single electronic catalogue.

The developments in this area require a stronger coordination between the standard organizations with the purpose of harmonizing their new standard releases with the goal

of effectively support multilingual content in different standard object levels, e.g. data type, vocabulary, documents, etc.

4.4.8 e-Catalogue Format

Nowadays, the majority of the electronic catalogue format standards are based on XML language. Each of these standards tries to build a structure to support different processes, documents and data types, and their capabilities can be appraised by their potential to accomplish the requirements on content model as well as on the information exchange process between companies.

The e-catalogue format plays a key role during the data exchange process between organizations as it defines the structure of the e-catalogue document with regard to the composition of the data type, the data element as well as the encoding of the data values, the most known format structures are based on CVS, EDI and XML languages [HaNe01].

The concept behind an e-commerce format standard is not new. EDI was the first attempt to standardize business documents and data, but nowadays most e-business standard organizations apply XML language to develop their commercial format standards.

Most current format standards have been developed by non-profit organizations created by volunteers from the industry to facilitate the engagement of those organizations in the electronic business with their trading partners.

When selecting a standard format, the main question that an organization should formulate is: How well-established and innovative is a standard? And, how well a standard handle the current and future e-business requirements of an organization?

The reputation of a standard and their respective organization can be easily investigated via a literature review and their market-share, in the organization's country as well as abroad. However, the extension in which a standard can support complex processes and products is a more delicate issue to be evaluated.

In today's business environment there are some major issues that companies have to carefully analyze while selecting a standard:

- Content model, e.g. product, price, tax, etc.;
- Information exchange model;
- Multi-vendor relationship;
- Multilingualism;

- Products and services relationship;
- Etc.

In fact, the survey did not intent to perform an extensive analysis concerning the format standards. The goal was essentially to identify the most popular standards adopted by large German enterprises.
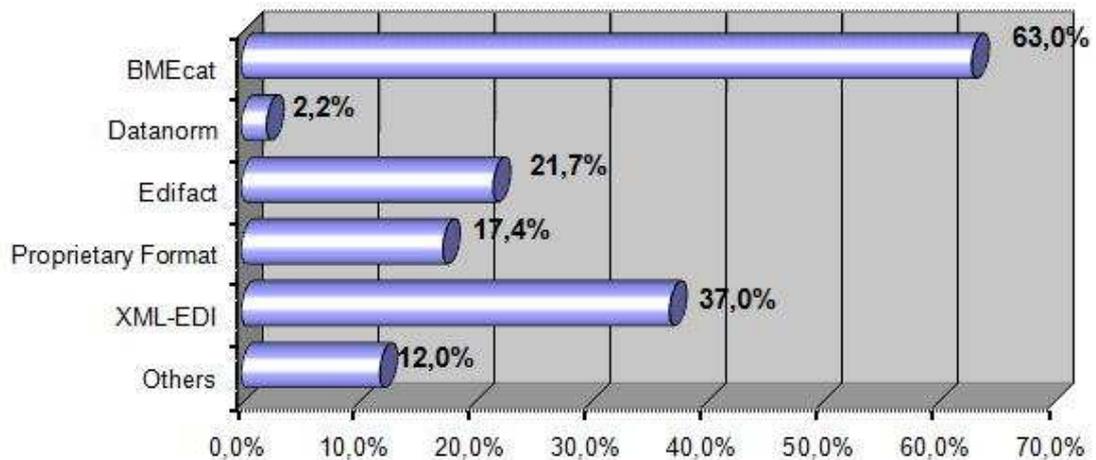
Figure 4.18 e-Catalogue Formats

Looking at the results, it was not surprising that the majority of the participants (63%) apply BMEcat to support their e-catalogue processes, considering that BMEcat is sponsored by the German purchasing council (BME), which is widely supported by the German industry, see figure 4.18.

Besides BMEcat, XML-EDI (37%) is the most popular standard, followed by Edifact (21,7%) and Datanorm with just 2% of the participants applying it.

Another interesting finding was that a relative high number of the participants are still employing proprietary formats (17,4%), e.g. excel, to support their e-catalogue routines, although the well-know advantages to deploy an electronic catalogue standard format.

4.4.9 e-Catalogue Classification System

In order to perform inter-companies product and service information exchange electronically, organizations have to classify their products using a clear code system that can be easily understood by their business partners. The employment of standard classification systems facilitates this process, while reducing the cost of maintaining a proprietary classification code.

An adequate classification model allows companies to group similar products into a single category, expediting the search and selection process by end-users. On the other

hand, companies can plan and control their commodity strategy effortlessly, while increasing their spend visibility.

The research looked at the major classification codes in the German market to provide a better overview of their deployment level in companies. As shown in figure 4.19, the most applied classification system by far in Germany is eCl@ss (58,7%), which is supported by a group of large German enterprises and the federal ministry of economics and technology (BMWI).

The UNSPSC code is a global classification standard sponsored by the United Nations, which is the most well-known format in the world, and in the survey, it has ranked as the second most applied standard behind eCl@ss in the German market with 18% of the respondents deploying it.
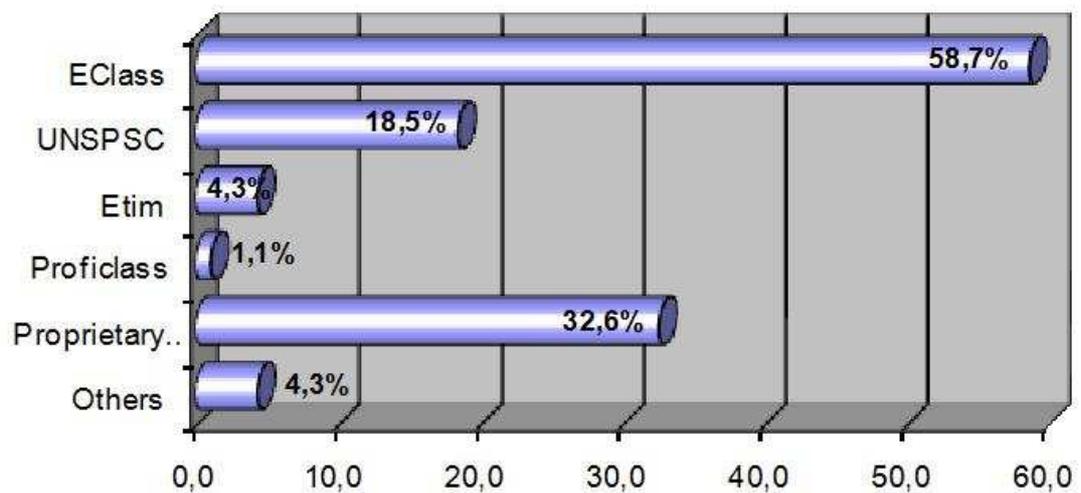
Figure 4.19 e-Catalogue Classification System

When considering also the proprietary classification systems, the survey has shown that this kind of classification code is, in fact, the second most deployed by the participants accounting for 32,6% of the responses, despite their adoption and expansion problems, i.e. it is applied just by a single organization, it requires high internal taxonomy expertise and it incurs in higher maintenance costs, etc.

Researches argue that companies which are truly determinate to act internationally and take full advantage of the benefits of their e-business infrastructure should migrate to recognized classification standards, which are accepted and understood by a greater number of enterprises worldwide and embody a more appropriate structure to support material management as well as spend analysis activities.

4.5 Recommendations and Future Perspectives

The research findings state briefly a correlation between the success of an indirect material supplier relationship management program and an organization approach to process standardization, investment in complementary solutions and their respective integration with an e-catalogue platform.

Enterprises have finally realized the truly advantages that an SRM program can provide to their purchase process performance. The following section gives a short overview of the research findings and their technical implications, which is further discussed in the next chapters of the work.

4.5.1 Survey Briefing

The survey results show that the SRM solutions regarding the management of indirect materials and services play an important role in large German organizations strategy, with most companies applying some sort of information system to support their purchase processes.

Nonetheless, as previous studies have indicated, different SRM solutions have different maturity grades in what is concerning their technological functionalities as well as their implementation stage in companies.

The closer analysis of the research results have revealed some key trends in the area of indirect material SRM solutions and practices, while reinforcing the idea that companies will continue to increase their investment on these technologies with the purpose of improving and expanding their purchasing processes supported electronically.

Organizations from different sectors and sizes have realized that SRM solutions are more related to long-term strategic issues as they are to short-term cost reduction reasons, and although the obstacles have remained basically the same, companies have started to face new matters, e.g. management of complex material groups, integration problems, etc.

The most deployed and mature systems are the ERP, e-procurement and e-catalogue solutions, which have overcome already the deployment grade of EDI technology in companies.

Even though, it is in the sourcing technologies, e.g. spend analysis, supplier selection / evaluation, contract management, etc., that the future wave of developments and implementation projects will take place.

A controversial discernment was about the current level of companies' spend supported electronically, which has suggested that while enterprises have invested heavily in information systems in the last years, they are still struggling to increase the adoption level of these solutions among their suppliers and internal users.

Based on these findings, the study proposes the following recommendations to improve the current SRM practices in the German market:

- Organizations that are seeking to improve their purchasing processes should focus on long-run strategic objectives, which may be achieved easily when companies invest on the development of standard integrated processes supported by integrated SRM modules;
- Managers should introduce affected employees and suppliers in the beginning of the SRM project with the aim of increasing the acceptance level of the new processes and systems, which can be facilitated by the introduction of change management programs and the deployment of user friendly tools;
- The continuous IT landscape implementation should progress smoothly with the intention of not overwhelming companies' stakeholders with new information, processes and different systems functionalities;
- Companies which have already mature SRM projects in place should explore further supplier relationship management areas, implementing and integrating new functionalities to their systems' landscape, while expanding their e-business projects to cover bigger purchase cycles, e.g. sourcing-to-payment process;
- Enterprises should analyze prior to their decision to implement new SRM applications, the benefits and pitfalls of applying third part providers' solutions and services in their programs, which can reduce the cost of ownership and increase systems' flexibility.

4.5.2 Research Technical Proposition

The survey was aimed to respond some open questions in the field of indirect material supplier relationship management and to determine some trends that could support further IT developments in this important business area.

The technological overview together with the practical insight given by the research have provided the essential subside that the author needed to decide for the development of a number of new functionalities to aggregate value to current SRM technologies.

Based on the information that more than 70% of the large German enterprises adopt an e-catalogue platform to support their indirect material business processes, and around 45% of the total survey population has a mature e-catalogue project.

The author has decided to apply this technology and expand it functionalities according to the research results to provide a user-friendly environment for companies to support their sourcing-to-order process in a cost effective way.

The work contributes to the current development in the area, adding to this research field an innovative framework of an e-catalogue based supplier relationship management system to manage and control electronically the indirect materials source-to-order process, i.e. sourcing, acquisition; data consolidation, harmonisation, enrichment and controlling, in a unique information system landscape, which provides also a specialized and integrated spend intelligence solution.

The next chapters deal with the conceptualization of an e-catalogue supplier relationship management framework, which will support buyers, commodity managers and organisation's executives in their indirect goods purchasing processes, see figure 4.20 to visualize the framework.
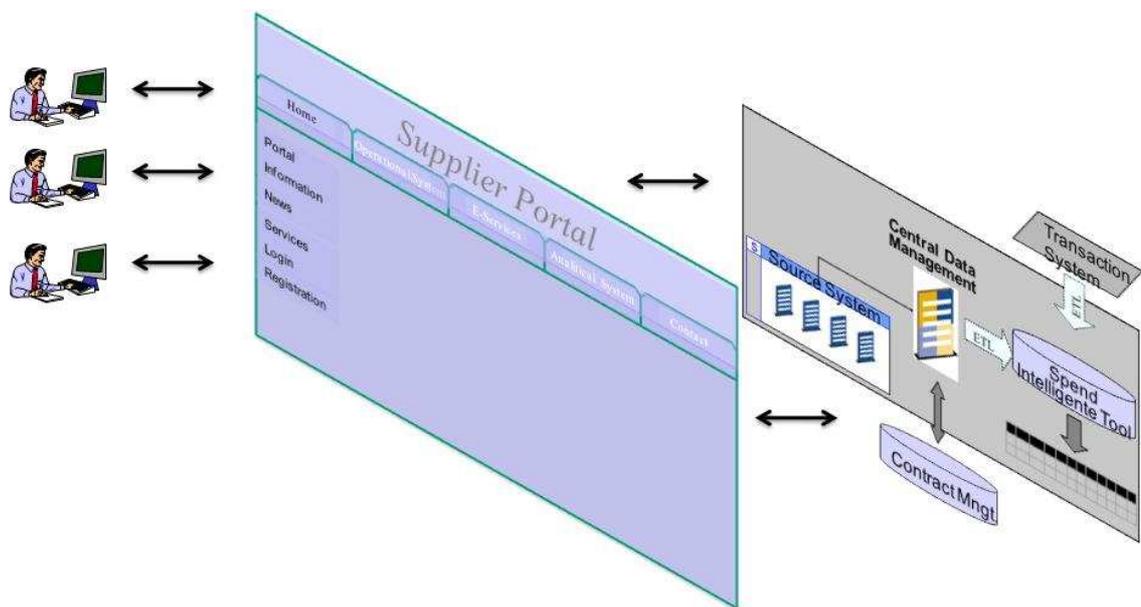
Figure 4.20 e-Catalogue Supplier Relationship Management Framework

After a detailed analysis of current e-catalogue functionalities and the range of information that those systems manage, an e-catalogue architecture has been designed to expand the scope of this system towards diverse supplier relationship management functionalities, which companies see as important, according to the empirical research, i.e. central data management, spend intelligence and e-sourcing.

The framework conceptualization was based on the electronic catalogue platform from the POET AG, i.e. POET X-Solutions, which has been analyzed during the content supply chain management project, q.v. www.poet.de.

The proposal is to apply the e-catalogue solution from the beginning of the sourcing process, when purchasing departments specify their needs and start to source for and suppliers via the application of information technology, e.g. e-sourcing and supplier collaboration, until the ordering process, including spend intelligence and master data management functionalities to create the complete solution, which gives buyers a unique environment to carry out their SRM processes electronically.

5 Central Data Management

The following chapter describes the central data management concept. Therefore, the chapter first introduces a short discussion about master data management (section 5.1). Then the central master data management concept is portrayed, including its architecture, data model, data enrichment and classification processes (section 5.2). In the next step, the data quality management approach is discussed to complete the solution design and its managerial principals in an organization (section 5.3).

5.1 Master Data

Many organizations that apply information technology to manage their SRM processes do not have an appropriate data quality control. Hence, they cumulate a huge amount of content that has to be cleansed and consolidated before being used in global corporate operations and spend analysis activities.

The IT strategy to expand the information system landscape along the years by the integration of additional modules and systems from different providers has led to a situation in which each system has its own content and its own format, creating numerous island of information within a company.

This has increased drastically the transaction systems integration costs as well as the costs to implement a spend analysis program in companies, i.e. in data-mining projects 80% of the project resources are employed in data quality issues [NeKn05, 97].

In the purchasing area, poor data quality drives to many disadvantages, e.g. during the buying process, while end-customers are searching for their desired products, an incomplete or miss-leading information about a product can cause inadequate or wrong search results.

This leads to higher operational costs through the utilisation of the purchasing department to support end-customers, or even worst, this may conduct to the decrease of the system's acceptance and to maverick buying.

On the other hand, the maintenance of incomplete and incorrect information in operational systems database makes almost impossible the accurate analysis of spend data, and its rationalisation process is a costly and often highly manual task that takes a long time to be completed. Besides that the rationalisation process often does not guarantee the future content quality of enterprise's master data.

Master data is applied to describe business objects, e.g. suppliers, products, etc., and create a unique identification of those objects by the use of identification codes

[HeKa07]. They form the basis for business processes. In the context of business data processing, master data denote a company's essential basic data which remain unchanged over a relative long period of time [Rose87].

In order to increase consistency and improve the data quality, it is recommended the appropriate storage of enterprise's master data in a central database, which should be deeply integrated with other transaction as well as analytical systems.

5.2 Central Data Management Concept

The cultivation of a central master data strategy is meaningful to all company's processes. In especial in the supplier relationship management area that the global sourcing and the core-competency strategies have leaded to a situation in which the required information is stored in numerous databases, which may deploy different data structures and formats.

The next sections introduce the concept of applying an e-catalogue platform as the central organization's repository of indirect material's SRM master data. In order to do that, the following sections describe how an e-catalogue system can be deployed in this new application scenario, at the same time it explains the main functionalities and processes supported by this new system approach.

5.2.1 Central Data Management Architecture

Nowadays, most large organisations have a supplier relationship management environment in which the same data are stored in different transactional systems which execute either the same kind or complementary procedures.

This scenario implies a much higher cost of ownership to companies, who are starting to seek new ways to reduce the data inconsistency and increase synergy within their information system landscape.

Therefore, there is the necessity to deploy a central data management (CDM) system to support the data harmonisation, consolidation and management processes. This component should be employed as the major database for company's purchasing information, ensuring data consistency, accessibility and correctness to users.

A database management system (DBMS) is a software that manages databases, which is a structured collection of data that is stored in a computer system. DBMSs may apply any of a variety of database models, such as the network model or the relational model, which is currently the most common database model applied in companies [Wiki09].

A distributed database management system is a DBMS which is a collection of centralized DBMSs, a data communication network connecting the centralized DBMSs, and a software component, i.e. middleware, controlling the distribution and replication of data items [Hvas96].

In order to support distributed services processes, firstly the addressed applications have to be integrated. This is an essential pre-requisite for exchanging master data between different information systems.

For the purpose of creating consistent master data among different data bases, it was possible to identify four architecture approaches in the practices: Central Master Data System, Leading System, Master Data Harmonisation via Standards, Repository System [LoLG04].

This research applies a hybrid of the Leading System and the Repository System architecture approaches to solve the master data quality matter in company's SRM activities, see figure 5.1.

The e-catalogue platform was selected and expanded to act as the leading system of the framework. Therefore, there was the necessity to implement additional integration mechanisms to enable the exchange of data in different formats and standards, e.g. XML, Excel, CSV, with other relevant systems, e.g. ERP, Business Intelligence, e-Procurement, etc.
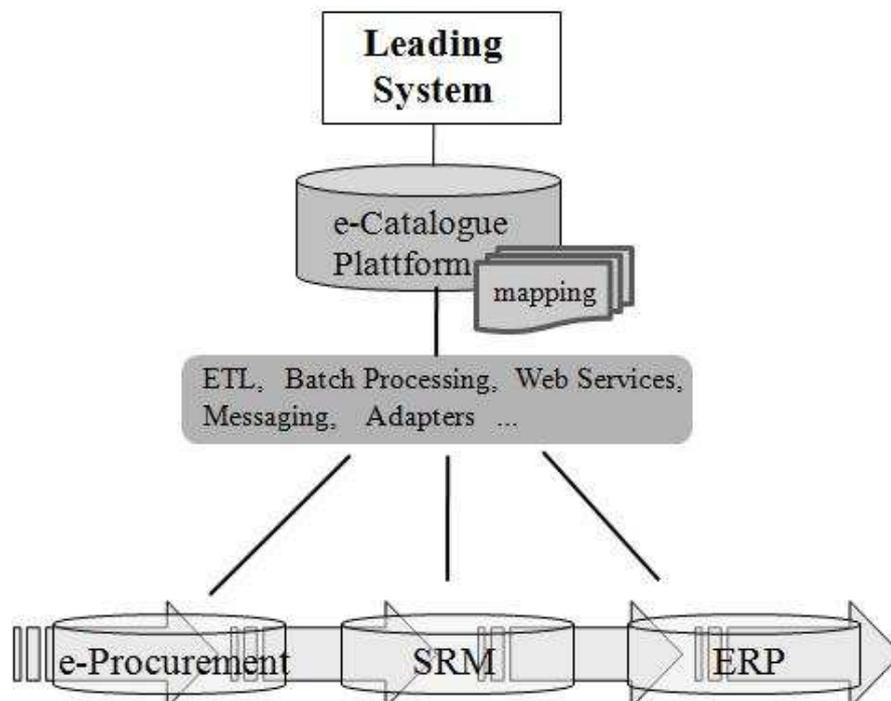
Figure 5.1 Central Data Management Architecture

The creation of the master datasets is done both in the leading system and in the receiving systems of the framework, though the data transfer is limited to the defined central data management data model within the e-catalogue platform, which specifies the master data attributes of the architecture.

The data storage is central, but the framework allows the maintenance of duplicated data in different operational systems, in which additional attributes can be created and locally maintained to support specific business processes.

To make possible the distribution process, it is necessary the design and implementation of mapping tables in the e-catalogue solution to enable the diverse logical relationships between the central data management solution and the different applications of the framework.

The leading system provides a global key that is directly related to all primary keys of the other applications, this mechanism assures the correct exchange of information between the diverse systems.

In addition, the format in which the data is imported or exported must be defined for each source and target system, so that the electronic catalogue platform can be configured to transfer and receive data from a number of different solutions, either automatically or manually, to maintain the data consistency along different systems, in case of modifications in the datasets.

The table 5.1 provides a short resume of the described architecture:

	Leading System	Receiving Systems
Initial Data Creation	Global key and defined master data attributes	Defined master data and additional attributes
Data Maintenance	Global key and defined master data attributes	Additional attributes; data maintenance may be performed decentralized
Data Storage	Global key and defined master data attributes	Selected attributes of the leading system and additional attributes
Master Data Distribution	Defined master data	Defined master data
Mapping	Mapping takes place in the leading system	-
Primary Key	Global key and an additional primary key for each application	-
Availability of Master Data in the Receiving Systems	-	with a daily (batch) or in real time (synchronous exchange - Manual)

Table 5-1 Architecture Characteristics adopted from [LoLG04]

The approach adopted in this work has as its main advantages its relative simplicity, high performance and flexibility in the creation and maintenance of master datasets in multiple systems, which is coordinated by a leading application that manages the exchange of the defined master data in the framework.

This system independency cannot be achieved without the necessity to create dedicated mappings to each new system integrated in the architecture, what from one side it affords the high flexibility of the model and from another side it leads to data redundancy in the different solutions.

The next sections describe the enhancements required in the e-catalogue platform to perform the content integration, consolidation and harmonisation processes. Nonetheless, the current electronic catalogue functionalities are not addressed in this work due to the fact that these capabilities, e.g. authoring, versioning, object and data relationships, security, privacy, etc., are already well documented and in use in different e-catalogue projects.

Therefore, the focus of the research is primarily on the conceptualization of a central data management approach to consolidate, harmonise and manage organizations' SRM master data.

5.2.2 Data Model

The key challenge to develop a central data management system in a supplier relationship management scenario is the consolidation and future use of redundant supplier and product master data from different databases without modifying business units and department applications [HeKa07].

To solve this problem, the first thing that has to be defined is the sort of master data that would be supported by the central data management platform with the purpose of keeping just the essential data in the repository without impacting the overall process performance or creating a database full of irrelevant data.

The data that were not classified as a master data should be further maintained in the original transaction systems to assist the required processes, while the master data is step-by-step homogenised and migrated until the entire framework has only a "single source of truth", the e-catalogue platform.

In a SRM scenario four business objects play an important role: Organization, Supplier, Systems' user and Product/Service. These objects must be stored in the central repository and their data model must describe the object details to attend along other matters two key functions:

- The creation of a unique object identification;
- The basis to conduct consolidation and harmonisation processes.

The attributes of each object must represent the essential information to unambiguously identify this business object, without populating the database with information that will not be used.

Therefore, a careful analysis must be performed to ensure the representation of just the essential information in the data model, at the same time that it should guarantee and not limit future demands on the system.

The discussion in the last sub-section has demonstrated that in the central data management database should be stored just the datasets which have impact in all or most SRM applications in a company, leaving the specific content to be managed outside of the central data management platform.

In this way, it must be identified the datasets, which are common to all company's information systems and their relations between each other. The picture below shows that different SRM modules have a range of datasets, which can be classified according to their deployment or not in other different modules, i.e. common to all SRM

applications (a), common in part of the SRM modules (b), and specific information of a single solution (c), see figure 5.2.
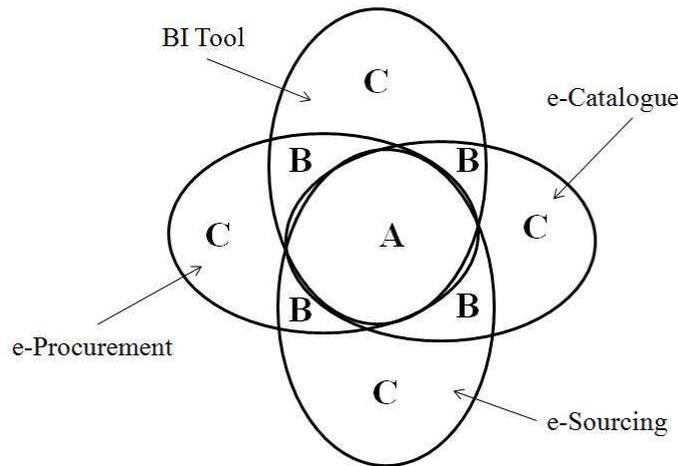
Figure 5.2 SRM Data Relationship

The picture can be used to describe and limit the sub-datasets of the SRM applications, which can constitute the basis for a list containing the complete datasets of a company systems' landscape and their relations between each other, for example an e-procurement data can be also an e-sourcing relevant data, although it is not significant to an e-catalogue solution.

The data model presented in this chapter has as its main goal to build a starting point for a concrete data model in the real world, which must take into account the company's system landscape and the application scenario in which the data model will be deployed.

The data structure supports the features and process design of the framework regarding the data management tasks. And it is described in this work through the utilization of tables to support a simple understanding of the model by business users.

Product/Service

The information concerning product and service is an essential part of any supplier relationship management framework, thus their effective maintenance is a crucial part of a data model.

The goal of the product data model is to create a product description that allows the unambiguous identification of a product or service in the system. Therefore, it is required the adoption of product identification aspects such as an identification code to assure the product search via a unique identifier.

Other relevant aspect is the creation of reference instruments to construct relationship types between a product and other entities in the data model as well as in the system

framework. Depending on the relationship category, different functions have to be developed to facilitate the systems' tasks and ensure the relationship transparency for administrators and users inside the solution.

The product data model has been structured as follows, see table 5.2:

Product Attribute	Data Type	Mandatory	Comment / Example
Global_Product_Key	Alphanumeric	Yes	Unambiguous / Unique identifier
System_Product_id	Alphanumeric	Yes	Unambiguous ID in the local system
Unique identifiers	Code	No	EAN
Short Description	Text	Yes	Product description with less than 40 characters
Long Description	Text	No	Product description containing between 41 and 200 characters
Free Search Keys	Text	No	a group of product related terms, e.g. Notebook, laptop
Standard Classification System	Code	No	eCl@ss
Organization's Classification System	Code	Yes	Proprietary classification system or a standard classification system
Unit of Measure	Code	Yes	Piece, Kilogram
Image File	Multimedia	No	Picture, Film
Manufacture	Text	No	Producer's name
Supplier	Reference	Yes	relationship to a product's supplier
Supplier Product Number	Number	No	Product number at the supplier side
Organization	Reference	Yes	Relationship to a Business Unit / System
Product Reference	Reference	No	complement, alternative, new model

Table 5-2 Product Data Model

Supplier

The supplier data has to provide also the requisite information to identify each of the enterprises' suppliers as well as the information indispensable to support and control the supplier management process, see table 5.3.

A significant information that should be included in the data model is the DUNS number or any other identification code to recognize a supplier outside company's boarders and / or light up the business relations of a supplier with potential subsidiaries, associate companies and so forth.

Supplier Attribute	Data Type	Mandatory	Comment / Example
Global_Supplier_Key	Alphanumeric	Yes	Unambiguous / Unique identifier
System_Supplier_id	Alphanumeric	Yes	Unambiguous ID in the local system
Supplier name	Text	Yes	Legal form of the supplier name
Address	Alphanumeric	Yes	Street, number, postcode, city, country, etc.
Bank details	Alphanumeric	Yes	Bank name, account, connection, etc.
Supplier system's responsible person	Text	Yes	Responsible person data, i.e. name, gender, nationality
Contact data	Alphanumeric	Yes	e-mail, telephone, fax, etc.
Identification number	Alphanumeric	No	Duns number or any other identification code
URL	Alphanumeric	No	Web-page
Language	Text	Yes	Language to be used while communicating with a supplier
Currency	Text	Yes	Transaction currency
Buying organization	Reference	Yes	Relationship to company's business units
Products	Reference	Yes	Relationship to the suppliers' products

Table 5-3 Supplier Data Model

Organization

The organization is the main entity of the data model and to which most entities have a relationship with. It is characterized in the data model according to its representation in the real world, illustrating each legal entity of a buying organization and their relationship with the other business units and organizations entities, see table 5.4.

Organization Attribute	Data Type	Mandatory	Comment / Example
Global_Organizations_Key	Alphanumeric	Yes	Unambiguous / Unique identifier
System_Business unit_id	Alphanumeric	Yes	Unambiguous ID in the local system
Organization name	Text	Yes	Legal form of the business unit
Address	Alphanumeric	Yes	Street, number, postcode, city, country, etc.
Systems' users	Text	Yes	Responsible person data, i.e. name, gender, nationality
Contact data for each system	Alphanumeric	Yes	e-mail, telephone, fax, etc
Organization Hierarchy	Reference	No	Position of the business unit in the organization
URL	Alphanumeric	No	Web-page
Language	Text	Yes	Language adopted
Currency	Text	Yes	Transaction currency
Suppliers	Reference	Yes	Relationship to suppliers
Products	Reference	Yes	Relationship to products

Table 5-4 Organization Data Model

System's User

The system's user data management in a supplier relationship management environment encompasses a number of different functions and relationships that must be managed applying an access and use rights approach.

The modules described in this work show some of the numerous tasks that a user may perform, thus with the aim of reducing the administration tasks redundancy and increasing the integration level between systems and functions, the user data model is limited to the minimum information necessary to execute organization's SRM processes, see table 5.5.

System's User Attribute	Data Type	Mandatory	Comment / Example
Global_User_Key	Alphanumeric	Yes	Unambiguous / Unique identifier
System_Users_id	Alphanumeric	Yes	Unambiguous ID in the local system
Surname	Text	Yes	Surname
First name	Text	Yes	First name
Login	Alphanumeric	Yes	Login
Password	Alphanumeric	Yes	Password
Signature, Certificate	Alphanumeric	Yes	Signature, Certificate
Rights	Reference	Yes	Rights in the systems
Company	Reference	Yes	Working organization
Company's department / function	Reference	Yes	Function in the organization
Contact data	Alphanumeric	Yes	e-mail, telephone, fax, etc.
Deliver address	Alphanumeric	No	Street, number, postcode, city, country, etc.
Substitute person	Text	No	Substitute person in case of absence

Table 5-5 System user's Data Model

The connections between the objects is also represented in the e-catalogue platform logic, however the transaction relations and other functions specific information are not described and stored in the central database, instead this information is allocated in the search engine database as well as at each single operational system.

Based on the data model all import, export, consolidation and harmonisation processes were implemented. These processes take place throughout the integration of the organizations' transactional systems and the e-catalogue platform, as described in the next sections.

5.2.2 Data Enrichment

The first step to adopt a master data management strategy is the cleansing of organisation's content, in which missing mandatory fields are detected and filled with appropriate values, doublets are identified and consolidated and wrong entries are eliminated.

The e-catalogue system deploys a proactive data control and improvement approach, which is done from one side during the approval process of the e-catalogue by suppliers, which avoid poor data to be imported and stored in the system at the first instance. And in the case of already available content, the e-catalogue platform cleanses the data based on dedicated rules and the application of adapters.

The solution offers validation and cleansing adopters to support to some extent the automatic cleansing and validation processes. Each adapter proceeds pre-defined rules to check and improve specific properties related to the data quality.

These validation and cleansing rules comply with the formalities required to keep control of semantic and syntax subjects, while imposing some constraints on the data structure.

The base of the rule validation procedure that has been used may be named as follows: (1) take the base which needs to be validated as a theory, (2) try to prove the theory by performing deductions based on the resolution principle until no new deduction can be inferred, (3) use the deduced theory as the base to construct a theorem [PiSt93, 164-173].

In order to design the basic validation adopters, it was decided first which content properties had to be addressed to avoid potential data inconsistency and incorrectness in the database. This information was used to construct the algorithms, which are applied to improve data quality during the import process.

In case the validation rules are not respected, the system will localize and report the source of data inconsistence and will either not allow the data import into the system until these errors are manually corrected or will impose an automatic procedure to improve the data quality.

Here, it is listed some standard validation rules defined in the solution to guarantee the data quality in the framework:

- Presence of key attributes;
- Use of pre-defined unit of measure and currency in a specific format, e.g. ISO;
- Application of a set of constraints to the object description, e.g. minimum/maximum characters quantity;
- Logical coherence between different product attributes, e.g. order unit/minimum order quantity;
- Specific classification systems description, e.g. eClass in the 4th level.

The data enrichment process was designed seeking to create a data stand with high quality standards to serve as the master data basis for all indirect goods purchasing activities in an organisation.

5.2.3 Data Consolidation and Harmonization Process

In case the content is already stored in other transactional systems, the data have to go first through an extraction process to pull the data from these systems out, improve the data quality and merge the data sets, before they can be used as a master data.

It has to be noted thou that a central data management project is normally implemented in a phased approach, starting with a limited number of applications integration, which should provide the highest return on investment to underpin the project business value, towards several rollout phases until the organization's goal is achieved.

5.2.3.1 Systems Integration

Before the consolidation and harmonisation processes can take place, first the receiving systems must be integrated with the e-catalogue platform through the deployment of a system interface in which all relevant parameters are maintained, e.g. name, type, tables, keys, etc.

Once the systems are integrated, a routine must be placed in the e-catalogue platform that specifies if a system acts as a source or a target entity, and the correspondent up-date mode, e.g. automatic trigger, batch, manual, etc.

In addition, it is also required during the configuration process the information about the sort of format, e.g. XML, Excel, CSV, etc., supported by the receiving system to permit a smooth data transfer.

The table 5.6 illustrates the structure to extract/export data from/to other applications:

Function	PK	Description
S	PK	Source System ID
	PK	Company Code
		Company Name
		Business Unit
		Local Currency

Table 5-6 Exchange Data Structure

It is crucial the identification of the Source System ID and the Company Code to guarantee the uniqueness of the primary key (Primary Key / PK) of the source system in the e-catalogue platform. In addition to the code numbers, it is also relevant the information about the company's name, its business unit as well as the local currency.

In order to identify if the system acts as source (S), target (T) or both (B), the table provides this information into parentheses. The information above is not required for the existing data model, but it is important for a clear data transfer procedure.

The initial load of the datasets into the central data management system is done through the implementation of a master data integration process. The CDM data load procedure has some similarities to the usual ETL process applied to load data into data warehouses, i.e. chapter six provides a more detail description of a traditional ETL process.

However, before the master data integration process takes place, the systems that are going to become the source of master data to an organization, have to be first analyzed and characterised, i.e. data model, data quality, structure, semantic, etc.

Once the system landscape is portrayed and the master data integration effort is estimated, the ETL process can be performed to extract the data from the source systems, then to cleanse it and to transform it from the source system's data model to the central data management system's data model, and finally the content can be loaded into the central database.

The load process can apply either database replication technologies, if the profiling task has been done at a database level or otherwise, adapters to the system interfaces can be employed.

At the staging area, the extracted data is processed and cleansed, in this phase the data quality of the source system is improved through the utilization of constraints to correct errors, data inconsistency and check possible data duplication.

After the cleansing process is done, the data is transformed from the source system data model to the target system data model, and after this transformation procedure, the data can be finally loaded into the central data management system.

Nonetheless, the source systems still have a low data quality, even thou the ETL process has increased the data quality in the central data management system. Therefore, the necessity to perform a "reverse" ETL process into the source application, by which the high quality data from the central data management solution are loaded into the respective source systems.

This synchronization process may require specific cleansing and transformation procedures for each source system as the data model between the target and source systems as well as between different source systems might be different.

After the first synchronization process, the source systems have to be constantly loaded with the changes and new entries in the central master data repository. This can

be done using a batch processing mode, e.g. once per night, in an incremental fashion way, in which only previously not available information is transferred to other systems in the framework.

However, not all master data stored in a central data management system has to be synchronized with every source application. Actually, in most cases, a master data is deployed by just a few applications.

For that reason the distribution process has to be linked with the master data location according to its original system_ID in the master data model, and a batch processing should be performed only when up-dates concerning a specific application have been carried out.

Despite the fact that the central data management system is synchronized with the other systems of the framework, due to synchronization approach applied, i.e. batch and ETL process. It is possible that some updates or new entries in the central database are not available in the other applications.

Therefore, in additional to the synchronization processes described above, the source system may validate if a object is new for an organization or if it already exists, performing a matching process and returning to the source application the response as part of the application transaction.

This response can be provided in three main ways: 1) no record response, in case of no match; 2) single record for the exact match of a query; and 3) a list of potential match for a query request.

In the case, there is a match for the query request and an update has been done after the last batch process, the up-to-date information is sent to the receiving solution and the process triggers the update of the receiving system. Otherwise a message is delivered in order to ensure the data accuracy of the source application.

Nevertheless, in case the object is not available in any of the solutions, the new entry can be either created at the source system, and later exported to the central data management solution, or a request can be sent to the responsible supplier via the e-catalogue platform to entry the new product information and after the new object is created, the central data management system can update the framework.

This procedure requires the interception of a task on the application level to freeze the requested process, e.g. search for a product, until the framework responds it with the information from the central master data system.

The source application waits until the response is available and the job can be appropriately executed. Nonetheless, this routine occurs behind the application level, so the user cannot perceive that the job has been done by another application.

With the aim of supporting the just described process, this synchronization routine is developed applying a SOAP Service (Web) in XML format. The SOAP (Simple Object Access Protocol) is an http object-based protocol in which XML documents can be exchanged [Mehr07].

The SOAP specification institutes a standard message format that consists of a XML document capable of hosting RPC and document-centric data. This enables synchronous (request and response) as well as asynchronous (process driven) data exchange models [Erl04].

The transfer of data using SOAP is enabled through the implementation of a Web-Service in the source system, which communicates with the SOAP service of the e-catalogue platform. This transmission approach uses a so-called push mechanism in which the extraction process is not triggered at the electronic catalogue platform, but at the source application.

Due to the multiple transmission models deployed, it is reasonable the introduction of an approval process and an audit functionality, e.g. import/export error report, to control the data exchange process between the diverse systems.

The audit of the data transfer process is possible via the application of a monitor report that indicates which systems have loaded a specific dataset, the upload modus, e.g. manual or automatic, when, if the data set was already approved and the process responsible, see figure 5.3.

The user can apply filters to navigate and identify faster which systems have not uploaded the required data and whether the approval procedure of a system was performed. And if necessary, the system's administrator can be notified per e-mail about the analysis result or the lack of information from their systems.

Figure 5.3 Monitor Report

Moreover, an import error functionality has to be available with the objective of informing in detail the status of the data synchronization to the central data management administrator or any other power user.

This functionality may be configured to act either as an interactive feature that strives to repair some pre-defined errors automatically and actively inform the system's responsible about a status report, or as a traditional monitoring feature in which import status and errors are listed and some actions have to be taken to complete the synchronization task. An import report may contain the following information:

- The import status, e.g. not imported, import aborted, imported with errors, successfully imported;
- Import information, e.g. errors' type, field, warnings, source system, etc;
- Task time report, e.g. import duration, task's start and end time;
- Import responsible, e.g. system (automatic), responsible person (manual);
- Which datasets were imported, e.g. size, quantity, percentage of the total, etc.

The import report describes the import process and it can be applied also as a support tool to assist system's designers to add new validation rules and innovative automatic error corrections methods.

5.2.3.2 Data Consolidation and Harmonization

With the intention of maintaining the synchronization process costs as low as possible, the data has been differentiated between master and local data to facilitate the

consolidation and harmonization process in the framework, at the same time that automatic routines have been developed to support the consolidation and harmonisation process wherever is possible.

Therefore, adapters must be added in the e-catalogue platform to conduct the automatic data management. The adopter receives and transforms data in the proper format and prevents the exchange of incorrect content.

An adapter is a specialized software component used to connect heterogeneous applications. For legacy integration projects, adapters are required to bridge technology gaps that exist between incompatible platforms.

They can be applied in: legacy systems, remoting technologies, databases and data access protocols, application servers, integration brokers and numerous proprietary solutions [Erl04].

The data transformation mechanism converts data from a source format to a target format. For this purpose, mappings have to be designed during the integration of each additional system to enable the data conversion from the e-catalogue to the receiving system format and vice-versa.

First of all, it is necessary the mapping between the source systems' format and the e-catalogue platform schema, which can be consisted either of standard formats that have already well-defined mapping methods in the market or of not standard data formats, which will require a specific mapping procedure that can be constructed in the electronic catalogue platform.

In a central data management scenario, the e-catalogue platform works as the target system as well as the source system, for this reason, it is also necessary the conversion from the e-catalogue format to the other operation systems' schema.

Therefore, the conversion process is carried out applying a star mapping structure, having the e-catalogue schema deployed, at the same time, as the source, target and intermediate format. Not forgetting that the mappings should be defined in both directions, i.e. source-target, just in the case that there is a data transfer in both systems' directions.

A critical matter during the data conversion is the possibility of losing information, throughout transforming the data from different data schemas. Hence, the necessity to analyze the different data formats applied in a company's system landscape with the aim of comparing their information against the other relevant formats, i.e. e-catalogue schema, and classifying the data elements affected into mandatory, optional or missing fields.

The difference in the data structure may cause also problems during the conversion process. The main divergence that can occur between different data schemas are: difference in the data element size, different numerical and time precision, difference in unit of measure standards, etc.

The generated document should contain at least the mandatory fields of the central data management data model to ensure the data compliance and to maintain the data quality in the central data management system.

If the source system does not have the minimum attributes to guarantee the data quality in the target system, the datasets should not be imported. Nonetheless, a potential solution for this case is to add the missing content during the transformation process, applying therefore other data sources, or correct this inconsistency direct in the receiving system before the transformation process takes place.

After the data is revised, the content is distributed to proceed further with the consolidation process. The source system has therefore to inform their master data including their supplier ID and product ID to the e-catalogue administrator.

The e-catalogue administrator will create a mapping table based on this information in the e-catalogue platform to merge the systems' information with the e-catalogue data structure.

The mapping table works as an intermediate, facilitating the transformation process and reducing future customization costs, in case the data structure of any application is changed after the systems are integrated, see an example in the table 5.7

The consolidation process is further supported by the application of the doublet recognition mechanism, though a hundred percent match may not be always possible due to poor data quality and divergences in semantic.

The master ID (Global Key) is generated and managed by the application of the mapping table mechanism, which must be developed to provide number groups which can be applied in different operational system data structures. All-important is that every receiving system has its own mapping table, to fit its specific data structure and the other systems characteristics, e.g. tables' layout.
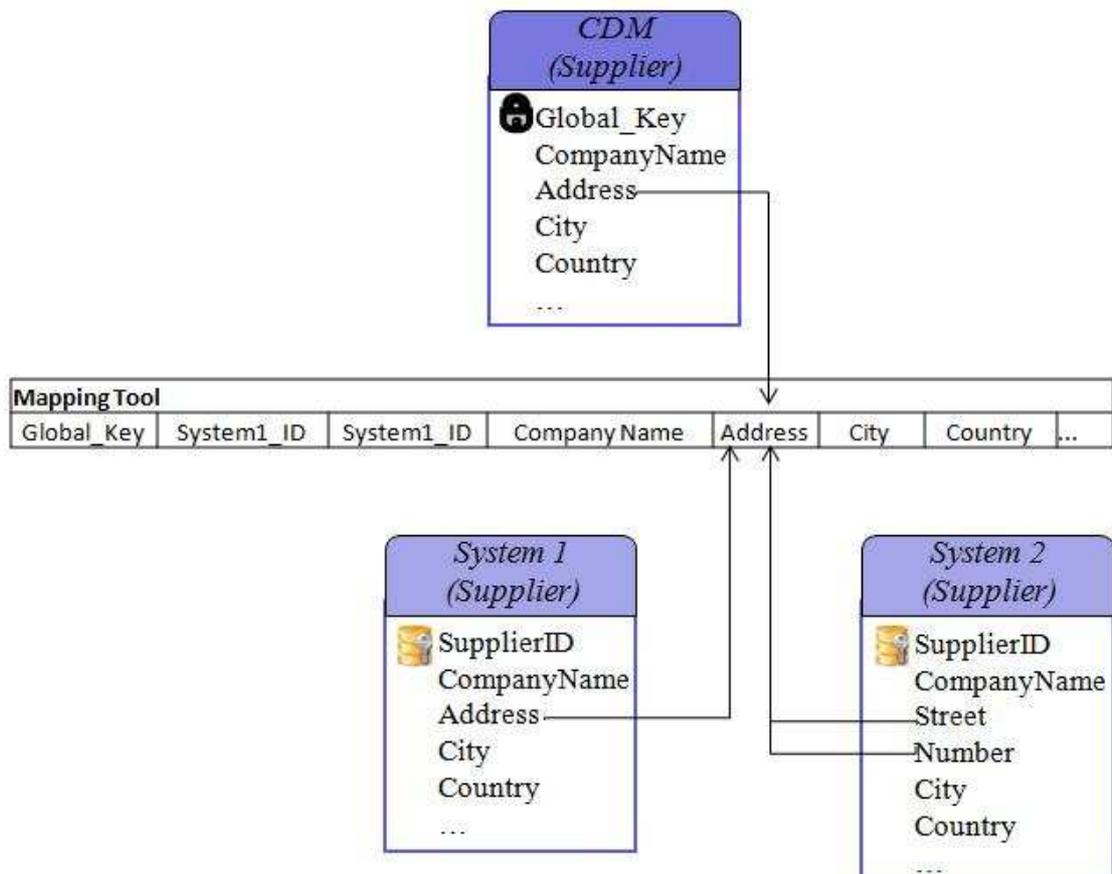
Table 5-7 Mapping Mechanism

The master ID together of the object ID at the source system enables cross-reference processes, which enables the inclusion of a detailed search query functionality, which may display the complete view of a master data, including information from diverse systems that are not part of the master data model, based on reference linkages.

A key procedure during the consolidation process is the doublet recognition and consolidation. Therefore, a probabilistic matching functionality based on deterministic logic, filters and parameter constraints, which classifies suspect duplicated items according to their attributes' matching levels and score weighting, e.g. low, medium, and high or in percentage, must be defined.

Prior to the mapping procedure, the rules as well as the attributes that are going to be applied to detected potential doublets must be defined to enable the cross matching process between the datasets, e.g. suppliers may be considered equal if their DUNS number and their legal name are the same.

Auxiliary, the algorithm should offer a semantic and synonym identification and a data entry errors capability to increase the matching performance, as the practices have demonstrated that different users characterise a product or a supplier in different ways, applying therefore diverse taxonomies and often misspelling errors occur.

For this reason it is necessary the implementation of a group identification mechanism, e.g. synonym, same supplier different name description, etc, to facilitate the consolidation and harmonization process.

This feature may be based on tables, which contain the main keywords used to identify a product or a supplier. The method increases the system capacity to integrate similar data that in other way would be barely possible to compare and identify them, see table 5.8.

Syntactic group	Data Type	Data Record
Synonym	Group_ID	"0123"
	Keyword	"Laptop", "notebook", "portable PC", "portable computer", "personal computer"

Table 5-8 Group Identification Table

Alongside the doublet recognition result, the solution starts a feature to back the doublet consolidation up. In this feature, after the duplicated entries are found, the user must decide on the action that should be executed with the doublet results.

Therefore, the corresponding attributes are compared against one another to precisely identify their matching level. Based on this comparison, the user can choose between three actions: data set merger, data set creation and data set removal. The remained data sets will be then referenced in the matching table to future harmonisation purposes.

After the consolidation process, the different data models must be reallocated according to the e-catalogue platform data structure. Hence, the operational systems data, e.g. ERP, EBP are consolidated and a unique general identification code is provided to create a corporation-wide central data ID. This process must be done with all relevant business objects, e.g. supplier, product, etc, and follows a similar consolidation process.

Many business objects are managed in different back-end systems. Nonetheless, for the indirect goods procurement in which the e-catalogue database contains the most accurate and up-to-date information, the back-end systems can use the e-catalogue platform to request this information via OCI calls or other related formats to take advantage of this up-to-date centre of information.

Moreover, with the intention of keeping the data repository up-to-date at a minimum cost, after the data consolidation process, the data maintenance should be done by companies' suppliers applying the e-catalogue platform in which suppliers can manage their data within their own operational domain.

In this process, the acquisition of product information is started through the request of product information to a potential supplier, applying therefore the self-service functionality of the e-catalogue platform.

In this case, the description is controlled first for duplicate entries and in case of a negative result, the data is sent to the potential provider, including the product global key.

The supplier receives an automatic e-mail requesting the product information and he/she can proceed with the data processing online, direct on the e-catalogue platform, or using the MS excel to enter the data required, e.g. price, delivery time, discount information, etc.

After the product information is entered in the e-catalogue template, the excel sheet must be imported into the e-catalogue platform and send back to the buying organization, which carries out the data information and business conditions quality control, and as the case may be, the new entries are approved and distributed throughout the framework.

As soon as the content is updated by the suppliers and approved by the responsible purchase personnel, the batch processing transfers the new information to the back-end systems to up-date them based on the matching tables.

Additionally to this approach, systems that do not require local data storage can connect to the central data repository via a pull mechanism (web-Service) to retrieve appropriate data on demand.

Using the designed central data global key, the systems can connect and exchange information with each other at any time and so all organisations' master data are permanently harmonised.

After the primary harmonisation process is performed, the central repository (leading system) becomes the unique system for changes in the master data entries with the purpose of maintaining the systems consistency, while establishing a structured procedure to manage the data maintenance.

New entries in local systems is thou supported by the central data management model as well as the entry and edition of additional attributes based on existing objects available in the central repository.

In case the new item is not yet part of the central repository, the new object will be exported to the central data management application, where it will go through all validation and enrichment processes.

At the same time, the new business object gets a new global key, which is stored in the central database. Afterwards, the new business object can be transferred to all relevant back-end systems of the framework to maintain the framework consistency.

5.2.4 Data Classification

Along the consolidation and harmonisation process, the most important content management resolution to support purchasing activities is the selection and adoption of a common classification schema, e.g. eCl@ss, and a unique supplier identifier, e.g. DUNS number, q.v. [D&B08].

Companies need the access to accurate and logically organised and classified data to assist their procurement strategies and management decisions. Nowadays, most enterprises have as the main attribute the product short description, but despite of the numerous available approaches for product description in e-catalogues, suppliers are often not able to prepare an e-catalogue with a high quality short description specification.

Hence, the most efficient content strategy in this field is the adoption of industry standard classification systems, e.g. UNSPSC, eCl@ss. Universal standards such as eCl@ss provide a universally accepted metadata layer for organizing and controlling spend data.

Industry standards are often broader than internally developed classification systems, thus enabling enterprises to map all spend data to a single schema and, if necessary, to company's internal classification systems [Aberd03, 9].

The product information classification allows in-depth spend visibility, allowing buyers to analyze their product portfolio not just in a regional and supplier basis, but also in a commodity basis.

A classified spend data can facilitate to elucidate issues such as: How much of company's spending is going to office-material? And who is the main supplier of personal computers? This transparency allows also the comparison of different dimensions and attributes across regions, suppliers and material groups.

In order to achieve a greater data quality, organisations should apply information systems that support the content classification process, without this assistance, buyers and suppliers, who are often not familiar with data classification, are tempted to classify most of their product portfolio incorrectly or as "miscellaneous", a factor that would reduce dramatically the spend data transparency.

Therefore, the best approach is to support and control product classification at source. Information systems have to put forward classification libraries and help tools to assist users through the spend data classification process.

This work introduces the application of electronic catalogue systems to support the product classification process. The model makes available to buyers and suppliers a classification library in which the acquired knowledge base is stored and maintained.

The knowledge acquisition of the classification library is performed in two ways:

- On the one hand, the database is actualized each time that a new product is added to the e-catalogue application, thus along the years an organization build a vast database consisting of all material and services managed by its purchase department. This database includes the short description provided by company's suppliers as well as their selected classification code.
- And on the other hand, the standard classification system adopted by the buying organisation, e.g. eCl@ss, UNSPSC, consisting of the short description and the code, are included in the database.

The database, which is populated with the organization's classification system and the combination of supplier's product descriptions and its respective classification codes, is integrated with the search engine of the e-catalogue platform.

In this way, the material taxonomy library can support the classification of similar product data in the future, based on previous product classifications, increasing so the coherence of company's content.

The library enables users to search for the most appropriate material group for their products and services, using the search technology to rank the respective codes per relevance, applying a fuzzy approach to statistically combine different factors with different priority levels to define effectively the statistical relevance of a query result.

It has to be kept in mind that the queries are performed by non-technical content managers with a high material management expertise, who often do not have a profound information technology knowledge.

Hence, the importance to create a user-friendly search engine technology that takes advantage of user's domain expertise, while classifying their products and services according to a structured classification system hierarchy in the system.

In this environment a phonetic search could be an interesting methodology to be applied, as most of the users are familiar with internet search engines as Google, though

this technique has a lot of problems with syntax, which could partially be solved with the integration of synonym and automatic correction of spelling errors technique.

However, the combination of these methodologies could not deal with three crucial problems during the product classification process:

1) The need to rank the attribute per relevance;
2) The ability to predict an appropriate result based in some attributes, instead of all of them;
3) The empty result effect.

Other search engine techniques are not appropriate for this use due to its data model approach, e.g. the attribute and the parametric search. Therefore, it is crucial the application of a combination of search techniques that can recognise the importance of each product attribute, providing results that consider the user's preferences and improve the search results by the avoidance of irrelevant hits.

The search technique must also provide product classification suggestions which may deviate from the combination of the listed attributes, but still satisfying most of them, to avoid the empty result effect.

The classification engine conceptualized in this work combines different search mechanisms, i.e. full text search, synonym and automatic correction of spelling errors techniques and the preference search, in order to cover all common input options, see figure 5.4.
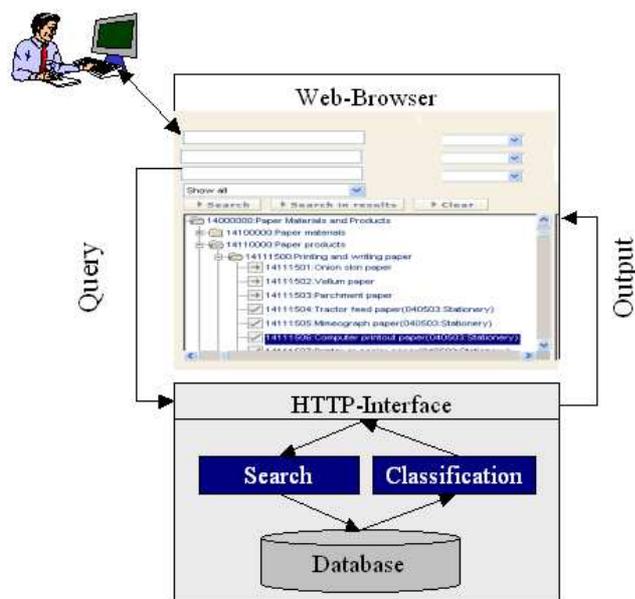
Figure 5.4 Classification Engine

The application is web-based, thus do not require that users have any special equipment to access and perform queries, requiring just a fast internet connection. The internet browser communicates with the classification library through an interface, which allows the access to the data available into the material code database.

As most e-catalogues are XML-based, the application runs over XML and has the capacity to convert XML content into HTML output and vice-versa, the HTTP-Interface is responsible to acquire and distribute the data between the two environments.

In order to illustrate this mechanism, the work introduces a classification process that applies the search engine, which is constituted by a three levels grading approach, i.e. high, neutral and low, as well as the possibility to restrict the search outcomes either to selected material groups or to all material groups of the deployed classification system.

In the example illustrated in the figure 5.5, the supplier accesses the search engine via a web browser to classify her/his short description according to the eCl@ss classification system.

In the suppliers' opinion the most important information from the short description is – *printer paper A4* – being paper the most relevant attribute, thus it has been scored as of high relevance.

The supplier has decided not to restrict its search to a limited number of material groups, but to search for the most appropriate result in the entire eCl@ss structure, i.e. *Show all*, which can be selected from the dropdown list.
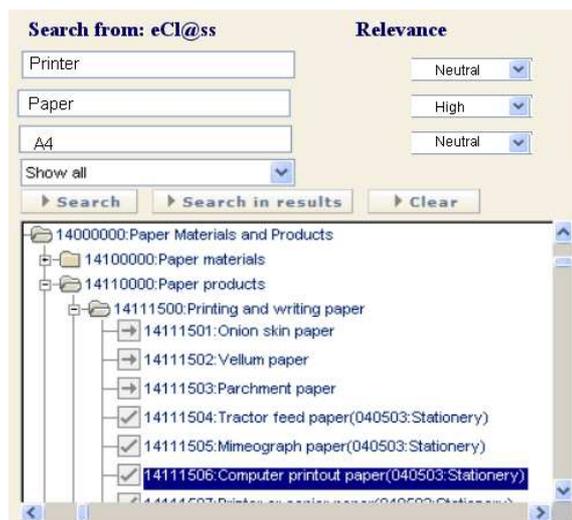
Figure 5.5 Search Example

Once the user has entered the search attributes and selected from the dropdown list the grading level and the material group scope, the query is started and executed by the search engine.

In the example the following search algorithms is created and executed.

/classification #[attribute_2 is 'paper' prior to (attribute_1 is 'printer` and attribute_3 is 'A4')]#

Please notice that soft constraints are scoped by *#[...]#'*. Equal importance is expressed by syntactical term '*and*' (Pareto preference), while the term 'prior to' represents the prioritisation of a search attribute [DFKP05, 39-48].

The query is then executed in the database through the matchup between the inputted parameters and the information recorded in the classification library, respecting the relevance of each parameter of the list.

An organization can configure the weight of the matching process given more emphasis either to supplier's input in the database or to the company's classification system with the purpose of classifying their data in line with enterprise's strategy.

In order to assist the users' analysis, the findings are listed based on their matching relevance regarding the match between the search attributes and the information available in the database, which is illustrated in percent next to the search results.

The results are given in a standard format, e.g. eCl@ss, and it is displayed in the form of a classification tree. The search hits can be navigated through all four eCl@ss-tiers to facilitate the selection process by the domain expert, who should be familiar with the products listed in the result set.

This methodology takes advantage of user's expertise to select the product attributes, which on the other hand, leads also to the main drawback of this methodology: The subjectivity of choosing the flexible values of a product description [MoPa06, 558-563]. Nonetheless, this apparent snag was the only way found to explore the supplier's domain knowledge to increase confidence in the search engine outcomes.

5.3 Data Quality Management

The concept described in the previous sections introduces a new approach to execute the enrichment, consolidation and harmonisation processes in companies. The resulted master data repository should act as the "single source of truth" for up-to-date information, which is then made available to users and systems across all organisation, which has now a reliable source of purchasing and spend information to support their operational and analytical activities.

Nonetheless, the data quality issue must be addressed constantly in order to succeed in any master data management project, independent of the framework or solution applied to cleanse, consolidate, harmonize and enrich the purchasing data.

Therefore, this section introduces a general concept for the data quality management (DQM) in organizations, which should be implemented together with the solution described to ensure the maintenance and continuous increase of the data quality in company's purchasing operations.

Hinrichs defines in accordance with the concept of "quality" of DIN EN ISO 9000:2000 Standard, q.v. [Deut00], the notion of data quality as the degree to which a sentence characteristics attend a data product requirement [Hinr02].

The content requirements should be defined by the data users. Hinrichs provides a taxonomy of the possible data quality characteristics, q.v. [Hinr01] and [Hinr02]:

- credibility: accuracy, consistency, reliability;
- usefulness: completeness, accuracy, timeliness, redundancy freedom, relevance;
- interpretability: consistency, clarity, intelligibility;
- key integrity (relational): key clarity, referential integrity.

The basis for a data quality management model are the goals and requirements defined to manage the master data quality along the years. In the introduced approach, those objectives and requirements can be subdivided into:

Primary objectives, which are general goals that a company should achieve, e.g. low level of data incompleteness, high accessibility, high harmonization grades, etc. And several more specific secondary objectives, which specify measures that should be used both for a constant quality control and a continuous improvement process, for example:

- Fast response time from any system of the framework, e.g. less than 5 seconds;
- Mapping of all SAP ERP source systems;
- Acquisition of all supplier primary keys from the operational systems;
- High level of product classification, e.g. 80% of the total indirect product stored in the transactional systems;
- Etc.

In addition, a data quality team should be created with the task to decide for objectives, targets, measures, and to monitor the entire quality process. The team should be composed of members of the high-management, and formulate reasonable goals to avoid reluctance among company's employees and frustrate the data quality efforts.

The team structure should vary according to the organisation structure and the framework complexity. In multinational scenarios, it may make sense to create national groups, and if necessary, sub-divide the teams in specific operational systems expertise, e.g. SAP and non-SAP.

The quality teams must be able to determinate milestones that should be met, list activities that must be performed, view all project assigned and the interdependencies between different systems and working groups.

It is fundamental to implement a data quality controller function in the quality team to guarantee the continuity and the future of the quality program. The quality controller should work alongside end-users and the IT department to facilitate the project controlling and maintenance.

This employee is the first contact point on matters regarding data quality and his/her tasks combine a number of activities such as performing requirements analysis, plan and carry out quality tests as well as the elaboration of improvement suggestions to the data quality team.

It has to be noted that the DQM is besides an organizational approach, mainly a process method to increase data quality levels in companies, and it should be guided by the Deming Cycle, i.e. PDCA cycle and the phases of an improvement process, see figure 5.6.
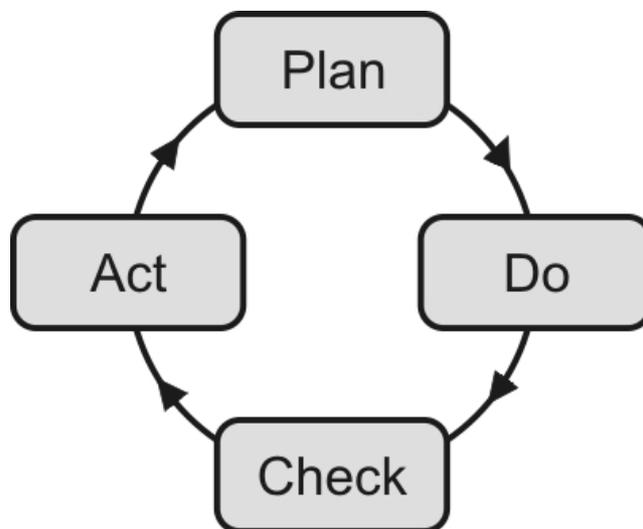
Figure 5.6 PDCA Cycle

The process starts with the company`s Is-analysis to get the information necessary to begin with the plan phase (Plan) of the improvement process. During the plan phase, objectives, ratios and methods have to be defined to constitute the basis by which the

improvement process will be measured, e.g. harmonization grades, systems integration, mapping, etc.

After measures and methods have been established, the second phase (Do) starts with the execution of the decisions of the plan phase. Afterwards these objectives and the program implementation have to be critically controlled at the third phase (Check), based on the targets and measures defined at the plan phase.

In the last phase (Act), on the basis of the inspection results, the reasons of the observed deviations have to be identified, corrective processes stipulated and new quality standards created.

Furthermore, the creation and holding of certain minimum quality levels are just as important as the quality improvement objectives, thus these goals should be supported by appropriate arrangements in the plan phase in order to avoid the deterioration of the program quality level.

With the aim of measuring the quality improvement, it has to be designed a data quality index. The criteria used at [BrDi07] is a good starting point to create this index, which has to contain concrete measures that can be constantly controlled by the data quality team, for example:

- Percentage of well-maintained supplier master data records;
- Percentage of systems containing consolidated master data;
- Percentage of harmonized product classification;
- Data extraction status, e.g. automatically or manually;
- Etc.

The criteria should be established by a team consisted of employees from different departments, e.g. purchase and IT, to avoid possible subjectivities beforehand for the accomplishment of the objective.

For each of these criteria weighting and evaluation scales have to be defined, and based on them the total evaluation result will demonstrate the quality status and the discrepancy to the program objectives.

The control of these measures should be proved also by dataset tests, in which errors in the extraction, consolidation and harmonization processes are identified and compared with the data of the source systems.

In advance, the quality controller should be trained to perform those tests and moreover to create reports that would give detailed status views of company's content.

This approach has the advantage to take in consideration local conditions, e.g. countries, systems and ensure a uniform quality standard for all organization.

The quality tests can be done in different process stages to prove different data aspects, e.g. grading of extracted data, harmonization level of data from different source system, etc.

Those quality tests should be done continually in pre-specified timeframes in the central data management system, i.e. e-catalogue platform, or after each extraction process.

The "check" process can be initiated either automatically or manually, depending of the test complexity and the control method applied, e.g. dataset sums, field checks, mapping performance.

Random tests may be also adapted to address strategically important issues for the organization such as the material and supplier harmonization based on established standard classification systems.

After the tests, a detailed error description has to be written and the results documented. They are of crucial importance for the data quality control and the future development of the quality program and the framework itself.

For a spend management application a clean, consistent and high quality data pool is a critical point to support trustful analytical analyses and value reports. For this reason, the central data management system is the optimal source of information to a business intelligence tool.

A spend management application may profit from the central data management application due to its high data quality and data model approach, which reduce dramatically the integration, transformation and loading costs as well as the synchronization cycles between the systems.

The preliminary concern of the next chapter of the work is the design of a spend intelligence concept to complement the framework functionalities with a business intelligence module specialized on "catalogable" products, i.e. indirect products and services, to increase company's data transparency and compliance.

6 Spend Intelligence

In this chapter, the spend intelligence tool based on an e-catalogue platform is introduced. In sections 6.1 and 6.2 the concept of spend intelligence as well as its benefits and challenges are discussed. Section 6.3 illustrates the spend management system, which is in focus in section 6.4 regarding its conceptual design that includes but are not limited to the ETL process and the data model construction. Finally, the chapter presents in section 6.5 the potential limitations of the proposed solution.

6.1 Business Intelligence

Companies gather along the years vast amount of information through the daily business relations with their partners, e.g. suppliers, costumers, and their internal business processes. The idea that high management lacks data to support their decision making process is barely true.

In fact, often organizations have adopted the strategy to collect information from their environment in order to interact better with it. Indeed, the introduction of information systems to bolster company's activities had as the main driver the automation of business processes and the collection of relevant business data.

Nonetheless, these data are dispersed in numerous operational systems, e.g. ERP, MRP, e-procurement, which are designed mainly to support the mechanization of enterprise's activities and not the decision making process.

This information system infrastructure has engendered a situation in which although managers have the data necessary to assist their decisions, they are not able to extract this information from their operational systems, or even worse they are not aware that the required information are already available in their organizations, reducing so the return on their operational systems investment and missing important business opportunities.

The consolidation and transformation of data into knowledge is a hard task. Therefore, a new generation of information systems has been developed to fulfill the deficiencies of the operational systems, which cannot deliver relevant information for the decision-making processes of companies, because of the data inconsistency, incompleteness and redundancy which are stored in those solutions.

This poor data quality is mainly caused by the operational systems nature, which have their focus on the automation of organizations processes, which leads to the collection of irrelevant data for managers.

Furthermore, these systems were often implemented in companies as individual platforms without integration, creating island of data which made difficult the collection of accurate historical information.

At the end of the eighties, the Gartner Group introduced the term Business Intelligence to describe the set of information systems that deals with the extraction of data from different databases and the consolidation of these data in a unique environment with a structured data model, especially constructed for business analysis purposes, from which information could be generated through multidimensional data analysis in an easy fashion way which could be understood by company's managers.

Or as Bange [BANG05] defines, Business Intelligence systems support the collection, preparation and allocation of decision relevant data to plan, manage and control organization's performance.

Those decision support systems (DSS) deliver the essential information to the knowledge development process of organizations, which allow them to react faster to market trends as well as improve their competitiveness.

6.2 Spend Intelligence Benefits and Challenges

The utilization of business intelligence technology to underpin company's performance has become a key factor in the procurement managers' agenda. Spend data management – also referred to as spending analysis - is the process of aggregating, classifying and leveraging spend data for a purpose of reducing costs, improving operational performance, and ensuring compliance [Aberd04, 7].

Nowadays, most companies are still performing their spend analysis activities manually without the benefit of business intelligence tools to automate the extraction of relevant data and to support the design of supplier development and spend saving programs.

These companies apply tools such as Microsoft Excel and Access to manually consolidate the data from different operational systems, a process that is error-prone and highly timing consuming.

Since most market studies suggest that those systems are still in its infancy and most companies have still not deployed this technology, the market of spend and supplier intelligence applications should continue its high growth rate in the next years.

A study from AberdeenGroup [Aberd06, 2] has identified the top factors driving the adoption of formal spend intelligence programs in companies. The table 6.1 lists these factors and their respective benefits:

Key Factors	Benefits
Identifying and forecasting new savings opportunities	Reduce material and services costs; reduce stocks and expedition costs
Placing more spend under management	Increase the ROI of IT investments and the transparency through a higher coverage of the total purchasing
Identifying and prioritizing spend categories	Improve the management of current commodities under management and the roll-out toward new material groups
Tracking off-contract ("maverick") spend	Increase savings through the use of contract pricing and influence policies and programs for spend categories already under management
Leveraging spend intelligence continuously	Enable the adoption of category spend management program
Identifying top suppliers of goods and services	Increase the bundling effect and the bargain power
Identifying top commodities – current or future	Facilitate the reduction of the supplier base and unnecessary products introduction
Decreasing sourcing cycle time	Improve the purchasing process and freeing resources to more strategic tasks
Identifying top sites for spend	Homogenize the purchasing program in the organization and find potential process improvement across the enterprise
Determining M&A synergy	Increase the saving potential of M&A strategies in the procurement department

Table 6-1 Spend Intelligence: Key Factors and Benefits adopted from [Aberd06]

Nonetheless, there are some key challenges that companies have to address in order to build a serviceable spend intelligence environment to achieve companies' goals and the benefits listed above.

As it was already mentioned, most spend analysis processes are currently made manually and ad-hoc, applying spreadsheets to classify, cleanse and analyze the data available in different data sources.

These data sources consist mainly of transaction systems, e.g. ERP, e-Procurement, e-Sourcing, which are not integrated with each other and do not support reporting and analytical functions.

Therefore, the data structure of those systems is not adequate to carry out analytical processes and the data available often lacks important information about company's suppliers and products.

Additionally, the information that are available in these disparate systems, in most of the cases, are not consistent and single products and/or suppliers may be described with different names, e.g. University of Karlsruhe, Uni. Karlsruhe, Karlsruhe University, etc.

This lack of naming conventions reduces the transparency of the entire supplier relationship management program, limiting spend analysis capabilities and reducing potential negotiation gains.

Hence, enterprises when deploying a spend intelligence strategy have firstly to inspect their information technology landscape to adopt business intelligence technology that meet their system requirements without forgetting the system's usability in order to provide their employees with a single environment in which they can perform their analytical processes in a smooth way without to require deep IT knowledge.

6.3 Spend Management System Concept Motivation

This work analyzes the indirect goods spend analysis processes with the aim of designing a business intelligence application that provides companies with the relevant spend information to support buyers and managers during their decision making process.

Nonetheless, the solution has first to reprocess the data acquired from those systems to attend the data specifications of a business intelligence environment, given that the data quality of the information available to managers is a key factor for an effective decision-making process and its definition and extraction process play a critical role in the implementation of a spend analysis project.

In this work the relevant business data is divided into two main classes of content category: 1) product, buyer and supplier information, and 2) the transaction data. The acquisition of data and its transformation into information faces yet numerous obstacles, which to the most important ones belong the high integration costs and the poor operational systems date quality.

The experience shows that 50-80% of the total cost of a Business Intelligence Project is related to the definition and implementation of the data integration process [ChGl06]. Consequently, the selection of the data sources is of crucial importance to a BI project

success and the analysis of the is-situation an important step to the project implementation.

Indeed, most of the problems come out from the differences in nature between operational and analytical systems. A simple comparison of the main characteristics of these two systems shows that the data integration between them requires a significant preparation of data through a methodical process.

In addition, many indirect materials' SRM projects have grown through the deployment of independent information systems to construct current's SRM environment and often multinational organisations have adopted merger and acquisition strategies to grow, what created an even more complex and disparate information system landscape.

Besides this fact, most BI projects are designed based on a standard ideal architecture and the desire to create a company-wide integrated analytical information system, which often barely delivers added-value to end-users.

An appropriate spend management architecture should be designed on the basis of company's situation, its complexity as well as the specific application scenario, which defines the level of investment and detail that a business intelligence solution should provide to users.

In other words, innovative ways have to be investigated to deliver companies the expected project results, instead to adopt an invariable out-of-the-box approach to all business intelligence scenarios.

While designing a business intelligence application three main objectives have to be considered [ChGl06], see figure 6.1:

1) From the end-user point of view, the most important factor is the system flexibility, e.g. constant new analysis possibilities with different approaches in multiple display formats with short-response times.

2) The BI technology manager, on the other hand, sees as the most important aspect the systems quality, i.e. high data quality, system availability and performance.

3) This conflict can only be solved fully at the cost of the third management goal, the project expenses.
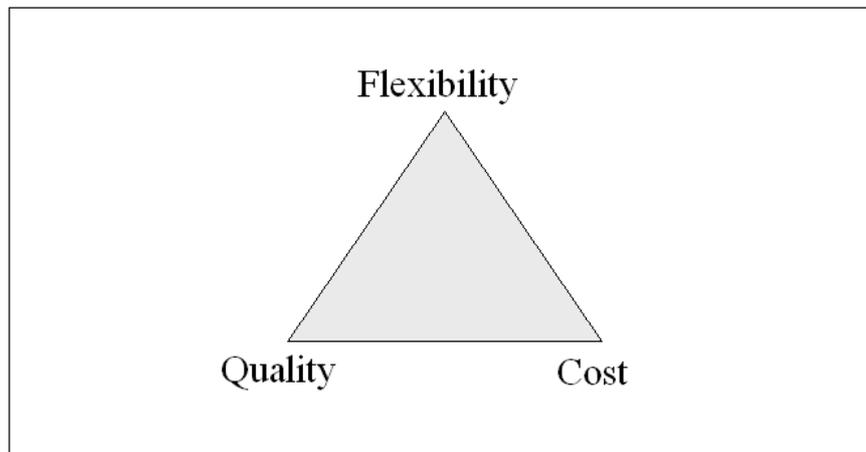
Figure 6.1 Business Intelligence Objectives adopted from [ChGl06]

6.4 Indirect Material Spend Management System

In order to provide a satisfactory equilibrium between these three business intelligence goals, this work proposes in the next subsections an alternative architecture to reduce the extraction process costs by the utilisation of an electronic catalogue platform and its search engine as the main source systems of the business intelligence solution.

This concept creates a dedicated indirect good's business intelligence environment, which reduces dramatically the necessity to integrate the data warehouse with multiple operational systems, while maintaining the system flexibility and increasing its data quality.

6.4.1 Application Functional Design

In this architecture the extraction process takes place between the e-catalogue platform and its search engine, the external sources and the staging database. The raw data is first transferred to the staging area by the application of extractor programs, which restructure the data of the source system in an adequate structure to be stored in the business information database, in which transformation programs adequate the data in pre-defined structure and quality specifications, see figure 6.2.
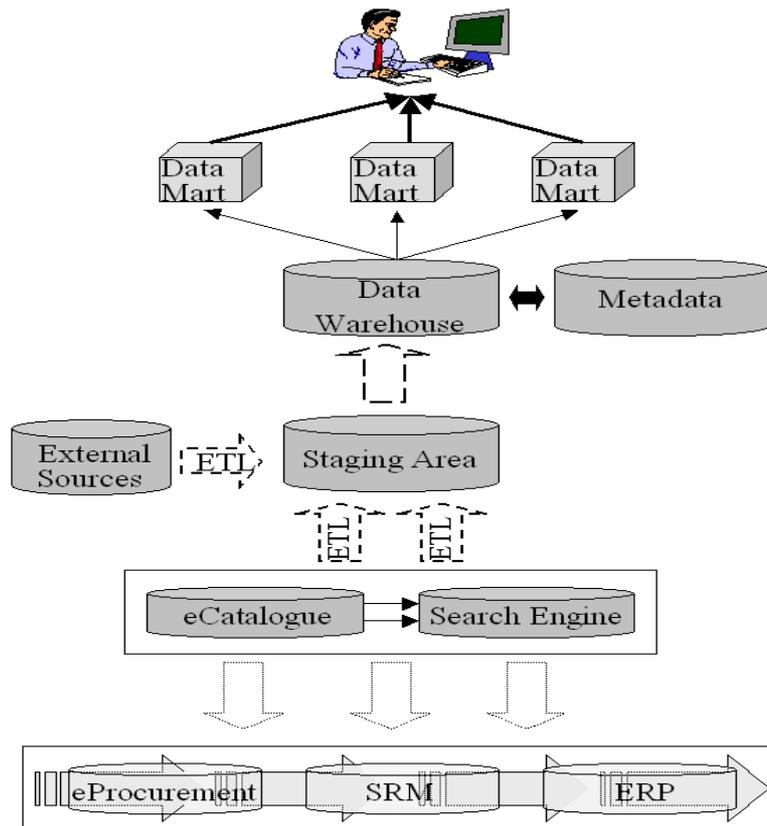
Figure 6.2 Business Intelligence Architecture

The staging area works as the intermediate storage of the "raw data", before the multidimensional data processing and classification, which constitute the basis for the logical data structure that will assist buyers data search and reports generation, take place.

The processed data will be then transferred to a data warehouse, which is according to Inmon "a subject oriented, integrated, non-volatile, and time variant collection of data in support of management′s decisions" [Inmo96], in which the content is consolidated into different groups, e.g. product, supplier, etc., containing the relevant information in a logical structure to users.

Database systems are nowadays the central storage block of all sort of analytical information system. Indeed, the relational database technology has proved to be a technical mature and stable environment to manipulate large data volume [ChGH05].

After the consolidation process in the data warehouse, if the data is still not aggregated satisfactorily according to company's' requirements, the data pool may be further aggregated according to specific topics and interest groups and stored in diverse Data Marts [ChGH05].

The data marts due to its reduced volume may improve the response performance of complex analysis. Nonetheless, as in this case the content is already tailored to a single

use and department, the necessity to deploy data smarts to further divide the content has to be analyzed in each application case.

From the data warehouse, the information is acquired by the reporting tool and displayed to users in a unique reporting environment. The Graphical User Interface (GUI) is customized to provide a similar visual environment as the e-catalogue platform to improve the usability effect of the tool, displaying a user interface that is familiar to the purchasing department staff.

In addition, the solution provides a central database to manage system's metadata, which includes all information required to analyze, design, build and understand an information system [VaVe01, 273-298].

The metadata can be accessed by users to facilitate their understanding of the solution and to assist the IT department to maintain the application and it should include: Data naming lexicon, Thesaurus, Data structure, Data integrity, Cross-reference table, Data directory, [MuBe98].

The main advantages of this architecture are the reduction of interfaces required to acquire the necessary data to support spend analysis activities and the reduction of the extraction, consolidation and aggregation process costs.

It is recommended though the integration of the e-catalogue platform and the search engine back-up systems with the business intelligence solution to avoid eventual performance problems due to an eventual source system's breakdown.

This approach addresses also the fundamental problem of business intelligence projects: The poor quality of the operative system's content, e.g. incomplete and inconsistent data, duplicated and/or ambiguous content, by means of the access to already enriched and classified data delivered from the electronic catalogue platform, as described in chapter five.

6.4.2 Extraction, Transformation and Load Process

To illustrate the advantages of the proposed solution in the field of indirect material spend analysis compared to the usual business architecture found in the literature, this section describes the data transformation process of a spend analysis project as well as its main pitfalls, which are considerable reduced by the adoption of the proposed spend management tool.

The data transformation process is responsible for the extraction, transformation and storage of data from operational systems into the data warehouse, while throughout this process the content available in an organization is converted into business information,

which will be used to create operational figures and business measures to assist the decision-making process.

Justified by the long lasting growth of operational systems data pool and the deployment of various independent solutions in companies, the data redundancy and inconsistence is hardly avoidable and semantic deficiencies are the norm.

With the application of an Extraction, Transform, Load (ETL) tool to assist the data transformation process, the framework will cleanse the data available in the source systems and prepare them to be stored in a data warehouse.

This process is executed once per day, at night by the use of a scheduling component as a background job to prevent any kind of negative influence on the affected systems and reduce the process costs.

The possibility to shorten the time between two ETL processes was also analysed, though the reduction of this time or even the application of a real-time data integration approach would not deliver a sufficient valued-added to this application scenario that would encourage the increase of the number of replications of this process.

The first task of the data integration process is the extraction of data from the operational systems. Unfortunately, the data stored in those systems are full with non-conformities, which have to be corrected before the data can be stored and used in spend analysis activities.

The central data management application presented beforehand in this work reduces dramatically the necessity to validate and cleanse the operative data. Nonetheless, the source system databases still have to be scanned with the objective of identifying the unconformities and correct them through the application of standardization, cleansing and enrichment methods.

This process is carried out parallel to the data extraction by the use of convergence rules to alter and enrich the raw data during the allocation of the table columns from the source system in the new database.

The validation process can be to a certain extent executed automatically by the application of validation rules. In case of errors and inconsistencies already known and expected by the project managers, these validation rules can facilitate the correction of data unconformities by adopting pre-defined mapping tables and statistical methods, e.g. ensuring the presence of mandatory fields, consolidation of synonyms, controlling of content and format plausibility, etc.

Nonetheless, the majority of the inconsistencies cannot be automatically corrected. Thus these corrections must be done manually by field experts so that errors derived

from the operational systems do not deteriorate the content quality of the spend intelligence solution and thereby influence negatively end-user's acceptance. These nonconformities must be yet in short or middle-term corrected at the corrupted source systems to eliminate these inconsistencies for good.

After the data is extracted from the operational systems, the content has to be classified into pre-established groups or dimensions, e.g. product, buyer organisation, supplier. This harmonisation may introduce further problems to the project, if the source systems apply different codes and terms.

In this case, the project managers have to decide for the necessary adjustments and create a unique taxonomy to identify the different groups/dimensions and their meanings. Subsequently, the synchronization method has to be defined as well as the harmonisation keys, for example:

- Harmonisation of the primary keys: In case the source systems deploy different primary key codifications for the same object, e.g. supplier, these codes must be harmonised through the creating of an additional code to homogenise the primary keys of the source systems which will become foreign key at the new environment, allowing so the consistent analysis of this object.

- Data with the same meaning, but different representation, e.g. female and male represented in one system by "1" and "2", and in another system by "F" and "M". The solution is the selection of a unique code and the adoption of mappings.

- Other common syntactic discrepancies are: Synonym, attribute with the same meaning, but different names; Homonym, attributes with the same name, but different meaning, duplicated entries and so forth.

In the reference to the proposed framework, this phenomenon would take place already at the operational system level, so the extraction process would require much smaller effort to consolidate and transform the data.

Nonetheless, the consolidation of different units of measure into a common convention to increase consistency during the reporting and analysis activities occurs in the business intelligence environment.

The reason for this process is that often suppliers apply different package size and units of measure to commercialize their products, consequently buyer organisations, which intend to have a uniform view of their suppliers' products, have to adopt a

method to convert the different units of measure into comparable base units, i.e. Kilogram into Gram, Pound or Ounce.

To assist this unit/quantity conversion, the spend analysis tool has to execute during the loading process the homogenization of different units of measure into a uniform schema, applying therefore mapping tables available at the conventions library.

The "Physikalisch-Technische Bundesanstalt" provides the physical classification of diverse dimensions and time based on international standards, q.v. [PTSI07]. The conversion of each basis unit into a different unit of measure respects a specific conversion rule, q.v. [PTBE04], which must be adopted to assist the calculation activities during the loading process.

In case, it is required to reduce the package quantity to units, e.g. piece, bottle, the information necessary to proceed this conversion has to be extracted from the e-catalogue platform, which possesses for each supplier its package attributes, e.g. basis unit, package quantity, order quantity, etc., and based on mathematical methods this information can be matched and converted into a consistent schema.

6.4.3 Data Modeling

The modelling of organisation's processes is a highly complex and detailed activity, which is normally done through the segmentation of company's processes in different views. This segmentation makes possible the use of appropriate instruments and techniques to expose these processes, their objects as well as their relationships and dependencies.

The main views adopted to illustrate business processes are:

- The data view, which describes the data objects and their relationship;
- The function view, which reproduces the functions that will be performed supported by information systems technology;
- The organisation view, which maps the organisation structures, its employees as well as their relationships;
- The business process view, which represents the logical correlation of tasks, events and objects in an organisation.

Due to the detailed nature and high dependency of each implementation scenario, the modelling of organization's business processes is not the focus of this work. Instead, the work concentrates on the multidimensional and logical modelling of the framework.

6.4.3.1 Multidimensional Data Model

Business managers analyze organisations data on the basis of multiple criteria. These users have a practical view of information which often diverges from operational systems data structure, for example, they want to know the total revenue of a particular product for a period of time in a selected region.

For this reason, analytical systems represent and demonstrate company's data in a comprehensible multidimensional data structure, applying a three dimensional data cube to reproduce the multidimensional data structure and the inter-dependency between business objects. The following figure illustrates the previous example:
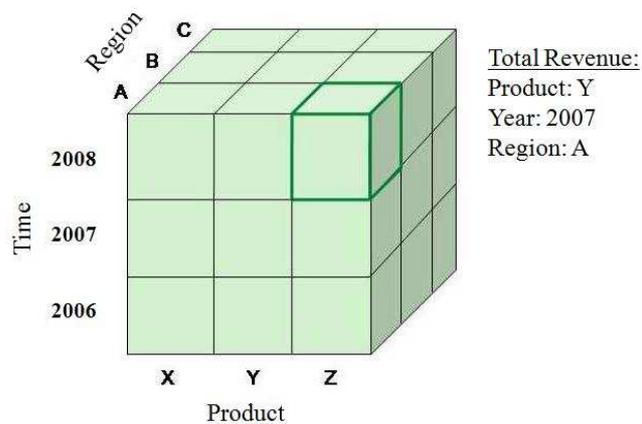
Figure 6.3 Multidimensional Data Structure

In this example, there are three dimensions: product, time and region. Each edge represents a dimensional element, i.e. here: three elements. In practice, however, it is considered a much higher number of dimensional elements.

In order to reduce complexity and increase performance, the quantity of dimensions was kept in the data model as few as possible. Every additional dimension included in the data model would increase considerable the data structure complexity.

Consequently, the identification and definition of relevant dimensions and their specification were done by following a restrictive criterion. In addition, the selection of the dimensions and the facts has been made to conceptualise a harmonious and consistent data model to allow a smooth aggregation of the dimensions to facilitate user's navigation during the analysis process.

A data model helps business users' to understand the logic of the business intelligence environment, by helping the user envision concerning all parts and pieces of the data model and their relationships [Imon00].

The data model should interpreted the end-users knowledge about their business and it translates them into a logical computer format that organizes the essence of end-users

expertise through facts, dimensions and business attributes relationships, which can be then easily understood and analyzed by the end-users, in this case, the purchase department employees.

The definition of the dimensions started with the analysis of the application scenario of the business intelligence solution: The analysis of indirect goods spend data in organisation's purchasing process to support company's strategic decisions and supplier selection.

Hence, the data model should allow the answer on the following generic question: How much did the organisation spend with a specific supplier in a determinate period of time?

In order to respond this question, the system performs an addition operation, which is the most common aggregation process applied in spend management projects. Other mathematic operations often used to aggregate dimensions are: mean, distribution and division [Lehr03].

The model has to enable also the answer of more complex questions, applying OLAP operations to navigate across dimensions and elucidate questions such as: Which were the top products bought from a supplier during a defined year? This means in a multidimensional model that the aggregation level has to be sub-divided to achieve a more detailed view of a dimension.

In this example, there are three dimensions, i.e. supplier, product and time. The representation of these three dimensions requires the application of cubes, which allocate the business measures in their slices.

The business measures together with the time object can be modelled following a hierarchical structure, which makes possible the aggregation and breakdown of the business figures.

This kind of relationship creates consolidation and navigation paths in a dimension and shapes the dimension structure. The basic elements of the lowest level of the structure define the so-called granularity of the cube, and thus the most detailed level, which a user can access in a report. All other dimensional elements are identified as derived or compressed elements, and they all together consist the multidimensional structure [Hahn05].

In the spend analysis application scenario, the most important aspect that has to be considered is the historical timeframe. The timeframe can be established using different methodologies regarding the time measure model, e.g. in hours, days, weeks, etc.

In this work, the author has opted for the application of the western calendar to structure the **dimension time (1)**, which is structured as follows:

$$Day \rightarrow Month \rightarrow Quarter \rightarrow Year \rightarrow TOP \qquad (1)$$

Basically, it should be differentiated between a company's fiscal year and the calendar year, even though it may be possible that they are the same or have just a minimal difference, i.e. in a SAP R/3 there are 16 different possibilities to define a time period to cover different time structures and to support organization's account processes.

In case it is decided to represent the dimension time in different time methodologies, e.g. year based on weeks, Chinese calendar, fiscal year, these new objects must be integrated in the time dimension structure.

Nonetheless, it is not foreseen the introduction of formal connections between the different time dimensions in the data model, though an intuitive correlation of those dimensions is in the practice possible.

The hierarchical structure of a dimension is supported to facilitate the data consolidation inside a specific dimension. The top-down hierarchy is crucial to make possible historical data analysis inside the time dimension and to divide the analysis in different aggregation grades.

This classification hierarchy is adopted throughout all dimensions to assist the data consolidation and support the business analysis across the established dimensions in different aggregation levels, for example in the case of the dimension time it is possible to generate reports in any time period, not just at the highest level, i.e. year.

Moreover, another alternative time dimension has been deployed to support the analysis of suppliers' contracts. This dimension was based on e-catalogue versions, since the creation of a new catalogue version is often related with the negotiation of new contract conditions with suppliers.

Therefore, buyers could use this additional time dimension to compare supplier's contracts along the years and control the price and product portfolio historical behaviour of a supplier. The **dimension catalogue version (2)** is hierarchically organized according to the following structure:

$$Catalogue\ Version \rightarrow Catalogue\ Name \rightarrow Catalogue\ Type \rightarrow TOP \qquad (2)$$

In order to enable a more precise historical analysis and financial comparison, it is important to add to the time dimension, indexes that represent the currency

comportment along the time. Indexes are measured values applied to compare chosen criteria in two different time periods [STIE06].

When there is the necessity to analyze different time periods of spend carried out in the same currency, the index used should reflect either the regional currency variance, e.g. Inflation, or pre-defined cost of money conventions.

Companies can also insert other business parameters, which they judge appropriate to execute their spend analysis and compare their performance with other industry benchmarking. These indexes should be then combined with the standard currency of the organisation to deliver a more precise view of company's spending along the years.

After having introduced the time relevant dimensions and the indexes that allow the price variance analysis over a period of time, the **dimension price** itself has to be defined to identify company's spend in monetary value; it is recommended to deploy a standard price type for the purpose of increasing compliance during the evaluation of reports in different objects perspectives.

In Europe the most common price type used for controlling purposes is the net price, which is the price of a product or service without to consider its taxes, thus the framework applies the net price as the standard price. Other price types that could be introduced are, for example: the gross price, the sales price and the list price, etc.

It was not introduced in the data model concept, the capability to manage company's stocks. Nonetheless, if there is the future need to support this process, a specific dimension for this objective has to be introduced to standardize the analysis of stocks in a unique accounting method, e.g. FIFO / LIFO accounting.

Furthermore, it is crucial in international environments the support of multicurrency relations. Therefore, a **dimension currency (3)** must be included to allow international business analysis and the convergence of diverse currencies into a reference one, see figure 6.4.

For controlling reasons, the currency dimension has to be classified as follows: Transaction currency is the currency in which the contract terms are paid, and it can be sub-divided into: 1) The standard currency, which is the currency adopted by the corporate group, i.e. a company that has its headquarters and most of his businesses in Europe will probably choose the Euro as its standard currency; 3) the foreign currency, which is all other currencies, other than the one fixed as the standard one.

<div style="text-align:center">

Transaction Currency

Standard Currency

Foreign Currency

</div>

(3)

<div style="text-align:center">
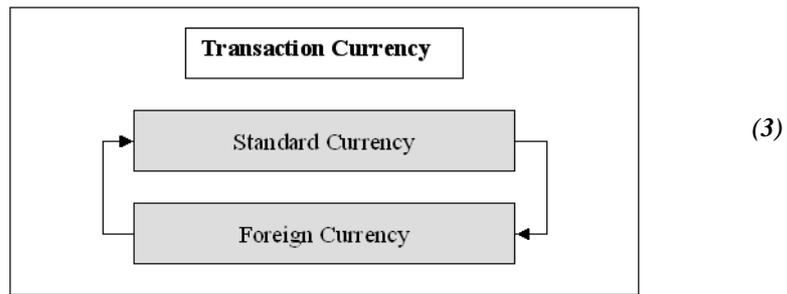
Figure 6.4 Dimension Currency

</div>

In the data model concept, the exchange rate to convert the values from one currency to another has to be acquired from external sources. However, for the purpose of enabling historical analysis, the daily exchange rates should be stored into company's database for a determinate period of time according to organisation's needs.

In the physical aspect, **the dimension product** and the material groups have also to be identified to enable the filtering of organisation's spend in different classes. The previous section has already treated the application of classification code systems (CCS) to identify and classify products and services, normally deploying pre-defined conventions in a tree structure schema.

It is recommended that **the dimension classification system (4)** contains as its basis, international standards such as eCl@ss to decrease the implementation costs and facilitate future application scenarios.

<div style="text-align:center">

*Commodity Classes → Groups → Main Groups → Segments → **TOP***   *(4)*

Ecl@ss - classification system dimension

</div>

However, in the practices companies often apply internal classification systems, designed especially to meet their needs. The main reason for this practice is the perception of some organisations that the structure of current international classification systems does not cover their needs and provides a complex and overwhelming approach.

Hence, companies define their own classification system to attend the requirements of their purchasing department and specify their material groups in a way that it can be easily allocated to a cost centre, and thereafter this internal structure can be mapped to an international classification system code.

On account of this, the support of multiple classification system dimensions is relevant to provide companies with a familiar classification structure and the possibility to apply international classification conventions to their future expansion activities and to assist their inter-organisational e-business processes.

In the framework, the classification systems mapping occurs at the operational system level, i.e. e-catalogue platform. This process enables the mapping of international classification systems to a pre-defined internal classification code direct at source, increasing the data consistency inside the company, see figure 6.5.

Figure 6.5 Classification System Mapping

The spend intelligence tool provides though the capacity to extract the objects' relation information from the e-catalogue platform and it organises them as a multi-dimensional approach.

The CCS harmonisation process together with the supplier consolidation are the two most important content harmonisation initiatives to assist the evaluation activities of the purchasing department.

The **dimension supplier organisation (6)** was implemented to define the relation that an organisation entity has with a supplier and the products that a supplier provides to an organisation. This is vital to identify the spending of a company towards a supplier and to detect product and supplier bundling potentials.

Supplier affiliated companies→ Supplier Holding → TOP   (6)

Unfortunately, most e-procurement and e-catalogue systems do not provide an automatic supplier hierarchical structure. Hence companies have to constitute the associations either manually, which is really time consuming, especially in the case of multinational suppliers or they have to use the services of commercial information vendors such as Dun & Bradstreet (D&B).

The DUNS Number, i.e. Data Universal Numbering System, is a nine characters code that has been developed and introduced in 1962 by Dun & Bradstreet to guarantee a unique worldwide identification of companies, q.v. [DunB05].

The Dun & Bradstreet (D&B) identifies with their DUNS Number database, among other things, corporations and their affiliated companies worldwide, their SIC code (Standard Industrial Classification), number of employees, etc. The following graph provides an example of a D&B Family tree, q.v. [BrDi07]:
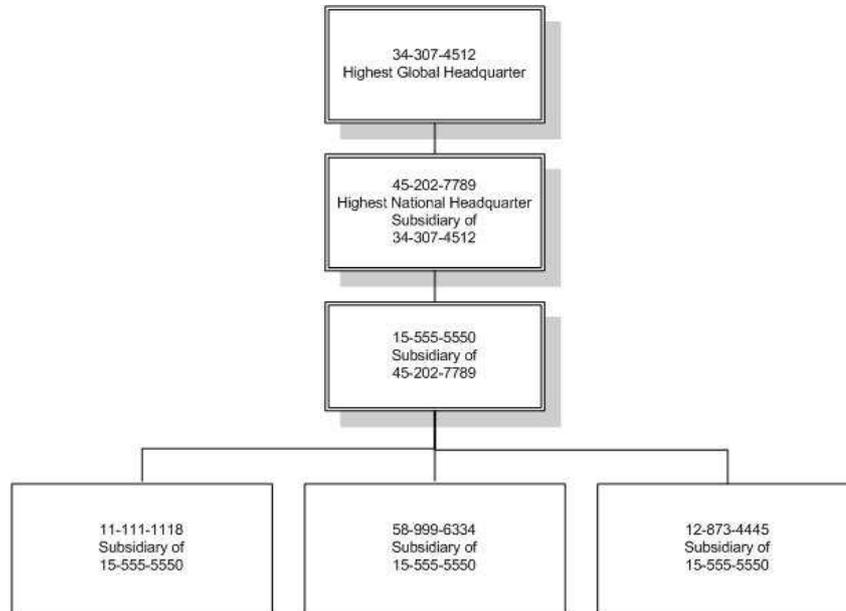
Figure 6.6 D& B Supplier Family Tree adopted from [BrDi07]

With the use of this standard, enterprises can adopt supplier corporate codes to aggregate information from suppliers, who are affiliated to the same holding, increasing so the complete view of the organisation spending with a supplier.

In order to facilitate the allocation of company's spending to a business unit (BU) or even to a buyer, the **dimension buyer organisation (5)** is represented in the data model.

This dimension supports two processes: first, the structure of the analysis within the organisation level or as the case may be in territorial level, and second, it supports the access right of the spend analysis tool and its reports, which depend on users function inside an organisation.

Buyer→ Branch→ Regional Office→ National Subsidiary→ Regional Headquarters→ Holding →
TOP (5)

The information to manage the access rights are extracted directly from the electronic catalogue platform, with the intention of maintaining a consistent company structure in the spend analysis solution. This method contributes also to keep the administration cost as low as possible.

The access view is customized to offer three access levels:

- Pre-defined information for all users, e.g. suppliers purchasing volume, purchasing volume of a material group in a business units, etc.;

- Specific information for responsible buyers e.g. product price, product quantity, etc.;

- Free access to all information of a company's division to Business Unit managers, e.g. total spending per buyers, suppliers' information per buyer, etc.

Currently, most e-catalogue systems do not provide inside their hierarchical concept the information about functional inter-dependency between organisation's employees, e.g. Manager <-> purchase assistant.

For this reason, it may be required that this organisational inter-dependency is constituted in the business intelligence environment, creating horizontal and vertical restrictions of the views to be accessed by a user according to his/her hierarchy and responsibilities.

6.4.3.2 Logical Model

The association between the dimensions described above should be shaped to organise the information extracted from the sources systems in the data warehouse, creating a structure in which the different dimensions are inter-related to allow multi-relational analysis of company's spending.

The design has been made by means of end-user interviews to provide purchase department employees with relevant information to perform their analyses and support the decision making process.

Nonetheless, the dimensions can be, when necessary, deleted or restructured to adjust the data model to company's changes and evolution, e.g. change in organisation's structure, personal responsibilities, change in the product portfolio.

In this case, the consistency during the analysis of a timeframe affected by the data model modification is deteriorated. A mechanism that may be implemented to enable the analysis of modified dimensions and the research of lost information is the historization of attributes, relationships and entities over time.

The logical modelling of the system has been performed based on a star schema and the conceptualization was done at the basic cubes level. The Star-Schema is a method applied to store multidimensional data structures in a relational database. The Basic proposition of the Star-Schema is the classification of content into two groups: Facts and Dimensions [Poe96].

The star schema has become the standard for data warehouse database design due to its capacity to [PORE96]:

- Create a database providing fast response times;
- Provide a design that can easily be modified or added to throughout development iterations and as the data warehouse grows;
- Parallel, in the database design, how end users generally think of and use the data;
- Simplify the understanding and navigation of the metadata for both developers and end users;
- Broaden the choices of front end data access tools, as some products require a star schema design.

The schema consists of a central fact table, which contains the relevant quantitative measures for the analysis of company's purchasing operations and the dimension's primary keys. In the figure below the fact table is presented with the abbreviation *t_fact,* see figure 6.7.
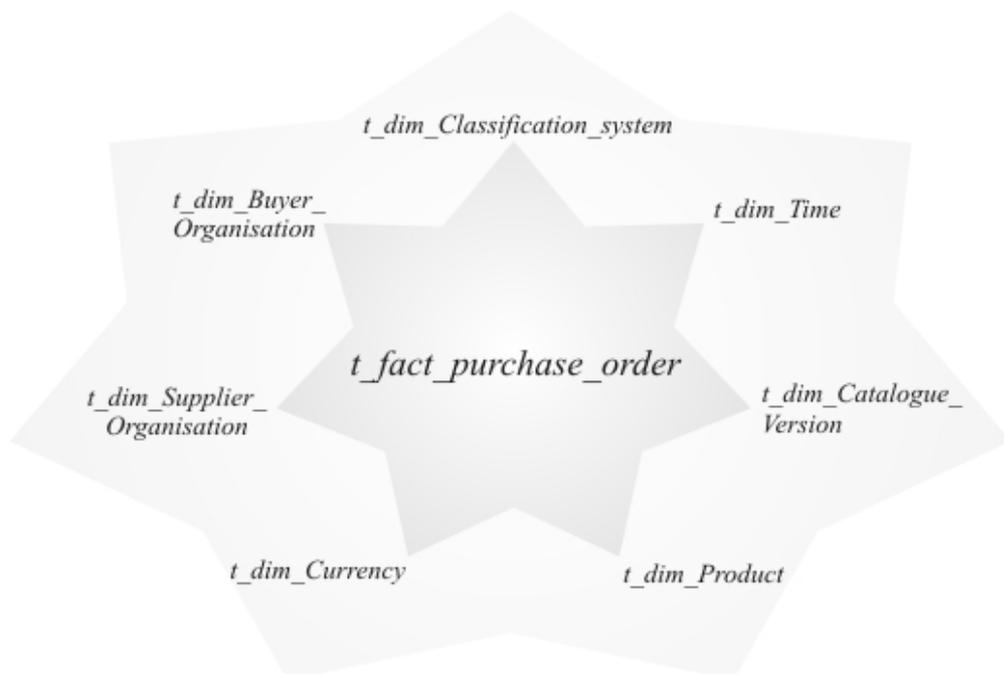
Figure 6.7 Star Schema – Purchase Order

Connected with the fact table are the dimension tables, abbreviation: t_dim, which contain the qualitative data to characterise the facts. The dimension tables enable the creation of different views of the facts, divided into different grouping, e.g. supplier,

time, product, and within the dimension it is possible the examination of the facts in different aggregation levels, e.g. day, month and year.

The dimension tables incorporate the data, which describes the variable content of the fact table. They fulfil three functions [Hahn01]:

- Description of the facts, so that meaningful statements arise;
- Definition of the search criteria by which the measures' analyses are performed;
- Specification of the hierarchy through the definition of the analysis summarisation level.

Before the design of the Star-Schema, a requirement analysis has been carried out through the detailed examination of the available literature and interviews with some key buyers to conceptualise the schema and the report environment.

This analysis has shown that buyers and purchase managers need to get purchase order information by suppliers and products within the buyer organisation structures, e.g. business units and buyers.

This information must be available in different time periods, e.g. monthly, quarterly, yearly and perhaps different currencies. In addition, the purchase managers require different detail levels to analyze company's spending.

Therefore, there is the necessity to design a star schema that accommodates the lowest level of data granularity to access information until the document level, in different detail grades.

In the star-schema described above, the focus is on the fact table with the net purchase order in the transaction currency as well as the information about business measures such as product cost and purchase quantity to enable a multidimensional analysis of company's spending.

At the time dimension table, it can be found the characteristics of the calendar year illustrated in different time periods, e.g. year, month, days, which plays a key role in the query design. The "time support dimension" catalogue version is also represented to facilitate the query and navigation process.

The currency dimension is represented in other table, including standards related to companies' transactions. The currency characteristics represent the transaction currency and the local currency.

The buying organization dimension is used to identify the operating entity and can be mapped to the company structure to represent the diverse objects of an organization and their relationships.

The dimension classification system and supplier organization include navigation features related to products and suppliers, i.e. "DUNS Number" and "CCS code", which are the attributes to identify products and supplier groups in the system.

In the second star-schema of the model, the fact table includes the product price and the values are represented in the transactional currency, applying thereof the data available in the e-catalogue platform, see figure 6.8.

Moreover, the products have a unique identifier that represents the same product in different e-catalogue versions to make possible the sourcing process that will be focus of the next chapter.
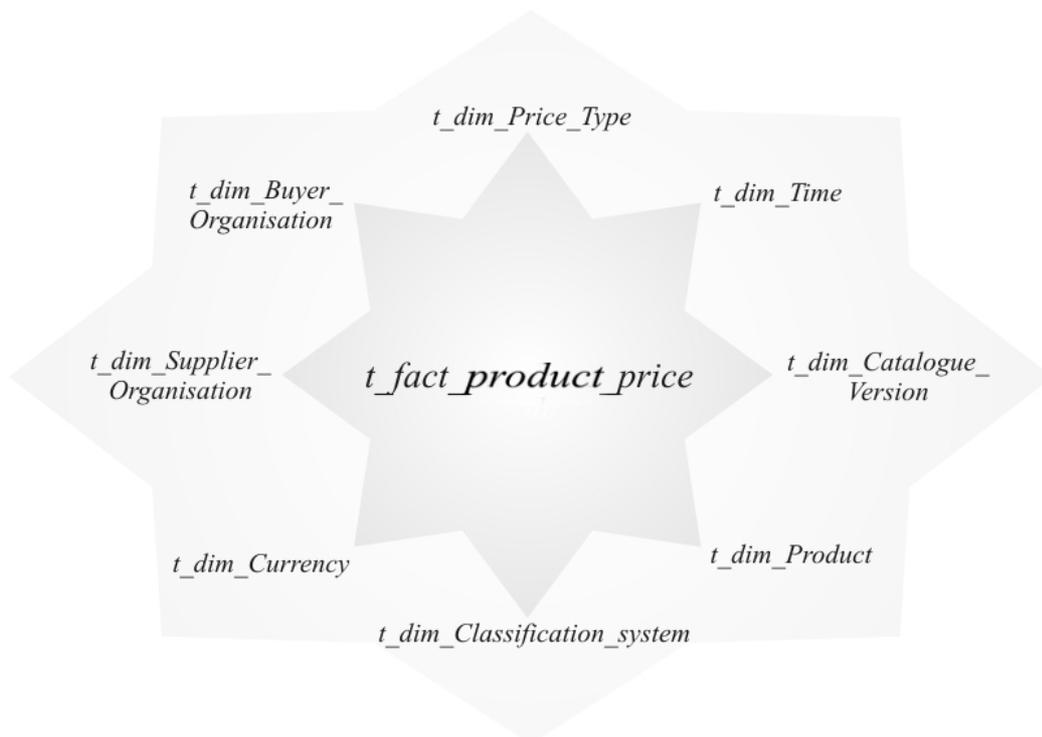
Figure 6.8 Star Schema – Product Price

The dimension tables are the same as in the figure 6.7, with the addition of the price type dimension, which contains the information necessary to analyze the price behaviour of a product based on different price types, e.g. net price, total price, tax price, etc. This model deploys the net price as standard for the spend and source analyses.

The fact table communicates with the dimension tables by the adoption of primary keys, which designate the foreign keys of the dimension tables. On the other hand there is no relationship between the dimension tables, see figure 6.9.

This relationship enables spending analysis based on favourite dimensions and in different detail levels, hence the dimension table has to include all information about a specific business entity, e.g. Supplier – supplier name, address, Duns Number, etc.
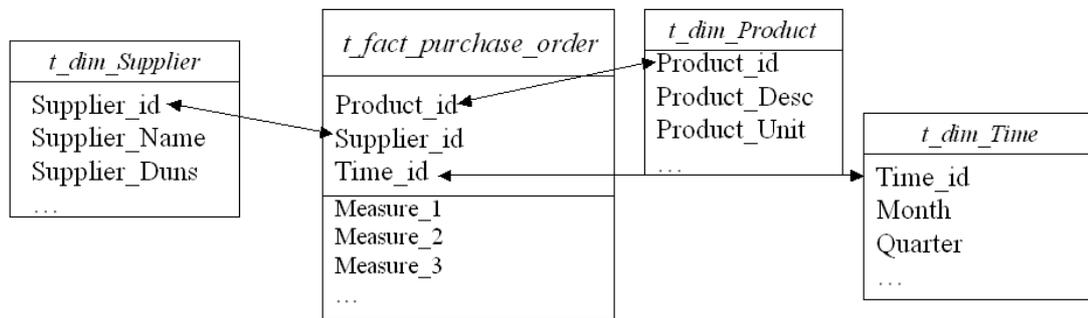
Figure 6.9 Relational Representation

6.4.3.3 Reporting

Based on the requirement analysis results, it was designed a flexible reporting environment in which users may access their information in two distinct, but familiar views. These two report modus make possible for buyers to analyze their spend information in different perspectives and detail, facilitating their decision making process:

1) Standards reports that were configured to attend buyer's everyday needs in a web application direct at the electronic catalogue platform. They consist of "static" reports, which were customized in the reporting tool to provide pre-defined views that are considered interesting by project managers to the purchase department daily activities.

   These reports contain pre-established attributes which cannot be changed or moved, providing users with an intuitive and comfortable user interface in which analysts can navigate through pre-defined report views, navigation trails and evaluation models, reducing so the training costs and increasing the system usability.

2) The Pivot table report offers, on the other hand greater flexibility to end-users and a familiar environment that applies Excel to generate different reports, using the well-known Excel functionalities.

   These reports are adequate to power-users, who prefer to have individualised reports and views of their spending data. The available functions enable purchase managers to personalise their analyses by means of filter criteria, e.g. time, buyers, material groups; display of attributes at the horizontal or vertical axes, addition or suppression of an attribute and so forth.

The OLAP technology let buyers navigate in the data pool to search for relevant information and access their analytical reports. The fundamental functionalities of an analytical system were allocated centrally in the business information warehouse with an OLAP processor, which has as its main goal the translation of user's queries and the reproduction of the typical OLAP features to navigate through the result set [ChGH05].

1) Using the Roll up and Drill down functions, users can navigate through different detail levels, e.g. from a monthly to a yearly view (Roll up) or from a Material group to specific product (Drill down);

2) Through the filter function selection, users can select the needed information, this can be done by applying the Slice and Dice feature, e.g. Check all products of a supplier along the years.

3) Rotation to roll the hypercube around its axes to generate a new bi-dimensional view, often applied in spread sheet programs, e.g. Pivot table (MS Excel).

To improve system's usability and reduce the access to irrelevant information, the reports were further divided in two distinct areas: controlling and process reports.

The Controlling reports deal with organisation's spending with a financial approach, enabling the analysis of company's purchase expenditure in a buying volume perspective, the main reports are:

- Companies spending by time;
- Spend by category;
- Contract volume goals versus supplier orders;
- Spend by supplier;
- Supplier overview by time;
- Forecast potential savings / Spend amount.

The Process reports give a view of company's spending in a process oriented approach to support the purchase department with the design and execution of their business processes, the main reports of this group are:

- Order quantity per supplier;
- Average order volume per supplier;
- Number of active suppliers per category and their perceptual order volume within the category;
- Difference in price across business units for the same supplier;
- Difference in price over time for the same supplier.

In addition, to effectively analyze company's purchase behaviour, the system must provide absolute as well as relative measures to users. The application of a single measure often does not supply the information required to analyze business facts properly.

Therefore, the system may provide absolute numbers, e.g. revenue, costs, profit, etc., as well as benchmark information, e.g. plan data, competitors' information, other market benchmark. Other applied instruments to support business analysis are the application of ratios and indexes.

In summary, the requirement analysis elucidated some design criteria that has been addressed during the system conceptualization, for example:

- Illustration of product portfolio based on material groups and suppliers;
- Standard and Ad-hoc reports functionalities;
- Application of graphical analysis methods, e.g. Trends, Portfolio, ABC-analysis;
- Integration of OLAP functions with MS-Excel (Spread Sheets);
- Inclusion of a Help function.

The solution permits the customization and creation of new reports without the need to change the data model or the data warehouse, since the business reports have been integrated just on the report tool.

The idea is to create a simple, but consistent spend analysis environment, offering the minimum number of reports to buyers to transform data into spend information and assist managers to answer their business questions and carry out their decision making process, without to overload them with information, which would not deliver anyway any further value-added to company's spend management programs.

For each user was defined a group of independent views of the data which can be accessed without impacting the performance of the system or other users activities, enabling the simultaneous access of numerous users by the application of a client-server environment in which the data transfer between server and clients is rigorously monitored.

6.4. Spend Intelligence System Limitations

The application scenario of the spend intelligence solution developed in this work is limited to mature supplier relationship management projects, which applies e-catalogue platforms to manage its product and supplier information and the catalogue search engines to start the purchase order process.

The empirical study has demonstrated that a relevant number of German large enterprises apply e-catalogue solutions to manage its indirect goods and services purchasing, what ensures the potential and the significance of the described application to companies.

However, this solution leads, on the other side, to a slide deterioration of the data quality, in what is regarded to the precise representation of the purchase volume, as the information acquired is based on the shopping card data, which represents just the purchase requisition sent to the ERP system and/or supplier.

This purchase requisition can then create or not a product order to suppliers, the reason is just that the purchase requisition is only a "product request", which occurs at the beginning of the buying process and will go through a validation procedure until it is approved or not by the e-procurement system or an employee's supervisor. Other source of data discrepancy is the application of SRM systems to start the purchasing process without the utilisation of the e-catalogue search engine.

Nonetheless, the adoption of the e-catalogue search engine is an interesting alternative to reduce the extraction process costs and increase the data quality, since current e-catalogue projects show that in most cases more than 90% of the purchase requisitions become a product order, and the utilisation of other operational systems to initiate the order process is generally not expressive.

Finally, the hypothesis that the extraction of transaction data from e-catalogue search engines would generate a satisfactory data pool for organisations to carry out their spend analysis process of indirect products was also endorsed through interviews with purchase managers of current e-catalogue projects.

7 e-Sourcing

In chapter seven is explained the electronic catalogue sourcing tool designed based on the previous spend intelligence solution construction portrayed in chapter six. Hence, the chapter initially introduces the e-catalogue sourcing tool approach (section 7.1), which is further detailed throughout the e-sourcing process and function description in section 7.2. Section 7.3 describes then the ETL and storage processes designed especially for this feature.

7.1 e-Catalogue Sourcing Tool

In order to support the indirect goods and services sourcing process in companies, the work introduces the application of the e-catalogue platform combined with the previously described spend analysis tool.

This approach extends the existing functionalities of the two modules to offer an environment in which alongside spend analysis features, buyers have the possibility to execute their indirect material sourcing process electronically based on reliable data and employing statistical and simulation methods.

The required information to support the negotiation process is extracted mainly from the e-catalogue platform and its respective search engine, though deploying a marginal different ETL process, data storage and data structure methodologies that is presented in section 7.3.

The purchasing master data, e.g. product ID, product description, is obtained directly from the e-catalogue platform, while the relevant ordering information, e.g. product price, monetary volume, product quantity, etc., is extracted from the search engine. The spend intelligence tool is applied then to collect, normalise, classify and display the information in a user-friendly way.

Based on this information, sourcing relevant analyses, e.g. suppliers' price behaviour, e-catalogue portfolio simulations, customer satisfaction level, etc., as well as electronic request for quotation (e-RFQ) processes, can be carried out to determinate an appropriate source strategy and potential suppliers for a buying organisation.

The e-catalogue sourcing tool has been designed according to current purchase process' practices, which involve the following demands on the overall system concept:

- Support the purchase strategic planning;
- Demand recognition;

- Identification of potential suppliers;
- Negotiation capabilities;
- Spend saving analysis;
- Supplier performance and customer satisfaction measuring;
- Content management.

The approach can be used in a number of different sourcing scenarios, although its main objectives are the reduction of manual tasks and the boost of companies' bargain power via the increase on the process control.

For the purpose of understanding the introduced approach, the next section describes the suggested e-sourcing solution, applying for it, the description of an ideal sourcing process based on the framework's functionalities.

7.2 e-Sourcing Process and Function Description

The lead buyer principle is employed in several large German organizations in the area of indirect goods procurement. This method applies the product segmentation into material groups as a pre-requisite for the introduction of a material group management, thus a precise classification of goods and services in classes or groups is crucial to the success of this approach. This is reflected in all purchase activities, i.e. at the strategic, tactical as well as operational levels.

A material group management team is composed of buyers and technicians of various business units, which are managed by a superior lead buyer, who establishes together with the high management the purchasing department objectives and often negotiates with the organisation's key suppliers.

The main objectives of the lead buyer concept are the cost reduction of the products acquired as well as the indirect costs of purchase and supplier management processes, mainly by the application of bundling strategies, process reengineering and the deployment of information technology.

At the beginning of each year, the material group management team establishes the goals of the purchase department, which has often as its main goal the cost reduction of the department in a certain monetary value or in a defined percentage of current material as well as process costs.

After the annual strategic goals are defined, the superior lead buyer has to analyze with his/her team the procedures that have to be carried out, and as the case may be, to decide in which material groups, suppliers, and in which extension the cost reductions will take place to achieve the organization's strategic objectives.

163

Once the goals of each purchase group have been established, buyers start to seek with their respective suppliers the commercial conditions to attain their personal objectives by means of price reductions and product portfolio bundling.

The framework introduced in this chapter assists buyers from the strategic planning process described above to its execution by the application of the e-catalogue platform and the spend analysis module as presented in the following sections.

Nonetheless, before introducing the sourcing process and the respective system functionalities, the entities that are involved in the process are introduced for a better understanding of the described process and their involvement in the framework:

Buying Organization

The buying organization is the highest element (entity) of the system. It represents an organization and as the case may be its subsidiaries as well as their relationship between each other.

A Buying organization can be considered either as a consolidated group of enterprises, thus having just a general company code, or it may be embodied by a group of individual companies, each having its company code and been connected with a higher entity which is the holding company.

Buyer

The entity buyer embodies the purchase department's employee, who is responsible for the operative as well as the tactical procurement business processes, it executes most tasks in the introduced framework, including in its duties the systems' administrative assignments as well as the control over other entities activities, e.g. supplier, system user, third part service provider.

Manager (Lead Buyer)

Under this concept is represented the purchase department employee, who has a key role in the strategic purchase process and assumes the responsibility and control over the purchase department activities and results. In the illustrated sourcing process, it can be also indentified as the lead buyer personnel.

Internal system user

The internal system user is the entity, which performs the purchase requisition from any department of an organization, although the procurement activities are not part of their function. It represents the internal customer of the purchase department and along

with the purchase requisition task, it may incorporate also the supplier evaluation function.

Goods receiving department

In case an organization adopts a central receiving department approach, there is the necessity to include a new entity, i.e. goods receiving department, in the organizational design, which will take over the supplier evaluation task from the internal system user entity.

Third part service provider

Third part service providers can be deployed to intermediate the business relations between a buying organization and its suppliers, thus they incorporate part of the sourcing process tasks, according to company's purchase strategy.

Supplier

The entity supplier represents a company's commercial partner, and it requires a link or domain in the e-catalogue sourcing solution to communicate and exchange information with an organization or its third part service provider.

This entity can be divided into two sub-groups, current business partners, which have access also to the e-procurement functions of the e-catalogue platform, and potential suppliers, which have access temporally just to the e-sourcing function of the platform.

7.2.1 Strategic Planning

A crucial task of the strategic planning is the forecast of the future purchase demand of an organization. This forecast should not be done based just on products and services, but instead it should take into account material groups, suppliers as well as the buying organizations.

In order to perform the demand forecast, the material group management team requires actual as well as historical information to investigate the purchase behaviour of the buying organisation and its suppliers. Only after a detailed analysis of this data they can decide for logical and reachable objectives for its department.

The spend analysis module offers a number of reports to boost this evaluation, which includes diverse OLAP functionalities such as Roll up and Drill down functionalities as well as filter features.

First of all, the management team has to find out the total purchase volume of the previous year and its evolution along the past years to compare them with other relevant

business information, e.g. commercial and financial reports, pre-defined company's goals, etc., with the aim of predicting the future demand of the purchase department.

This analysis is based on business objects, e.g. product group, supplier, buying organization, etc., which can be dispersed in a flexible time approach. The aggregation and disaggregation of the business objects can provide a data portray in different consolidation levels, which enables the design of diverse reports to support the forecast process.

A large number of forecasts can be performed on a high aggregation level, e.g. material group, and for a long period of time, e.g. a year. Hence, a Top X ranking report has been designed to support this analysis and it can be customized to generate ABC-curves of favoured material groups, as shown in the example from table 7.1.

Material Group	2008		2007		2006		2005	
	Spend Volume	Number of Orders	Spend Volume	Number of Orders	Spend Volume	Number of Orders	Spend Volume	Number of Orders
Office products	€ 40.000,00	950	€ 38.000,00	870	€ 35.000,00	810	€ 32.600,00	740
Tool	€ 37.000,00	1350	€ 36.000,00	1150	€ 33.654,00	1005	€ 31.000,00	870
Electric engineering	€ 32.000,00	750	€ 30.000,00	700	€ 28.200,00	608	€ 27.150,00	532
Marketing	€ 25.000,00	650	€ 23.500,00	600	€ 21.750,00	459	€ 20.864,00	389
Home technology	€ 21.000,00	100	€ 19.300,00	86	€ 17.250,00	71	€ 16.532,00	62
...	€ 38.750,00	1800	€ 36.700,00	1560	€ 33.963,00	1420	€ 32.000,00	1294
Total	€ 193.750,00	5600	€ 183.500,00	4966	€ 169.817,00	4373	€ 160.146,00	3887

Table 7-1 Top X Ranking Report

The material spending, classified in rankings and/or using the ABC-curve, can be illustrated with graphical representations in different colours, e.g. A-material groups in green, B-material groups in yellow and C-material groups with no colour. In addition, chart functionalities are available to transform the table figures in visual friendly diagrams.

In this report, the columns Spend Volume, Volume Evolution, Number of Orders and their impact on the total purchase volume can be determinate and sorted as required. Thus buyers can learn at a glance which material groups have the largest/lowest impact on the total purchase volume and their evolution, on a historical basis.

The report, in the example above, demonstrates precisely which material groups impact most the purchasing costs and in which groups cuts can be done to achieve the global goals of the company. A detailed view of a specific material group is also possible, clicking on the desired material group on the report.

The new report that will open, shows the list of suppliers within this material group and their sales volume, regarding this specific product group with the buying organisation, see table 7.2.

166

Suppliers	2008		2007		2006		2005	
Office products	Spend Volume	%	Spend Volume	%	Spend Volume	%	Spend Volume	%
Offfice Depot	€ 16.500,00	41%	€ 14.050,00	37%	€ 11.423,00	33%	€ 10.560,00	32%
Corporate Express	€ 8.050,00	20%	€ 6.500,00	17%	€ 5.600,00	16%	€ 4.800,00	15%
MRO	€ 7.600,00	19%	€ 5.900,00	16%	€ 4.950,00	14%	€ 4.100,00	13%
Gilbert	€ 5.006,00	13%	€ 3.540,00	9%	€ 2.980,00	9%	€ 2.560,00	8%
Karstadt	€ 1.524,00	4%	€ 1.230,00	3%	€ 1.150,00	3%	€ 1.150,00	4%
...	€ 1.320,00	3%	€ 6.780,00	18%	€ 8.897,00	25%	€ 9.430,00	29%
Total	€ 40.000,00	100%	€ 38.000,00	100%	€ 35.000,00	100%	€ 32.600,00	100%

Table 7-2 Supplier per Material Group

Of course, if necessary, a deeper view of a vendor can be provided including the supplier's total sales divided by material groups and their evolution. It has to be noted that the analysis can be executed in various detail levels, as the information available in the data warehouse has been stored at the document level.

The price indicator report shows the product price behaviour based on a time series analysis of the material prices. This evidences the average supplier price comportment, whether it was constant, increasing or declining, thus indicating if a price increase/decrease was long overdue, or if the suppliers of a segment tried to maximise their profits in the last years.

Nonetheless, for a better appreciation of company's spend analysis, it is recommended the integration of key ratios and benchmarks. Hence, a global strategic analysis should not be just oriented by organisation's internal data. A comparison with external indices, e.g. inflation, material groups and market segment price development, etc., may illustrate better the real company's performance and facilitate the decision making process, based on external and independent market trends.

After the overall objectives have been decided and the cost reduction goals in each material group are arranged, the superior lead buyer and his/her team can select and execute the best sourcing strategy for their materials and suppliers:

- Negotiation with current suppliers;
- Initiation of a negotiation process with current or new suppliers;
- Suppliers bundling;
-Etc.

7.2.2 Current Supplier's Portfolio Negotiation

The negotiation price with current suppliers is the most common negotiation process in companies and it represents more than 80% of the total negotiation activities in the indirect goods purchase process, according to the interviewed buyers, see figure 7.1.

It is also the simplest process supported by the framework in the area of electronic sourcing. The standard process is automatically triggered by the nearing of the purchase contract expiration.

The management team decides a timeframe in which the product price negotiation should take place, before the contract ends, e.g. two months before it. Once the defined timeframe is achieved, the system checks both, if the buyer has already started a negotiation process with a supplier, or if there is the necessity to begin this process through the procedure start approval, from the side of the responsible buyer.

In case that there is the necessity to carry out this process, the e-catalogue platform sends via its notification system, an e-mail requiring a new e-catalogue version of a supplier, with the prices for the next contract period. This process is repeated until the supplier imports its new e-catalogue version in the platform.

Once the new e-catalogue version is approved by the seller, the catalogue is published and an e-mail is sent to its responsible buyer, who has to perform the new price proposal analysis, before approving or rejecting the new supplier e-catalogue and, as a consequence, its new price conditions.

The evaluation of new price conditions has two main purposes, first to assess the financial impact of these new price conditions, and second, in case the negotiation took place out of the platform, to control the conformity of the contract's conditions previously negotiated with a supplier.

The framework backs the assessment task in different ways:

1) Multiplying the previous order volume of a product (Qa) with its new price (Pan) and adding this result to all the products ordered from the catalogue of this supplier, during the last contract or in a defined period of time.

New purchase volume (Np) = Qa*Pan+ Qb*Pbn+ ... + Qx*Pxn

Optionally, it can be configured the possibility to add an index to the previous formula, e.g. the average consumption evolution (Ca) concerning a product group along the years.

New purchase volume (Np) = Qa*Pan* (1+Ca) + Qb*Pbn*[1+Cb] + ... + Qx*Pxn*[1+Cx]

2) In order to demonstrate the total monetary difference between the two periods and in consequence its respective financial impact, the tool calculates the difference of the new

purchase volume in euro, based on the new price conditions (Np) and on the former price terms (Nf).

Diff = Np-Nf

Nevertheless, the single estimation of the financial impact is yet not enough to evaluate the new price conditions. Buyers have also to detect which products are the cost drivers and which of them had high price increases, especially because, the practices show that in the area of indirect goods purchasing, suppliers often have frame contracts with hundreds of products, although less than 20% of these products are effectively ordered by the buying organisation.

Hence, the framework enables, through the use of filters, the selection of just ordered products and their visualisation in different ways to analyze their price comportment and the impact on the supplier product portfolio, see table 7.3.

Office Depot	Order Volume (PP)		Order Volume (FP)		Total Volume Difference		Proposed Price (PP)		Former Price (FP)		Unitary Difference		Order Quantity
Product A	€	10.920,00	€	9.800,00	€	1.120,00	€	1.560,00	€	1.400,00	€	160,00	7
Product B	€	11.200,00	€	10.800,00	€	400,00	€	1.400,00	€	1.350,00	€	50,00	8
Product C	€	6.860,00	€	7.350,00	-€	490,00	€	980,00	€	1.050,00	-€	70,00	7
Product D	€	6.000,00	€	5.800,00	€	200,00	€	150,00	€	145,00	€	5,00	40
Product E	€	4.160,00	€	3.900,00	€	260,00	€	160,00	€	150,00	€	10,00	26
Product F	€	2.470,00	€	2.350,92	€	119,08	€	95,00	€	90,42	€	4,58	26
Total	€	41.610,00	€	40.000,92	€	1.609,08	-		-		-		

Table 7-3 Products' Purchase Volume Behaviour

In case the supplier's price suggestion is accepted, the e-catalogue is approved and the negotiation process is concluded. Otherwise, the new or the actual e-catalogue version can be applied to perform price simulations to support buyers during their next negotiation round with this or other potential suppliers.

These simulations can be done directly on an Excel sheet, which can be generated exporting the data sets from the system and converting them into a spreadsheet format. The originated table may contain all or just selected products, so buyers can adjust the product price analysis as desired, taking advantage of the known MS Excel features until he/she reaches his/her desired cost reduction.

This information can be either sent to the supplier or used to back the negotiation process. In case an agreement is not met, an alternative supplier has to be selected. The framework assists this search and selection processes, by seeking a supplier in the internet and supporting the appropriate negotiation process.
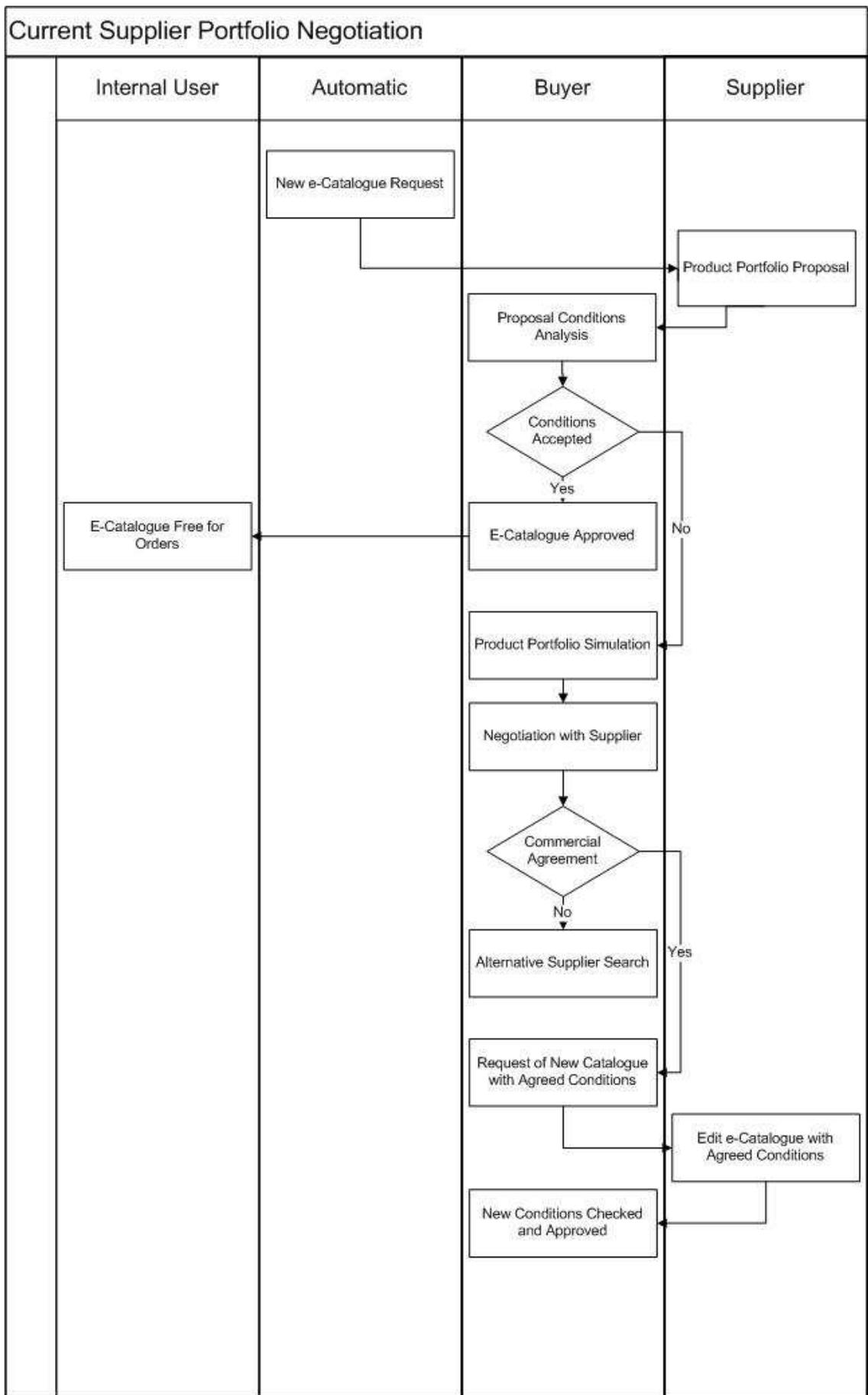
Figure 7.1 Current Supplier Portfolio Negotiation

7.2.3 Supplier Evaluation

The supplier selection process is a complex task that can take place in different ways, e.g. selection of a complete new supplier, selection among current suppliers, division of a supplier portfolio into several suppliers, etc.

At the same time, the criteria to select new suppliers are numerous and depending strongly on the company's politics. The most common attribute used to select a supplier in the indirect goods procurement field is price, along with other qualitative information, which in the last years it has become the most appropriate approach to support the supplier's selection process.

In the market, there are few examples of internet application systems, which support both kinds of sourcing analysis processes. Therefore, the framework concept suggests the expansion of the electronic catalogue dashboard functionality to assist a multi-attribute e-RFQ process.

The supplier evaluation process is designed to be performed by the e-catalogue platform's end users and in companies that apply a central receiving department, by the employees of this division.

In this approach, end users have an additional task during their buying process: the assessment of companies' current suppliers, via the application of structured ratings based on scales, which will be available in the e-catalogue search engine.

The decision to apply solely ordinal and cardinal scales was taken to facilitate the normalization, extraction and analysis process of end users' assessments. A free text evaluation approach would increase drastically the complexity of this procedure, thus it would be hardly possible to be effectively deployed in organizations' procurement department routine.

This task must be executed by an end user or a receiving department employee, due to the often deployed decentralized approach, in which buyers are responsible from one side for the supplier selection, but end users execute the order requests and the product receiving process.

Therefore, the concept has incorporated the end users into the evaluation process, including them indirectly in the decision-making process, via the appraisal of company's suppliers performance.

The end users evaluation supports then the decision-making process of company's buyers, concerning either the extension of a frame contract with a supplier, or the development of a supplier into a strategic partner.

The data acquisition is conducted, while either the end user or the receiving department employee gets the material ordered and verifies the criteria established by the purchase department. This employee enters then his/her evaluation in the system, using a cardinal scale to indicate his/her satisfaction level on each criterion, for example:

- Product quality;
- Price;
- Inquiry response;
- Service;
- Delivery time punctuality;
- Supplier assortment.

The collection of numerous users' feedbacks enables buyers to abstract their internal customer approval regarding a supplier, based on their objective judgment of a supplier's performance.

Nonetheless, companies have to decide if the data acquisition is configured to be an obligatory task of the purchasing process, or if it will constitute an optional activity for their internal users.

The data input is done via the utilization of a standard form at the users' interface. Once the data acquisition has occurred, the data sets are stored in a database to be normalised and grouped with the evaluations of other users.

The aggregation process happens in the data warehouse of the spend intelligence tool introduced in chapter 6. The aggregation and normalization route is performed in a way that no user has a higher weight then another, so before the addition process is started, the system has to execute a mean calculation to gather all evaluations of a particular user in a single position.

This procedure increases the appraisal quality related to a supplier performance, providing buyers with an additional subside to carry out their decision making process, while evaluating a seller or comparing its performance with other suppliers that provide the same material group to an organization.
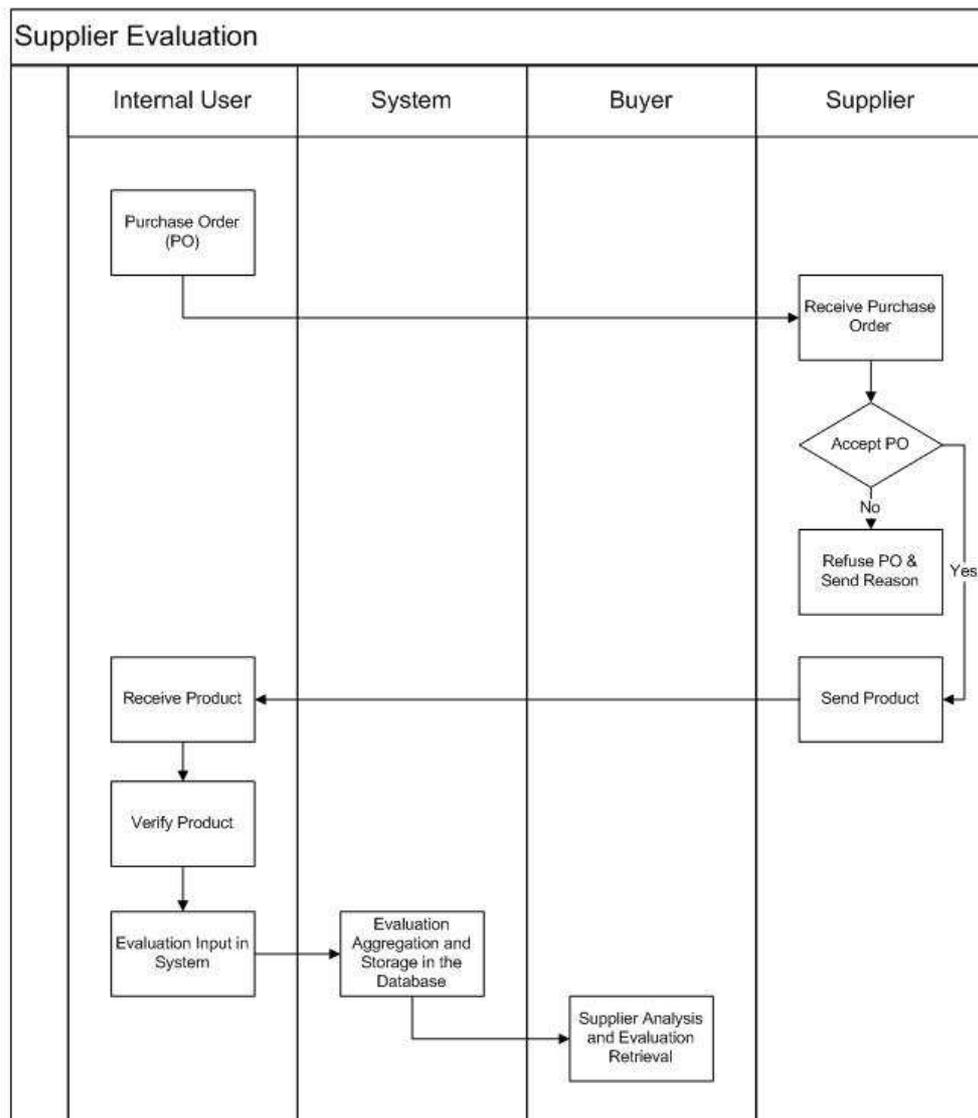
Figure 7.2 Supplier Evaluation

7.2.4 Alternative Supplier Search

The simulation of the purchase cost of an alternative provider and its comparison against competing suppliers is a crucial aspect of the supplier selection process. Companies often have a major supplier of a product group, who is its primary reference source, though a couple of alternative providers of the same product group are generally available in the enterprise's portfolio.

Before companies search for an alternative supplier outside of its current business relations, they should first look for an alternative among their available suppliers. The framework facilitates this job by the search of substitute suppliers in the same material group and their comparison in the spend analysis tool.

The illustration of two or more suppliers who offer products within the same material group can be done without problems. Nonetheless, the exact conciliation between two suppliers at the product level requires a much greater effort, as in their product

catalogues the same product may contain several discrepancies in their product attributes, e.g. different short description, different manufacturer, but the same material group, etc.

In the case of a similar product, produced by the same manufacturer, it is possible the adoption of classifications based on a unique and unambiguous identification criterion such as the International Article Number (EAN).

However, in the case of two identical products, but from different manufacturers, the identification has to be carried out using the product descriptions and their technical properties.

This leads to the situation in which the more the complexity of the product the more the matching effort, thus with the purpose of solving this problem, the following alternative supplier searching approach was conceptualized.

The semi-automatic mapping concept aims at the allocation of identical products from both different manufactures and different suppliers, based on the current catalogue version of those suppliers.

The application tries, on the basis of technical product properties and the deployment of a specific algorithm, to find potential substitutive products in the selected supplier electronic catalogue.

For products for which no corresponding counterpart in the alternative catalogue can be found, the system will deliver a set of products that may fit the product mapping requirements.

At this point, the buyer has to select manually from this set the products that fit the specifications and to delete the ones that could not be allocated to any product of the alternative catalogue.

After the identification and allocation of substitutable products, the expected financial impact when replacing the supplier, in absolute and relative values, can be calculated as well as the price difference of specific products. In addition, a link between individual products and a detailed view of their attributes can be configured.

This analysis may be done based on the order quantity of the reference catalogue (1) or with the addition of the order quantity of both catalogues (2). The formulas below demonstrate both of the evaluation methods:

1) Multiplying the order volume of a product (Qr) from the reference catalogue with the product price of the alternative catalogue (Pa) and adding this result to all products ordered in the catalogue during the last contract or other defined time period.

Expected purchase volume (Ep1) = Qr1*Pa1 + Qr2*Pa2 + ... + Qrx*Pax

2) Multiplying the sum of the order volume of a product (Qr+Qa) from both catalogues with the product price of the alternative catalogue (Pa) and adding this result to all products ordered during the last contract or a defined time period.

Expected purchase volume (Ep2) =

(Qr1+Qa1)*Pa1 + (Qr2+Qa2)*Pa2 + ... + (Qrx+Qax)*Pax

The total monetary (Mdiff) and percent (Pdiff) difference between the total order volume based on the alternative catalogue price (Na) and the reference price conditions (Nr), can be calculated applying the formulas:

Diff = Na-Nr

diff= Na/Nr

It has to be noted that different suppliers may apply different units of measure to market their products. If this is the case, the calculation must be expanded to convert the different unit of measure into an unequivocal value. The computation is done by the conversion of the unit of measure adopted by a supplier in a unique parameter at its basic unit.

The introduced alternative supplier searching approach shows whether the alternative supplier would offer more favourable terms compared to the reference supplier or not. Nonetheless, this functionality is not only for the analysis of alternative provider eligible.

It is also recommend checking at any time if similar products or product groups from different suppliers are available in more favourable condition and indicating them as the "best buying" product to end-users. This would reduce costs and open future possibilities for a bundling program.

However, this concept has some disadvantages:

- The error prone and costly manual intervention;
- The product mapping may not be always sufficiently accurate;
- This method ignores the cost reduction possibility, while bundling the suppliers.

7.2.5 e-RFQ Function

Having this in mind, another concept has been designed to support buyers to define the best approach to select a supplier, whether a new supplier or an alternative supplier from current organization's portfolio.

The framework applies an e-RFQ based on the electronic catalogue technology to compare and select suppliers based on quantitative data. This method solves the problematic regarding the product matching through the application of e-catalogue templates, generated on the e-catalogue platform of the buying organisation, see an example in the table 7.4.

e-RFQ	Order Volume (Pa)	Order Volume (Pb)	Order Volume (Pc)	Proposed Price (Pa)	Proposed Price (Pb)	Proposed Price (Pc)	Order Quantity
Product A	€ 8.400,00	€ 8.750,00	€ 8.050,00	€ 1.200,00	€ 1.250,00	€ 1.150,00	7
Product B	€ 10.000,00	€ 10.800,00	€ 9.200,00	€ 1.250,00	€ 1.350,00	€ 1.150,00	8
Product C	€ 5.250,00	€ 4.550,00	€ 5.950,00	€ 750,00	€ 650,00	€ 850,00	7
Product D	€ 6.400,00	€ 6.200,00	€ 5.800,00	€ 160,00	€ 155,00	€ 145,00	40
Product E	€ 1.950,00	€ 1.820,00	€ 2.080,00	€ 75,00	€ 70,00	€ 80,00	26
Product F	€ 2.548,00	€ 2.626,00	€ 2.470,00	€ 98,00	€ 101,00	€ 95,00	26
Total	€ 34.548,00	€ 34.746,00	€ 33.550,00	-	-	-	-

Table 7-4 e-RFQ Analysis

There are two application scenarios in which this methodology can be used:

1) The analysis of alternative suppliers within company's portfolio: In this procedure, buyers need first to identify the suppliers which have a substitutive product portfolio oriented by the material groups, deploying thereof either the method described above or simply the products' material group. After these vendors are identified, the e-RFQ process should be conducted, including those suppliers.

2) The e-RFQ is carried out with actual and other potential suppliers; hence the decision about the execution of an open or closed e-RFQ has to be made. By an open e-RFQ, any supplier who has access to the supplier portal can participate; on the other hand, by a closed e-RFQ, just suppliers who were invited can join the process.

In order to be able to carry out this process, it is required the deployment of a specialised e-catalogue supplier portal, in which the e-RFQ process can take place. The conceptualisation of the supplier portal is focus of chapter eight.

On the condition that the necessity to execute an e-RFQ is identified, the catalogue template, including those products for which the RFQ will be done together with their technical proprieties and their brand/mode, has to be created.

The e-RFQ data model should provide users the data structure necessary to exchange the required information to support this procedure. Hence, the information regarding the products that are part of the e-RFQ process is a critical issue of the data model concept.

The goal of the e-RFQ data model is to create a product description that from one side, makes possible the unambiguous identification of a product or service, and from the other side, allows the entry of variable data from suppliers.

For this reason, it is necessary the division of the data model into two categories, see tables 7.5 and 7.6:

- Fixed attributes, which are product specifications adopted by the buying organization with the aim of describing the products to suppliers. They cannot be edited by the suppliers and generally it includes parameters to characterize the desired product and service;

- Variable attributes, are the product specifications that are going to be edited by the e-RFQ participants and define their commercial conditions or proposal to the buying organization.

  The necessary information is defined by the buying organization, although the effective information regarding the commercial conditions and supplier identification is given by the suppliers.

Product Attribute (Fixed)	Data Type	Mandatory	Comment / Example
Product_id	Alphanumeric	Yes	Unambiguous / Unique identifier
Short Description	Text	Yes	Product description with less than 40 characters
Long Description	Text	No	Product description containing between 41 and 200 characters
Standard Classification System	Code	No	eCl@ss
Organization's Classification System	Code	Yes	Proprietary or standard classification system
Currency	Code	Yes	Transaction currency
Organization	Text	Yes	Buying organization
Quantity	Number	Yes	Product contract quantity
Unit of Measure	Code	Yes	Piece, Kilogram
Size	Number	No	Product's size
Weight	Number	No	Product's weight
Other product parameters	Alphanumeric	No	In case, there is other product specifications

Table 7-5 e-RFQ Data Model (Fixed Attributes)

Product Attribute (Variable)	Data Type	Mandatory	Comment / Example
Supplier	Text	Yes	Supplier legal name
Supplier product number	Alphanumeric	No	Product number at the supplier side
Price	Number	Yes	Product price proposal
Delivery time	Number	Yes	Expected delivery time
Payment condition	Reference	Yes	Selection of one of buying organization's payment conditions
Quantity discount	Alphanumeric	No	Possible discount models
Order Unit	Number	Yes	minimum / standard order unit
Image File	Multimedia	No	Picture, film
Manufacture	Text	No	In case product from another producer

Table 7-6 e-RFQ Data Model (Variable Attributes)

The templates containing the product specification is then sent electronically to the supplier portal, at the same time that an automatic e-mail is sent to potential suppliers. The template can be either manually generated by buyers or, in case the products already exist in the e-catalogue platform, a derived catalogue containing just the descriptive attributes can be extracted.

Simultaneously, the system allocates an e-RFQ number for each potential participant, which consists of the e-RFQ number plus the supplier number, to guarantee an unambiguous identifier.

In the case that a supplier is still not a member of the network, the e-mail should contain also a provisory login and password as well as a short tutorial / leaflet about the template editing process.

The suppliers can either participate on the selection process or they can reject it, in this case they should provide a reason to refuse the e-RFQ, which can be given in free text or selecting from a pre-defined list available in the system and standardized by the buying organization, which will use the response for future buying decisions.

Supplies which decide to participate on the bid process, need to identify the products that they have in their portfolio, according to the information disposable in the template, and complete the template on-line or in an excel sheet with the quantitative data requested, e.g. price, deliver time, discount quantity and so forth.

The products that they do not have in their portfolio should be refused and the system represents the lack of the product with an empty field, so that they will not be part of the analysis.

After the supplier has completed the information and approved his/her inputs, the complete catalogue is sent back to the buying organisation along with a communication e-mail.

This procedure closes the supplier processing task and generates in the system respectively the status supplier e-RFQ completed and received, including the respective timing as soon as the buying organization system acknowledge the template receiving.

Once all the participants have sent their fulfilled templates back to the buying organization, purchasers can initiate their analysis process, applying for it the already introduced OLAP functionalities and filters, and if the case may be, select the most appropriate provider for those products or start a new selection process.

For tiered prices products, a filter was designed to allow buyers to select between the analysis of these products based either on their first lower bound, the average order volume or the most common order volume of each product.

An on-line tracking functionality has been designed to provide buyers with the possibility to trail their e-RFQ events via the access of the workflow data and its status. In this manner, the e-RFQ can be controlled from its start until the final supplier analysis and potential selection. And in case it is required, communication mechanisms, e.g. e-mail, can be applied to speed the procedure up.

The tracking functionality has it focus on the collection of data concerning the e-RFQ process and its representation to the responsible buyers, for this purpose the status

information is gathered and stored in the data base for on-time checks and future process control and improvement proposals.

Before a buyer approves and publishes a selected e-catalogue in the e-catalogue procurement platform, the contract conditions as well as the contract itself, has to be generated and sent to the supplier to be signed.

Therefore, the e-RFQ data sets can be exported to a database system, e.g. Access from Microsoft or to a customized database in the e-catalogue platform, which contains contract models of different products groups and can be configured in diverse forms, e.g. create new contract, additions, configuration of different paragraphs, deployment of standard contract model.

The generated contract can be sent electronically to the supplier including an electronic signature and once the supplier has agreed with the contract conditions, a template with the complete product information is sent to the supplier for its import, in the e-catalogue procurement platform, following the usual approval process.

On the other side, the e-RFQ data will be once more used to check, at the buyer side, if the contract conditions have been respected during the creation and approval of the new supplier catalogue.

The proposed approach is an effective method to identify and evaluate suppliers of indirect goods with no single or large product offers due to its capacities to appraise electronically the financial implication of multiple products quotation, without the product identification issue, at the same time that it assists buyers with their bundling analysis.

Figure 7.3 Alternative Supplier Search

7.3 The ETL and Storage Process

The data necessary to perform the e-sourcing process is extracted from the e-catalogue platform, e.g. product, organisation and supplier data, and from the search engine database, e.g. ordering data, as well as from other less relevant external data sources. For more detail please read chapter six concerning the spend intelligence conceptualization.

Nevertheless, the ETL-process has incurred in some modifications to attend the requirements of the e-sourcing activities, without impacting the performance of neither the source system nor the spend analysis module.

The acquisition of the e-catalogue data, which includes information about products and the e-catalogue itself, is triggered via both the approval of the supplier e-catalogue, as well as the buyer catalogue, see figure 7.4.
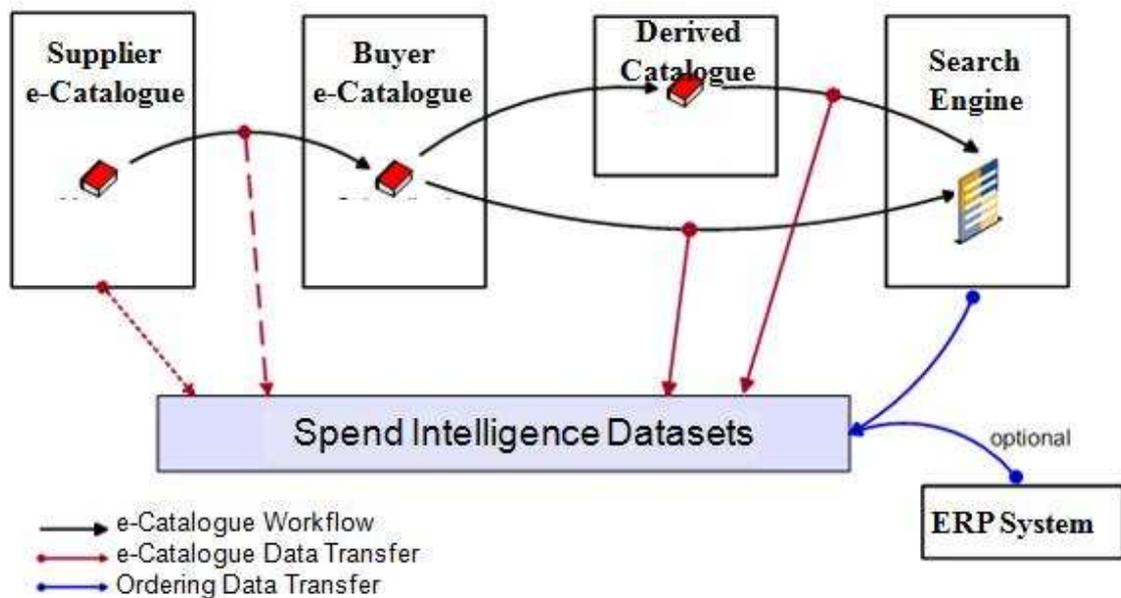
Figure 7.4 e-Catalogue Workflow - Sourcing ETL Process

The catalogue data export is integrated directly into the system workflow, and since this is configured independently for each catalogue, the system administrator has the chance to select the appropriate workflow for every catalogue, i.e. include an instant data export to the spend analysis module.

On the other hand, the ordering data acquisition is configured to occur once per day, at night, to not affect end-users daily operational activities, by the deployment of a scheduling program that controls the interval of the data transfer, from the search engine database to the business intelligence solution.

The e-catalogue data extracted from both the supplier catalogue and the e-RFQ catalogue, which are used essentially for the assessment of alternative material sources, are temporary stored in the business intelligence database.

From these two e-catalogue types, just pre-defined assessment relevant attributes are transferred to the temporary storage and used in the product portfolio evaluation process, e.g. price, product description, delivery time, discount quantity, material group, etc., and only when the e-catalogue is approved by the buying organisation, the definitive storage in the database takes place.

In the case of the e-RFQ catalogue, the template has to be first created by a buyer, who can do it either manually or by preparing in the e-catalogue platform a derived catalogue, which may contain a complete catalogue, a subset of a catalogue or a combination of several supplier catalogues.

After the template is generated and sent to the RFQ participants with the descriptive product information, the suppliers can complete the catalogue information and sent it back to the buying organisation, where the data are extracted and analyzed.

In both scenarios the primary product identification key of the e-catalogue platform data structure is the "product_id", which does not offer a clear identification of identical products from different suppliers.

Therefore, there was the necessity to create a supplementary secondary key on the e-catalogue platform, to allow the comparison of identical products from different providers through the use of a well-defined and analytical friendly identifier.

The identifier consists of a "product_id" and the combination of the "supplier_id" and the "catalogue_version". This combination creates a unique code that appears just once on the table and gives the system an appropriate identification code to back the sourcing process.

The essential information is temporary stored in the database, in a separate data structure, to increase queries and computation performance. The main advantage of this approach is the reinforced consideration of the functional requirements during the modelling of the two data structures to increase the system capacity and reduce the respective data structure complexity.

The e-catalogue data transfer to the storage area is an independent process, which is specialised on the acquisition of the temporary data and its singularities. The extraction of the permanent data is handled by a second ETL-process, which has been already described in chapter six.

The temporary data is kept in the database during a pre-defined timeframe. However, it is given to buyers the possibility to recover this information if the data has been deleted before the necessary business analysis has been carried out.

The e-catalogue sourcing tool introduced in this chapter has been designed to improve the current practices of indirect goods' sourcing process due to the fact that most sourcing activities in this area are done currently manually or with a limited level of information systems application.

The solution includes a supplier negotiation as well as a supplier evaluation functionality, which together with the other functionalities of the framework, provides companies with an innovative environment in which buying organizations can perform their entire source-to-order process electronically.

8 Supplier Portal

The chapter introduces the supplier portal concept applied to support the framework. In section 8.1 is introduced the supplier portal concept that is further developed in section 8.2, which deals with the technical requirements of the solution. Section 8.3 explains then the supplier portal architecture and finally in section 8.4 it is described the core portal processes.

8.1 Supplier Portal

The introduction of internet portals in the business environment has allowed companies to perform their marketing as well as their cross company communication activities through the World Wide Web, applying different information systems to support their electronic transactions and participate in virtual networks.

This practice has dramatically impacted operational and analytical systems usability and delivered a number of benefits to company's activities, e.g. process improvement, cost reductions and increase in revenues.

Indeed, the Internet access in the European Union has achieved its mature stage with more than 90% of the European firms in all size-bands and sectors (except food and beverages) connected to the Internet.

Nonetheless, less than 30% of these firms carry out online purchase in a volume greater than 5% of their total purchasing volume, and less than 20% perform some kind of marketing and sells activities online [Empi05].

The key to enable a secure and user-friendly e-business environment and so to increase the commercial use of the internet is the deployment of supplier portals for companies to interact with their business partners.

Even the biggest supplier network today has only a small fraction of the suppliers in the world. That also means that any company using a supplier relationship management solution needs to compare different supplier networks to see which ones have the most suppliers with which they want to do business, as well as which ones have the best tools for bringing new suppliers onboard [Bart07].

Therefore, this chapter introduces a dedicated indirect material supplier portal model, which integrated with the tools previously described in this work, fulfils the framework that the author believes will enable organisations to overcome the current obstacles to succeed in their e-business initiatives, while assisting them in their electronic business processes.

8.2 Technical Requirements

The supplier portal has been designed using standard solutions based on open source technology to facilitate the integration with other existing information systems that support companies' supplier relationship management activities, while keeping the development and maintenance costs as low as possible, see figure 8.1.
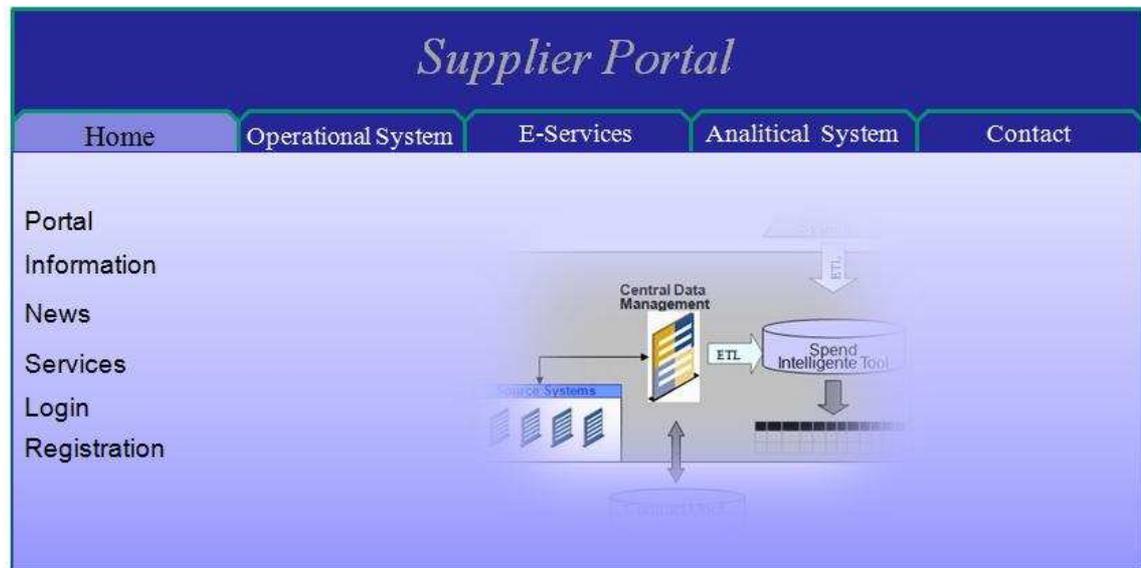
Figure 8.1 Supplier Portal

The application and its components were conceptualised according to global accepted specifications, i.e. Java Specification Request 168, q.v. [JSR07], Web Services for Remote Portlets, q.v. [WSRP07], HTML, XML, etc., to guarantee the smooth integration with diverse back-end solutions.

The widespread deployment of those standards which are supported by numerous large software houses, e.g. BEA Systems, IBM, SAP, Sun Microsystems, ensures the long-term viability of the supplier portal without incurring in high maintenance costs.

In addition, the deployment of portlets to access content and back-end systems functionalities gives users the freedom to personalize their portal views depending on their own needs, which increases the extend of the portal usage and facilitate the daily operation of diverse applications.

Portlet is a pluggable Web component managed by a portlet container. It provides dynamic content as part of an aggregated user interface and it can be added to and removed from dynamically. The portlet container manages the life cycle of the portlets and handles requests from the portal by invoking portlets inside the container [RAVL04].

Users can personalize their portal layout as well as the portal content, adding and/or deleting pre-defined portlets, using for it the dedicated edit-mode of the solution. In

order to customize the user interface, the portal applies web feed technology, e.g. RSS to provide users with actual information and to allow the access, from the portal, to other information systems.

Therefore, the necessity to allocate the relevant users' rules, e.g. buyer, supplier, visitor and their respective personalised access to individual portlets, thus a user can only call the functions which he/she has been given by the portal rights management mechanism. This mechanism can be further mapped to other modules to enable a single-sing-on functionality.

With the purpose of optimising the usage of the application, the number of portlets was kept as few as possible. The following sections describe the portal architecture as well as the services provided to users by the application, which should enable users to manage the entire framework developed in this work, while given them the impression that the entire solution consists of a unique environment.

8.3 The Supplier Portal Architecture

The introduced supplier portal suggests a new approach to overcome the limitations of current e-Business portals. The proposal is to use a web-based infrastructure to allow companies to access a range of e-Services of crucial importance to their virtual activities, while using their current corporate infrastructure.

The commercial transactions are supported essentially by an electronic catalogue platform, which provides the adequate technology to foster business relationships due to its appropriateness to manage electronic product and supplier information, communicate with diverse back and front-end systems and provide a powerful search engine to discover products, services as well as potential customers and suppliers.

The architecture was divided into diverse layers to facilitate the understanding of the portal design and maintain its conceptualization as short as possible. The infrastructure consists of four layers, i.e. a technology layer, an e-Services layer, an e-Collaboration layer and an e-Trust layer, see figure 8.2.
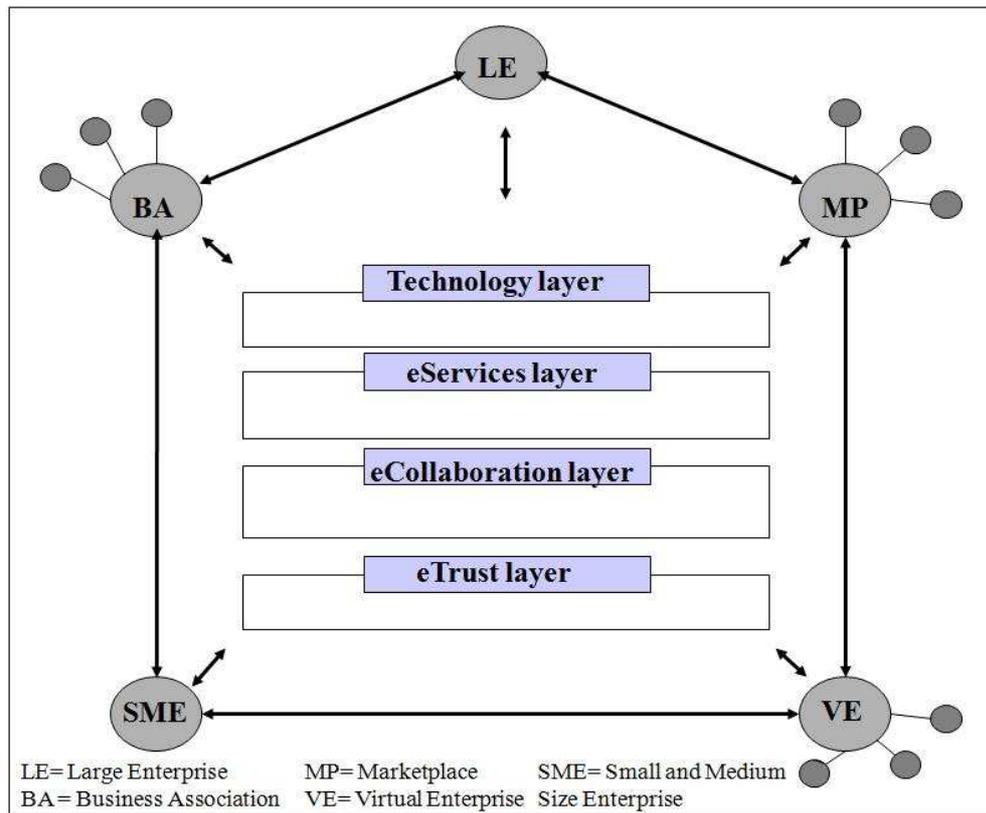
Figure 8.2 Portal Architecture

The following sections describe each layer and its functionalities in detail:

8.3.1 Technology Layer

The portal is composed of web applications that enable the access to the network by anyone who has a broadband internet, at anytime and anywhere. These applications have been designed based on current standards, e.g. eXtensible Markup Language (XML), to facilitate the electronic communication between different organizations, to guarantee an easy maintenance and to ensure the future of the portal.

The main components of this layer embrace, but are not limited to:

- Portlets to access back-end systems;
- Workflow applications to support business processes;
- Messaging services to support the exchange of messages across company's boundaries, e.g. inform of a new e-RFQ, reminders, request of additional assortment information, etc.;
- Standard e-catalogue management system to assist the exchange and management of product information;
- Advanced search engine to discover products, services and commercial partners in the network;

- e-Sourcing application;
- Supplier management functionalities.

8.3.2 e-Services Layer

The e-Services layer, together with the e-Collaboration layer, is the centre of the network. At this layer, companies can find components and services to manage and improve their e-Business activities.

This layer allows companies of all sizes, regions and sectors an access to a range of products and e-business services, which facilitate their virtual presence in the marketplace with an affordable price.

The layer is based on a repository that works as an e-Library, which provides a pool of the current major e-Business standards, e.g. eCl@ss, UNSPSC, BMEcat and their respective versions, to maximize the interaction capacity for companies and boost the application of world-class classification systems.

The services are divided into strategic and operational services: Strategic services are services that make possible companies to adopt the best e-business strategies in the indirect material field, providing organizations with the support in areas such as process and spend analysis, sourcing and content management.

On the other hand, operational services assist companies to focus their efforts on higher value-added opportunities for their business, leaving low-value activities to be automated or semi-automated.

Other services that are available in the e-Services layer are:

- Process Wizards to facilitate the use of the web applications;
- Central company and product database, i.e. a kind of advanced yellow page to reduce the search effort for new products and partners;
- Customization services to adopt the portal interface to the user's needs and personalise the components into company's business processes;
- Ranking of supplier services and other parameters specified in the network to improve vendors selection;
- Etc.

8.3.3 e-Collaboration Layer

One of the main objectives for companies to join a virtual network is to collaborate with their business partners in order to improve their business processes and gain competitive advantage. Therefore, collaboration tools are of vital importance to cultivate a successful e-Business strategy.

The collaboration infrastructure as it happens in the e-Services layer was designed based on existing e-Business standards to enable the interoperability of different systems and facilitate the commercial transactions.

In the internet era companies are developing constantly new business and relationship models with their partners. Nonetheless, the diversity of systems and processes has been acknowledged as the biggest barrier to achieve an effective communication level throughout the supply chain.

The e-Collaboration layer intends to support companies and their business partners during their transactional processes in the marketplace, by applying a group of tools and methods that facilitate companies' e-Business activities, providing standard features such as:

- Electronic catalogue management to exchange product and services information between business partners;
- e-Catalogue generation based on current business standards, e.g. BMEcat, EPC (GS1), eCl@ss, UNSPSC [Poet05];
- Negotiation tools, which can be either based on auctions that after the price agreement could be automatically transformed into a valid e-catalogue, or in an e-catalogue schema, in which bids can be done on a multilateral negotiation approach [CaSt06, 207-212];
- Search mechanisms to find products and services from company's suppliers, and in case that company's current suppliers do not have the desired product, a search could be done at the e-Library repository located at the e-Services layer to find candidate suppliers, based on free text or classification codes search, e.g. eCl@ss;
- Business process workflow based on standard processes, e.g. ebXML [Erl04].
- An access management tool to control the access rights based on cooperation status, rules and privileges of their staff;
- And the possibility to include invoicing and payment services to facilitate business transactions.

8.3.4 e-Trust Layer

Trust is considered as the most important challenge for virtual networks success, besides the technological framework and its interoperability. Therefore trust-building mechanisms should be developed to enhance trust between the network members and to

promote a reliable atmosphere to balance simultaneous competing and collaborating behaviour.

The first step to achieve this goal is to create a registration center, in which companies can describe their profiles and offers, which can be accessed and administrated by a user password.

This information would be then available for all members of the network, who during their business relations with other organizations can publish their comments on companies performances based on parameters especially designed to cultivate member's reciprocal trust, q.v. [Heß08].

Other important mechanisms that have been made available in the network are:

- Security mechanisms to guarantee information and company's privacy, e.g. encryption, authentication, digital signature.
- Secure access of information and functions, e.g. access control, privileges, domain model to ensure company's strategic information security, q.v. [PeJo07];
- Common rules and laws that must be accepted by all members of the network, during the registration process;
- Members evaluation;
- Etc.

8.4 Portal Standard Processes

In order to have access to the portal services, users are supposed to register themselves in the portal. Otherwise, they will have just a limited view of the network, which is restricted basically to the portal's news and information, e.g. contact data, services description, partners, and the registration portlet.

The registration occurs directly on the web-page, when users have to identify their business group, i.e. supplier or buyer, and additionally inform their organisation's data, contact person as well as their assortment based on a standard classification system, which has been pre-defined during the portal's configuration, e.g. eCl@ss.

The portal identifies automatically the user group´s requirements and rights and it will allow the access to user´s specific information and functionality, which may be customized over time.

However, the registration process is not concluded until the data authentication is done through the user's e-mail address and the confirmation of the contact data with the password on the page linked to the confirmation e-mail, which must be changed after the first login.

The portal has as its main users: suppliers and buyers organisations, which have different demands. These requirements must be defined in the general supplier and buyer rule management mechanism to provide specific functionalities to each user group and within a user group to each individual user.

The **supplier** registration can take two paths:

1) The supplier portal works in an open mode, which allows the registration of any company interested in joining the network; in this scenario the application offers a mechanism in which suppliers can create their user account on-line by the submission of the organisation's information;

2) The portal consists of a close network in which the suppliers are first pre-selected by a buyer and just then they can join the network with the login provided by the buying organisation.

To register to the portal, users apply the supplier registration portlet which supports the supplier account creation process. The registration process is divided into three subsequent steps assisted by a process workflow wizard.

The first step consists of the introduction of the organisation's data, e.g. name, address, contact person, etc. And once the information is inserted, the data is sent to the portal and the next mask comes up, but beforehand the validators' check the provided information for possible input errors, e.g. incorrect e-mail, missing information, etc.

In case the information is correct, the contact person, e.g. employee, mask comes up and must be fulfilled. Finally, in the third mask, suppliers have to input their product portfolio according to the classification system appointed in the portal, e.g. eCl@ss, which will constitute, together with the company's name and location, the main information to support the supplier search in the network.

After the account has been stored in the portal, a confirmation e-mail is sent to verify the account data, and after it is confirmed, the account may be definitively stored in the database and activated.

Suppliers can though edit their company's information at any time through the supplier data administration portlet, which is just available to existing suppliers and is secured by their login data.

A third rule was implemented to manage and maintain the supplier portal. The **administration** rule is addressed to a limited number of power users, who have the right to deploy new portlets in the solution, create/edit/delete user accounts and establish users' rights in the administration portlet in the portal server.

This is important to keep safe the maintenance of the system and the security of user's information, which must not have access to other users' business information, unless a business relation between the organisations takes place or, as the case may be, a general vertical hierarchical relationship, e.g. buyer->supplier is available in the portal configuration.

For security reasons, the creation of **buyers'** account is just possible through the administration portlet by a portal administrator, as buyers may have access to critical information from other organisations present in the network, i.e. suppliers.

After the account is created, a notification e-mail is sent to the buying organisation contact person, who has to connect himself/herself in the portal at the buyer login portlet, to confirm and/or to edit their company's data, to change their password and to save the correct and most actual company's information.

Once the accounts are created, users have access to general portal information / news as well as their specific e-services available at the portal, which were established during the account creation, e.g. e-catalogue platform, e-sourcing, business intelligence reports, etc.

The subsequent connection to the portal is done via a user login and a personal password, which identify unambiguously the user in the system. With the purpose of increasing the system's security via the users' authentication and the data exchange integrity, it was adopted a public key certificate, which includes a digital signature, maintained by a certificate authority.

After the system login, the user is identified and a customized interface of the portal is displayed together with the disposal of individual views and data sets, which limited the available functionalities and data sets to the essential, increasing so the overall system performance.

The portal personalization can be carried out based on individual users or general user groups, e.g. end user, supplier, thus standardized profiles may be created for each user group or department, which would reduce the systems maintenance costs.

On the other hand, this approach increases the system usability via the presentation of user-friendly and intuitive interfaces to inexperienced users, along with more sophisticated views and functionalities to power users.

The portal can be customized in diverse ways. However, without to forget the main purpose of the framework, which is the management of electronic business relations between buyers and suppliers, consequently the portal provides a number of services to support these business processes:

- At the supplier side, the key services delivered by the portal are the notification of tasks, e.g. additional information request, assortment request, catalogue/e-RFQ initiation, etc.; transactional system access, statistical reports as well as a range of support services to facilitate the creation of e-catalogue and the general use of the portal, e.g. tutorials and user guides.

  Due to the relative complex process of e-catalogue creation, especially for non previous e-catalogue users, the introduction of content management service teams to assist suppliers during the creation of their e-catalogues and e-RFQs is recommended.

- At the buyer side, the major services are the management of supplier's information and their respective accounts, supplier's search and selection inside the portal as well as the management of the notification mechanism to configure the automatic notifications of tasks in the portal or to other independent e-mails addresses, e.g. while the creation of new suppliers, new e-catalogue versions, information updates and so on.

The authentication and authorization checkout are executed automatically by the portal, first to ensure the users' access to the system, e.g. validity period, data sets and functions access, and then to warrant that the user perform just admissible requests in the system, e.g. view of permitted product groups, connection with allowed suppliers, etc.

The portal includes a supplier management portlet to assist buyers with the exhaustive task of supplier account and e-catalogue/e-RFQ management. In this portlet, a range of functionalities are available to back users with these processes, see figure 8.3:

- Detailed supplier account information, including their creation dates, organisation, contact person and assortment information;

- e-Catalogue history, and in case the referenced supplier has already imported a catalogue, a link to the previous catalogue versions in excel and text format is available;

- Management of suppliers catalogue;

- Search engine, i.e. supplier and assortment;

- Supplier account activation, cancelation and deleting functions.
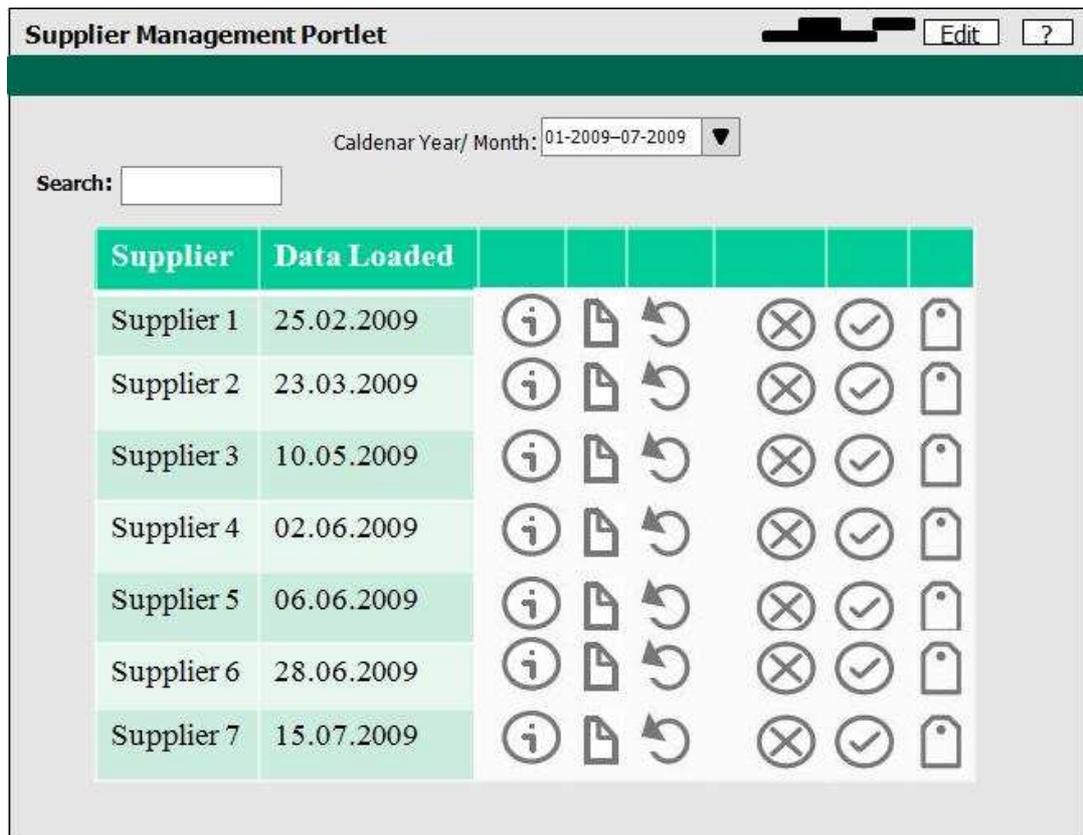
Figure 8.3 Supplier Management Portlet

Indeed, one of the key issues addressed in the portal is the management of e-catalogue and e-RFQ creation, distribution and analysis, as well as the general control over buying organisations spend.

These processes can take place in different ways, being the most common one the creation and management of e-catalogue by suppliers using the supplier domain of the e-catalogue platform.

The work suggests the division of suppliers according to their relationship status with the buying organisation and their e-catalogue process knowledge:

- Supplier A: Suppliers which have previous knowledge of e-catalogue creation and product classification, and are already registered in the transactional system of the buying organisation.

  These suppliers are responsible for their own catalogues and RFQ processes from the bid through the catalogue creation and distribution in the e-catalogue platform to their respective maintenance.

- Supplier B: Consist of suppliers which have basic knowledge of e-catalogue creation and product classification, and are already registered in the transactional system of the buyer organisation.

195

The suppliers type B receive their first catalogue version from the buyer organisation and based on the first catalogue template they have to maintain their e-catalogues up-dated in the e-catalogue platform.

During a bid process, these suppliers become the e-RFQ template on the portal and have to complete the requested information, e.g. price, delivery time, and upload the catalogue again on the portal.

- Supplier C: They have no previous knowledge neither of e-catalogue creation nor product classification, and may or may not have previous electronic commercial relation with the buying organisation.

  In this case, the account manager at the buying organisation must carry out the e-catalogue processes for these suppliers, they have no access to the e-catalogue platform and when they participate of a bid process, they perform the process as illustrated to the supplier type B.

The portal offers a range of portlets to assist the e-catalogue import, e-RFQ process management and the access to the e-catalogue platform. The e-catalogue portlet allows the access to the e-catalogue platform directly from the portal, in which suppliers can perform their e-catalogue and e-RFQ processes.

The e-RFQ process portlet has on his first page the list of all bids that are occurring at the time, including their information, e.g. bid timeframe, bid name, bid participants. The portlet includes functions to administrate the bid process, e.g. edit, cancel, delete, etc., and a link to the detailed view of a bid, in which the list of participants and their e-RFQ templates can be downloaded or imported to the e-catalogue platform, where the sourcing analysis occurs with the support of the business intelligence tool presented in chapter 6.

The portlet offers also a search engine to facilitate the navigation in the portlet and a depository functionality to keep the bid processes' history. At the supplier side, other portlet assists the bid procedure with the following functionalities: bids information, detailed view and template download/upload in a pre-defined format, e.g. MS Excel, CSV, BMEcat. Nonetheless, in this portlet suppliers can see just their information, which can be edited as often as required until the bid's deadline.

For suppliers type B and C, the portal gives them the possibility to get their e-catalogue templates and upload their worked versions direct on the portal in a specific format such as MS Excel. Besides that, the portlet provides information and indexation features.

In this section, it was described the main processes and portlets of the supplier portal. However, the chapter did not intent to provide an in-depth view of the network concept, instead it gives a general conception of the portal that can be understood by both business users and IT specialists.

The chapter yet achieves its goal to provide readers with the overall view of the portal conceptualisation, and IT experts with the key elements of the portal design, completing the general objective to give users and researchers the information system model to expand current e-catalogue systems towards a more efficient and effective mechanism to support the complete indirect goods supplier relationship management process.

9   Conclusion

The later developments in the global economy and the increase in market competition caused mainly by the concentration process of companies, the reduction of markets' entry barriers, the increase on customer's demand and the high speed on product innovation, have forced companies to look into their business functions more critically with the purpose of finding new ways to gain and maintain distinctive competitive advantage.

The purchase department due to its high potential to impact company's performance has happened to be one of the main functions to be addressed in order to leverage enterprise's competitiveness, which has changed dramatically their employees' routines and the department status within the modern organization, from a merely administrative division towards a strategic driving function.

In this context, the information system technology has played a key role and has been implemented in companies for the last decades coming a long way, ranging from EDI to connect organizations to their strategic suppliers, ERP systems including dedicated purchasing functions, to extensive and specialised supplier relationship management solutions, which aims to cover the entire purchasing cycle from the demand identification to the order / contract management.

The main goal of this research is from one side the analysis of German supplier relationship management practices through the application of an empirical research among large German organizations with the purpose of identifying the state-of-the-art of the SRM solutions and their deployment in companies as well as of elucidating the trends in the area, which will influence the future developments of this technology.

The research is though not limited to the general SRM concept, but rather it has extended its focus towards other web-applications which have emerged from the necessity to manage indirect goods and service purchase processes, which includes in particular the electronic catalogue technology.

Therefore, the research has been concerned also about obtaining crucial information in relation to this solution with the purpose of creating a concept, which can be employed to expand the capacity of e-catalogue systems to communicate with other solutions and manage a wider scope of activities within company's supply chain.

The information gathered in the first part of the work has been applied during the conceptualization process of three new functionalities which are either integrated into the e-catalogue platform or consist of an expanded part of the original solution, i.e.

central data management, business intelligence and the e-Sourcing tool as well as a specialized e-catalogue supplier portal to facilitate the communication between business partners and the systems' access.

The literature review, which is the focus of the chapter two of this study, has discussed concepts and theories in the area of the information system strategy and the deployment of electronic business applications in companies.

The chapter provides the required background in the area to give the author the information necessary to develop and carry out the empirical research, at the same time that it provides readers with the essential knowledge to understand the discussions and contributions of the work, which includes business management analysis as well as information technology issues.

Based on previous market studies and on the literature review, the empirical research has been designed and conducted to analyze the adoption of supplier relationship management solutions by large German organizations with the aim of elucidating the state-of-the-art of those systems and to confirm and to draw trends that have been used to develop a new solution to support current and future e-business needs of large organizations.

The sample consists of 445 organizations from which 92 companies have participated on the survey. The respondents were mainly high managers allocated either in the purchase or in the supply chain department of their enterprises.

The participants come from different sectors of the German economy, e.g. automobile, mechanical engineering, chemical, service, technology, etc., which has granted to the study a widespread perspective and a neutral investigation of the research problem.

The majority of the respondents deploy for quite a long time supplier relationship management solutions, thus providing the research a mature and experience view of the issues addressed.

The survey results have demonstrated that the SRM solutions regarding the management of indirect materials and services play an important role in large German organizations strategy, with most companies applying some sort of information system to support their purchase processes.

Nonetheless, as previous studies have indicated, different SRM solutions have different maturity grades in what is concerning their technological functionalities as well as their implementation stage in companies.

The closer analysis of the survey's results has revealed some key trends in the area of indirect material SRM solutions and practices, while reinforcing the idea that companies will continue to increase their investment on these technologies with the purpose of improving and expanding their purchase processes supported electronically. The main findings of the research can be resumed as follows:

- The e-procurement applications have achieved already their technical maturity;
- However, higher integration level has to be achieved between those applications and other systems of the organization;
- The level of the purchase volume under e-procurement initiatives is still relatively low;
- And most projects implement e-procurement solutions just in a limited number of material groups, e.g. office materials, tools and electric engineering;
- Data consistency among companies procurement content have still not reached the desired level;
- In contrast to the e-procurement functionalities, most of the e-sourcing functionalities have still not achieved its maturity;
- Compliance management is an issue that has not been properly addressed by the e-procurement vendors;
- The benefits of spend and contract management are gaining more and more attention from companies;
- The transparency of the purchase processes and data as well as the strategic approach to SRM projects are perceived as crucial for the success of a SRM project;
- Integrated SRM features including contract management, spend analysis, ordering and payment are required;
- Companies have started to face new matters to their projects, e.g. management of complex material groups, integration problems, etc.

At the managerial level, it seems that the majority of the respondents have underestimated the end-users acceptance influence on their supplier relationship management projects.

In the last years, supplier relationship management solutions have been implemented and often have not achieved their full potential either due to the lack of user acceptance or misleading project planning.

As supported by the survey results some key elements have been ignored, e.g. system users, integration issues, project scope, new system functionalities, etc. This has implications for both, managerial and technological developments as well as the return on investment of the SRM solutions.

On the other hand, based on the findings concerning the technological aspects of the subject, the work has proposed the following framework to improve current electronic purchasing practices and reduce the functional limitations of the available SRM solutions for indirect materials and services.

The Framework concept description starts in chapter five with the design of a central data management solution to improve the data quality and consistency, which should enable a higher integration potential among diverse companies' purchasing systems, while increasing the data and process transparency.

Therefore, the work introduces the concept of an electronic catalogue platform deployed both as a central database and as the leading repository of company's SRM information.

Nonetheless, in case the model is implemented in a mature SRM environment, the impacted applications have first to be integrated to enable the smooth exchange of master data between the different systems.

The framework applies a mix of mappings and matching tables to support the consolidation and harmonization process of the available data, while deploying a sophisticated monitoring mechanism to guarantee the data import and export process between the different solutions.

In order to increase the data consistency, reduce the data redundancy and improve the framework performance, the work has defined the data model in a way that just the essential data is represented and stored in the central repository with the aim of reducing potential performance pitfalls in the framework.

The e-catalogue platform adopts a proactive data control and enrichment process, which validates the imported data through the application of a range of validation rules and constraints before storing the data in the central database.

In addition, the concept has included a data classification method to support suppliers and buyers during the product classification process based either on proprietary or standard classification systems.

In chapter six, the spend intelligence tool is introduced, applying therefore a general business intelligence concept to design a dedicated indirect material business

intelligence environment, including but not limited to its ETL process, data model construction and its logical and reporting design.

In view of the application scenario in which the business intelligence module is going to be applied, i.e. the spend analysis process of indirect goods and services. The work has suggested the division of the relevant business information into two distinctive categories: 1) product, buyer and supplier information; and 2) the transaction data.

The data sources applied to extract this information are mainly the e-catalogue platform and its search engine, which should reduce dramatically the ETL process costs, assuring the system flexibility and increasing the data quality due to the developed central data management approach.

During the application functional design, the work has its focus on the ETL process and the multidimensional data modeling. In this part of the research, the minimum requirements of the data structure as well as the extraction and transformation process has been described.

The integration concept has been developed on a purely business perspective point-of-view, having in focus the business dimensions and their logical representation in the solution reference model.

In addition to the concept design, the research has recommended a range of standard and customized reports divided into controlling and process information, which may be changed, deleted or added with other reports and/or key performance indicators without the necessity to modify the entire BI solution.

Derived from the spend intelligence module and the e-catalogue platform, a sourcing functionality has been conceptualized to support the indirect goods negotiation and supplier evaluation process.

Chapter seven introduces an ideal process model in which the framework may be applied to support the negotiation process of catalogable products and services. The ideal model is consisted by a step-by-step process description of an e-catalogue based sourcing process.

The process phase is divided into strategic planning, current supplier portfolio negotiation, supplier evaluation, alternative supplier search and the e-RFQ procedure. Furthermore, the specific ETL process, required to acquire and convert the data in the right format to enable the execution of the e-sourcing activities, has been described in this chapter.

Finally, in chapter eight, the supplier portal concept used to facilitate the electronic communication between two or more business partners is portrayed. The proposed

portal intends to create a devoted environment in which indirect product and supplier information can be exchanged and the above mentioned framework can be accessed, while increasing the interoperability of the diverse SRM solutions.

The main focus of the supplier portal is on the development of a broad e-Business infrastructure for companies to communicate with their business partners, while promoting electronic commerce and co-working initiatives.

The proposed architecture is underpinned by a web-based infrastructure consisting of Technology, e-Services, e-Collaboration and e-Trust layers. Through these layers, the infrastructure should provide the support for trading functions, data and system integration, network building and trust development between the portal participants.

Even though the research has contributed to elucidate key questions concerning SRM solutions and their implementation in companies as well as the definition of new trends in the area, there are some limitations to the study, which is recommended to be further addressed in future researches.

The research intended to generalize its findings in a broad basis, however it must be noted that the sample is consisted by a group of large German organizations. Therefore, in order to validate the survey results or increase its extension, the study must be either carried out in other countries or in other market segments, e.g. small-and-medium-size-enterprise sector.

By doing so, the survey results could be compared between different countries and market segments, giving a better understanding of the actual and future situation of the supplier relationship management practices.

Other in-depth research is required to elucidate some specific findings of the research as for example, the reasons for the actual low level of spend volume under management and the system acceptance among business users.

The study has focused on the indirect good SRM projects with the special emphasis on the e-catalogue platform deployment, limiting the findings concerning other modules of the SRM system landscape.

Regarding the concept design, its application is adequate either to mature e-catalogue projects or to companies which are planning to base their future indirect good purchase process on this technology.

The main goal of the framework is to increase the application scope of current e-catalogue solutions, while increasing the number of functionalities available to buyers and suppliers to perform their electronic purchasing processes.

Nonetheless, even supposing that this approach would deliver to companies' purchase processes a satisfactory or even a considerable better technological approach compared to other internet applications, this hypothesis has not been proved during the research.

In conclusion, although the research has given an in-depth and at the same time broad perspective of current SRM technology and practices, there is still the necessity to undertake further research to look at this important area of the information system technology.

Supplier relationship management solutions are still in its early life as the research results have demonstrated, thus researchers have to investigate consistently new application areas to anticipate potential market trends to develop innovative solutions to improve the current systems' functionalities and capacity as well as companies' purchasing processes.

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Appendix

A: Presentation E-mail

Sehr geehrte Damen und Herren,

worin sehen Sie die Vorteile von e-Procurement? Glauben Sie, dass diese Potenziale in Ihrer Firma voll ausgeschöpft werden? Würden Sie sich Verbesserungsmöglichkeiten wünschen?

Mit diesen und anderen Fragen befasst sich eine Studie, die die Universität Karlsruhe zum Thema e-Procurement realisiert.

Parallel dazu findet eine Umfrage bei den wichtigsten deutschen Unternehmen statt, zu denen Sie gehören. Die Beantwortung dauert nicht länger als 10 Minuten. Anonymität und Berücksichtigung des Datenschutzes sind gewährleistet.

Mit Ihrer Teilnahme helfen Sie, die Elektronikbeschaffung in Deutschland besser zu verstehen. Als Dankeschön für Ihre Teilnahme stellen wir Ihnen gerne die Untersuchungsergebnisse zur Verfügung.

Erreichbar ist die Umfrage unter folgender Internetadresse:
http://survey.2ask.de/292f2e80a669da76/survey.html

Mit freundlichen Grüßen

Eulalio Campelo

B: Reminder

Erinnerung: „e-Procurement Trends in Deutschland"

Sehr geehrte Damen und Herren,

vor wenigen Wochen hat die Universität Karlsruhe die Studie „e-Procurement Trends in Deutschland" begonnen. Dazu wurde ab Ende September ein Fragebogen an 450 große deutsche Unternehmen versendet.

Über X Unternehmen haben mittlerweile an unserer Studie teilgenommen. Wir möchten Sie noch einmal um Ihre Unterstützung für die Studie bitten, da Ihre Expertise wichtig ist, um die Elektronikbeschaffung in Deutschland besser zu verstehen.

Die Beantwortung dauert nicht länger als 10 Minuten. Anonymität und Berücksichtigung des Datenschutzes sind gewährleistet. Als Dankeschön für Ihre Teilnahme stellen wir Ihnen gerne die Untersuchungsergebnisse zur Verfügung.

Erreichbar ist die Umfrage unter folgender Internetadresse:
http://survey.2ask.de/292f2e80a669da76/survey.html

Mit freundlichen Grüßen

Eulalio Campelo

C: The Survey Questionnaire

01. Wie hoch ist der jährliche Umsatz Ihres Unternehmens?

    a. Weniger als 40 Mio Euro
    b. 41-250 Mio Euro
    c. 251-1.000 Mio Euro
    d. 1.001-10.000 Mio Euro
    e. Mehr als 10.000 Mio Euro

02. In welcher Branche ist Ihre Firma tätig?

    a. Maschinenbau
    b. Dienstleistung
    c. Automobil
    d. Elektronik
    e. Pharma / Chemie
    f. Technologie
    g. Handel / Großhandel
    h. Sonstiges

03. Welche Funktion haben Sie innerhalb der Firma?

    a. Beschaffung / Supply Chain
    b. Logistik
    c. Geschäftsprozessmanagement
    d. IT
    e. Finanz
    f. Vertrieb
    g. Sonstiges

04. Hat Ihre Firma ein e-Procurement-Programm für indirekte Güter?

    a. Ja, seit mehr als 3 Jahren
    b. Ja, seit 1 bis 3 Jahren
    c. Ja, seit weniger als einem Jahr
    d. Nein, aber geplant innerhalb von 12 Monaten
    e. Nein, keine Pläne

05. Welches sind die Nutzen Ihres e-Procurement-Programm für indirekte Waren?

1=trifft nicht zu – 5= trifft voll zu

a. Automatisierung des Beschaffungsprozesse
b. Reduzierung der Beschaffungskosten
c. Zentralisierung des e-Procurement-Prozesses
d. Verbesserung der Kostensichtbarkeit und Compliance
e. Schaffung von Freiräumen in Einkauf für andere (z.B. strategische) Aufgabe
f. Effizientere Zusammenarbeit mit Lieferanten
g. Erhöhung des durch Einkauf kontrolliertes Beschaffungsvolumen
h. Sonstiges:_____

06. Welches sind die Haupthindernisse in Ihrem e-Procurement-Programm für indirekte Güter?

1=trifft nicht zu – 5= trifft voll zu

a. Fehlen von e-Business-Standards
b. Fehlende Akzeptanz bei internen Anwendern
c. Beschränkte System/IT-Funktionalität
d. Widerstand und Unverständnis der Lieferanten
e. Hoher Aufwand bei der Katalogverwaltung (und technische Lieferantenanbindung)
f. Mangelnde interne Unterstützung für komplexere Warengruppen
g. Systemintegration / IT-Integration
h. Sonstiges:_____

07. Welches sind nach Ihrer Meinung die Schlüsselfaktoren für ein erfolgreiches e-Procurement-Programm im Bereich indirekte Güter?

1=trifft nicht zu – 5= trifft voll zu

a. Konsolidierung der Lieferanten
b. Bündelung der Einkaufstätigkeiten
c. e-Procurement-Prozess- Reengineering / Standardisierung
d. Verbesserte   Kosten / Leistungsanalyse
e. Outsourcing von Lieferant-Anbindung, Katalog-Management
f. Integration mit anderen Supply Chain Management-Technologien
g. Einsatz von Supplier Networks
h. Sonstiges:_____

08. Welche Systeme wendet Ihr Unternehmen an, um die Beschaffungsprozesse für indirekte Materialien zu unterstützen? Kann Tabelle nicht ausfüllen, da dann das System abbricht!

a. ERP

	Heute	Geplant innerhalb von 24 Monaten

b. e-Procurement System
c. e-Sourcing / Auktion System
d. E-Katalog System
e. EDI
f. Contrakt-Management-System
g. Lieferantenbewertungssystem

09. Wie viel Prozent Ihrer indirekten Materialen (Beschaffungsvolumen) werden elektronisch eingekauft? Es fehlt die Frage nach der Masse, d.h wie viel Prozent Ihrer indirekten Materialien (Anzahl der Aufträge) werden elektronisch eingekauft.

a. 1-15%
b. 16-30%
c. 31-50%
d. 51-75%
e. 76-100%

10. Wie viel Prozent Ihrer Dienstleistungen (Beschaffungsvolumen) werden elektronisch eingekauft?

a. 1-10%
b. 11-25%
c. 26-40%
d. 41-50%
e. Mehr als 50%

11. Wie viel Prozent Ihrer indirekten Materialien (Anzahl der Aufträge) werden elektronisch eingekauft?

a. 1-15%
b. 16-30%
c. 31-50%
d. 51-75%
e. 76-100%

12. Setzt Ihre Firma „Spend Analysis" für den indirekten Einkauf ein? Wenn Ja, was sind die Kriterien?

Ja
nein

Ausgaben nach:

a. Lieferant
b. Warengruppe
c. Einzelne Produkte

    d. Region

    e. Produkte mit höchstem / niedrigstem Volumen („ Renner / Penner")

    f. Sonstiges:_____

13. Wie verhandeln Sie Verträge mit Ihren indirekten Lieferanten? Basierend auf: (mehrfach

    a. Einzelne Produkte

    b. Gesamtsortiment

    c. Warengruppe

    d. Produkte mit höchstem Volumen – „Top-Seller"

    e. Sonstiges:_____

14. Wendet Ihre Firma andere Kriterien außer Preis an, um ihre indirekten Lieferanten zu beurteilen / auszuwählen? Wenn Ja, welche?

    a. Keine

    b. Qualität des Produktes/Dienstes

    c. Lieferzeit / Liefertreue

    d. Gesamtportfolio

    e. Technologische Leistungsfähigkeit

    f. Services

    g. Ausführung

    h. Sonstiges:_____

15. Setz Ihre Firma E-Katalog-Systeme ein?

    a. Ja, seit mehr als 3 Jahren

    b. Ja, seit 1 bis 3 Jahren

    c. Ja, seit weniger als einem Jahr

    d. Nein, aber geplant innerhalb von 12 Monaten

    e. Nein, keine Pläne

16. Wie viele Lieferanten unterstützt Ihr E-Katalog-System derzeit?

    a. Weniger als 50

    b. 51-100

    c. 101-250

    d. 251-500

    e. Mehr als 500

17. Wer erstellt Ihren Kataloginhalt und pflegt ihn?

    Lieferant

        Elektronische Kataloge, z.B. BMEcat

        Punchout

    Intern

Einkauf
IT
Dienstleiter
Katalog- Dienstleister
e-Marketplace
Business process outsourcing Anbieter
Lieferantennetzwerk

18. In welchen System ist Ihre Katalog-Lösung integriert?

	Heute	Geplant innerhalb von 24 Monaten
a. e-Procurement		
b. ERP		
c. SRM		
d. Contract Management		
e. Business Intelligence tool		
f. e-Sourcing / Auktion		
g. Supplier network		
h. Sonstiges:_____		

19. Welche Produktgruppen sind in Ihrer Katalog-Lösung integriert ?

a. Maschine
b. Medientechnik
c. Werkzeug
d. Bautechnik
e. Büromaterial
f. Dienstleistung
g. Energie
h. Elektrotechnik
i. Fahrzeugtechnik
j. Hauswirtschaft
k. Hilfsstoffe
l. Life Science
m. Chemikalien
n. Marketing

Heute	Geplant innerhalb von 24 Monaten

20. Was sind aus Ihrer Sicht die entscheidenden Kriterien für die Leistungsfähigkeit eines Katalog-Systems? Tabelle ist falsch angeordnet!

a. Einfache Änderungsübersicht
b. Automatisierte Qualitätssicherung
c. Entscheidungsunterstützung durch Statistik + Reports

Heute	Zukunft

220

    d. Automatisierte Datenbereinigung
    e. Lieferant Self-Service
    f. Ausgereifte + Benutzerfreundliche Suche
    g. Workflow mit Benachrichtigungen
    h. Spend-Analysis Unterstützung
    i. Angebotseinholung auf Katalogbasis
    j. Integration in e-Sourcing
    k. Integration in Contract Management
    l. Integration in Lieferantenportal
    m. Integration in ERP
    n. Integration in Lagerhaltung
    o. Sonstiges:_____.

21. Welches sind die Hauptvorteile einer E-Katalog-Lösung von einem Spezialanbieter (Spezialanbieter für was) im Vergleich mit anderen ähnlichen Systemen?

    a. Keine
    b. Mehr Funktionalitäten
    c. Skalierbarkeit
    d. Spezialisierung auf E-Katalog-Kompetenz
    e. Leistungsfähigkeit bei großen Volumina (Anzahl Katalog / Produkte)
    f. Kosten-Nutzen-Rechnung
    g. Flexibilität bei System-Anpassungen
    h. Sonstiges:_____

22. In welchen Sprachen erhält Ihre Firma Kataloge?

    a. Deutsch
    b. Englisch
    c. Französisch
    d. Spanisch
    e. Italienisch
    f. Chinesisch
    g. Sonstiges / Gesamtanzahl:_____

23. Welches Format wendet Ihr Unternehmen an, um ihren elektronischen Produkt-Datenaustausch zu unterstützen?

    a. BMEcat
    b. Datanorm
    c. Edifact
    d. Eigenes Format
    e. XML-EDI
    f. Sonstiges:_____

24. Welches Produkt-Klassifizierungssystem benutzt Ihre Firma?

a. EClass
b. UNSPSC
c. Etim
d. Proficlass
e. Eigene Klassifikation
f. Sonstiges:_____

D: Association Analysis

Riables	Association		Effect	
	Value	p-value*	Cramer's V	p-value*
In which sector of the economy is your company? * e-Auction	23,130	0,026	0,382	0,017
In which sector of the economy is your company? * EDI	35,108	0,000	0,442	0,003
In which sector of the economy is your company? * How many percent of your indirect material spending (i.e. purchase volume) is currently supported electronically?	35,030	0,031	0,356	0,020
In which sector of the economy is your company? * How many percent of your services spending (i.e. purchase volume) is currently supported electronically?	29,868	0,094	0,345	0,076
In which sector of the economy is your company? * How many percent of your services spending (i.e. purchase volume) is currently supported electronically?	24,586	0,028	0,290	0,014
In which sector of the economy is your company? * How many suppliers does your e-catalogue system currently support? Crosstabulation	34,041	0,037	0,343	0,146
What is the annual revenue of your organization? * Supplier – Punchout	14,921	0,002	0,410	0,004
What is the annual revenue of your organization? * Intern – Purchase Department	10,904	0,018	0,353	0,014
What is the annual revenue of your organization? * e-Catalog Provider	10,214	0,022	0,353	0,020
Does your company deploy e-Catalogue systems? * Supplier – e-Catalog	20,015	0,000	0,473	0,000
Does your company deploy e-Catalogue systems? * Intern – Purchase Department	12,580	0,009	0,372	0,008
What is the annual revenue of your organization? * e-Procurement	16,804	0,017	0,314	0,020
What is the annual revenue of your organization? * ERP	14,119	0,049	0,302	0,031
What is the annual revenue of your organization? * SRM	16,112	0,019	0,316	0,022
What is the annual revenue of your organization? * Business Intelligence Tool	13,329	0,026	0,314	0,031
What is the annual revenue of your organization? * e-Auction-Q19	14,627	0,033	0,313	0,021
e-Procurement System * e-Procurement-Q19	28,520	0,000	0,409	0,000
e-Procurement System * ERP-Q19	8,730	0,053	0,212	0,078
e-Procurement System * SRM-Q19	28,448	0,000	0,381	0,000
e-Auction-Q9 * SRM-Q19	20,099	0,000	0,333	0,000
e-Auction-Q9 * Contract Management	6,599	0,059	0,221	0,045
e-Auction-Q9 * e-Auction Q19	15,522	0,002	0,305	0,001
e-Catalog * e-Procurement	39,520	0,000	0,514	0,000
e-Catalog * SRM	10,782	0,017	0,255	0,019
EDI * SRM	23,678	0,000	0,351	0,001
EDI * Contract Management	7,219	0,092	0,191	0,195

Contract Management System * e-Procurement	10,139	0,031	0,237	0,034
Contract Management System * SRM	9,598	0,036	0,229	0,046
Contract Management System * Contract Management	14,632	0,000	0,338	0,000
Contract Management System * Business Intelligence Tool	7,971	0,039	0,218	0,059
Contract Management System * e-Auction	7,403	0,099	0,196	0,120
Contract Management System * Supplier network	7,779	0,037	0,235	0,029
Supplier Evaluation system * e-Procurement	8,301	0,077	0,213	0,078
Supplier Evaluation system * Business Intelligence Tool	7,851	0,032	0,235	0,029
Supplier Evaluation system * e-Auction	8,685	0,063	0,205	0,105
What is the annual revenue of your organization? * Media Technology	20,877	0,002	0,374	0,002
What is the annual revenue of your organization? * Tool	12,974	0,075	0,292	0,046
What is the annual revenue of your organization? * Office Products	17,165	0,010	0,363	0,003
What is the annual revenue of your organization? * Service	21,861	0,002	0,347	0,004
What is the annual revenue of your organization? * Home Economics	20,498	0,002	0,363	0,005
What is the annual revenue of your organization? * Marketing	17,500	0,013	0,327	0,011
In which sector of the economy is your company? * Construction Technology	21,632	0,028	0,400	0,010
Does your company deploy e-Catalogue systems? * Media Technology	15,816	0,019	0,336	0,008
Does your company deploy e-Catalogue systems? * Tool	43,841	0,000	0,492	0,000
Does your company deploy e-Catalogue systems? * Office Products	42,751	0,000	0,527	0,000
Does your company deploy e-Catalogue systems? * Electric engineering, automation	27,803	0,000	0,393	0,001
Does your company deploy e-Catalogue systems? * Automotive Technology	14,525	0,028	0,280	0,065
What is the annual revenue of your organization? * workflow with notifications – Today	8,018	0,074	0,294	0,084
What is the annual revenue of your organization? * workflow with notifications – Future	10,176	0,025	0,310	0,058
What is the annual revenue of your organization? * Spend Analysis Support – Future	10,402	0,022	0,341	0,023
What is the annual revenue of your organization? * Bid based on e-Catalog – Future	9,715	0,034	0,326	0,037
What is the annual revenue of your organization? * Integration with e-Auction – Future	13,335	0,006	0,384	0,006
What is the annual revenue of your organization? * Integration with Contract Management - Today	7,565	0,077	0,330	0,055
What is the annual revenue of your organization? * Integration with Contract Management - Future	16,528	0,001	0,427	0,001
In which sector of the economy is your company? * Bid based on e-Catalog – Today	13,004	0,039	0,437	0,013
In which sector of the economy is your company? * Bid based on e-Catalog – Future	11,437	0,099	0,364	0,093
Does your company deploy e-Catalogue systems? * Simple modification Overview - Today	11,216	0,020	0,346	0,024

Does your company deploy e-Catalogue systems? * Simple modification Overview - Future	14,623	0,002	0,457	0,001
Does your company deploy e-Catalogue systems? * Automated Data Cleansing e.g. Supplier self-service - Today	8,264	0,077	0,305	0,070
Does your company deploy e-Catalogue systems? * Sophisticated + user-friendly search - Today	12,652	0,009	0,375	0,009
Does your company deploy e-Catalogue systems? * Sophisticated + user-friendly search - Future	10,555	0,019	0,362	0,014
Does your company deploy e-Catalogue systems? * workflow with notifications – Today	15,837	0,002	0,421	0,002
Does your company deploy e-Catalogue systems? * Bid based on e-Catalog – Today	10,337	0,021	0,354	0,020
Does your company deploy e-Catalogue systems? * Integration with Supplier portal – Today	9,210	0,037	0,317	0,051
What is the annual revenue of your organization? * Specialized e-Catalogue skills	13,617	0,006	0,390	0,005
In which sector of the economy is your company? * System Customization	12,788	0,055	0,369	0,082
Does your company deploy e-Catalogue systems? * Capability in number of suppliers / e-catalogue enabled	13,444	0,007	0,388	0,006
Does your company deploy e-Catalogue systems? * System Customization	9,527	0,040	0,327	0,042

E: Summary Reliability Statistical analysis

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	3,438	2,346	4,346	2,000	1,852	0,296	31
Item Variances	1,053	0,382	1,926	1,545	5,048	0,173	31
Inter-Item Correlations	0,114	-0,575	0,741	1,316	-1,289	0,070	31