RESEARCH

Oliver Münch

First-Time-Right Procurement

Substitution of the Paradox Purchasing Savings through First-Time-Right Procurement (FTRP)

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Oliver Münch
Munster, Germany

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Abstract

This dissertation is based on a comprehensive literature survey and empirical research. The exploratory study's findings indicate that monetary purchasing savings negatively impact sustainable company success. It is evident that an alternative to savings must be found, because they are incompatible with the objectives of supply chain management. To achieve long-term success, is the author proposes that the monetary measurement of purchasing savings be conducted by measuring process times within the procurement organization. A new, quantifiable method is developed during the case study. The former is not based on monetary factors and supports the objectives of supply chain management.

This case study, conducted within the German defense industry, compares purchasing-savings with supply chain management objectives. It shows that the objectives compete. Compared to supply chain management objectives, purchasing savings also negatively influence sustained corporate success. Furthermore, a quantifiable method based on a definition of “quality in procurement” and the First-Time-Right principle is developed that supports the objectives of supply chain management and is expected to have long-term, sustained effects on the company's performance and to replace purchasing savings as a performance measuring method.

This study fulfills an identified need to further determine whether purchasing savings are compatible with the objectives of supply chain management and if not, how they could be replaced. The research may lack generalizability due to the case study approach. Researchers are therefore encouraged to test the assumptions to determine whether the new, quantifiable measurement method can be implemented effectively in other procurement organizations.

Key words: Supply chain management, purchasing savings, procurement, first-time-right, quality management, business process management, defence industry, sustainability, Six Sigma, performance measurement

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Acronyms And Abbrevations

BAUT	parts or assemblies specified or developed in-house
BSC	balanced scorecard
CA	cost advantage
CG	control group
CM	cost management
CIP	continuous improvement process
COTS	commercial of the shelf
CRM	customer relationship management
CSF	critical success factor
EG	experimental group
FTR	First-Time-Right
FTRP	First-Time-Right procurement
FTRPM	First-Time-Right procurement measurement
GFSO	German Federal Statistical Office
H	hypothesis
Inf	inflation
JiT	just-in-time
KPI	key performance indicator
KRI	key result indicator
LCC	life cycle cost
LT	lead time
MFT	multifunctional team
MoB	make or buy
OEM	original equipment manufacturer
PCE	parametric cost estimation
PDCA	plan-do-check-act
P_{LT}	process lead time

PQ	procurement quality
QCT	quality-costs-time
QM	quality management
R&D	research and development
RDE	Rheinmetall Defence Electronics GmbH
ROI	return on investment
ROM	rough order of magnitude
RQ	research question
SC	supply chain
SCM	supply chain management
SCCT	supply chain cycle time
SCOR	supply chain operation reference
SM	structural modeling
SIPRI	Stockholm International Peace Research Institute
SR	supplier relations
SRM	supplier relationship management
TC	target costing
TCO	total cost of ownership
TQM	total quality management
TTM	time-to-market
VE	value engineering
VA	value analysis
VAWP	value analysis working plan

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1 Introduction

This chapter introduces the framework for the dissertation. With its three sections it covers the background to the research performed, the objective of the research, and a brief description of the study's methodology and structure.

1.1 Preamble

Staff members involved in the procurement process are under great pressure to succeed. In many companies, 50% of the total costs are attributable to purchased products or services (Melzer-Ridinger, 2004: 12). Rising cost pressure and shorter time-to-market cycles cause decision making in the Procurement Department to become increasingly complex.

The result is a purchasing environment in which, apart from cost and quality, time plays an increasingly important role. Under the influence of the quality-cost-time triangle (Thonemann et al., 2004: 134), the company's only way to secure a competitive advantage is to achieve the objectives set by the market faster, better, and more sustainably than its competitors do (Melzer-Ridinger, 2004: 12).

Jean Paul Getty (*December 15, 1892, †June 6, 1976) once said “The man who comes up with a means for doing or producing almost anything better, faster or more economically has his future and his fortune at his fingertips . . .”. Prerequisites have to be met, i.e., the sustainable use of suppliers' expertise, good supplier relationship, and strategies for open and trusting intercompany teamwork are essential for achieving objectives.

This new procurement profile requires suppliers and procurement to undergo a fundamental shift in their basic understanding of each other, in corporate structures, and in their relationship. Such thinking cannot be learned through seminars or trainings; it must be developed through long-term activities and continuous application.

At the latest, when a company has to deal with a crisis situation, such as the current global economic crisis or a sales slump, it will be asked what contribution procurement

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has made to solving the problems at hand. The rapidly growing interest in purchasing savings forces procurement to make decisions that could bear serious consequences.

Procurement has various alternatives for achieving success. One of them is price renegotiation. However, this could jeopardize the long-term supplier relationship, since an existing win-win situation between two parties begins to shift to supplier's detriment. At that point, the partnership relationship, in which all parties should have equal rights, is terminated. Self-interest takes control over purchasing activities and the holistic approach to supply-chain management is pushed into the background.

The newly negotiated prices and realized purchase savings inevitably raise the question of why these savings have not been realized until now. Why were those prices not realized during the first negotiation with the supplier? This impacts procurement in several respects.

It may raise doubts about procurement's competence and the relationship with the supplier suffers damage. At first glance, procurement could be accused of poor performance for having accepted too high a purchase price for the product in prior years. One-hundred percent purchasing quality based only on the purchase price should mean that the “right” purchase price had been negotiated the first time around.

Since it wasn't, management now fails to recognize procurement's ability to achieve major savings from a business perspective. The credibility of the assertion that the right price for the product has already been reached will be difficult to defend not just in times of crisis, but also in relation to corporate planning, since many companies assume purchasing savings to be an almost guaranteed annually success.

To minimize damage to the supplier relationship and realize required annual savings, discussions revealed that “economically justifiable” higher purchase prices are acceptable in the first procurement contract to capture necessary savings for the coming years up front. This behavior is linked to heavy financial damage in terms of opportunity costs for the companies involved. The situation in which companies are unable to consciously, transparently, and measurably execute First-Time-Right in procurement

subsequently encourages and rewards such behavior due to personal goals tied to annual purchasing savings.

Purchasing savings is produced by the isolated measurement of monetary indicators in procurement. Three examples of these classic indicators are:

1. renegotiated price reduction amounts,
2. amount of price increases blocks, and
3. amount of all differences between the lowest and highest offer (Buck, 2005: 452–453; Lemme, 2009: 124).

These days, a company's success or failure no longer depends just on its own business model or financial figures. System suppliers exercise a major influence on the business results of the original equipment manufacturer (OEM) due, for instance, to their own economic situation or outsourcing activities.

A company's economic future depends not only on its products, but is also shaped by the company's current development. For this forward-thinking evolution, qualified, correct decisions in procurement are as fundamental as innovations, market knowledge, supplier know-how, and the relationship between a company and its suppliers. Accordingly, it is necessary to integrate supply chain management aspects into procurement performance measurement. The partnership win-win situation is just one example of such an aspect.

When thinking about a solution approach for this situation, we come to the conclusion that the whole system only brings sustainable benefit when procurement constantly realizes First-Time-Right considerations. This leads to the inference that such a system cannot be based on monetary facts alone.

1.2 The Study's Aim

The procedure according to the First-Time-Right approach is difficult for outsiders to understand. Also, there is a lack of effective reporting and controlling systems capable of evaluating and confirming First-Time-Right in procurement so that it is recognized

and accepted within the company. It is therefore necessary, to define First-Time-Right for procurement and to develop an adequate measurable control method. The aim of the new method will be to focus more on the process time factor within procurement. This should, for example, reduce opportunity costs, reduce time-to-market cycles and review the supplier base for its suitability.

To achieve this objective, the following questions must be answered based on a comprehensive literature research:

- What is supply chain management and what are its success factors?
- What is influencing the success factors?
- Do purchasing savings a negative impact on sustained corporate success?
- What means 100% quality in procurement?
- Can purchasing savings be obtained if 100% procurement quality is achieved from the start?
- What are the requirements to performance measurement?

1.3 Study Layout

After a general introduction in, which covers the preamble and aim of the study, the necessary theoretical foundations for the study are discussed in chapter 2. The basis for this chapter is a comprehensive literature review covering the scientific research on the different subject areas. Finally, the various topics will be evaluated and correlated in a short summary.

The main part of this dissertation is chapter 3. Here is the design and the framework of the study as well as the methodology is presented. Deductive conclusions are developed and research questions are formulated in detail based on chapter 2. Furthermore, it describes the database in brief and explains what information was analyzed.

Chapter 4 deals with the current situation in the company and exposes vulnerabilities and consequences. The study is based on observations, discussions with experts, and data evaluation, which is carried out during the study period in the company.

The requirements and concept for First-Time-Right in procurement are elaborated in chapter 5. In addition this chapter is dealing with important factors which have to be considered before and during the implementation of the First-Time-Right in procurement. Chapter 6 describes how the First-Time-Right activities of procurement can be controlled.

Chapter 7 represents the final part of the case study. It contains an exhaustive summary of the collected evidence and data as well as the analyzed results. Furthermore, this chapter provides answers to the formulated research questions and the deductive conclusions from chapter 3 are discussed briefly.

The last chapter provides the final inference regarding this case study and First-Time-Right in procurement but also some recommendations for the practice. Furthermore it includes limitations and recommendations for further research and adaptation options in the First-Time-Right procurement area.

2 Literature Review

The main objective of this chapter is to create a common understanding of the theoretical basis. It also sets the framework for further consideration of the dissertation. Especially important is a consistent tenor in the subjects of purchasing savings, creating a win-win situation, and the relationship between different topics in this chapter.

2.1 Supply Chain Management

This section will cover in brief the history of supply chain management with its main stages of evolution. The interpretation, which has changed over the decades, as well as its tasks and objectives will also be discussed. Finally, critical success factors are identified that significantly influence the company's sustainable success when supply chain management is applied.

2.1.1 The History Of Supply Chain Management

In practice, the history of supply chain management (SCM) basically extends back to when mankind learned to build organizations. However, its modern roots harken back to its military origin (Batten, 2008: 49) during the period 1940–1946 (Fearon, 1968: 48). Monczka, Handfield, Giunipero, and Patterson (2011: 23) describe this period as “The War Years.” The modern roots of SCM therefore reach back to the time when the armies began to consider logistics and supply chain (SC) as part of their proper strategy (Batten, 2008: 49).

From 1947 until the end of the ’70s (Monczka et al., 2011: 23–24), a variety of management disciplines focused on the various functional areas. These were, just to name a few, logistics, customer service, operations management, and in some cases sales and marketing. We ultimately arrived at SCM via these different functional areas. SCM's premise was that the crucial link for efficient, effective customer satisfaction is the integrated action of all functions and companies involved in the SC (Speh, 2008: 247).

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“The Global Era” followed, lasting until 1999. Procurement entered into focus at this time. Never before in industrial history had competition intensified so quickly, and SCM began to grow during this period.

More than ever before, companies concentrated on managing material, services, monetary, and information flows from suppliers to end customers (Monczka et al., 2011: 25). SCM has been compared to military operations in which a logistics problem can claim more victims than the war itself. In the worst case, it can even lead to an army's losing the war. In the economy, an SC dysfunction can affect growth and, in the worst case, lead to the SC's collapse (Batten, 2008: 49).

SCM has been emphasizing the importance of the suppliers since 2000. The relationship with the supplier tends ever more toward a collaborative approach with precisely selected suppliers. Among other things today, supplier development, full-service suppliers, sustainability in the relationship, and total cost suppliers are factors that make a special contribution to the SC. In this period of “integrated supply chain management” (Monczka et al., 2011: 25), the emergent SCM concept is absorbing individual functions such as logistics, procurement and materials management/supply management.

The outsourcing issue is another trend that still continues today. Here for example, parts of the procurement process are purchased externally (Hahn & Kaufmann, 2003: 262). Distributors (purchasing card provider) can be involved as part of C-part management. They offer companies the required goods and services with the help of catalogs (Orths & Ruland, 2002: 929–931). In addition, the company's activities today are increasingly managed through electronic means. The Internet plays a very important role here (Hahn & Kaufmann, 2003: 269–270).

Due to increasingly complex supplier structure, supply network management (Vögele, 2005) or a supplier swarm (Gloor, 2006) are more often talked about these days than of a conventional SC. Due to the ever-increasing competition on world markets, companies develop new techniques and methods to optimize the SC and maximize potential for their own business growth (Batten, 2008: 49–50).

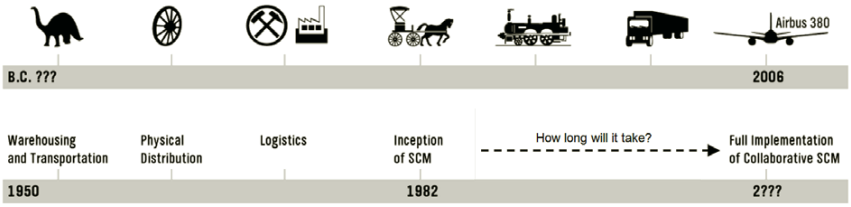

Figure 1: The evolution of the SCM concept
Source: Speh, 2008: 247; modified

Figure 1 describes the evolution of the SCM concept (see Johnson, Leenders & Flynn, 2011: 5–7). It shows that, given the relatively immature nature of the SCM discipline, it is not surprising that its implementation has not yet been fully realized. Therefore, it can in fact take some time before the full potential is realized after the SCM approach is completely implemented (Speh, 2008: 247).

The evolution of the term "supply chain management" in theory dates back to the '80s. Anglo-American consultants coined the term in the United States during the early '80s (Houlihan, 1985; Jones & Riley, 1985). Oliver and Webber (1992) can be cited as examples of practice-oriented SCM. The SCM concept was taken up by the theory in the late '80s, initially only in the United States.

People like Bothe (1989), Christopher (1992), Davis (1993), Ellram (1990), Ellram and Cooper (1993), Fisher (1997), Hewitt (1994), Macbeth and Ferguson (1993), Stevens (1989), and Towill (1996) were significantly involved in implementing the SCM concept in theory. In Germany, SCM theory and practice were first established in the mid-nineties (Werner, 2010: 3).

SCM evolved from a marginal phenomenon in the '80s and '90s into a major theme in literature and business. Since 2000, the number of scientific papers and publications on this subject has increased greatly (see figure 2). This illustrates how much relevance is currently attributed to SCM. Figure 2 shows an EBSCO database evaluation based on the keywords "supply chain management" in publications' title.

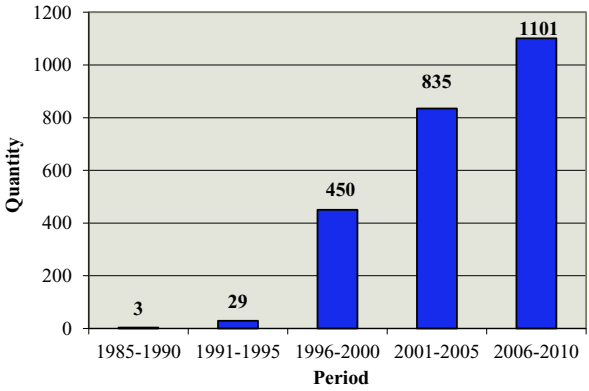

Figure 2: Number of scientific publications on SCM
Source: Author's illustration; EBSCO, 2010

The reason SCM is becoming increasingly important for the economy is the potential that companies want to realize by implementing effective SCM. IBM was able to tighten value-added activities to realize cost savings of about seven billion U.S. dollars in fiscal 2004 (Wanner, 2005: 1).

Becker (2004: 86) mentions that the consulting company PRTM attributes the following potentials to SCM:

- Inventory reduction of 50% to 80%.
- Delivery performance improvement of 10% to 25%.
- Overdue orders reduction of 70% to 90%.
- Order processing time reduction of 40% to 75%.
- Overhead costs reduction between 10% and 30%.
- Manufacturing cycles reduction of 30% to 90%.

Taking these figures into consideration, Werner (2010: 1) suggests that they should be evaluated critically. It cannot be proven that improvements are attributable solely to SCM. However, it does seem to confirm that the SCM approach harbors immense

potential to improve company processes. A company can save a lot of money through process improvement and the forced management of the organization's internal and external interfaces.

2.1.2 Definition And Objectives

According to Gibson, Mentzer and Cook (2005: 17), SCM is a discipline still in its infancy. Thus no single definition has yet been formulated. Just as SCM's relevance for the economy has changed, its definition has shown itself to be highly variable in the recent years.

Practitioners and academics have offered a variety of definitions for the SCM concept. A brief overview of definitions existing in the literature will be given below. The information in the table is arranged by the year of each definition's publication.

Table 1: Selected SCM definitions

Year	Definition
1994	"Supply Chain Management covers the flow of goods from the supplier through manufacturing and distribution chains to the end user . . ." (Christopher 1994: 22).
1997	"Supply Chain Management is a collaborative-based strategy to link cross-enterprise business operations to achieve a shared vision of market opportunity . . ." (Bowersox, 1997: 181).
1997	"Supply chain management is the integration of business processes from end user through original suppliers that provides products, services and information that add value to the customer . . ." (Cooper, Lambert & Pagh, 1997: 11).

Year	Definition
2004	"The process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and related information from point of origin to point of consumption for the purpose of conforming to customers requirements . . ." (Simchi-Levi, Kaminsky & Simchi-Levi, 2004: 3).
2005	[Supply chain management is] ". . . the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole . . ." (Christopher, 2005: 5).
2007	"Supply Chain Management is the design and management of seamless, value-added processes across organizational boundaries to meet the real need of the end customer . . ." (Fawcett, Ellram & Ogden, 2007: 8).
2010	Supply chain management involves the end customer-oriented organization and coordination among a cross-company value chain in the process-oriented and institutional level to maintain or improve competitiveness (Herrmann, 2010: 35, translated).

Source: Author's illustration

A variety of contributions on financial SCM including the corresponding definitions exists even in the financial sector's literature. Authors Pfaff, Skiera, and Weiss (2004: 67) can be cited as an example.

Although the definitions listed in table 1sound very different, they bear in part the same core messages:

- SCM has no organizational boundaries.
- SCM is a cooperative approach.
- SCM affects all members of the entire supply chain.

- SCM considers and integrates internal and external processes.

Processes and interfaces play a decisive role in the SCM approach. This is shown in the Supply Chain Operations Reference Model (SCOR Model). It is an internationally used representation of SC processes developed by the Supply Chain Council in the United States.

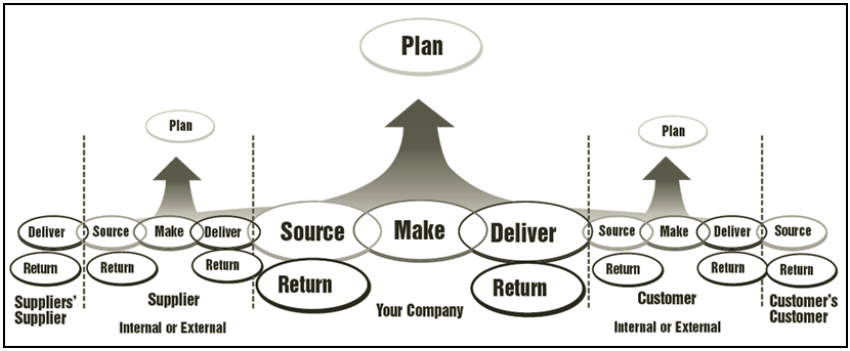

Figure 3: The SCOR Model's five different management processes
Source: Supply Chain Council, 2009: 3

The SCOR Model describes four hierarchical levels (see figure 4) consisting of reference levels. The multiplicity of procedures or process chains can be modeled with its help. In addition, it is possible to conduct this activity at first from the perspective of a single company (Supply Chain Council, 2009: 3). The fourth level, which is not specified in detail, should enable the company to consider its own company-specific activities.

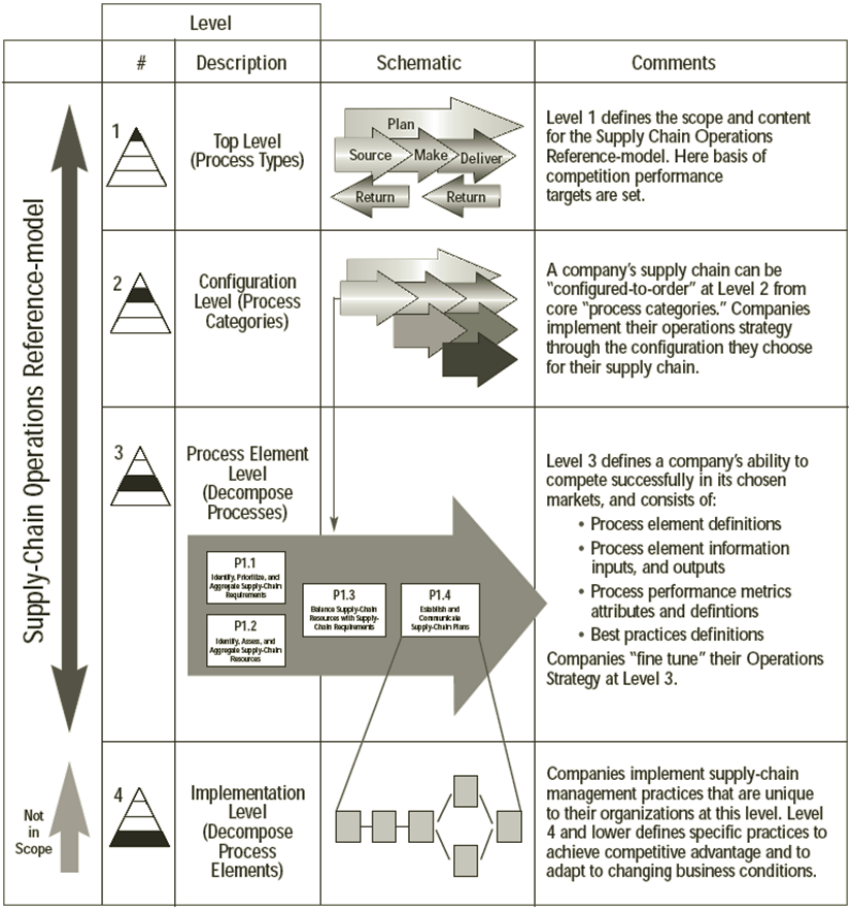

Figure 4: The SCOR Model's four levels

Source: Supply Chain Council, 2009: 7

Starting at level one, processes can be presented in increasing detail via this model (Jehle, 2005: 130). Based on these in-house process flows, the entire value chain can be drawn by using interfaces to suppliers and customers, who also use the SCOR Model (Weber, 2002: 200). Standardized representation of company-wide performance measurement is feasible, e.g., in the form of a benchmark (see sub-subsection 2.5.2.3).

In addition, this model enables redesign of the value chains and formulation of a holistic SC strategy. Furthermore, the basis for unified SCM software is established (Hagen, Springer & Stabenau, 2002: 47). The method's limits lie in the sometimes very detailed characteristics of value chains. Taking all special needs into consideration leads to the deterioration of transparency and comparability (Weber, 2002: 201).

Based on the SCOR Model and the various definitions listed table 1, the author defines SCM for this dissertation as follows:

SCM is a cooperation-based management strategy that extends beyond company borders. Its objective is the optimization of internal and external processes and interfaces throughout the entire supplier network. This will enable the network to deliver the desired product in a minimum time period at the lowest possible life cycle costs to the end user.

Based on the definition and the SCOR Model, SCM can be visualized as in figure 5.

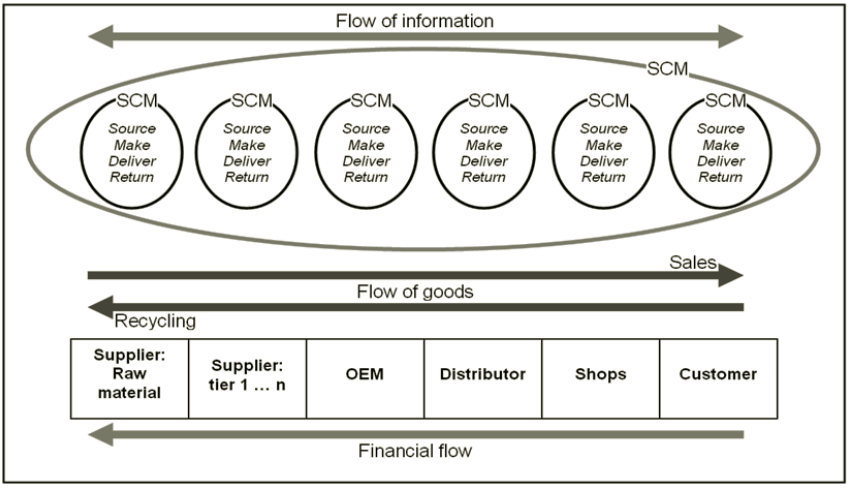

Figure 5: SCM within the SC – integrated planning and optimization

Source: Author's illustration

In SCM, business processes are coordinated from the end customer and the raw-material supplier with the processes of one's own company. Coordination of the various partners in the chain is the key to effectiveness and success. Through uniform, company-wide planning and optimization of procurement, production, and sales processes, a win-win situation is achieved for all parties in the whole SC. Poirier and Quinn (2003: 40–47) confirm this win-win situation. The author will elucidate their study in more detail below.

2.1.3 SCM's Evolution Stages

In their study, Poirier and Quinn (2003: 40–47) identify five key stages of evolution for SCM (see figure 6). Their study also showed that in the end, only a few companies are really leading in terms of SCM development. Over half of all companies examined were rated at level 1 and level 2. Thus, these companies have not reached the external perspective (levels 3 to 5) while implementing SCM. They are still dealing with the internal perspective.

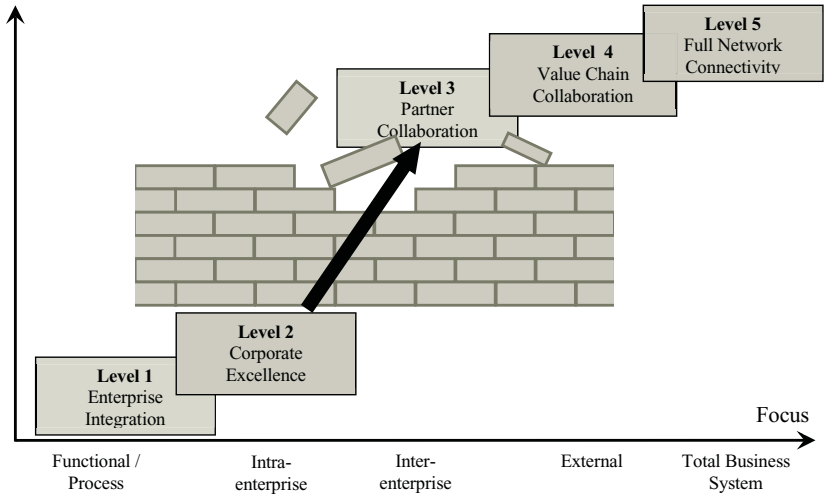

Figure 6: The five levels of supply chain evolution

Source: Author's illustration based on Poirier & Quinn, 2003: 42; modified

2.1.3.1 Level 1 — Enterprise Integration

Poirier and Quinn (2003: 41–42) describe level 1 as a kind of basic level. This level should form the foundation for SCM in the company. This is especially important because if the organization itself hinders or even prevents internal cooperation, the company has no potential in terms of intercompany cooperation. Wrangling about corporate responsibility and intradepartmental thinking prevent any chance of optimizing the internal and external SC (Kuhn & Hellingrath, 2002: 23–27).

At level 1, the company focuses first on respective functional areas that can optimally realize the desired internal supply chain processes. The above-described SCOR Model (Supply Chain Council, 2009: 7) is very often used to support this level.

At first, the company mostly concentrates procurement and logistics. Supplier quantity reduction and purchasing volume bundling have to be achieved (Poirier & Quinn, 2003: 41–42). For Newman, Hanna, Gattiker, and Huang (2009: 24), this level has a special meaning. They state that deficits in the functional areas severely hinder SCM's expansion and further development.

2.1.3.2 Level 2 — Corporate Excellence

The next step in the continuing progression, company-wide process integration, can be accomplished based on level 1. Process chain structure is particularly important at this stage (Poirier & Quinn, 2003: 42). Internal functional areas are interlocked through these process chains (Werner, 2010: 13).

The target is company-wide excellence. Therefore, all functional areas must be aligned around a common objective, which requires an adjustment to the performance measurement. Only after this stage is successfully completed are the other steps pursued (Poirier & Quinn, 2003: 42).

Newman et al. (2009: 24–25) explain that cooperation with partners is a kind of cross-functional cooperation. Studies have shown, that companies already having experience

in the field of corporate cooperation are more successful and in demand when company-external cooperation is involved (Kuhn & Hellingrath, 2002: 23–27).

2.1.3.3 Level 3 — Partner Collaboration

According to Poirier and Quinn (2003: 42), level 3 deals with information exchange between customer and supplier. It represents SCM's next stage of development. The number of suppliers is reduced at the beginning of this level. A partnership situation is subsequently implemented with the remaining suppliers. Concentrating on a few partners makes their integration into the company's business processes possible early on. For this kind of cooperation, partners pursuing the same goal as the company itself are selected. This type of cooperation enables a company to learn more about the other partners' competences and restrictions. An optimal process is developed for all parties involved based on this knowledge, thus creating a win-win situation.

Schulte (2005: 526) says that partnerships and cooperation within the SC are used to integrate all of the parties involved in the value chain. Thus, the parties are involved in all cross-functional tasks. According to Lee (2004: 5), the development of collaborative relationships with suppliers should lead to the point where companies are working together on the design and redesign of work processes as well as on preparing recovery and backup plans. Champy (2002: 3) calls this step “X-Engineering Stage 2”.

A technology-based process links a company to suppliers. Thus, subareas of the companies communicate directly and create a win-win situation for both sides. Liker and Thomas (2004: 1) even refer to a technologized global partnership between companies as an SC's lifeblood. Kersten, Kern, and Held (2003: 8) argue that this concept demands fundamental entrepreneurial rethinking: forget “I”; think “We”. Consequently, the company can only be successful if the intensity and transparency of the cooperative relationship is stipulated. However, this must be one of the first steps in, as Tapscott and Williams (2007: 280–284) say, building a smart company that recognizes that openness and information sharing enhances growth and improves competitiveness.

2.1.3.4 Level 4 — Value-Chain Collaboration

Level 4's objective is the integration of all business processes of all companies involved in the value-added chain. Integration should not be restricted to two partners. A network should be established that is optimized as a whole and covers the entire supply chain (Poirier & Quinn, 2003: 42–43). Thus, for instance, according to Tapscott and Williams (2007: 287), in BMW X3 or BMW 7 serial production, 70% of the vehicle is not constructed by BMW, but by a worldwide network of suppliers.

2.1.3.5 Level 5 — Full Network Connectivity

Level 5 is the highest and final stage of SCM development. It characterizes a network based on communication and cooperation as well as on the use of technology. Companies thereby secure their market dominance. However, it must be added that few companies are able to establish and maintain such a network. Therefore this remains a very theoretical approach (Poirier & Quinn, 2003: 43). Tapscott, Ticoll, and Lowy (2001: 230) emphasize in this context that in the era of the effective business web, information management is essential for a company's activity.

The ability to act depends largely on how quickly decisions are made, problems are solved, and how partner cooperation is achieved in the system. According to Marchand (2000: 123), optimization of the use and quality of information is very important in times of "hyper competition".

2.1.4 The Aim Of Supply Chain Management

In part, only brief descriptions of SCM's objectives can be found in the literature. Ehrmann and Olfert (2005: 32) simply state that SCM concerns the effort to optimize the SC. Werner (2010: 25) points out that the supply, disposal, and recycling of integrated enterprise activities is the goal of SCM. He adds that the SCM approach is focusing on optimizing effectiveness (see also Bowersox, Closs & Stank, 1999: 6; Poluha, 2007: 43–47; Batten, 2008: 66–68) and efficiency, as well as harmonizing of competition factors (cost, quality, time, and flexibility). Tapscott et al. (2001: 133)

suggest that effectiveness and efficiency increases and costs can be reduced due to a merger of systems. The aim must be to create end-to-end integration across the value chain.

In today's prevailing competitive situation, companies must satisfy their customers' requirements and desires. This is the only way they can survive in the market. Karrer (2006: 18) points out that companies depend on their customers. The seller's market no longer exists. Customers are the only members of the SC bringing in money. Fawcett et al. (2007: 32), states that by using SCM, companies should create their processes in a way so that they meet customer expectations. Businesses should always ask the following questions.

- What benefit does our company sells to the customer?
- How can maximum customer satisfaction be achieved?

Through these questions, the company focuses on added value and waste reduction.

The customer satisfaction is the degree to which the product meets customer expectations. Knowing the customers' expectations is the key to a great customer satisfaction. As a result, the company is able to provide goods and services that meet customers' expectations (Fawcett et al., 2007: 36–38). Customer benefit is directly linked to the degree of fulfillment of the performance targets quality, cost, flexibility, time, and innovation (32–34).

Cross-company planning and optimization of individual processes in the entire SC, shown in figure 2, should result in the win-win situation for all parties mentioned by Poirier and Quinn (2003: 40–47). This win-win situation relates ultimately to the maximization of profits and to competitive advantage for the companies involved. Schönsleben (2007: 74) states that long-term, intensive cooperation in the SC is the target, and a prerequisite for a well-balanced, win-win situation for all parties.

Experts believe that SCM leads to a 40% increase in delivery performance while reducing delivery time by 30%. In addition, these experts say that neither the company's size nor the industry play a role in such a performance increase (Heinrich, 2004: 223).

SCM's ultimate goal, supply-chain optimization (Busch & Danglmeier, 2004: 8–9), is articulated by Weber, Dehler, and Wertz (2000: 266) in three areas. Therefore cost advantages, time savings, and quality advantages must be achieved by SCM.

Nowadays many OEMs procure already highly integrated components. These components are partly developed by 1st-tier suppliers. Companies ultimately pursue only one goal through such a decision: they want to increase the benefits their product bring to the end user. Therefore, it is imperative to add the dimension of transparency (see Kuhn & Hellingrath, 2002: 154; Wannenwetsch, 2005: 72; Cohen & Roussel, 2006: 255) to the performance goals mentioned by Fawcett et al. (2007: 32–34). Especially the last point, transparency, must be emphasized regarding collaboration, collaborative engineering, and process integration.

Based on the above statements and by considering several authors, it can be stated that SCM pursues two main objectives. One is the maximization of all supply chain members's satisfaction; the other is establishment of the win-win situation. This is achieved by increasing effectiveness and efficiency in the SC. For this definition, differentiation between win-win situation and customer satisfaction is done as described below.

The win-win situation is achieved by aligning, availing, and improving the joint capabilities (Pirron, Reich, Kullow & Hezel, 1998: 60–61). For this purpose, the entire SC is aligned and controlled according to standards agreed to among all stakeholders (Affeld, 2002: 14). Pursuing common interests and overcoming traditional role perception play an important role (Corsten & Gabriel, 2004: 18). Costs must be reduced effectively, not simply passed along (Vollmann & Cordon, 1999: 3).

Individual SC members' striving for profit maximization impairs the win-win situation. E.g., open know-how transfer and cooperative mutual interaction are beneficial. Thus with the help of the win-win situation, it is possible to achieve long-term stability within the SC (Busch & Dangelmaier, 2004: 55). According to the author, the win-win

situation is shaped significantly by the way SC members (from the raw material supplier to the end customer) treat one another.

As mentioned at the beginning of this subsection, customer satisfaction is ultimately the result (output) of the SC's efforts and represents an actual comparison between end constomers' expected and realized requirements. The more the requirements and customer expectations are met the higher the customer satisfaction. Customer satisfaction indicates whether or not the correct action has been taken. Therefore, the attributive noun “customer” in “customer satisfaction” means “end user/end customer.” More explanation about customer satisfaction can be found in subsections 2.2.4 and 2.6.3.

2.1.5 Critical Success Factors For Efficiency And Effectiveness

Based on SCM's defined objectives, the question arises about what effectiveness and efficiency in SC mean and how they can be achieved. Effectiveness means “Doing the right things”. Efficiency describes whether or not things are being done correctly. Thus, effectiveness has a strategic orientation. It makes statements about the effectiveness of activities. Efficiency has an operational focus; it aims for a favorable cost-benefit ratio (Werner, 2010: 25). These comments do not provide a sufficient indication about the critical success factors (CSF) contributing to effectiveness and efficiency and ultimately determining the achievement of SCM objectives.

Rochart (1979: 81–92) defined the CSF concept in 1979 as “. . . the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization . . .”. He states that a CSF draws attention to areas in which everything must be running correctly (things must go right). Boynton and Zmud (1984: 17–27) define CSF as “. . . few things that must go well to ensure success for a manager or an organization . . .”. They call the CSF approach a very good planning instrument.

Generally valid, reliable findings in the research of SCM success factors do not exist. A variety of unsystematic enumerations of success factors in SCM can be found in the

literature (Scheer & Beckmann, 1999: 7). Some authors offer an apparently almost arbitrary set of success factors such as trust, knowledge, and information technology (Schräder, 1996: 61–63) or segmentation, strategic sourcing, integrated monitoring, logistics network, and others (Reinhardt, Ansorge & Selke, 2000: 71). Berentzen (2000: 88) referred to process orientation, information and communications technology, logistics control, cooperation, and service quality as SCM success factors. However, it seems this practice lacks a scientific basis.

On the one hand, these “collections” are without logical connection; on the other, no recommended action can be derived from them. Publications by consulting firms that deal with the so–called “supply chain excellence” mention success factors such as agility, responsiveness, and intelligence (Pfohl, 2000: 24–25). These findings are based on a survey of over 2000 European companies (Kearney & ELA, 1999: 1–3). General recommendations for action cannot be derived from these survey results without further effort either.

SCM's goal is to maximize customer satisfaction (everyone in the SC is a customer) and a win-win situation for all involved parties (see subsection 2.1.4). Thus, success factors can only be those factors that directly influence effectiveness and efficiency within the SC. According to the author, success factors must therefore meet the following requirements.

- To prove their general validity, the factors must be applicable for all SC participants.
- The company size should not have a restricting effect on CSF applicability.
- The factors must be valid across all industry sectors.
- The CSF's must form a logical connection.
- According to Leidecker and Bruno (1984: 23–32), not more than six factors should be selected.

The following table shows the CSF's selected based on the literature review conducted because they meet the requirements above. Furthermore, the cited authors have correlated them directly with success or SCM's objective.

Table 2: Critical success factors for SCM

Source	Critical success factor					
	Costs	Quality	Delivery	Flexibility	Innovation	Transparency
Batten (2008: 267)	X			X		
Champy (2002: 82–83)						X
Chen, Daughetry, and Landry (2009: 36)					X	
Christopher (2005: 4)	X					
Cohen and Roussel (2006: 255)						X
Fawcett et al. (2007: 32)	X	X	X	X	X	
Kopczak and Johnson (2003: 32)	X				X	
Kuhn and Hellingrath (2002: 154)						X
Mentzer et al. (2001: 7)					X	
Liker and Thomas (2004: 1)						X
Sennheiser and Schnetzler (2008: 6–9)	X	X	X	X		
Tapscott and Williams (2007: 280–284)						X
Tapscott et al. (2001: 133)	X					X

Source	Critical success factor					
	Costs	Quality	Delivery	Flexibility	Innovation	Transparency
Thonemann et al. (2004: 134)	X	X	X			
Wannenwetsch (2005: 72; p. 176)		X	X			X
Weber et al., (2000: 266)	X	X	X			
Werner (2010: 25)	X	X	X	X		

Source: Author's illustration

In addition to above factors meeting the requirements mentioned for CSF's, the selection will once again be justified briefly at this point. Individual CSF's are explained in more detail in sub-subsections 2.1.5.1 to 2.1.5.6.

For example, it was possible to reduce internal and external interface costs with the help of transparency (see subsection 2.1.3 and section 2.2). Efficiency can be assessed through lower cost. As already mentioned, efficiency describes the ratio of costs to benefits. Thus, for example, a company's or SC's efficiency can be derived from the cost-to-profit ratio.

Whether a company or SC also works effectively can be inferred from the level of customer satisfaction. Based on the literature review conducted, the author believes that the factors of cost, quality, time, flexibility, and innovation directly impact customer satisfaction.

Therefore in conclusion, it can be stated that the factors cost, quality, time, flexibility, innovation, and transparency are the CSF's that impact on customer satisfaction and the

win-win situation due to their direct influence on efficiency and effectiveness.

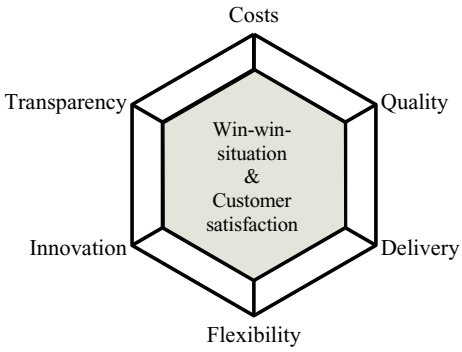

Figure 7: The aim of supply chain management
Source: Author's illustration

2.1.5.1 Costs

A product's costs are still one of the main criteria influencing the customer's purchase decision. Whereas purchase prices were previously considered, total cost of ownership (TCO) is increasingly in focus now (Fawcett et al., 2007: 33). However, significant operating and disposal costs can occur depending on the product. Therefore customers often make their purchase decision based on life cycle costs (LCC). Different types of costs and prices are discussed in detail in subsections 2.5.1 and 2.5.3.

If companies want to reach the greatest possible market share, they have to do everything to reduce the costs across the entire value chain. This must happen without losing the balance of the success factors among each other. Cost reduction in the SC is an essential driver for increasing a company's market share and competitive advantage (Fawcett et al., 2007: 33).

According to Fawcett et al. (2007: 33), there are four recognized strategies for reducing costs:

1. Providing the most efficient suppliers
2. Introducing modern processing technologies
3. Increasing productivity
4. Relocating to low-cost countries

In addition to these strategies, activities from value engineering (VE) are very useful (see section 2.3). Many companies have set the objective of cost limitation and reduction using methods and tools from VE.

Simchi-Levi, Chen, and Bramel (2005: 4) state that SC dynamics is the reason costs occur in the SC. Jay Forrester had already studied dynamic systems such as SC networks in the ’50s and ’60s. He described the so-called Bullwhip Effect for the first time in 1958 and 1961 (Alicke, 2005: 100).

2.1.5.2 Quality

In addition to costs, quality is the second major criterion influencing the customer's decision to purchase a product or not (Fawcett et al., 2007: 33). This is because the customer can directly see, feel, and experience quality. However, quality should not always be reduced to merely the tangible product. The quality of a company's services is equally important.

Quality binds the customer to the company. Oscar Wilde said “I have the simplest taste. I am always satisfied with the best . . .”. Mercedes coined the guiding principle “Quality is, when the customer returns but not the product”. This suggests that quality is defined by the product's freedom from defects and the satisfaction of customer needs. If both are achieved, a long-term business success can arise.

Garvin (1983: 65–75) identified eight variables. They enable the companies to identify how customers understand quality. The variables are performance, features, reliability,

conformance, durability, durability, aesthetics, and perceived quality. The SCM's task to transfer this quality into products and processes (Karrer, 2006: 21).

Fawcett et al. (2007: 33–35) say that the quality of individual parts and processes determines the final product's quality. Final product quality can therefore not be better than the quality of the processes and parts it contains. It is therefore necessary to focus equally on processes and components.

2.1.5.3 Delivery

According to Fawcett et al. (2007: 34) delivery means ". . . "doing things fast"—consistently . . .". Customers expect fast product availability (lead time). They also attach importance to the proper time of delivery and expect high delivery reliability. Customers in today's world expect ever shorter cycles, and new or revised products. Therefore, the time-to-market cycle (TTM) plays an increasingly important role. In consequence, it is also an aspect of delivery times.

TTM cycle is the entire time interval between the product development and product launch. Christopher (2005: 38–39) believes that supply reliability is the reason for safety stocks. A company can thereby minimize SC uncertainties. But the key to enhanced delivery reliability is greater SC transparency. For Graham (2005: 384), the delivery aspect covers both delivery time and reliability, as well as production lead time.

2.1.5.4 Flexibility

According to Alicke (2005: 192), no longer companies, but SCs compete. Therefore, achieving correct flexibility is the central role in the SC's design and operation. Here, companies must achieve flexibility in all processes occurring in the SCOR Model (Sennheiser & Schnetzler, 2008: 78). Ellram et al. (2007: 33) describe flexibility as the ability to adapt quickly to new or changing conditions.

Flexibility is necessary for companies in many different areas. Companies enjoy a competitive advantage if they can respond quickly to special customer requests. This way, they are able to offer the customer the desired product. Flexibility furthermore

describes how quickly and how well companies react to unexpected events arising in the corporate environment. The use of modern IT systems support SC flexibility by facilitating information exchange (Sennheiser & Schnetzler, 2008: 137).

2.1.5.5 Innovation

Garcia and Calatone (2002: 110–112) say that there is currently no uniform, generally accepted definition of innovation. Weise (2007: 12–13) differentiates process-related and object-related innovation. He adds that innovation might be a product of chance since invention is not necessarily be an intended result (2007: 11).

Innovation is identified in most cases with product innovation. This implies that breakthroughs in product architecture and even entirely new products are meant. This kind of innovation creates new market opportunities for a company and can contribute to changing industry standards (Fawcett et al., 2007: 35).

Process innovations are also of great importance from the SCM perspective (Simatupang & Sridharan, 2008: 409–411). Innovation is defined as the generation, acceptance, and implementation of new ideas, processes, products, or services (Chen et al., 2009: 36).

Tapscott and Williams (2007: 117) argue that the right mix is very important for the innovation. How much external technology is too much and how little internal research and development (R&D) is too little? Finding the right proportions is the basic challenge for a company.

Tapscott and Williams (2007: 188) say further that innovation is cumulative. Each generation uses and builds upon innovation from the previous generation.

2.1.5.6 Transparency

Probably the biggest issue in the SC is missing or delayed transmission of information. Extreme fluctuations in demand can be triggered as a result. These fluctuations in demands are responsible for the Bullwhip Effect (Alicke, 2005: 99–122).

Fawcett et al. (2007: 33) say “Information is power, especially in the hands of the customers . . .”. Through modern information technologies, consumers have a wealth of product and pricing information. This enables them to collect prices and specifications for selected products. They can subsequently evaluate and compare the results with each other.

But not only the end customers enjoy this possibility. It is available to all SC members. Similarly, this applies to the Procurement organization in a company. The former can quickly identify potential suppliers and compare their prices and capabilities. Procurement is thereby already provided with useful information about the supplier in anticipation of possible negotiations (Fawcett et al., 2007: 34).

Another major practical problem is that many decision makers do not allow any transparency. They do not share critical information with relevant members inside the company or with its external SC partners. Champy (2002: 82–83) state “There is no way that partners in a supply chain can be truly connected unless most of their processes are transparent . . .”. He further argues, that there is a risk of company-confidential information penetrating to the outside. However, this risk must be weighed against the benefits offered by a comprehensively informed, productive network.

A cooperative awareness must be cultivated, as stated by Tapscott and Williams. They further say that shared responsibility and transparency must be allowed if one is engaged in a cooperative community. Tapscott and Williams (2007: 292) also believe that control should be partly surrendered. Champy (2002: 152–155) even goes a step further. He believes that control has to be surrendered completely to ultimately get it back. Tapscott and Ticoll (2003: 22) define transparency “. . . as the accessibility of information to stakeholders of institutions, regarding matters that affect their interests…”.

2.2 Supplier Relationship Management

This section describes the general objectives and tasks of supplier relationship management with its holistic approach and strategies. Potential risks and issues are also

discussed briefly. Finally, the importance of supplier relationship management is discussed, since it represents a kind of link between SCM and procurement.

2.2.1 Definition And Objectives

The academic literature offers no unified understanding of supplier management relationship (SRM). There are also various perspectives on SRM. SRM is often understood as a generic term for internet-based procurement solutions such as eProcurement and eSourcing. These solutions arose in the late ’90s (Lutsch, 2007: 19).

Software manufacturer SAP describes SRM as a software solution the intent of which is to int*egrate the supplier into the overall procurement process. The entire corporate procurement process can thus be automated (Barking & King, 2002: 23–25).

Another perspective on SRM is supplier management, or operational and strategic procurement. Appelfeller and Buchholz (2005: 5) said that SRM must be understood as the design of strategic and operational procurement processes and supplier management design emanating from a procurement strategy. Wagner (2002: 11) said that supplier management is the design, management, and development of a company's supplier portfolio and relationships.

In Wannenwetsch's opinion (2005: 150), SRM is management of the entire supplier base, individual supplier relations, and the supplier processes. According to Hildebrand (2000: 12), SRM includes all of the activities associated with the supplier selection, development, and integration. The procurement process's strategic and operational development is thus affected.

Since it deals exclusively with the relationship with suppliers, SRM is the counterpart of customer relationship management (CRM). Corsten and Hofstetter (2001: 131) describe SRM as a proactive design of all supplier relationships of a company across all business areas. The goal of collaboration with suppliers and subcontractors is to develop, produce, and procure products better, faster, and at lower prices.

Riemer and Klein (2002: 7) also understand SRM as part of partner relationship management. SRM focuses on the relationship with external suppliers and any activities concerning planning, implementation, and monitoring of interfirm relations. According to Appelfeller and Buchholz (2005: 5), the use of conventional and Internet-based IT is very important for SRM. They defined SRM briefly as IT-based procurement and supplier management.

Based on the different definitions and interpretations above, SRM is defined for this dissertation as follows:

SRM is the IT-based planning, management, and control of all operational and strategic procurement processes in supplier relationships.

According to Appelfeller and Buchholz (2005: 5), SRM's objectives are:

- Reducing processing costs and cycle times for strategic and operational procurement processes and purchase prices.
- Improving process quality through identification and selection of suitable suppliers.
- Optimizing the customer-supplier relationship.
- Improving product quality.
- Continuous monitoring and analysis of purchasing processes and supplier performance.

It can be stated in summary that SRM's main objective is process integration. In the process, it pursues the reduction of costs and risks. SRM builds on the existence of supplier relations (SR). SR is the way customers and suppliers cooperate (Appelfeller & Buchholz, 2005: 8).

Appelfeller and Buchholz (2005: 12–13) systematize SR, showing in their 3-level model a possible procedure for organizing of supplier relationship. The overall procurement strategy is defined at level 1. This is used for goal-setting and strategic analysis to define the framework for integrating suppliers. Level 2 describes the strategic procurement process at the material group level. Here, process-related supplier relations are used.

Operational procurement processes are considered and the SR is implemented on level 3.

2.2.2 Strategy And Concept

The SRM approach pursues the improve of all supplier flows. It is based on a partnership approach, which requires a sustainable relationship. Ideally, this relationship begins with the common design and construction of products persisting thereafter throughout the whole product life cycle (Corsten & Gabriel, 2002: 17).

SRM's main strategies apply to supplier evaluation, selection, development, and integration (Wagner, 2002: 14–15). Supplier management, which is a part of the SRM approach, can be pictured graphically as a control loop (see figure 8).

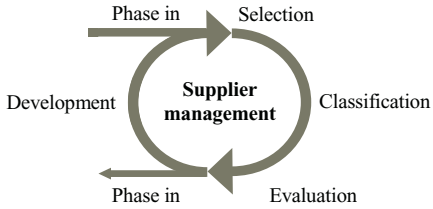

Figure 8: Supplier management control loop
Source: Author's illustration

If a company uses these strategies, procurement costs decrease, procurement efficiency increases, and long-term supply security are guaranteed (Gienke & Kämpf, 2007: 204). SRM's three main strategies will be explained in more details in the following sub-subsections.

2.2.2.1 Supplier Selection And Eevaluation

Selecting suitable suppliers is essential to achieving SRM's objectives. Suppliers today have a very large proportion of value creation and are therefore critical to a company's competitive situation. In the course of SRM, it is thus necessary to identify the right suppliers and to establish good business relationships with them (Lutsch, 2007: 22).

The strategic “supplier selection and evaluation” step's aim is to determine the right supplier for the company. It thus represents the cornerstone in forming a supplier base. Suppliers' performance is studied with the help of a supplier analysis. Dates and figures about suppliers' economic, environmental, and technical performance play a major role here.

Such a supplier analysis's criteria can be quality, prices, delivery times, flexibility, and other services (Appelfeller & Buchholz, 2005: 42–43). These and other important information about the supplier can, for example, be obtained with the help of supplier audits (Kämpf, 2006: 4).

Supply risk and the lead times are two critical factors to be considered during supplier selection (Thaler, 2007: 161). According to Wagner (2002: 74), there are two different approaches depending on the severity of risk being managed, the nature of the supplier relationship, and the products to be procured.

1. A simple offer evaluation suffices for standardized products with low procurement risk.
2. A holistic assessment of the supplier must be completed for complex, strategic, and technologically advanced products, which have a high supply risk. The goal is a long-term partnership.

Supplier evaluation is the systematic, comprehensive assessment of selected suppliers' performance capability (Gienke & Kämpf, 2007: 207). The variety of evaluation criteria that can be used has increased considerably in the recent years. In the past, the focus was mainly on logistics and price. These days, factors such as quality, cost, technology, and ecology are also in focus (Appelfeller & Buchholz, 2005: 47).

These assessments must be carried out regularly, especially for strategic suppliers. The results are then discussed together with the supplier. Thus, potentials are discovered, improvement actions can be initiated, and the supplier will be developed. The goal of the supplier evaluation to secure efficient supply sources, control the supplier relationship, and, not least, the associated securing company competitiveness (Gienke & Kämpf, 2007: 207–208).

But the supplier evaluation may not be conducted as an isolated or individual procurement activity. It is essential that it be the overall result of a multi-functional team that covers, for example, development, production, procurement, and quality management.

For execution of the supplier evaluation, a rating system must be available that allows supplier performance to be assessed. Such an assessment includes measurable/objective criteria (hard facts), such as delivery reliability, as well as subjective criteria (soft facts) such as quality of information provided by the staff (Thaler, 2007: 161).

2.2.2.2 Supplier Development

Several different steps can be undertaken if a strength-and-weakness analysis shows that the current supplier base's efficiency may not cover current or future goals or needs adequately. Besides a change of supplier or insourcing activities, supplier development can also be successfully used as a part of SRM (Wagner, 2002: 84–85).

Arnold (2004: 23) mentions that in the course of supplier development for example, the customer can initiate transfer of know-how, a consultancy on process optimization, or staff training improvements. The goal of supplier development is to increase the supplier's performance and to benefit in a long-term business relationship.

According to Wagner (2002: 86–88) supplier development has the following three characteristics:

1. The customer is willing to “invest.”, because he hopes to get better supplier performance in the future based on supplier development.
2. The customer is interested in a far-reaching, long-term, cooperative business relationship.
3. The customer actively supports suppliers with optimizing processes and procedures as well as with establishing and developing know-how.

It should be emphasized that supplier encouragement is probably the most common form of supplier development. Supplier-encouragement means that the customer provides support activities for its suppliers. The goal is continuous supplier-performance improvement.

Jacoby (2009: 246) describes supplier encouragement as supplier kaizen, defining it as follows: “Introducing continuous improvement initiatives into supplier organizations to synchronize supply chain goals and operations between two trading partners . . .”.

2.2.2.3 Supplier Integration

Thaler (2007: 110) states that supplier integration is an organizational concept for corporate-wide and interdepartmental integration of suppliers, service providers, and equipment manufacturers. It is primarily used for system suppliers (figure 9).

These system suppliers manufacture highly complex systems (such as preassembled modules) and also manage many subcontractors, who have no direct customer contact (Sokianos, Drüke, Seel & Wieneke-Toutaoui, 1998: 419).

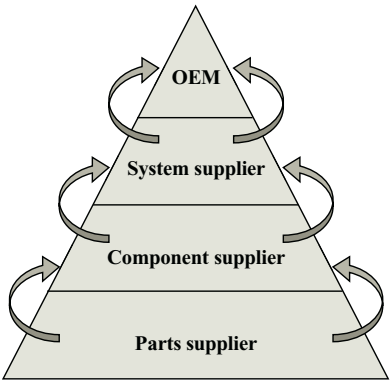

Figure 9: The supplier pyramid

Source: Author's illustration based on Corsten & Gössinger, 2008: 19; modified/translated

Arnold (2004: 13) believes that supplier integration is only used when there is a good customer-supplier relationship. The following objectives are achieved in this case:

- Creation of transparency and flexibility.

- Reduction of costs, risks and lead times.
- Improve product quality.
- Improving on-time delivery and responsiveness.
- Strengthen trust between the partners.
- Optimum customer benefit.

Supplier integration also covers supplier involvement during the product development process. Wagner (2002: 101–110) distinguishes between two different phases. In the first, the supplier obtains insight into the customer's development processes. This is typically envisaged to reduce costs and shorten development time. By using, for example, simultaneous or collaborative engineering, planning and development activities are carried out in parallel (Thaler, 2007: 111).

Another important aspect is the fact that it is possible to drive innovation or the introduction of new technologies through know-how transfer. This way, the customer gets access to technology the supplier already has, but not the customer (Wagner, 2002: 102; Thaler, 2007: 113).

The other phase, described by Wagner (2002: 111–115), is that of industrialization. In this phase, supplier integration is usually accompanied by an improvement in production and logistics processes. Activities for continuous improvement in procurement and production are carried out. The determining factors of this phase are, on the one hand, logistical responsibility on the suppliers' side, and the customer's logistical risk on the other.

The essential advantage of this phase of supplier integration lies in the continuous improvement of processes and products as described in sub-subsection 2.2.2.2. This leads for example to inventory reduction, fewer quality problems, and more stable prices. Furthermore, it contributes in a higher sense to responsibility connected with fulfilling a contract-related partnership.

2.2.3 Risks And Issues In The Use Of SRM

Corsten and Gabriel (2002: 18) state that cooperation is the basis for SRM. SRM is based on mutual trust, strong communication, and a willingness to cooperate. But those points represent the biggest problems while a company is implementing SRM.

Since SRM entails division-of-labor task fulfillment, two points are important: mutual communication and the coordination of individual steps during the process of goods and services production. But it is precisely in coordination that problems occur that must be addressed with adequate instruments (Corsten & Gössinger, 2007: 50–53).

Unilateral abuse of the relationship represents a further risk. Here, one party is unwilling to render the defined service in return. Instead, he tries, e.g., to cut prices or to shift responsibility for the stocks onto the partner (Werner, 2010: 100). Other problems that could lead to complications with achievement of the cooperation objective or even frustrate it are, for example, disputes over profit distribution, large amounts of time required for agreement, different corporate cultures, or the unwillingness to transfer know-how (Arndt, 2006: 179).

However, the biggest risk of SRM failure is concealed in the lack of support from a company's top management. Sustainable success for the parties cannot be achieved if it is possible only to develop SRM at the functional level without top-management support (Mostberger, 2008: 34–36).

Anklesaria (2008: 131–132) highlights particularly the supplier relation to a single source. He says that the win-win situation very often changes so that the supplier wins ever more frequently. He said “Treat your single or sole source suppliers like you would your best customer . . .” (2008: 132). In such a single-source situation, a company can choose between two paths: either it remains passive and complains about the facts, or it chooses the path of proactive optimists.

The Latter Group, which is among the optimists, has developed seven effective strategies for this situation. These include, among other things, the establishment of alliances, development of creative sourcing strategies, and the execution of a leap in technology and service.

2.2.4 SRM's Importance For SCM

SRM is an SCM instrument. It pursues the objective of process integration to reduce costs and risks. That requires intensive cooperation among all parties in the value chain and the use of modern information technologies (Wannenwetsch, 2005: 176).

As part of SCM, effective use of SRM has a significant impact on customer satisfaction (see figure 8). Wannenwetsch (2005: 176) added that inadequate SRM evinces deficits in quality, delivery reliability, and the relationship in consequence. Such deficits have a direct impact on business processes and thus result in negative customer satisfaction.

Therefore, a successful SRM not only leads to the mentioned cost and risk reduction, but also makes an important contribution to customer satisfaction and thus to the sustainable success of all parties involved.

Christopher (2005: 40) says that “Supply chain management by definition is about the management of relationships across complex networks of companies that, whilst legally independent, are in reality interdependent . . .”. Successful SCs will be those that strive for a win-win situation based on mutual trust. However, this is not a model derived from the past. Rather, it is one that will prevail in the future because SC competition will become the norm.

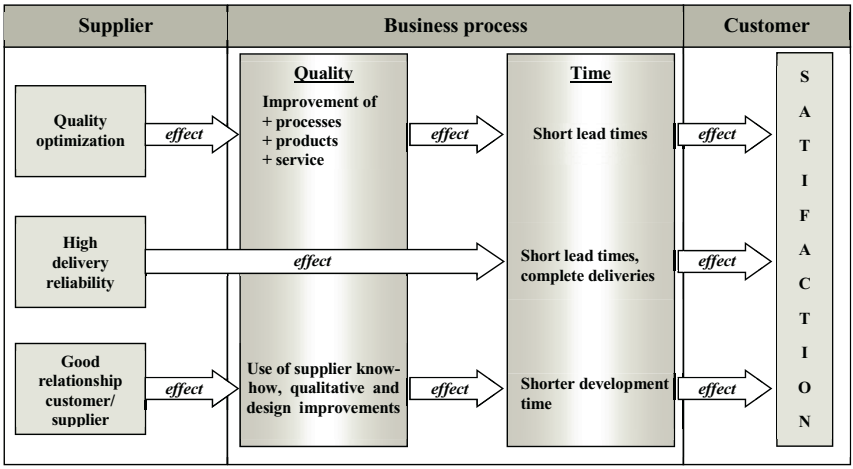

Figure 10: The benefit of SRM for a company

Source: Author's illustration based on Hartmann, 2004: 14; modified/translated

2.3 Procurement

Procurement's role within SCM is highlighted first in this section. Then, a clear distinction between purchasing and procurement is made. The changes that have taken place over time in the procurement area will be considered, and it will be shown how procurement makes a positive contribution in the SCM context. The section concludes with a discussion about measuring procurement performance in its entirety, as well as about purchasing success (purchasing savings) at a detailed level.

2.3.1 Procurement's Role Within Supply Chain Management

Busch's (1981: 27) sweeping statement, that everything for which a company receives an invoice can be described as "procurement", far from sufficiently reflects the importance of procurement's role from the SCM perspective. It is rather the case that procurement bears responsibility for most of the costs occurring within the company.

On average, 50% of all costs arise in procurement (Grossmann, 2007: 15). The importance of procurement for SCM emerges especially when procurement's objectives

are considered, while taking into account critical success factors in SCM (see subsection 2.1.5). These objectives are:

- Benchmarking (see sub-subsection 2.5.2.3) and reduction of the supplier base (Lysons & Farrington, 2006: 8).
- Exploration, observation, and analysis of the procurement market (Busch, 1981: 27).
- Selecting and evaluating suppliers (Bogaschewsky, 2003: 26).
- SRM (see section 2.2) and making, buying, and outsourcing decisions (Lysons & Farrington, 2006: 8).
- Translating corporate objectives into procurement objectives (Lemme, 2009: 29).
- Transferring market opportunities by providing expertise, know-how, and innovation while considering quality, quantity, cost, time, date, and delivery (Busch, 1981: 27).
- Building up cooperation's and developing suppliers (Lysons & Farrington, 2006: 8).

By consistently implementing these procurement objectives, the success of critical SCM factors (cost, quality, time, flexibility, innovation, and transparency) is substantially supported and, in part, even made possible. On the one hand, procurement has to meet the quality-cost-time triangle's conditions (Thonemann et al., 2004: 134); on the other, procurement provides the required innovation and flexibility to the company thru a consistent SRM (see section 2.2).

Transparency is probably the factor most difficult to produce, because it ultimately depends on trust. Establishing trust is also the task of procurement, since it is the contact for suppliers in the company. Creation of trust is one of the hardest tasks of all.

In their book “The Naked Corporation,” Tapscott and Ticoll (2003: 125) are of the opinion that it is very difficult to break old bad habits like distrust in a SC. A code of ethics on which trust, and not least the supplier relationship, can be established is therefore particularly important (Gloor, 2006: 86; Lysons & Farrington, 2006: 8).

2.3.2 Definition Of Procurement And Purchasing

No consistent demarcation between the terms purchasing and procurement be found in the literature. The terms are often used synonymously (Osburg, 1994: 3–4). Some sources define the purchasing function as a part of procurement (Kroeber-Riel, 1966: 12; Lieberum, 1999: 12). Others see in procurement an organizational unit that has the purchasing task (Hansen, 1990: 52).

For Lysons and Farrington (2006: 6) term procurement implies purchasing goods and services for monetary or other equivalent payment. Arnolds, Heege, Röh, and Tussing (2010: 2) state that the concept of procurement is often used to highlight operational activities. Formative (modern) procurement and managing (old) procurement must be differentiated. A safe, cost-effective supply sought through purchasing. Emphasis is on the safety aspect.

Arnold (2007: 13) sees the provision of goods, services, energy, rights, information, and the combination of these items as purchasing. Lysons and Farrington (2006: 6–8) first mention the classical definition of purchasing, and add “To buy materials of the right quality, in the right quantity from the right source delivered to the right place at the right time at the right price . . .”. They think this definition is obsolete, since it means that purchasing is reactive, transaction-based, and acting tactical. In their opinion, the suitable modern definition of purchasing is “The process undertaken by an organizational unit that, either as a function or as part of an integrated supply chain, is responsible for procuring or assisting users to procure, in the most efficient manner, . . . thereby contributing to the competitive advantage of the enterprise and the achievement of its corporate strategy . . .”.

For the remainder of this dissertation, the terms procurement and purchasing are defined as follows:

Procurement is a company's organization unit responsible for all strategic and operational, purchasing-relevant planning, strategies, activities, processes, and interfaces.

Purchasing is a subset of procurement. It is based on transactions and is responsible for the provision of goods and services required within the company at the right time, price, and quality.

The illustration in figure 11 supports these definitions.

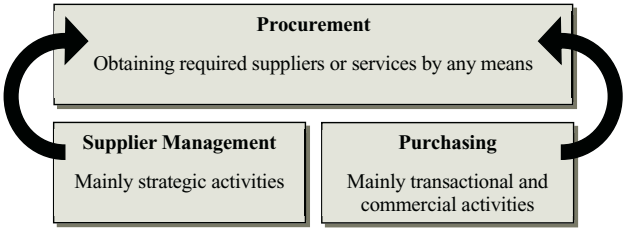

Figure 11: Relationship between purchasing and procurement
Source: Author's illustration based on Lysons & Farrington, 2006: 8; modified

The illustration shows that purchasing and supplier management are both united under procurement. Here, purchasing also covers activities such as monitoring inventory levels or executing delivery schedules. Issues such as benchmarking (see sub-subsection 2.5.2.3) or supplier reduction, make-or-buy decisions, SRM (see section 2.2), or cooperation fall under the heading of supplier management (Lysons & Farrington, 2006: 8).

2.3.3 Procurement — Past And Present

Lutsch (2007: 18–19) is of the opinion that the procurement was afforded too little attention for a long time. The same goes for dealing with suppliers. This situation changed only in early 1990.

The use of external resources grew quickly from this time on. Concepts like just-in-time (JiT) and SCM were established in response to increasing globalization. Through JiT and SCM, the entire field of procurement acquired increasing importance and close integration of suppliers became much more significant for companies.

Driven by this fact, SRM (see section 2.2) has become firmly established in procurement. Ever shorter product life cycles, smaller delivery units, and changing value creation within companies (Lemme, 2009: 9) caused procurement to sense that the market had changed drastically. Confronted with these changing environmental conditions, procurement was literally compelled to adapt.

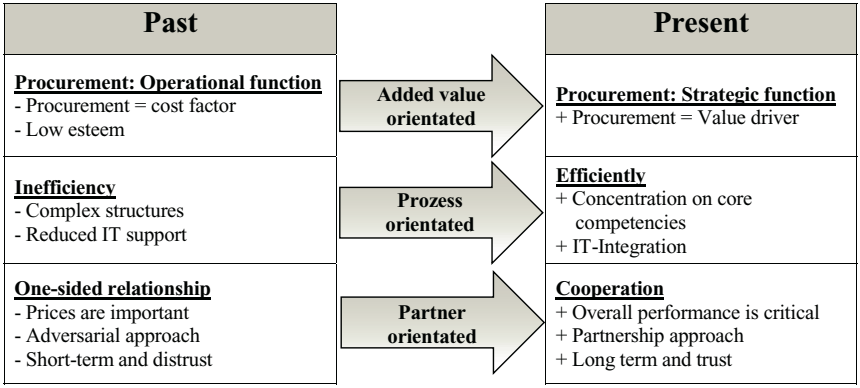

Figure 12: The change of procurement

Source: Author's illustration based on Kämpf, 2006: 1; modified/translated

According to Lemme (2009: 7–9), procurement's tasks have changed so much in recent years that this corporate organization got much more attention among the general public. Procurement is expected to use cost levers correctly through competent action. Lemme states further that a procurement is required that deals with tasks in a way so expertise can be used to sustainably reduce costs in the company.

Procurement today bears much more responsibility than ever before for the total cost aspect. This situation requires procurement to internalize the following four points:

1. There is a difference between a product's price and its cost (see section 2.5).
2. The decision for a cheap product can be a very expensive decision.
3. There is more than one decision criterion for selecting suppliers or products.
4. A way of thinking based on costs rather than on prices must be developed (Lemme, 2007: 8).

Modern procurement's policy is to optimize the price-performance ratio. It seeks to abandon the isolated consideration of prices. To achieve this goal, procurement is performing primary activities such as purchasing-market research, offer comparison, and contract negotiations. The order process itself plays a minor role (Arnolds et al., 2010: 2).

2.3.4 Sustainable Strategic Partnership

On closer examination, one concludes that the change in procurement (Lutsch, 2007: 18–19) enabled even minimal partner collaboration; partner collaboration being the exchange of information between customers and suppliers. Poirier and Quinn (2003: 42) also describe this as level 3. Such a status would be impossible in a relationship based on confrontation.

In a close, strategic cooperation, it is possible to relocate parts of the one's own added value to the partner. Corsten and Felde (2002: 85) say that partner organizations partly contribute up to 70% of a company's added value. Relocation can reduce costs while improving product quality (Schönsleben, 2007: 80–84). Companies travel a common route to achieving utility maximization and ultimately a win-win situation (Seifert, 2002: 375).

In their study, Corsten and Felde (2002: 85–89) state it is widely known that cost reductions in procurement lead to an improvement in net profit. Optimization potentials that can be worked out jointly with the supplier go far beyond mere cost savings. However for this to happen, the shift from confrontation, to cooperation and coordination through collaboration must be completed.

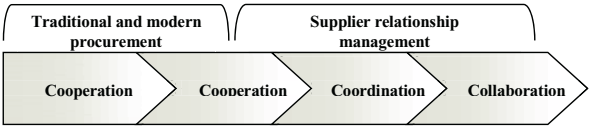

Figure 13: The four steps to achieving a strategic partnership

Source: Author's illustration based on Corsten & Felde, 2002: 85, modified/translated

Corsten and Felde (2002: 85–93) say furthermore that SRM's (see section 2.2) core lies in the support of collaboration between procurement and its suppliers. They see that collaboration is better than confrontation as an implicit assumption. They come to the conclusion that collaboration has a positive impact on the company's innovation performance as well as on its results.

It should be noted that not all companies can benefit to the same extent from these advantages. Joint planning, as well as the use and development of technologies form the basis for collaborative business cooperation. Responsible, careful supplier selection must have occurred regarding better, faster, and cheaper supply of needed goods and services. The care of the relationships with suppliers who are becoming partners is seen as a control variable for the success of their own company.

Information exchange plays a central role apropos collaboration in SCM. For the company and its partners involved in the SC, information represents the basis for joint control over all existing SC flows (Min & et al., 2005: 237–256). Information exchange contributes significantly the right decisions being made and improves the SC's visibility being improved (Simatupang & Sridharan, 2005: 263–265). Proactive information exchange achieves a monetary benefit. The former should not be viewed as the ultimate problem solver, but rather as an enabler (Simatupang & Sridharan, 2008: 406–408).

The ability to share information comprises two main interrelated components. The first is connectivity (Fawcett et al., 2007: 377–379). It describes the use of information technology, and thus the possibility of how the involved people and organizational units can communicate and work with each other. The second component is all relevant parties' willingness to engage in mutual information exchange (Handfield & Bechtel, 2002: 367–382).

Finally, it can be stated that trust is, on the one hand, responsible for the sustained success of a collaborative, sustainable partnership and, on the other, is also a requirement. Concerning the issue of trust between the parties, Gloor (2006: 86) says “The main glue that holds them together is the network of mutual trust. Trust can only be maintained if there is an agreed-upon code of ethics . . .”. When procurement is in a

position to achieve its objectives and establish a trusting relationship with the suppliers, the old phrase “The profit lies within procurement.” fully applies.

2.3.5 Procurement Performance Measurement

Successful procurement management is currently no longer limited to cost-optimal supply of required goods and services within the company. Procurement must be intensely focused on the supplier if cost reduction opportunities and competitive advantages are be worked out.

Procurement performance measurement, also called procurement (Lemme, 2009: 102–125) or purchasing controlling (Buchholz, 2002: 363–365), has to support this path adequately. It does so by promoting effective collaboration with suppliers and contributing to the whole SC's continuous performance improvement.

Buchholz (2002: 363–365) points out that performance measurement for targeted control of procurement processes has gained importance during the last years. Further, he says that because performance improvements in procurement have a huge leverage effect on the company's results, measurement and representation of procurement achievements is an important requirement of a modern procurement controlling.

Such a representation of procurement achievements can be effected a Balanced Scorecards (BSC), developed by Kaplan and Norton (1992a & 1992b) in the’90s. The premise of their reasoning was that traditional measurement systems were no longer adequate for managing companies. The company's actual performance and long-term viability cannot be judged through traditional measurement systems.

Those measuring systems had a purely financial character and were based on historical data. Thus they no longer fulfilled the company's requirements (Kaplan & Norton, 1992a: 37–38).

The BSC offers a balance of core elements necessary for strategy implementation. Financial and operational (performance) indicators, also known as key performance indicators (KPIs), accompany one another.

These figures are divided in the four perspectives: financial, customer, processes, and staff/learning. These perspectives allow strategic actions to be transferred into understandable goals and objectives. Actions based on measurable quantities can be derived from this information. If and when the objectives are reached may ultimately be assessed based on the resulting KPIs (Kaplan & Norton, 1997: 8–15).

The supplier's perspective must be integrated into the classical BSC to generate a practical, useful BSC for procurement. This perspective must include strategic objectives that render measurable, for example, improvement of supplier quality, supplier reduction, or the optimization of supplier integration (Appelfeller & Buchholz, 2006: 103; Buchholz & Roos, 2002: 54–58). The sample perspectives can fall into the KPIs listed as examples in the appendix.

Piontek (2004: 226) noted that the BSC promises success, because it emphasizes the possibility of reacting of a number of developments with an adequate factual reference. Furthermore, it admits the management-by-objectives principle. Thus, employees can be guided by indicators, targets, action plans, and target-performance comparison. Decisions can be made at all employee levels, because the BSC makes corporate strategy transparent.

Wagner and Weber (2006: 26) do not go into the same level of detail as the BSC. They divide total procurement performance into two levels. The first is purchasing performance. This is performance that leads to expenditure reduction. However, it need not lead inevitably to cost reduction compared with the previous period or the budget. The second level is purchasing result. This is the profit-and-loss effective result that leads to a cost reduction compared to the previous period or the budget.

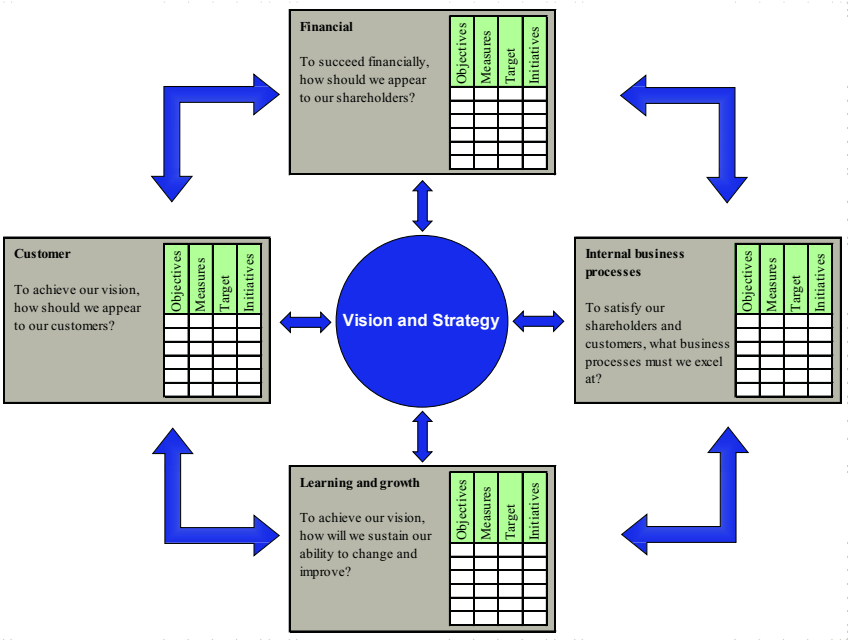

Figure 14: A BSC's four perspectives

Source: Author's illustration based on Lysons & Farrington, 2006: 652; modified

2.3.6 Purchasing Success — "Savings"

Monetary KPIs such as averted price increases are present in all representations or measurement systems for determining procurement performance. They are just represented or grouped in different ways. As in the BSC, the totality of all indicators reflects procurement's holistic performance. Thus, the purchasing success is only a subset of overall procurement performance.

There is no uniform, consistent definition of purchasing success (savings) in the literature. The company or the organizational unit Procurement usually defines its meaning. However, planning purchasing success is one of overall procurement controlling's most significant elements. A company with a 30% share of material costs

on turnover and a 5% return on investment, can achieve the same effect as a 30% increase in turnover (Lemme, 2009: 108) with a purchasing success by 5% (= material costs -5%).

Schumacher, Schiele, Contzen, and Zachau (2008: 93) see in purchasing success the determined difference between the new and the old price for a defined product or service. Roylance (2006: 26) include points such as price reduction and performance improvement at the same prices into purchase successes. In addition, Voegele (2005: 197) sees price reduction, including averted price increases of the supplier, as a purchase success (see also Voegele, 2008: 147; Voegele & Grass, 2006: 1118). Hug (2010: 25) divides the overall outcome of purchasing success in four different areas:

1. Cost reduction “hard savings”→ Direct effective profit and loss
2. Reduced capital commitment → Direct balance effect
3. Cost avoidance “soft savings” → Procurement performance vs. budget/market trend/initial offers
4. Value creation → Purchasing performance opposed to plan/objectives agreements

Hug (2010: 25) assigns purchasing cost changes, market price changes, or demand changes to cost-reduction “hard savings”. For Hug, cost avoidance “soft savings” unites issues such as price trend against market trend, averted price increases or suppliers' unpaid value-added services.

The sum of the differences between the lowest and highest offer represents negotiating success in procurement for Buck (2005: 452–453). But he also sees averted price escalations as a purchasing success. Despite varying distinctiveness of its definitions, it is possible to stated that purchasing success can be assign to three categories: cost avoidance, cost reduction, and performance improvement.

Table 3: Grouping of definition categories for purchasing success

Source	Statement	Cost avoidance	Cost reduction	Performance improvement
Buck, 2005: 452–453	The size of differences between the lowest and highest offer	X		
	Averted price escalations	X		
Hug, 2010: 25	Price reduction		X	
	Change of the market price		X	
	Demand change		X	
	Price trend as opposed to market trend		X	
	Averted price increases	X		
	Cost avoidance for first and one-time purchase	X		
	Free value-added supplier' services			X
Lemme, 2009: 124	Negotiating success	X		
	Discount rate		X	
	Purchasing price reduction		X	
Roylance, 2006: 26	Performance improvement at the same prices			X
	Price reduction		X	
Schumacher et al. 2008: 93	The calculated difference between the new and the old price for a defined product or service.			X

Source	Statement	Cost avoidance	Cost reduction	Performance improvement
Voegele, 2005: 197	Price reduction Averted price increases	X	X	
Van Weele, 2005: 255–256	Price/Cost reduction		X	

Source: Author's illustration

Lysons and Farrington (2006: 635) define purchasing success briefly as ". . . minimizing the cost of resources acquired without loss of quality, which is achieved by spending less . . .". It should be noted that the comments related to purchasing success dealing with purchase prices and not with costs occurring to manufacture a product (see section 2.4). For the rest of this dissertation, purchasing success will be called "purchasing savings", since no real success appears in the definition, just savings for procurement.

2.3.7 Procurement Ethics

Since companies are increasingly interdependent, different SCs compete with each other (Christopher, 2005: 40). Van Weele (2005: 292–293) points out that a well-functioning SC requires planned, long-term collaboration and comprehensive information. He says further that under such conditions, solid trust between the involved parties is particularly important.

Well-trained employees are a first step in creating confidence and trust. To achieve sustainable trust, the company must develop business-ethics policies for its employees. These policies enable staff to act consistently and reliably. Thus, cooperation between customer and supplier remains the same despite employee turnover (Van Weele, 2005: 292–293).

Business-ethics policies are based on moral principles and values. The centuries-old proverb, ". . . whatsoever ye would that men should do to you, do ye even so to them . . ." is a good example. Business-ethics policies unite accepted social principles, legislation, and fairness, and transfer them into the business relationship (Monczka et al., 2011: 567).

According to Lysons and Farrington (2006: 655) the most important principles of business-ethics are the following:

- Impartiality and objectivity
- Openness and full disclosure
- Confidentiality
- Diligence, competence, and a duty of care
- Loyalty to professional principles
- Potential or apparent conflict-of-interest avoidance

Aspects especially important for procurement are also covered if business-ethics principles are expanded to the suppliers' perspective. Among these aspects are fast payment, honesty and openness, courtesy to the supplier's representatives, and provision of practical assistance and counseling (Lysons & Farrington, 2006: 656–658).

Particular emphasis is placed on the last aspect, providing practical assistance and counseling. Lysons and Farrington (2006: 656) understand this to include the following points:

- The customer supports the supplier to make the former's own supply more effective and economical.
- Assistance in finding alternative customers to avoid over-dependence on any one source.
- The supplier gets feedback regarding unsuccessful tenders.
- Participation in design and production at the supplier.

- Conduct of supplier development.
- Delivery of contingent of contracts with local providers to support the welfare of the community in which the Procurement organization is located.

Van Weele (2005: 294) adds, among other things, the maximum amount of company revenue with the supplier. This is to prevent the supplier from becoming dependent on its own company. It is also necessary to determine how confidential price information should be handled.

An ethical buyer behaves equitably, decently, fairly, honestly, and consistently (Monczka et al., 2011: 567) towards its suppliers. A comprehensive business ethics enables every employee to know what is allowed and what is not. Employees know how they have to conduct themselves, e.g., with gifts from suppliers. Such guidelines make it possible to always achieve the best from the company's perspective during the negotiation with suppliers (Van Weele, 2005: 293).

M. Harding, W. Harding and M. Harding (2001: 40) stress that a company should have only one business-ethics policy. It is important to strictly avoid formulating ethics policies for different functions and hierarchical levels. This approach would divide the company into different classes with different rights.

2.4 Value Engineering

This section's intent is to briefly explain value-engineering methodology, with the help of which companies try to reduce purchasing costs. Thereby and via its methodology, value engineering helps to support the SCM CSF's defined in section 2.1.5. Furthermore, cost drivers are discussed, inasmuch as companies, and not least procurement, always try to identify and eliminate them.

2.4.1 Definition And Objective

The so-called father of value engineering (VE) is Lawrence Delos Miles. He had developed VE methodology in the ’40s, when he worked for General Electric (Kelly & Male, 1993: 8; Younker, 2003: 3; Mukhopadhyaya, 2009: 1–2).

Hoffmann (1994: 28) highlighted in the ’90s the substantial terminology of the U.S. terms, that are used in conjunction with product life cycle phase as well as the objective. VE is accordingly the generic term describing the value analysis of a product in the development phase. Value improvement represents value analysis work on an existing product. Value control means, that the company constantly examines its products prices in terms of function and value. Value assurance means that a company guarantees its customers that the affected products have been subjected to a value analysis.

The examples given by Hoffmann always describe the same approach. They just apply at different stages of the product life cycle. More current definitions of recent years no longer distinguish this fact. Mukherjee (2006: 97) defined VE “. . . as an organized and systematic approach to provide the required function at the lowest cost consistent with specific performance, quality and reliability . . .”. Cooper and Slagmulder (1997: 80) say VE “. . . is a systematic, interdisciplinary examination of factors affecting the cost of a product with the aim of devising a means to achieve its specified purpose at the required standards of quality and reliability and at an acceptable cost . . .”. Mukhopadhyaya (2009: 37–38) describes VE with its duties as the systematic application of techniques.

Recognized multi-disciplinary teams are supposed to identify the functions of products, processes, services or systems and assign them a value. Furthermore, the team should think creatively to develop alternatives that can be used to meet all necessary functions with lower overall costs. The core of the VE process can be grasped with five key questions:

1. Which component is concerned?
2. What is the component doing?
3. How much does the component cost?
4. What alternatives would also fulfill its duties?
5. How much does the alternative cost? (Miles, 1967: 37; Cooper & Slagmulder, 1997: 81)

These five key questions should help keep the focus of VE methodology, value analysis, on the correct subject (Cooper & Slagmulder, 1997: 81) and achieve a clear separation of value and features. At the same time, these steps are the basis for all activities for cost reduction (Hoffmann, 1994: 29).

VE can be used to solve problems, reduce costs, improve quality or performance, and maintain the function. Side effects of VE are the reduction of life cycle costs and the optimized use of resources (Younker, 2003: 22–23).

2.4.2 Value Analysis — The Methodology

According to DIN 69 910, value analysis (VA) is a method for optimizing a product's functional performance based on technical and economic aspects. Its objective is to minimize costs for materials and manufacturing (Thaler, 2007: 118). Its taxonomy aligns VA with product features. Two types of functions are recognized: the primary function and secondary function (Miles, 1967: 31).

Primary functions are the basic functions and the reason for the product's existence. They represent the product's direct benefit to the user (Cooper & Slagmulder, 1997: 137).

Secondary functions can arise for different reasons. They may meet customer expectations regarding the product's appearance, characteristics, or societal valuation (Miles, 1967: 31). Alternately, they are artifacts of the approach the developers to implement the primary functions (Cooper & Slagmulder, 1997: 137).

A functional improvement or cost reduction presupposes that the investigated product is understood. Analysis of the product's functions circumscribes the product's concept. Thus, the existing or conceived solution is no longer the basis of consideration, but the function or effect.

Younker (2003) and Miles (1967) divide the VA working plan (VAWP) into a different number of phases. Younker (2003: 25–28) selects a VAWP with six phases, while Miles (1967: 49–52) designs a total of seven phases.

In the ’90s, a five-phase VAWP had established itself in the industry. It was divided into the information phase, creative phase, evaluation phase, design phase, and proposal phase (Hoffmann, 1994: 73). Meanwhile, according to DIN 69 910 and VDI 2801, a VAWP with six basic steps has been established:

1. Project preparation.
2. Analyze status quo.
3. Describe the target state.
4. Develop alternative solutions/ideas.
5. Decide on solutions.
6. Implement solutions (Kern, 2004: 247).

In the first phase, objectives must be set, tasks must be defined, and the team has to be formed.

In the second phase, also called the information phase, all the necessary facts about features, pricing, processes, procedures, technologies, etc. are collected.

The desired functions will be determined for the object in the target state (phase three). These are the desired functions that cannot be dispensed with. Desired and actual functions are then compared with each other.

The fourth phase is the creative phase. The team works out solutions, such as how the object can be alternately designed and yet still implement the desired functions. Various brainstorming techniques can be used for this.

In fifth phase, solutions from phase four are reviewed for feasibility. The profitability audit is performed after that. That solution in which the target functions can be implemented at the lowest cost is chosen.

In the sixth and final phase, the solutions are implemented (Younker, 2003: 25–30; Kern, 2004: 247).

2.4.3 Consequence And Prerequisite

About 80% to 90% of the product costs are already defined during product development (Humel, 2007: 494). Thus long-term cost effects such as purchased parts, complex processes and systems, and a complex SC design are defined in a very early phase of the product life cycle. Customer requirements and the derived functions form the costs' basis.

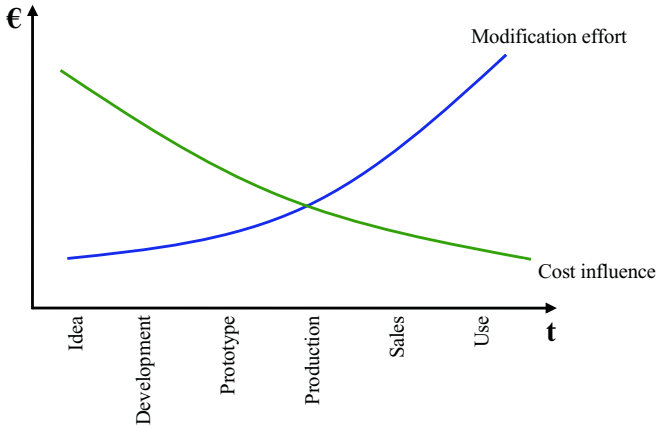

Figure 15: Effort-cost correlation regarding product modification
Source: Author's illustration based on Hoffmann, 1994: 35; modified/translated

The possibilities for influencing the cost progressively diminish and the cost of product changes increases as product development progresses (Hoffmann, 1994: 35). Only early, systematic use of VA and the resulting focus on functions will empower companies to reduce product costs, improve communication and cooperation, develop products aligned with the market conditions, and eliminate unnecessary features or product characteristics. Thus, products are technically simplified and production and administrative processes are optimized (169–194). Cost visualization is VA's basic requirement (143–144). The right approach brainstorming can be selected only if the contribution each production step, purchased part, or raw material makes to total costs is known.

Purchase-part analysis enables the cost of alternative products to be compared with those already used in, or planned for, the product. Practice shows that the cost transparency step is particularly difficult when performing a VA together with a supplier on an existing subcontracted part. Through the extensive disclosure of the required cost distribution, also called open book, the customer gets a deep insight into supplier's calculation and efficiency.

2.4.4 Cost Driver

The literature is indecisive about how to define cost drivers. Needles, Powers, and Crosson (2008: 899) describe cost drivers such as direct labor hours or labor costs, which have a cause-effect relationship with costs. Kück (2010: 203) says they are an object responsible for process costs. Albrecht and Wetzel (2009: 88) see expensive or failure-critical parts as cost drivers.

In practice it is often said that through VA, cost drivers are identified in products so that they can be eliminated afterwards. The open book method is the most suitable method to identify them. But whether the necessary processes or the components used may actually be a product's cost drivers must be called into question.

More likely, expensive parts and components used are merely described as what they are: high value items (Stump, 1989: 11–12). The explanation is simple. As mentioned above, the customer's requirements are the basis, and thus the reason for incurring cost (see subsection 2.4.3). In addition, points such as function definition and implementation are added.

These three points together lead ultimately to the requirements imposed on the overall product. In consequence, the product's requirements are reflected in the applicable requirements for the parts and processes used.

The requirements are thus the real cost drivers. They determine tolerances, manufacturing processes, surface, texture, and so forth, driving the cost and in turn the

prices. Suppliers' early involvement is an advantage when minimizing such costs drivers.

This step must take place at the beginning of development, because there costs are most easily influenced (see figure 15). Thus, via collaborative engineering (Thaler, 2007: 111), parts and components are developed or selected together with the supplier. This incurs the lowest possible cost during and after integration into the product.

2.5 Cost Management

This section's purpose is to create a uniform basic understanding of the terms cost and price, because the proper use of these terms is particularly important for this dissertation. Furthermore, some methods to determine product costs will be considered shortly. Using these methods, procurement is able to determine costs before requesting a supplier's offer.

2.5.1 Cost And Price Terminology

This subsection of the dissertation will provide a brief survey of the various cost types and, if necessary, undertake clear term definition.

2.5.1.1 Costs

A product's costs comprise three elements: direct material, labour costs, and overhead. The first two resulting from production and can be assigned directly to a product (Lysons & Farrington, 2006: 591; Mukhopadhyaya, 2009: 44). Overhead costs are incurred regardless of the product and can be further subdivided.

They consist of:

- production overhead (production buildings, insurance, etc.);
- administrative overhead costs (purchase, stocking, scheduling, etc.); and
- selling expenses (marketing, sales, etc.) (Mukhopadhyaya, 2009: 44).

Lemme (2009: 40–41) also describes direct costs as variable costs, since they change depending on the quantity produced. Overhead costs are fixed, since they accumulate up to a certain threshold at the same magnitude. Lysons and Farrington (2006: 592) add semi-variable costs, which are partly fixed and partly variable.

Product costs are also known as manufacturing costs (Horngren, Foster & Datar, 2001: 52–54; Aumayr, 2009: 36) and form the basis for VE activities (see subsection 2.4.2). It must be noted in addition, that costs are equivalent to expenses. If there is a decrease in the company's assets, company-internal are referred to. From the external, tax-law perspective, this is seen as expenses (Friedl, 2010: 31–42).

2.5.1.2 Price

Wherever goods and services are exchanged, there are prices (Diller, 2007: 30). The price is the purchaser's monetary unit. It flows to the supplier after the contracted good or service is received (Simon & Fassnacht, 2009: 6; Diller, 2007: 30).

Lysons and Ferrington (2006: 434) define it as ". . . the value of a commodity or service measured in terms of the standard monetary unit . . .". The price is to some extent the only thing that differentiates competing suppliers (Anklesaria, 2008: 12). It includes no incidental costs such as those covered under total cost of ownership (see sub-subsection 2.5.1.3).

Here too, a distinction must be drawn among particular perspectives. From the customer's perspective it is the purchase price. The supplier views it as the sale price. Therefore, the selling prices determine the purchase price (Simon & Fassnacht, 2009: 501).

The prices accepted by the market are referred to as the market price (Jain, 2008: 248; Diller, 2007: 30; see also sub-subsection 2.5.2.1). In markets with significant competition, prevailing market conditions set selling prices (Cooper & Slagmulder, 1997: 32). This fact means in effect that, in costing, the seller's market sets the

contribution margin. In a monopoly or a market with very high demand, it can happen that an excessive contribution margin is fixed.

2.5.1.3 Total Cost Of Ownership

Following Lemme (2009: 36), the total cost of ownership (TCO) contains the purchase costs as well as any applicable maintenance and operational costs for the product. The statement of many authors that the TCO is the sum of all costs incurred during the lifetime of a product or service, including the disposal (Anklesaria, 2008: 69; Jacoby, 2009: 247; Booth, 2010: 21) is not shared. This explanation is closer to the life cycle costs defined below, because the life cycle covers the disposal phase.

For this dissertation, TCOs are defined as the sum of all costs related to the purchase, transportation, integration, and installation of the product with all associated auxiliary costs (e.g., trainings, facilities, and foundation for machines) necessary for the product to be used properly.

2.5.1.4 Life Cycle Cost

In their handbook, the National Institute of Standards and Technology (1995: 135) defines life cycle cost (LCC) as ". . . the total discounted dollar cost of owning, operating, maintaining, and disposing of a building or a building system over a period . . ." of time. New South Wales Treasury (2004: 1) defined them as ". . . the total cost throughout its life including planning, design, acquisition and support costs and any other costs directly attributable to owning or using the asset . . .".

Lysons and Farrington (2006: 585) define LCC as the sum of

- purchase costs,
- operating costs,
- maintenance costs,
- energy costs, and
- disposal costs or residual value.

Mukhopadhyaya (2009: 45–47) defines LCCs very briefly, and stating that they cover all costs incurred for a product (from cradle to grave). With the focus on possible cost reduction, Younker (2003: 17) commented, if anything could be of benefit for the product, then it would be that the LCC is improved.

Based on the above facts, the definition of LCC for this dissertation is:

LCC is the sum of all recurring and non-recurring costs over the full life span of a specified good or service. This includes the TCO, operating costs, maintenance and upgrade costs, disposal cost, and value remaining at the end of the ownership.

2.5.1.5 Opportunity Costs

Lysons and Farrington (2006: 396) describe opportunity costs as a loss of profit, based on the selection of a particular course of action. For Schneider (2010: 192–194), opportunity costs represent the loss of profits (revenues or benefits) that were created because existing possibilities (opportunities) for the optimal use of resources were not perceived.

Opportunity costs have become a key concept in economics, which describes an expression of the basic relationship between scarcity and choice options. The concept plays a crucial role in ensuring that scarce resources are used efficiently. The colloquially expressions are costs of remorse or costs of lost profits.

Thus, the opportunity costs are not only limited on monetary and financial costs. The actual costs of lost production or services, lost time or other benefits must also be taken into account.

Opportunity costs are therefore not just costs, in terms of costs and activity accounting, but an economic concept for the quantification of lost alternatives.

2.5.2 Cost Determination

Four selected methods to determine costs of goods and services are presented in this subsection. A final evaluation will be conducted in subsection 2.7.4.

2.5.2.1 Target Costing — The "Classical" Approach

Target Costing (TC) represents a structured approach that is used to determine the costs, for which a specified product must be produced, to achieve the required profitability at a target sales price. Product target costs are calculated by subtracting the profit margin from the target sale price (Cooper & Slagmulder, 1997: 359).

Schulte (1996: 752) describes TC as a cost management technique. Costs can be planned, controlled, and monitored (Horváth, 2006: 514) with TC. This approach was already part of the cost-thinking at the Ford Motor Company in the '20s (Assfalg & Zehbold, 2006: 244). TC in its current form was developed at Toyota in 1965 and has been used in Germany since the '90s (Preissler, 2007: 191).

Instead of asking the question "What is the product going to cost?" TC focuses on the question "How much may the product cost?" (Horváth, 2006: 514). In a particularly advanced methodology, TC goes a step farther and asks "How much may a particular feature of the product cost?" (Weber & Schäffer, 2006: 330–331).

TC is divided into the phases cost finding, cost splitting, and cost attainment. The market is analyzed in the cost finding phase. The intent is to work out of how much the product is worth to the customer (Preissler, 2007: 191).

Horváth (2006: 519) recommends a distinction between hard and soft factors. Hard factors are the technical benefits while soft factors are, e.g., the product's image. The result of this phase represents the realistic market or target price. This is the price that a customer is willing to pay for that product. Maximum allowable production costs (the target costs) can then be derived from the realistic market price (see sub-subsection 2.5.1.2).

The cost splitting phase begins with the information available about price, type, and extent of the product's properties and the performance. Available financial resources are apportioned here (Preissler, 2007: 192). This requires that the product be divided into modules, so that so-called allowable costs can be assigned to them.

Modules get a share of the identified target cost in proportion to the functionality they contribute to the product. The cost framework's limitation prevents over-engineering of individual components.

The third phase, cost attainment, is tasked with analyzing any cost variations in a first step. Result of this analysis can be, for example, cost-cutting activities or functional enhancements (Preissler, 2007: 192–193). These steps and the actions taken are performed until the target price is achieved.

Horváth (2006: 514) sees as most likely the biggest advantage of TC the fact that cost and customer requirements are formulated, structured, and joined together at a very early stage. Furthermore, the entire process of product development is aligned with them. TC represents an interactive planning process with a strategic focus on developing a customer-oriented product (523). It allows consistent quality at lower average costs thus creating a good basis for sustainable market success (Preissler, 2007: 190).

TC's disadvantage lies its dependence on market analysis. If the determined data and information such as market price, customer requirements, required product features or properties are inaccurate, the product will be developed using false targets. It is also possible that customer-requested product functions or services are completely missing, even though they are indispensable for the customer.

However, these uncertainties do not just exist for products realized with the assistance of the TC method. The risk developing a product that is not aligned with the market's requirements is a perennial issue, especially for new development (Oertel, 1997: 106).

2.5.2.2 Kaizen Costing

Kaizen costing (KC) is the application of Kaizen techniques aimed at reducing existing components' and products' costs to a predetermined level. This goal is to be achieved through increased production-process efficiency (Cooper & Slagmulder, 1997: 357; Lysons & Farrington, 2006: 591).

The difference between TC and KC is that TC is applied during the product life cycle's development phase and KC during the manufacturing phase (Lysons & Farrington, 2006: 591). A combination of TC and KC can be described as a holistic approach to costs throughout the whole product life cycle.

Based on the idea of continuous improvement, KC provides an approach for further protecting the gain despite increasing price pressure (Horváth, 2006: 113). Kaizen costing' sequences correspond to the Deming circle (540).

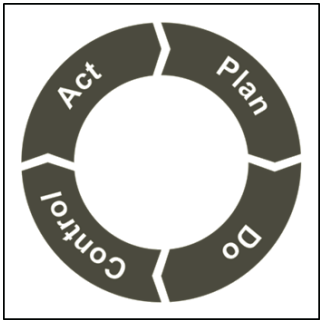

Figure 16: Deming circle
Source: Wikimedia.org, 2010

Cost targets are set and appropriate measures are developed (plan). The measures are adapted and improved using variance analysis (do). Afterwards they are checked for possible objective achievement (check). Finally, the measures are shaped, optimized, and fully implemented (act). Now the cycle begins again. The Deming circle (PDCA-circle) is used to improve quality in the context of total quality management (see sub-subsection 2.6.3.1).

2.5.2.3 Benchmarking

A processes comparison is enabled with the help of a systematic and methodologically sound approach during benchmarking (Thaler, 2007: 248). It is more than simply imitating competitors (Lysons & Farrington, 2006: 111). For Christopher (2005: 275–277) the new type of benchmarking means that companies measure themselves against

the “best in the class” and don't just align themselves with “best practice” anymore. He describes this approach as competitive benchmarking which he defines as “. . . the continuous measurement of the company's products, services, processes and practices against the standards of the best competitors and other companies who are recognized as leaders . . .” (2005: 276).

The SCOR Model's five processes (figure 2) are especially suitable for a benchmark. Cooper and Slagmulder (1997: 105) point out that a cost benchmark lends itself especially well to companies at a competitive disadvantage. They can benefit from such action to a special degree.

A cost benchmark can be potentially dangerous for highly effective companies. A positive benchmark result can lead to their neglecting the improvement goal from excessive self-satisfaction. The cost benchmark may be particularly helpful during the source or make process within the SCOR Model.

Anklesaria (2008: 44) argues that such a benchmark lends itself to determining the products and components for which competitors can achieve significantly lower costs. This shows the company the need to improve costs, or at least to find cost saving potential. Consequently, cost benchmarking can be used to determine the costs for products to be developed or procured by using information about comparable competitive products. This, however, requires very good knowledge about the purchasing market, competition, product realization, and the required product functions.

2.5.2.4 Parametric Cost Estimation

The RAND Corporation first introduced the use of parametric cost estimation (PCE) in the late ’50s. It was used to forecast military systems costs. The technique is based on historical data and is generally preferred to expert opinion (Parnell, Driscoll & Henderson, 2011: 146).

The PCE is commonly used in an early stage of the product life cycle, even before detailed design information are available. Since the PCE is designed to forecast future

costs, it is also often used for determining operating and maintenance costs. The objective is to get a cost forecast based on the mathematical relationships and dependencies between different factors (Parnell et al., 2011: 147; Stewart, Wyskida & Johannes, 1995: 233; Wongvasu, Kamarthi & Zeid, 2003: 210).

The costs for a satellite depend, for example, on the relationship between mass, orbit, and functionality (Parnell et al., 2011: 147). Using PCE, a product's production costs can be calculated based on many different product parameters known at a very early stage of the product life cycle. In the calculation, cost-influencing issues such as quantity, lot size, learning curve, weight, material, mechanical-electrical components ratio, and integration and testing effort are taken into account (Spix & Traal, 2001: 18).

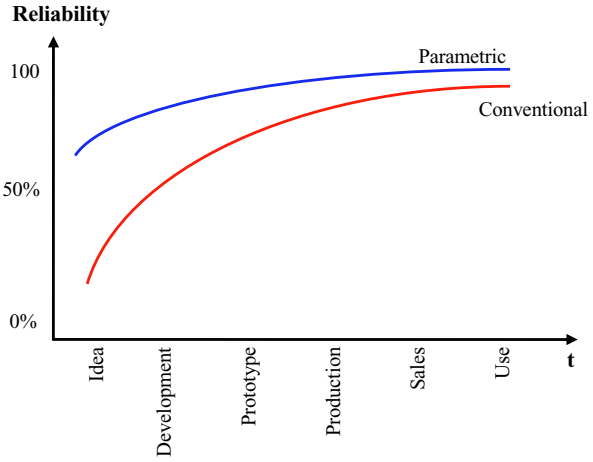

Figure 17: Reliability of parametric cost estimation

Source: Author's illustration based on Spix & Traal, 2001: 17; modified/translated

The PCE method's very high degree of maturity leads to much higher accuracy and reliability at a very early stage of the product development process. This cannot be achieved using traditional costing methods (Spix & Traal, 2001: 18).

PCE is based on the top-down approach. In this case, the product is the basis and the individual components are parameterized. This is done as far as possible for the

developer to describe which characteristics and properties the product has and what processes have to be used.

A NASA website (http://cost.jsc.nasa.gov/SVLCM.html) gives an example of how little information is needed about a product still in the concept phase to calculate the costs of a manned spacecraft. The top-down (PCE) and bottom-up approaches are opposites. The bottom-up is only useful and applicable if the way the product or component is manufactured is known in detail. This requires, for example, knowledge of hourly rates, turnaround time, test procedures, unit prices of purchased parts, and assembly time. A significant amount of detailed knowledge must therefore exist, which is unnecessary with the top-down (PCE) approach.

2.5.3 Correlation Of Costs And Price

Costs and prices are not the same (Booth, 2010: 90). According to Lemme (2009: 62–63), procurement should never just consider prices, but must always take into account a product's or service's (total) cost. For him, transacting differs from professional procurement in that professional procurement distinguishes between prices and costs.

As described in section 2.4, costs are the basis of any VE activities that the Procurement Department can initiate. The price in turn is the basis for target costing (sub-subsection 2.5.2.1).

A conventional surcharge/overhead calculation illustrates very well how costs arise from prices. By adding the required or requested contribution margin to the costs, the company ultimately reaches the sale price (Götze, 2010: 112–118; Rüth, 2006: 170–175). From this it can be concluded that prices represent the sale perspective. The purchase price results in goods' and services' purchasing costs (Friedl, 2010: 31–42). Those purchasing costs represent the customer's perspective (Diller, 2007: 31). The dependence of costs and prices can be shown schematically as follows:

production costs + contribution margin = sale price = purchase price = purchasing costs

A graphic representation of cost-price correlation appears in figure 18. It takes these dependencies, as well as the supplier's and customer's perspectives into account.

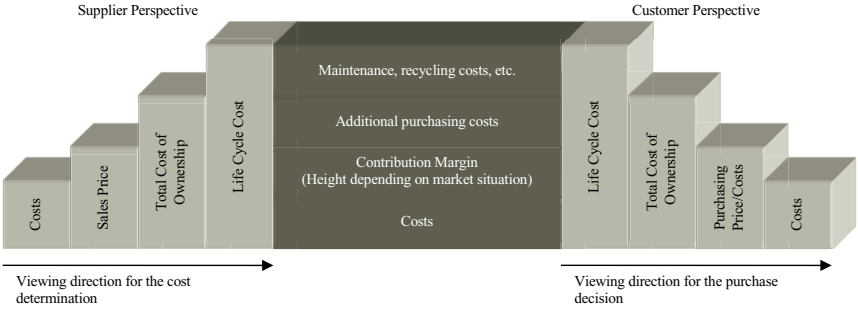

Figure 18: Costs-price correlation
Source: Author's illustration

However, whether or not price always represents the real product price must be called into question. If manufacturers are unable to meet market demand, or a monopoly is involved, it is possible that an excessive contribution margin will be used. Then it should no longer be considered a product's price (product price), but a price made possible by the market (market price), in which the calculation is carried out with an excessive or atypical contribution margin.

Therefore, it is important that procurement knows the costs and adds an industry-standard contribution margin. So if a pure price comparison is done, the product price (real product value) will be determined on the one hand and on the other, whether and which supplier is exploiting the market situation will be detected.

2.6 Quality

Because quality is one of the CSF's, its definition and objectives will be developed in this section. Quality management and selected methods and concepts from the quality area will be briefly introduced.

2.6.1 Definition And Perspective

DIN 55 350 and DIN EN ISO 8402:1995 refer to quality as the totality of a unit's characteristics related to its ability to satisfy stated and implied needs. The newer quality standard DIN ISO EN 9000:2005-12 goes a step farther. Here, quality is described as a capacity of all a product's, system's, or process's inherent characteristics for meeting customers' and other interested parties' demands.

Quality can thus be described in short form as the ratio of a unit's realized to required properties (Crosby, 1978: 17; Geiger, 2001: 803; Zollondz, 2006: 166; Geiger & Kotte, 2008: 68), where the noun “unit” means product, activity or service. However, the perspective (institution, customers, employees, businesses) from which quality-assessment rules are specified is not clearly defined (Bruhn, 2008: 34).

According to the German Society for Quality, there are two main approaches to defining quality. In terms of product-related quality, the quality is defined as the sum or level of all existing properties. Here, the consideration of objective criteria comes to the fore (“product-based”). When viewing quality from the customer perspective, product performance and features are in the foreground (“user-based”). Here, subjective criteria the main focus (Dickmann, 2008: 60–61; Bruhn, 2008: 34–35). The principle problem for companies arises if there are big differences between quality from objective and subjective perspectives (Bruhn, 2008: 35).

The company must place value on each product feature meeting quality requirements. This is the only way to avoid unnecessary quality costs. For Crosby (1978: 12), quality costs are those incurred through the non-fulfillment of requirements. According to DIN 55350, part 11, all costs incurred by regular audits or activities in error prevention, as well as internally or externally detected faults, are quality costs. Hence, the following four types can be derived:

1. Testing costs
2. Failure prevention costs

3. Internal failure costs
4. External failure costs

For Lysons and Farrington (2006: 267), quality means a balanced ratio of technical requirements, such as performance, security, reliability, with economic aspects, including price and availability.

Garvin (1987: 101) uses a value-based approach for quality in procurement. In this connection, he derives the quality from costs and prices: “Here, a quality product is one that provides performance at an acceptable price or conformance at an acceptable cost . . .”.

2.6.2 Quality Management

The right staff attitude and focused management is required to ensure quality and reduce costs. Quality management (QM) is used to achieve this.

A variety of definitions exists in the literature and in practice for QM (Strauss, 1994: 11–23; Dickmann, 2008: 58–61; Schmitt & Pfeiffer, 2010: 25–50). The definition for this dissertation is based on that in DIN EN ISO 9000:2000. According to this, *QM is responsible for all overall management activities defined within the framework of the QM system, quality policy, objectives and responsibilities, as well as their realization by such means as quality planning, quality control, quality assurance, and quality improvement.*

DIN EN ISO 9000:2000 refers to the following eight points regarding the QM principle:

1. Customer orientation
2. Involvement of people
3. Continuous improvement
4. Supplier relations for mutual benefit
5. System-oriented approach
6. Process-oriented approach

7. Leadership
8. Factual approach to decision making

QM gets high-level priority due to the widespread concept of quality policy. The former represents a strategic component of corporate policy just like commercial, financial, personnel, and sales policy. Not least, professional QM secures a competitive advantage for the company (Bruhn, 2008: 3–13; Thome & Sollbach, 2007: 31; Dawson, 2003: 150–152).

In his book "Quality is Free" back in 1978, Crosby defined the four cornerstones upon which QM is based:

1. Quality is conformity to requirements.
2. Quality should not be assessed, but achieved.
3. Zero defects must be the goal; almost zero defects is not enough.
4. Price is the measure of quality (Thome & Sollbach, 2007: 284).

Product quality assurance is based on the four principles of controlling process and product variability, focusing on the production processes, applying evidence-based management, and ensuring continuous improvement (Hackman & Wageman, 1995: 309–311).

In conclusion, it can therefore be stated that QM is assigned a leadership role. Applying the basic principle of preventing and planning is decisive to achieving the desired quality. QM employs different methods and concepts to achieve this and to implement the eight principles. A selection is briefly presented in the following subsection.

2.6.3 Quality Methods And Concepts

This subsection will briefly discuss selected methods and concepts from the field of quality. The selection was motivated by the significance of the method or concept for the present dissertation.

2.6.3.1 Total Quality Management

The idea of securing and improving the quality of goods and services drives the development and implementation of comprehensive quality management. All employees and managers must take responsibility for quality (Bruhn, 2008: 68; Dickmann, 2008: 59–60). This is reflected in total quality management's (TQM) concept and approach.

According to TQM, all the company's businesses units and employees must be involved in the quality improvement. Quality extends to all products, processes, and services. It is only given if established and assumed requirements are met. The term management should make clear that a process to be actively pursued is involved. It extends over the three strategic areas: customer, employee, and process orientation (Binner, 2002: 96–97).

TQM is mainly attributable to the basic ideas of Deming (1986 & 1993), Ishikawa (1985), and Juran (1969 & 1974). Based on their work, TQM is defined as a comprehensive philosophy of corporate governance. It aims to achieve a quality culture in the company resulting from long-term behavior change (Juran, 1974: 1–15; Ishikawa, 1985: 104–105; Deming, 1986: 11–12).

In the German translation of the DIN EN ISO 8402, 1995–08 paragraph 3.7, the term TQM was translated as comprehensive quality management. TQM is therein defined as *an organizational management method based on the participation of all members. It places the focus on quality and aims for long-term business success, as well as benefits for the organizations's members and for society, through customer satisfaction.*

TQM's goals are, among other things, compliance and improvement of customer satisfaction, which is placed at the center of all of the company's activities (Zollondz, 2001: 1164; Mukherjee, 2006: 40). A change in the way the company's employees think must to take place to achieve customer satisfaction (Lysons & Farrington, 2006: 268–273). Only through the cooperation of all employees can long-term business success be achieved and benefit for the organization's members and for society be created (Zollondz, 2001: 1164; Mukherjee, 2006: 40).

Failures and defects may no longer be considered the norm. They must be avoided through continuous improvement of processes (Cooper & Slagmulde, 1997: 359; Mukherjee, 2006: 40). Upstream and downstream processes, such as purchasing, logistics, customer service, sales, must also be scrutinized and improved in addition to production processes. Last but not least, the resource use should be optimized through TQM (Mukherjee, 2006: 40).

It can be noted that the TQM concept offers a philosophy for implementing a quality management system. It is not just a matter of meeting customer requirements, but also the interests of all members of the organization. TQM shows a way to secure the long term sustainable business success.

The customer-supplier relationship between the various process owners within the company and constant performance review (see figure 15) implemented in TQM motivates all company employees and creates the need for continuous improvement. TQM therefore regards quality as a superordinate element within the company (Zollondz, 2001: 1163). Quality policy becomes company policy. Only a corporate culture geared to quality and lived by managers can achieve the highest level of customer satisfaction.

2.6.3.2 Six Sigma Methodology

Six Sigma was developed at Motorola in 1979. Art Sundry, a senior manager, stood up at a meeting and said: “The real problem at Motorola is, that our quality stinks to high heaven!” This statement led to rethink among Motorola's managers. They recognized that quality costs money even as it reduces costs (Harry & Schroeder, 2000: 24).

Motorola engineer Bill Smith noted that a defective product does not satisfy the customer. He also found that detecting errors prior to delivery only generates a four sigma error rate (Harry & Schroeder, 2000: 25–27). Four sigma correspond to 6210 defects out of one million error possibilities (Mukherjee, 2006: 337). At that time, this number was only slightly above the U.S. average.

Smith managed to simultaneously increase quality and reduce the costs via more accurate measurements. Better measurements enabled problem areas to be actively, instead of just reactively worked (Harry & Schroeder, 2000: 25–27).

Based on the remarkable success at Motorola, Jack Welch, CEO of General Electric, established the Six Sigma concept throughout his entire company in 1995. He issued the objective of achieving Six Sigma within five years (Toutenburg & Knöfel, 2009: 3–4).

Six Sigma defines a process that is up to 99.9996% defect-free. In such a process, only 3.4 defects occur out of one million error possibilities. This is statistically error-free. Business economics describes it as zero-defect production (Mukherjee, 2006: 336–338).

The set target was not fully achieved by General Electric; however, due to the measures taken, the company succeeded in achieving savings of three billion U.S. dollars (Toutenburg & Knöfel, 2009: 3–4).

Six Sigma is an excellent supplement to TQM. The former's strengths lie in the rapid focusing of factors critical for improvement of business processes (Dickmann, 2008: 62). The causes of problems are analyzed and eliminated using this concept (Thome & Sollbach, 2007: 284).

Six Sigma uses an advanced development of the Deming circle (figure 14) called the DMAIC process (Töpfer, 2007: 69) to realize improvements in the company. The latter thus also involves a project-and-control-loop approach. The embedded toolset in DMAIC makes possible the achievement of measurable, sustainable success (Roenpage, Staudter, Meran, John & Beernaert, 2007: 26).

Figure 19: Graphical representation of the DMAIC process
Source: Dreamstime.com, 2010

The DMAIC Six Sigma method aims to improve within three to five months existing processes and products that do not satisfy requirements. The DMAIC process is used to make already existing processes measurable and to sustainably improve them (Dickmann, 2001: 63). The phases abbreviated as DMAIC have the following meanings according to Bicheno (2002: 32), Kroslid, Faber, Magnusson, and Bergman (2003: 67), Bergbauer (2007: 30) as well as Roenpage et al. (2007: 27–292):

- **D**efine: The problem and the project goal must be clearly defined.
- **M**easure: All process-relevant parameters and data are measured and recorded.
- **A**nalyze: The measurements are evaluated and the problem's causes problem are identified.
- **I**mprove: A solution is selected and implemented.
- **C**ontrol: The adapted process must be checked regularly.

Various tools can be used within DMAIC's different phases. Examples of the former are shown in the appendix.

Six Sigma analyses the existing process in particular. The process indicators thus obtained can be used for objective, static analysis. The advantage of this approach is that a new analysis can prove the project's success after a solution's implementation (Dickmann, 2008: 63).

Very good quality is one of the prerequisites for meeting customer requirements as well as for achieving customer loyalty. Furthermore, it enables competition in the market to be withstood and reduces costs. Therefore, like TQM, Six Sigma always focuses on the customer. Here it puts the customer's benefit first. According to Six Sigma, each process has a customer. The customer can be inside or outside the company (Roenpage et al., 2008: 2–9).

SIPOC analysis is applied to achieve consistent focus on the defined customer's requirements (internal or external). SIPOC stands for Supplier, Input, Process, Output, Customer (Töpfer, 2007: 81).

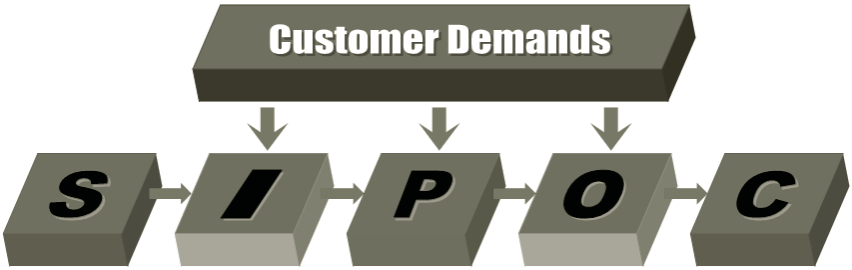

Figure 20: SIPOC graphic
Source: Author's illustration based on Guptap, 2005: 159; Roenpage et al., 2007: 23

In SIPOC analysis, processes are recorded with all relevant details. This leads to better understanding of the internal processes. In part, customer requirements on the process's output and the process's demands on the inputs (process requirements) are formulated. These are then compared with existing requirements (Gupta, 2005: 158–165).

2.6.3.3 First-Time-Right And Zero-Defects

TQM and Six Sigma are excellent methods for improving business processes and products. But when it comes to problem solving, company culture begins to control all further steps. Without a clear, company-wide commitment to the First-Time-Right approach (Mukherjee, 2006: 40–41), also called the Zero Defects concept (Crosby, 1978), common objectives are reduced to improving the business climate or to simply

reducing failures, deficiencies, and defects. When management then asks “What improvements or optimizations can we implement?” the answer is usually limited to fast, simple corrections (Richman, 2005).

The Zero-Defects approach assumes that manufacturing achieves a “zero defects rate” through mutual efforts, and the proper planning and control (Jain, 2001: 244). Crosby (1978: 131) represents the view that “The only performance standard is Zero Defects . . .”. He says that “Zero Defects is the attitude of defect prevention. It means ‘do the job right the first time . . .” (p. 302). It is cheaper for a company to prevent defects from the outset than to rework or scrap products (Crosby, 1978: 173).

Every system, every process, every action, or any results can be analyzed against this concept. If zero defects is the goal, then every aspect of the company is controlled in terms of performance measures. It thus describes the general pursuit of business excellence (Roenpage et al., 2007: 23).

First-Time-Right (FTR) does not mean being perfect. The FTR idea is to change the perspective of all stakeholders. This is achieved by calling attention to three main factors:

1. Quality problems lead to high costs.
2. Places where errors and defects can occur must be monitored continuously.
3. To identify weaknesses in systems and processes that can lead to defects it is necessary to work proactively (Evans & Lindsay, 2008: 109–111).

Crosby (1979: 270) says that the quality manager must be aware right from the start that FTR is not a motivational program. Rather its purpose is to convey the literal meaning of the words “zero defects” to all parties and the idea that everybody does everything right first time.

To err is human; to avoid mistakes is problematic (Kamiske & Brauer, 2008: 160). The business units and processes in which the FTR is used must therefore be carefully selected. If the business unit or process contributes to an enterprise-critical or complex

target, FTR must be strictly applied. But even if it is a useful concept, each company must be aware that the use of FTR alone is not enough to survive in the market.

2.7 Summary Of Literature Review

The individual topics' relationships and dependencies based on the literature research conducted will be discussed in this section. The topic of monetary purchasing savings is reviewed critically and a definition of "procurement quality" will be formulated. Finally, whether or not the work environment impacts cost determination will be discussed.

2.7.1 Correlating The Subjects

When reviewing the literature, especially the definition of SCM, it should be noted that SCM has to be regarded as superior. It combines all the various topics in sections 2.2 through 2.6. This is only logical, since it represents a cooperation-based management strategy based (see subsection 2.1.2). The aim is to optimize all processes and interfaces to meet customer requirements.

Trust, transparency and cooperation are ultimately spoken of in all subject areas. These qualities must therefore represent a major part of the foundation on which a company can build sustainable competitiveness in the market. The various issues' constellations and dependencies can be best represented pictorially as a house structure.

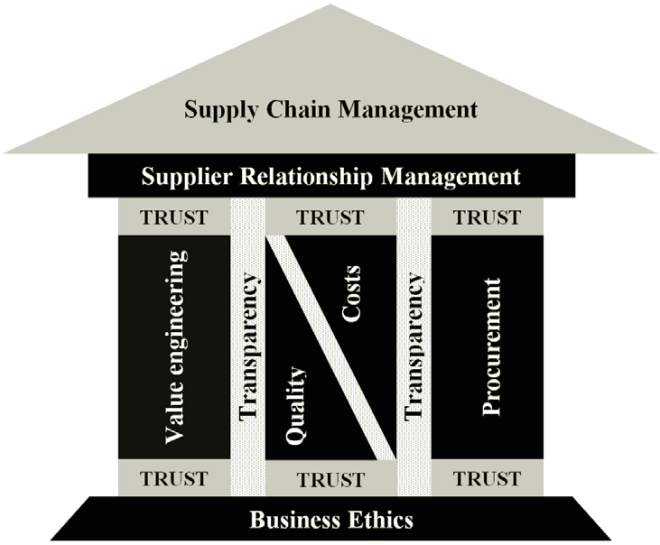

Figure 21: Topics correlation under SCM
Source: Author's illustration

Through the content and objectives stated in subsection 2.3.7, it can be stated that reasonably formulated and lived business ethics actively support the achievement of SCM's objectives as well as help to avoid and reduce costs. Clear, unambiguous guidelines in business ethics provide the company's employees a clear basis for their actions. This lends employees security and the confidence that they can perform their task in the right way.

According to Gloor (2006: 86), trust connects the various parties and therefore ultimately also the columns (topics) with each other as well as with the foundation and the roof. Transparency will arise only when trust is present. Thus, information flows within the entire construct, and it now becomes possible to predict the dependence of quality and cost.

Furthermore, that both value engineering (VE) and procurement can act in the corporate sense is ensured. If they have a lack of information, they are not able to achieve the

required optimum or they create errors. Procurement has to ensure that the products to be procured meet technical and quality requirements, thereby contributing to quality assurance.

To determine costs, procurement uses the cost management, which provides the required price/cost information. VE also uses information from the quality- and cost-management areas to work effectively.

SRM largely shapes the relationship with suppliers (see section 2.2). Since procurement is the direct contact to the supplier, it also directly influences VE and the success factors (see subsection 2.1.5) by shaping the supplier relationship (SR) and in consequence, on the entire SCM and hence on the company's competitiveness. Procurement's behavior influences confidence in the customer-supplier relationship due to, for example, conduct during negotiations, as well as during VE activities, e.g., a value analysis at the supplier's site or an open book calculation.

How obtained information related to the supplier is used and handled also affects trust. Requirements, which must be met by the suppliers and are derived from the ratio of cost and quality, also exert influence on the trust situation. Demanding high quality standards and unrealistically low prices also impacts trust, as does lack of information exchange with the supplier. The company can only develop and implement the optimum solution jointly with its suppliers if a basis of trust exists on the SRM level.

SRM's target, the win-win situation, can be achieved only if all factors such as profits, information, and transparency are in equilibrium. This seamless balance enables the win-win situation and contributes to the consolidation of trust between the parties.

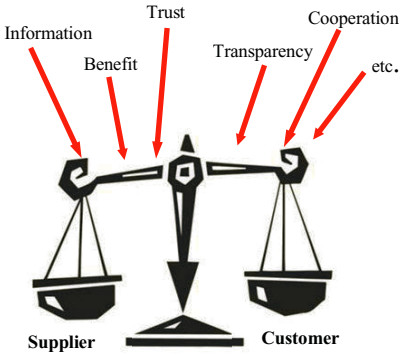

Figure 22: Influences on the win-win situation
Source: Author's illustration

Only in a trusting relationship is it possible to increase speed. If there is trust, all parties will act as needed even if the situation or events are unclear. It could also be proverbially express as “SC members blindly follow the leader”. This effect is not conceivable without trust.

The Six Sigma approach and perception should be stressed at this point. According to them, there is a customer and supplier for every system, every process, every action, or any results. They can be internal or external. This applies to all SC members. Thus, this balanced situation must not only be in place between different companies but also between different departments of a company such as Procurement, Quality, Value Engineering, and Development.

In summary, it can be stated that the success factors (see subsection 2.1.5) will only be realized if there is good SRM. SRM is only effective if there is trust. We arrive finally to the conclusion that trust is an important foundation for successful SCM.

2.7.2 Purchasing Savings

This subsection looks critically at several aspects and at the impact of the monetary purchasing savings.

2.7.2.1 The Identification Of Purchasing Savings

So far in the literature there is no consistent and uniform definition for the term purchasing savings. Usually it is the company or the organizational unit Procurement that defines purchasing savings. Despite the different definitions, it can be stated that the term purchasing savings is a composition of cost avoidance, cost reduction, and performance optimization.

Here, the difference between the new and the old price for the defined good or service is determined (Schumacher et al., 2008: 93). It should be noted that comments relate to purchase prices, thus the cost of the purchase, and not on costs incurred in product's production (see subsection 2.5.1).

But there is still the question about what real purchasing savings are. If they are merely the comparison of new and old purchase prices without deep knowledge of the market, it cannot be said whether the price change was market-driven, whether it is the real product price, or whether a monopoly or dumping price was offered (see sub-subsection 2.5.1.2).

Against a backdrop of supplier partnership, the justification for considering any cost avoidance, cost reduction, or optimization of benefits as purchasing savings must be called into question. Does this not imply that the supplier has previously unjustifiably provided too little output or intends to provide less output in the future? This suspicion would immediately cast doubt on the partnership relationship. Such behavior does not permit a relationship such as that provided in the SCM to exist.

Procurement also need to be subjected to criticism in matters of cost reduction and performance optimization. It has apparently agreed to the wrong product price in the initial contract negotiations (see subsection 2.5.1). Reasons for this may be ignorance of

procurement markets, selecting the wrong supplier, troubles within the supplier relationship, or missing target cost (see subsection 2.5.2).

Appelfeller and Buchholz (2005: 104) argue that the problem with savings in purchase prices is that not every reduction reflects a success for procurement. For example, value analysis performed on the products (see subsection 2.4.2) can result in cost reduction. This leads to a decrease in the purchase price. If the old and new prices are now compared, the conclusion is that purchasing savings were achieved under the above-mentioned aspect of cost reduction. But that must be called into question, because procurement might not have even been involved in the value analysis.

2.7.2.2 Purchasing Savings And SCM

Comparing purchasing savings' definition and objectives with those of SCM shows that they compete with one another. Since purchasing savings do not effectively reduce costs, but simply pass them on to the supplier, the objective sought by SCM, a partnership situation in which everyone should have equal rights (Poirier & Quinn, 2003), gets out of balance.

The long-term stability pursued by SCM in the supplier-customer relationship and respectively the supply chain is placed at risk. As the example of Opel shows (Trent, 2007; Rickes & Hassell, 2008), purchasing savings can be even considered a risk from the business perspective.

Based on a comparison of objectives, it must therefore be stated that purchasing savings' short-term, one-sided objectives compete against SCM's long-term partnership objectives. This ultimately leads to the question of whether purchasing savings and SCM can coexist at all, or even whether they mutually exclusive.

2.7.2.3 Inflation And Purchasing Savings

Statistics on the consumer price index's German inflation rate, published since 1992 by the German Federal Statistical Office (GFSO) in the GENESIS-Online database (see

appendix), shows an average inflation of +1.94% over the previous year. The year 2005 represents thereby the 100% mark (2005 = 100).

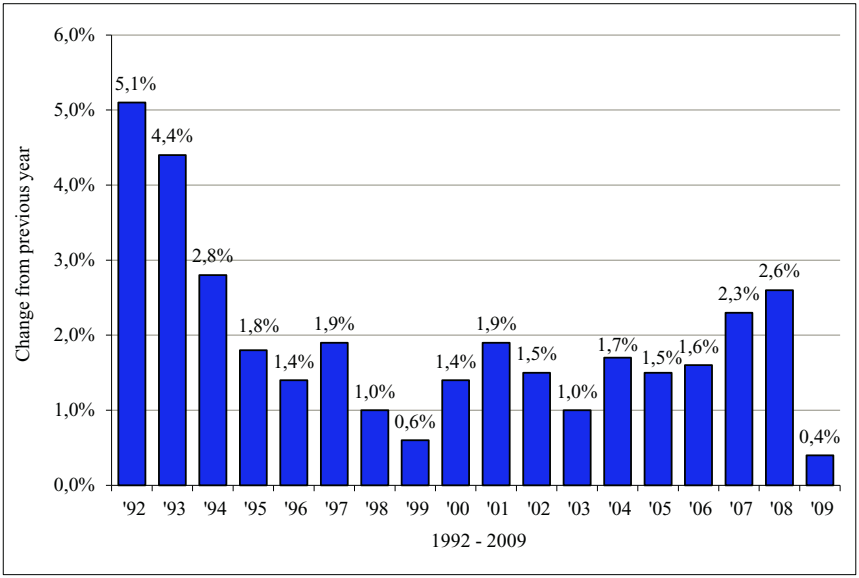

Figure 23: German consumer price index

Source: Author's illustration; GFSO, 2010

An evaluation of German producer price indices of industrial products for the example areas of metals, metal products, electrical equipment and machines gives the following picture.

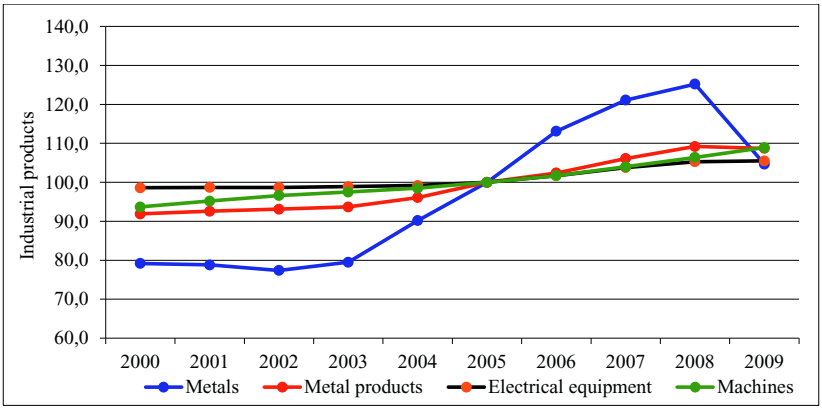

Figure 24: German producer price indices

Source: Author's illustration; GFSO, 2010

The following average inflation rates result after evaluation of individual producer price indices in comparison to the previous year:

- Metals: +2,8%
- Metal products: +1,9%
- Electrical equipment: +0,8%
- Machines: +1,7%

A total average annual inflation rate of +1.78% thus results for these four product areas. All other product groups retrievable from the GFSO also show a rising inflation rate. Only values in the areas

- printed products (-0,8%),
- pharmaceutical and similar products (-0.2%), and
- data processing equipment, electronic and optical products (-5.9%)

demonstrate a downward trend for the period 2000 to 2009.

The fact of inflation rates confronts purchasing savings. In many companies, purchasing savings are already firmly factored into business planning. Setting a stipulated annual purchasing savings of 2%, providing it as basis, and taking a price trend with an average inflation of +1.78% for four product areas mentioned leads to the following schematic picture in figure 25.

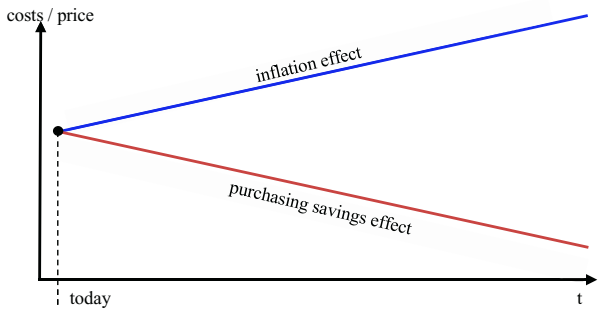

Figure 25: Correlation of inflation and purchasing savings
Source: Author's illustration

If the product price was 100 monetary units in 2010 for example, it will already exceed 140 monetary units in 2040 when accounting for inflation. This is vis-a-vis a purchase price of less than 69 monetary units, if actual annual purchasing savings of 2% are taken into account. The “purchasing target price” thus corresponds to less than 50% of the escalated producer price.

If the purchasing savings curve is extrapolated, the “purchasing target price” continues to drop thus theoretically tending to zero monetary units. If procurement expedites cost reduction measures together with the supplier, both can counteract inflation. But because no monetary change is measured, monetary measurement methods for purchasing savings show poor procurement performance. Thus, no purchasing savings can be demonstrated. Although this approach is highly theoretical, it shows clearly that purchasing savings contradict the general production situation.

2.7.2.4 Purchasing Savings' Risk

From a business perspective, the classic definition of purchasing savings must be considered as a business risk. If procurement staff members' personal goals include monetary success, the risk may rise. The danger of the tendency to “buy cheap” increases and TCO is no longer considered.

Furthermore, the time required for supplier selection and contract negotiations may increase unnecessarily. A supplier with a lower offer than the current one may always be found if only enough time is invested for market investigation.

As a theoretical construct for this purpose, it can be argued that a new low-cost-country supplier could be developed to achieve large savings. This would show a very favorable purchase price if only the difference with the highest/average offer is determined. Although the time and costs for the necessary supplier development would be very high, the purely monetary measure of purchasing savings will not reveal this fact.

The consequence for the company increased TTM and opportunity costs. This situation, however, does not just exist in the extreme case described above. Opportunity costs and TTM always increase when much time is spent in searching for savings and a lot of offers are evaluated.

Another risk is the possible demotivating effects of monetary measurement of purchasing savings on procurement staff. Taking rising inflation into account, rising procurement costs have to be expected. If buyers take measures to reduce costs together with suppliers, purchase price may remain stable causing it to behave atypically relative to inflation (see figure 26).

Although buyer and supplier will then have provided a good performance, monetary measurement of purchasing savings will not recognize this. No monetary alteration has appeared as should be expected from purchasing savings.

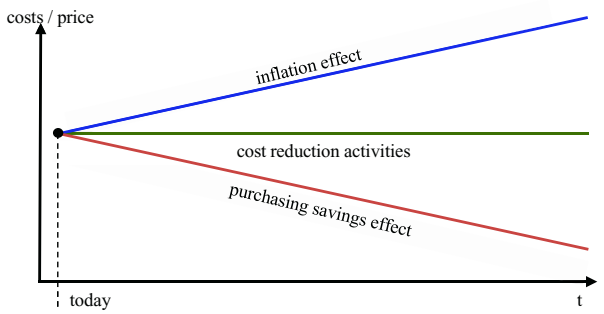

Figure 26: Correlation of inflation, purchasing savings, and cost reduction
Source: Author's illustration

That monetary purchasing savings impact the company's results or the return on investment (ROI) was already illustrated in subsection 2.3.6. But if purchasing savings are an “abuse” to achieve an increased ROI in financial statements, the company risks irreparable damage to the supplier relationship. When the company unilaterally cuts prices, many suppliers fear the well-known “Lopéz-effect”. The price dictated received this signet from the former head of Procurement at Opel and later VW, José Ignacio Lopéz de Arriorùa. Like a lawn-mower approach, Lopéz demanded a flat-rate price reduction of 10% from suppliers (Werner, 2010: 109). He enjoyed only a temporary success in consequence.

After all the suppliers who had not responded to his demands were out of the way, killed as he said, Opel was indeed saved, but delivery quality collapsed. Products coming from suppliers to the assembly line were, in the customers' opinion, overall so poor that some traditional Opel plants were nearly closed (Trent, 2007: 196–199; Rickes & Hassell, 2008: 182–183).

This would also have meant an existential threat for the suppliers. After the economy's having had such an experience in the ’90s, whether suppliers would agree to such an approach with flat-rate price reduction in this day and age must be called into question. They might prefer to terminate the business relationship. Then their know-how would no longer be available to the company.

From this perspective, the question remains about who has the real problem now: the supplier or the customer? The customer now lacks know-how and deliveries, and is therefore unable to produce. The conclusion must therefore be that the isolated analysis of monetary savings in procurement negatively impacts sustainable business success.

2.7.3 Procurement Quality

How can procurement quality be measured? This question cannot be answered satisfactorily based on the performed literature review. Numerous sources state that procurement shares responsible for quality assurance. Melzer-Ridinger (2004), Lysons and Farrington (2005), Van Weele (2005), Brunner and Wagner (2008), Lemme (2009), and Werner (2010) can be cited as examples.

Procurement is responsible for specified products' on-time delivery and quality. This situation is outlined in a quality-cost-time triangle (Thonemann et al., 2004: 134; Brunner & Wagner, 2008: 11). But the customer, for example development, manufacturing, or a project, expects a product that not only meets the triangle perspective, but the 5 Rs:

1. The right product
2. In the right quantity
3. In the right place
4. At the right time
5. Of the right quality (Wannenwetsch, 2005: 85; Jung, 2006: 521)

Six Rs originate by adding a further criterion, the right price (Lamprecht, 2000, p 142; Dickmann, 2008: 27; Fung, Fung & Wind, 2008: 20; Lai & Cheng, 2009: 4).

The purchasing process is to fulfill this criterion. The 6-Rs representation illustrates very well how great procurement's influence is on the first three critical success factors (see subsection 2.1.5): costs, quality, and delivery. The other three factors, flexibility,

innovation, and transparency are heavily influenced by the contracts, the supplier base, and the SRM, which are designed by procurement.

Procurement is responsible for the source process, which is one of the SCOR Model's five processes (see figure 3). The 6 Rs must be met with its help. In terms of process quality, the aspects Six Sigma, TQM, and FTR must apply with the manufacturing process (make) and the source process. In this case for example, process output is a product or a service purchased by procurement. Through its own process, procurement must fully meet the requirements of internal customers in accordance with the 6 Rs.

The question of defects arises with the reflection of FTR into this understanding of the source process. A defect exists if even one of the 6 Rs is insufficiently fulfilled, or even completely unfulfilled. Only when process output satisfies all the requirements from the customer's perspective (see subsection 2.6.1) it can 100% quality be spoken of.

As described in sub-subsections 2.5.1.5 and 2.7.2.4, increasing opportunity costs and TTM imply a waste of company time. Thus, an approach to define 100% quality in the procurement complements the 6 Rs, which are determined from outside, by an internal aspect: the time factor. The following definition then arises:

Procurement quality means that the procurement organization is able to provide the company within the **shortest processing time** with the **right products**, at the **right quantity**, at the **right place**, at the **right time**, the **right quality** and at the **right price.**

The presence of quality in procurement has not only greatly influenced all six success factors for SCM efficiency and effectiveness (see subsection 2.1.5), but also influences the company's competitiveness and future through speed. If 100% procurement quality exists, procurement has fixed the right product price with the supplier in the first approach. Thus the purchase price corresponds to the price from the 6 Rs, and commercial success in the classical sense (see subsection 2.3.6) cannot be achieved. Based on price, 100% procurement quality is therefore a “black zero”.

Sale price = Result of the cost determination = Purchasing price

2.7.4 The Work Environment's Impact On Cost Determination

Subsection 2.5.2 shows very clearly what the various cost determination methods can achieve. The risk that the environment in which they are used weakens them can arise from cost-related requirements or from knowledge about the sales and competitor market.

All information about the product that can derive from customer requirements is needed to determine cost. All of it together results in the 5 Rs (see subsection 2.7.3). The internal customer, for example development or manufacturing, thereby provides input to the cost determination process in the form of technical specifications, delivery dates, quantities, and the like. They influence costs (see subsection 2.4.4 and section 2.5).

The objective of the cost determination must be to map the 5 Rs into the sixth R: the price. For this purpose, it is advisable to conduct price determination in a multifunctional team (MFT) (Cali, 1992: 39–40). Procurement, development, manufacturing, quality assurance, project manager, and value engineering can be MFT members. The return flow of information about cost impelling requirements and specifications is thus secured in all relevant departments.

The MFT can use value analysis (VA) to work out the effects of requirement changes on price/cost (see subsection 2.4.2). There is thus cost-conscious development and procurement can consider important TCO when selecting a product.

What currently appears to be an advantage also entails expense. Product and market knowledge are necessary for such detailed costing (see subsection 2.5.2). For products with small market volume or a high degree of innovation such as defense industry products, the possibility exists that, for example, no appropriate benchmark product or company are available.

External errors are another possibility that negatively influences the benchmark method. The company risks “buying errors” with a benchmark. Even with the “best in class,” it should not be assumed that no cost-determination errors were committed (see sub-

subsection 2.6.3.3). Target costing (TC) proves difficult under the circumstances if, for example, the sales market is working with budgets or with public-sector budgets.

The parametric cost estimation (PCE) method is not vulnerable to these market factors. It is based on mathematical parameter correlation, which can be extrapolated into the future. Furthermore, it determines the production costs to be expected, and does not calculate them from prices like TC does (see sub-subsection 2.5.2.4). PCE thus represents a kind of neutral benchmarking calculating how much the product or component will cost (see sub-subsection 2.5.2.1).

Procurement may use PCE on this basis to verify, for example, whether the purchase price reflects the realistic product price. By adapting environmental parameters, procurement is able to reproduce a desired production situation at a particular supplier. Its prices can be verified as a result.

If the product is not yet ready for serial production, there is a risk that cost-influencing changes will be made. Therefore, recosting must be carried out after any technical modification or adaptation. The MFT will be reinvolved each time.

Baseline definition is another environmental factor negatively impacting cost determination. Product performance and specifications can be dynamic. Therefore they could be changed during the development phase. Development may also have overspecified the product to ensure meeting customer requirements. The speed at which the cost determination is performed supports procurement's performance, but it is primarily a team effort.

Cost determination's quality objective must be to determine the right product price on the first approach. If several approaches are needed to determine product price, there is a defect in the cost determination process. Faulty input (requirements) or the process itself may cause such failure.

Only when procurement has a reliable basis for negotiations, the cost determination process's FTR be talked about. This positively impacts the company's opportunity costs. It also increases the process speed, which in turn reduces TTM.

Finally, it can be stated that cost-determination process quality influences at least four of the six success factors. An increasing FTR rate for this process will improve the cost, time, flexibility, and transparency.

3 Methodology

Athaide (2010: 83) used a methodical procedure that includes all components necessary to serve as the basis as part of a scientific study. This is to ensure that the aim will not be lost sight of during the study.

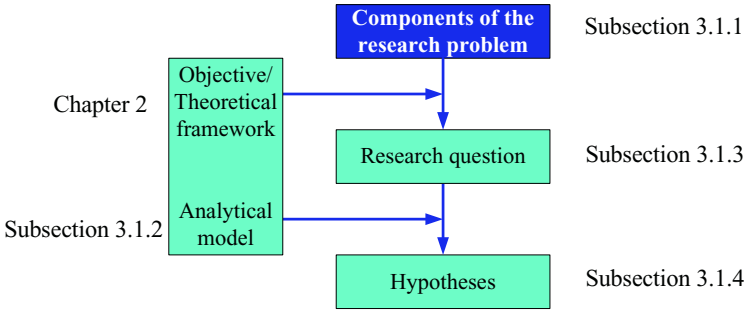

Figure 27: Deployment of research question and hypotheses

Source: Author's illustration based on Athaide, 2010: 85

Following Athaide (2010: 83–86), this chapter is structured as shown above. The research problem, research questions, analytical model, and hypothesis (conclusions) will be discussed below. Here, the structural-model and research-design topic complements the approach.

In the process, the requirements that the theory stipulates for the various components will be discussed (see section 3.1). These requirements are ultimately implemented in section 3.2 based on the theoretical part. They will be transferred into the present study and applied in the research approach.

3.1 Theoretical Context

This section deals with the various components' literary context of the various research components. The aim and the individual components' requirements will be briefly outlined for this purpose.

O. Münch, *First-Time-Right Procurement,* DOI 10.1007/978-3-658-08620-6_3,

3.1.1 Research Problem

Generally expressed, any assumption or assertion worthy of being challenged or examined may represent a research problem. The same applies to any question for which an answer is sought (Kumar, 2008: 20; 2011: 44). Research requires scientific curiosity, an eye for inconsistencies and inadequacies in current theory, and a good imagination.

To identify a specific problem, it is often helpful to ask a simple question (Walliman, 2005: 32). Yegidis and Weinbach (2008: 35) stated “First identifying and then specifying a research problem might seem like research task that ought to be easy and quickly accomplished. However, such is often not the case . . .”. It is important to formulate the research problem in such a way that it can withstand the necessary scrutiny. Therefore, a reasonable time frame must be planned for the research problem's development (Kumar, 2011: 44).

According to Athaide (2010: 80–81), research problem definition is subject to two crucial requirements: first, obtaining all necessary information must be possible and second, the research problem should support conduct of a research project. Two mistakes are often committed in this connection.

The first is an overly broad definition providing no clear guidelines for further steps. The second is an overly narrow definition, which may cause that some options to not be considered. Of these, those that are innovative and are not immediately obvious are particularly affected. Thus it is necessary to achieve a balance between a targeted and precise formulation when defining the research problem.

This implies that the definition must be kept in general terms and reduced to the specific components. The general statement draws attention to the problem. The specific components focus the problem's key aspects and provide clear guidelines about how to proceed.

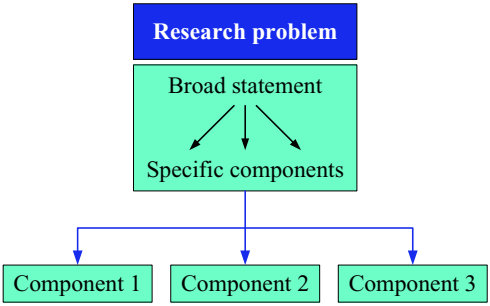

Figure 28: Proper definition of the research problem
Source: Author's illustration based on Athaide, 2010: 85

Many research problems are so complex that it is very difficult or even impossible to solve them without breaking them up into smaller subproblems. The short sentences developed during problem formulation can already give a first indication of the existence of subproblems. One indication is that first one aspect must be investigated before another aspect can be started (Walliman, 2005: 33–34).

3.1.2 Analytical Model

An analytical model deals with a number of variables and their interrelationships. It is used to represent real systems or processes in whole or in part. A distinction is thereby drawn between verbal, mathematical, and graphical models (Athaide, 2010: 83–84; Malhotra & Peterson, 2005: 49–50).

In the verbal model, variables and their interrelationship are expressed in written form. These models can only be a reformulation of a theory's main principles (Athaide, 2010: 83). The graphical model is used to isolate variables. It provides a first indication of the direction of the relationship between variables. With their logical steps, these two types of models enable the development of a mathematical model. The mathematical model shows the dependencies among variables in an equation (Malhotra, 2007: 51–52).

All these models describe the same phenomenon or the same theoretical framework. Only the presentation method differs (Malhotra, 2007: 52; Athaide, 2010: 84). Graphical

models are particularly helpful in a problem solution's conceptual design (Athaide, 2010: 84).

3.1.3 Research Question

Research questions (RQs) are the more refined representation of the research problem's specific components (Athaide, 2010: 84). RQs are formally expressed questions. Their intent is to provide indications and references about something, nor are they limited investigating the relationships between variables (Tayie, 2005: 18). In addition, they serve the researcher as the focus during the investigation for which he seeks answers (Grady, 1998: 14; Kumar, 2008: 20).

RQs are usually established in situations where a researcher is unsure about the nature of the research problem. Only preliminary data be thereby collected. However, testable hypotheses are often based on information collected during the RQ phase (Tayie, 2005: 18).

Grady (1998: 14) argues that unlike the case of most quantitative research, a qualitative RQ can be changed during the project. This does not mean that preliminary considerations can be inadequately performed. Rather it means that the questions can be further concentrated and focused through the collection of information.

Inexperienced researchers often select too large or too wide-ranging a subject. This can then lead to a research project that is too confusing to ultimately pursue a clear objective or to provide a result. This happens even if the project is too complex in spite of good definition. A small study being carried out carefully provides better information than a large project that is treated only superficially.

Many studies often raise more questions than they answer. The study's result supporting the original hypothesis does not mean that the final answer has been found. Rather, it means that the new information may enable the RQs to be stated more precisely. Results supporting the hypotheses typically lead to new research questions (Gravetter & Forzano, 2009: 33).

3.1.4 Hypotheses

Many different definitions of hypothesis can be found in the literature. Athaide (2010: 8) defines a hypothesis (H) as an unconfirmed conclusion or statement about a factor or a phenomenon. This can be a preliminary statement about relationships between variables as given by the theoretical framework or the analytical model.

Black and Champion (1976: 126) define it as ". . . a tentative statement about something, the validity of which is usually unknown . . .". Grinnell (1988: 200) states that "A hypothesis is written in such a way that it can be proven or disproven by valid and reliable data – it is in order to obtain these data that we perform our study . . .".

Other definitions describe the hypothesis as a directly-tested, formal statement about the relationship between variables. The predicted relationship between the variables turns out to be either true or false (Tayie, 2005: 19; Gravetter & Forzano, 2009: 18–19). Bailey (2007: 43) says that "A hypothesis is a proposition that is stated in testable form and predicts a particular relationship between two (or more) variables. In other words, if we think that a relationship exists, we first state it as a hypothesis and then test the hypothesis in the field . . .".

Hypotheses often provide one possible answer to the RQs. However, hypotheses are more far-reaching than RQs, because the former make statements about relationships and are not merely a series of questions for which answers are being sought. While RQs represent questions (?), hypotheses are assertions (!) (Athaide, 2010: 85).

Conducting examinations of a research question or hypothesis from different perspectives is necessary so that significance can be derived from the study's results (Tayie, 2005: 28). Gravetter and Forzano (2009: 28) distinguish two types of hypotheses: testable and refutable. A hypothesis is testable if all variables, events and people are real, and can be defined and observed. A hypothesis is refutable if it can be shown to be wrong. This means that the hypothesis allows potential results to be different than the actual prediction.

A hypothesis having eight characteristics will be derived for this study based on the literature review conducted:

1. It is a tentative statement.
2. Its validity is unknown (Black & Champion, 1976: 126).
3. It specifies a relationship between two or more variables (Tayie, 2005: 19; Bailey, 2007: 43; Gravetter & Forzano, 2009: 18–19).

Kumar (2011: 83–85) adds further characteristics:

4. It should be simple, specific, and conceptual clear.
5. It should be capable of verification and must be measurable.
6. It should be related to the existing body of knowledge.

Gravetter and Forzano (2009: 27–28) list two further characteristics of a good hypothesis:

7. It must be the true conclusion of sound arguments.
8. It must make a positive statement about the existence of something.

3.1.5 Research Design

The research design is the framework or plan describing how data are collected and analyzed. It ensures that the study is related to the research problem (Tayie, 2005: 19; Kumar, 2008: 30; Iacobucci & Churchill, 2010: 58).

There are different frameworks for the research design. They can be classified into three basic types: exploratory, descriptive, and causal (Ginsburg, 2010: 103; Iacobucci & Churchill, 2010: 58).

The focus of the exploratory research is on the discovery of new ideas and insights (McQuarrie, 2006: 6; Iacobucci & Churchill, 2010: 58). Descriptive study deals generally with determining the frequency with which something happens, or with the relationship between two or more variables. Causal research is concerned with determining cause-effect relationships and makes use of experiments. It should be noted

that these three types are combined with one another as a single stage of an ongoing process (Iacobucci & Churchill, 2010: 59).

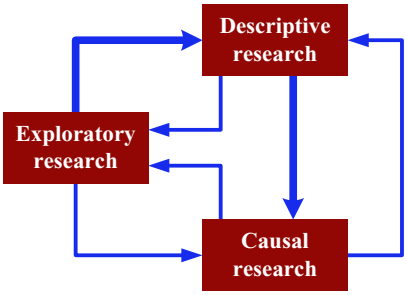

Figure 29: Relationship among research designs
Source: Author's illustration based on Iacobucci & Churchill, 2010: 59

Iacobucci and Churchill (2010: 59) assign different purposes to the three types, and define them with the different frameworks in which the study can be conducted.

Economic research uses mainly the empirical social research in the search for empirical research approaches. It separates the quantitative and qualitative approach.

In the quantitative approach, data are collected by using survey techniques. Afterwards they are analyzed statistically. Thus the results can be very well compared and generalized.

The qualitative approach focuses on describing, understanding, and recognizing as well as on the subjective interpretation of relevant phenomena (Tayie, 2005: 84–87; Karrer, 2006: 266; Klupp 2010: 171–172). The opportunity to generalize results here is not as great as in the quantitative approach. This is due to the smaller sample size, and the greater depth of analysis. Sometimes there is even an individual case basis (Karrer, 2006: 266; Klupp, 2010: 171).

It should be noted, that the term qualitative research is equivalent to exploratory research (Iacobucci & Churchill, 2010: 61).Individual case studies are also performed in

qualitative research (Karrer, 2006: 266; Klupp, 2010: 168–207). Case studies are also one of the qualitative methods (Tayie, 2005: 100).

Table 4: Types of research designs

Type	Purpose	Framework
Exploratory (qualitative)	• Formulate problems more precisely • Develop hypotheses • Establish priorities for research • Eliminate impractical ideas • Clarify concepts • Ethnographies	• Literature search • Experience survey • Focus group • Interviews • Case studies • Projective tests
Descriptive (quantitative)	• Describe segment characteristics • Estimate proportion of people who behave in a certain way • Make specific predictions	• Longitudinal study • Panel • Sample survey
Causal (quantitative)	Provide evidence regarding causal relationships by means of: • Concomitant variation • Time order in which variables occur • Elimination of other explanations	• Laboratory experiment • Field experiment

Source: Author's illustration based on Iacobucci & Churchill, 2010: 60–62; Klupp, 2010: 171

Lamnek (2005: 299) argues that it is the goal of a qualitative case study, to draw a holistic and therefore realistic picture of the social world. By using this methodology, it is possible to integrate all of the dimensions relevant to the examined object into the

analysis. By focusing on a single company it becomes possible to perform an intense investigation of the object.

When selecting research design, Gravetter and Forzano (2009: 381) differ according to the “single-subject design” or “single-case design”. Concentration is either on a single subject or a participant, or it is on the establishment of cause-effect-relationships.

Case studies are particularly useful for conducting unique research. The statistical description and analysis of a research object can be achieved with them. A case study is needed when the objective is to study and understand a very complex phenomenon (Yin, 2009: 4–6).

A case study is a limited system that is bounded in time and location. For example, processes can be involved here that consist of a sequence of activities. To get a detailed understanding of the case, the researcher uses a variety of sources, such as documents, interviews, observations, reports, and data. The achievement of an in-depth understanding requires that only a few cases be investigated. For every other case examined by the researcher, the researcher has less time to explore the deeper background (Miller & Salkind, 2002: 163).

Tayie (2005: 100) emphasizes that case studies are particularly useful for identifying new relationships and less for verifying existing hypotheses. Very complex phenomena can be studied and profoundly understood through case studies (Tayie, 2005: 100; Gravetter & Forzano, 2009: 373–377; Yin, 2009: 4–6).

With respect to the causal research approach, it has to be mention that the term experiment also covers so-called pre-experiments and quasi-experiments. Experiments can be performed in a variety of ways. Here the design of the experiments directly affects the validity of the results (Judd et al., 1991: 100–127; Churchill, 1995: 210–223; Gravetter & Forzano, 2009: 272–298; Reichardt, 2009: 46–71; Bacon, 2010: 260–264; Iacobucci & Churchill, 2010: 111–119). Some experiment designs are listed in the following figure. The relationship between design and validity is also visible (see also subsection 3.1.6).

Table 5: Relationship between experimental design and validity

	Internal							External
	History	Maturation	Testing	Instrumentation	Regression	Selection	Mortality	Interaction of testing and X
Design								
Preexperimental:								
One-shot-case study	-	-				-	-	
One-group pretest-posttest design O X O	-	-	-	-	?			-
Static group comparison	+	?	+	+	+	-	-	
True experimental design:								
Pretest-posttest control R O X O R O X O	+	+	+	+	+	+	+	-
Posttest-only control group R X O R O	+	+	+	+	+	+	+	+
Quasi-experimental design:								
Time series O O O X O O O	-	+	+	?	+	+	+	-
Multiple time series O O O X O O O O O O O O O	+	+	+	+	+	+	+	-

Source: Author's illustration based on Bacon, 2010: 264; modified; see also Gravetter & Forzano, 2009: 272–298

A plus in indicates that the factor is controlled (relative advantage); a minus indicates a definite weakness (relative disadvantage). A blank field indicates that this factor is not relevant for the corresponding design. A question mark denotes a possible source of concern. An X represents "the exposure of a group to an independent variable, treatment or event, the effects of which are to be determined. The process of observation or measurement of the dependent variable to the test units or group of units . . ." is represented by the O. An R indicates "the random assignment of test units or groups to separate treatments . . ." (Bacon, 2010:: 254–264).

A mix of methods can be used in a qualitative approach (see figure 30 and figure 31). Although this procedure is time consuming for the researcher, it provides an accurate and thorough understanding of the research problem (Gilmore & Carson, 1996: 22–26; Hill & McGowan, 1999: 11–12; Carson, Gilmore, Perry & Gronhaug, 2005: 204–215).

Figure 30: Concept of "integrative" methodology

Source: Author's illustration based on Gilmore & Carson, 1996: 23; modified

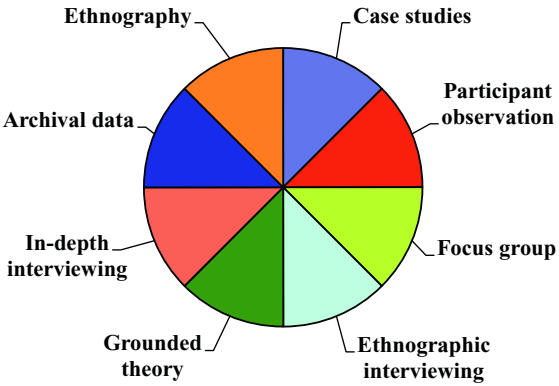

Figure 31: Merge of qualitative methodologies

Source: Author's illustration based on Hill & McGowan, 1999: 11; modified

Gilmore and Carson (1996: 24–26) combine a case study with the integrative research methods mix to achieve a longitudinal stream of research (see figure 32). A single company is the focus of an in-depth study in stage 1. Various methods are used; in this example, there are surveys, observations, group discussions, and discussions with employees.

It could be started with a survey conducted with an employee sample over a short period of, e.g., four weeks. This survey may be related to procurement processes or activities. It can, for example, show that the majority of internal customers are dissatisfied with the level of service the Procurement department provides.

Stage 2 builds on the data described, and the experience and knowledge of the case study's ongoing data analysis from stage 1, assuming they were collected in comparable companies within the same industry. By adding other company's experiences, researchers are able to understand the phenomenon under investigation better and more deeply.

Another step in this research-flow approach is stage 3. It seeks further progress, and an even deeper understanding of the research object can be achieved. This stage builds on the first and second stages. It also focuses on companies in the same industry, but this time their geographical locations differ. Alternately, this stage focuses on one particular aspect, such as procurement area, that should be investigated in depth.

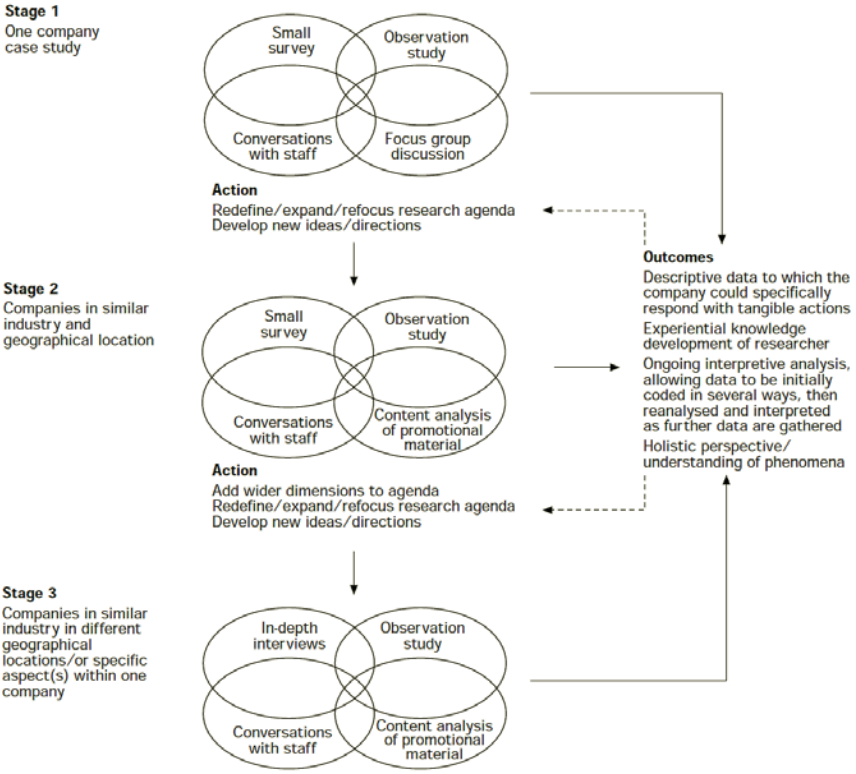

Figure 32: Integrative stream of research

Source: Gilmore & Carson, 1996: 25

This integrative methodology can be selected to investigate specific issues or problems that were identified at an early stage of research. According to Gilmore and Carson

(1996: 26), this staged process's advantage lies in its taking the changing, evolving nature of service into account.

Another advantage of conducting a study as a staged process is the improved understanding and knowledge that gradually builds up. With an increasing understanding (in depth and breadth) the researcher develops the ability to identify key components within the research topic and to assess them in the context with their occurrence.

3.1.6 Criteria For Judging Research Design Quality

Basically, it should be noted that the results developed by a research paper must meet certain quality standards. To be accepted from a scientific perspective, the results must be valid and reliable. To achieve this quality, the appropriate experimental design should be selected when the data collection starts. Based on the particular research, the design affect the results' validity and reliability (Churchill, 1995; Flick, 2009; Gravetter & Forzano, 2009; Yin, 2009; Bacon, 2010).

Reliability is a measure describing formal accuracy of scientific measurements. It represents that part of the variance that can be explained by true differences in the measured feature. Highly reliable scientific results are considered to be almost free of random errors. This means that the same results will be achieved if an experiment is repeated under identical conditions. Reliability is a precondition for the reproducibility (replicability) of results under identical conditions (Judd, Smith & Kidder, 1991: 50–52; Churchill, 1995: 83–87; Jackson, 2011: 81–84; Flick, 2009: 385–387; Gravetter & Forzano, 2009: 82–86; Yin, 2009: 45; Iacobucci & Churchill, 2010: 591; Zalesky, 2010: 318–320).

In the scientific context, validity describes the resilience of assumptions and statements. Validity can be understood as a kind of criterion for assessing a measuring instrument's results. The capacity to operationalize (“Does the instrument measure what it is supposed to measure?”) and the robustness of the measurement based on assumptions and statements (“To what extent it is true that X influences O?”) are assessed. The

degree of the results' quality does not just depend on the instrument, but also on the nature and characteristics of the examined group (Judd et al., 1991: 51; Jackson, 2011: 80–88; Flick, 2009: 387–391; Gravetter & Forzano, 2009: 75–81; Yin, 2009: 40–45; Iacobucci & Churchill, 2010: 593; Zalesky, 2010: 320–321).

It must be added that different types of validity are distinguished. Construct validity deals with the issue of whether the identified variable is truly the variable being measured. It exists when a construct's measurement is neither affected nor falsified by systematic errors or by other constructs. Construct validity is considered the most important type of validity (Judd et al., 1991: 27–28; Churchill, 1995: 535–536; Reichardt & Mark, 1998: 196–198; Jackson, 2011: 86; Gravetter & Forzano, 2009: 79; Yin, 2009: 41–42; Iacobucci & Churchill, 2010: 257–258; Zalesky, 2010: 320–321). It reflects whether a scale proves to be a reasonable criterion (criterion variable) in relation to other selected variables.

Criterion validity can take two forms based on the period: concurrent and predictive validity (Churchill, 1995: 534; Jackson, 2011: 86–87; Gravetter & Forzano, 2009: 76–79; Zalesky, 2010: 320).

Content validity, also called face validity, is concerned with the issue of whether an expert would confirm that the investigated question was appropriately dealt with (Judd et al., 1991: 54; Churchill, 1995: 534–535; Jackson, 2011: 85–87; Gravetter & Forzano, 2009: 76; Yin, 2009: 40–41; Iacobucci & Churchill, 2010: 256–257; Zalesky, 2010: 320).

Internal validity refers to the possibility that the observed effect can be attributed to the experimental variable and not to other factors (Judd et al., 1991: 28; Churchill, 1995: 201–204; Reichardt & Mark, 1998: 195–196; Gravetter & Forzano, 2009: 588; Yin, 2009: 42–43; Bacon, 2010: 254–255).

External validity focuses on the problem of generalization of experimental results. The question is “Can the research results with respect to other situations, organizations and individuals be generalized?” This is often not the case with regard to laboratory

experiments (Judd et al., 1991: 28–29; Churchill, 1995: 201–204; Reichardt & Mark, 1998: 198; Gravetter & Forzano, 2009: 586; Yin, 2009: 43–44; Bacon, 2010: 255).

Reviewing the research's quality regularly is generally recommended. Four different tests for research design have proven to be very useful for this purpose: construct validity, internal and external validity, and reliability testing (Judd et al., 1991; Corbin & Strauss, 2008; Yin, 1998 & 2009; Kirk, 2009). Yin (1998 & 2009) recommends that this review be performed throughout the whole research process. This includes the steps study design, data collection, data analysis, and research-report creation.

Such an approach increases the the research's quality enormous and serves to allay points of potential criticism. Whether the research results meet quality requirements also depends on selection of the experimental design (Churchill, 1995; Jackson, 2011; Gravetter & Forzano, 2009; Yin, 2009, Bacon, 2010).

Yin (1998: 243 & 2009: 41) brings the four most common tests for obtaining quality in research results in a relation to a research project's phases. He gives examples of how validity and reliability can be proven when different methods are used. In addition to the most common four methods, content/face validity is supplemented by table 6 and table 7.

Table 6: Case study methods for validity design tests

Test	Methods in case study	Research phase in which method occurs
Construct validity	Using multiple sources of evidence	Data collection
	Establishing chain of evidence	Data collection
	Having key informants review draft case study report	Composition
Content or face validity	External business executives review	Data analysis
Internal validity	Doing pattern matching	Data analysis
	Conducting external audits	Data analysis
	Doing time series analysis	Data analysis
	Multiple informants reviewing study	Data analysis
	Doing explanation building	Data analysis
	Address rival explanations	Data analysis
	Using logic models	Data analysis
External validity	Using theory in single-case studies	Research design
	Using replication logic in multiple-case studies	Research design

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Flick, 2009; Creswell, 2012

Table 7: Case study methods for reliability design tests

Test	Methods in case study	Research phase in which method occurs
Reliability	Researcher or Investigator triangulation	Data analysis
	Peer review or debriefing	Data analysis
	Using case study protocol	Data collection
	Rich and thick description	Data collection
	Generating rich data	Data collection
	Developing case study database	Data collection

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Flick, 2009; Creswell, 2012

Regarding the relationship between validity and reliability it can be stated that reliability is a statement about the consistency, but not about the accuracy of the results. A test can be reliable but not valid, but if it is valid, it is also reliable (Jackson, 2011: 87; p. 321; Gravetter & Forzano, 2009: 85–86; Zalesky, 2010: 321). The objective should therefore be to choose an experimental design that promises the greatest validity (see table 5).

3.2 The Study

This section is based on the prior literature review for research design. Previously developed theoretical requirements are taken into consideration thematically and incorporated into the study in the sequel.

3.2.1 The Research Problem

As described in section 2.7, it is doubtful that, in the present day and under prevailing conditions, purchasing savings are the right indicator for measuring performance within procurement. It is furthermore doubtful in an era of partnership and win-win situations that purchasing savings represent an instrument positively impacting SCM objectives and sustainable company success. The magnitude of savings will more likely perturb a long-term relationship and may lead to the SC partners' separation.

The customer then suffers a diminution of know-how, which affects their own company's success. Purchasing savings are therefore considered to be a disturbance variable that impedes SCM objectives and companys success. The requirement to analyze business processes' and functions' performance in terms of their efficiency and effectiveness is uncontroversial. The logical consequence of doing so is that a new approach has to be developed capable of measuring procurement's performance and of subsequently replacing purchasing savings.

3.2.2 The Analytical Model

This subsection is divided into three sub-subsections. The basic model is created in the first. It serves as a starting point in the sequel. The second deals with the status quo while the third deals with construction of the research approach. An analytical model in verbal and graphic form is created for the present study.

3.2.2.1 Basic Model

In this sub-subsection, the basic model that will serve as a starting point for the status quo as well as for the research approach is created. Based on the literature review (section 2.1 to 2.6), the analytical model below can be conducted using a deductive (logical) line of argument.

To survive in the market, companies must satisfy end customers' requirements and desires. Only the end-customers bring money into the SC thereby engendering companies' dependence (Karrer, 2006: 18). The companies' aim must therefore be to meet the customer expectations with the former's product, thereby achieving a high customer satisfaction (Fawcett et al., 2007: 32).

Customer satisfaction indicates the degree to which customer expectations have been met. This depends crucially on the performance objectives of quality, cost, flexibility, time, and innovation (Fawcett et al., 2007: 32–34). Thus the customer expectations and customer requirements determine the factors of quality, cost, and time for the QCT triangle and are responsible for its characteristics.

To satisfy customer requirements as well as possible, the company must examine whether and in which form its own product meets customer expectations. If deviation is detected, appropriate adaptive measures must be undertaken. This process is repeated until the best possible match between customer requirements and product realization is achieved.

The TTM cycle consists of various process elements (Meyer, 1993: 17–18). It covers the time interval between idea and market introduction (Milling, Schwellbach & Thun, 2000: 5). This time interval also includes review of the above-mentioned coverage range. The consequence is that any necessary process adjustments prolong the TTM cycle.

Deliberate TTM cycle abbreviation may increase cost, but delayed market entry can lead to loss of profits (opportunity costs), loss of reputation, or shrinking market share (Wangenheim & Dörnemann, 1998: 302–304; Wiesinger & Housein, 2002: 505).

Since TQM can also be used for processes (Binner, 2002: 96–97; Bruhn, 2008: 68; Dickmann, 2008: 59–60), costs for process adjustments when process deviations occur must be taken into account (Welborn & Kasten, 2006: 129; Rashidy, 2009: 113–115). Process variations imply that the resources were not optimally utilized. The costs must therefore be considered opportunity costs (Schneider, 2010: 192–194). These unplanned costs affect the company's profit (Lysons & Farrington, 2006: 396).

During the course of relationship management, SRM controls the relationship to and cooperation with suppliers (Hildebrand, 2001; Riemer & Klein, 2002; Wagner, 2002; Appelfeller & Buchholz, 2005; Wannenwetsch, 2005). One aspect of this is flexibility. Flexibility refers, for example, to how fast the supplier can adapt to changing conditions (Ellram et al., 2007: 33).

Adaptation requires the supplier to achieve flexibility in all SCOR Model processes (Sennheiser & Schnetzler, 2008: 78). The use of modern information technologies is intended to accelerate information exchange (Wannenwetsch, 2005: 176; Sennheiser & Schnetzler, 2008: 137) and increase transparency. This is particularly helpful for identifying suppliers and comparison capabilities (Fawcett et al., 2007: 34).

Transparency is almost a prerequisite if simultaneous or collaborative engineering is used for planning and development activities. Only then can reduced costs and shorter development time be achieved (Thaler, 2007: 111).

Since SRM also deals with supplier-portfolio and supplier-base design (Wagner, 2002: 11; Wannenwetsch, 2005: 150), it has a significant influence on the external innovation that suppliers bring into the company. A portfolio of suppliers exhibiting high innovation yields the opportunity to participate in these external innovations (Wagner, 2002: 102; Thaler, 2007: 113).

With one of its objectives being the reduction of process costs and cycle times (Appelfeller & Buchholz, 2005: 5), and with design of the supplier base and supplier portfolios (Wagner, 2002: 11; Wannenwetsch, 2005: 150), SRM accordingly influences opportunity costs and development times (Hartmann, 2004: 14), and hence the TTM cycle.

That trust in the form of cooperation influences SRM is not only fully confirmed by the literature (Corsten & Gabriel, 2002: 18; Arnold, 2004: 13; Christopher, 2005: 40; Van Weele, 2005: 292; Gloor, 2006: 86; Lysons & Farrington, 2006: 8), but is also reflected in daily business practice. The same goes for the duration of contract negotiations.

Here, trust between partners also positively influences the length of contract negotiations (Marsh, 2001; Woolthuis, Hillebrand & Nooteboom, 2005). The length of contract negotiations influences the necessary resources (time and money) and that has consequences for TTM cycles and opportunity costs, also known as lost profits (Lysons & Farrington, 2006: 396).

Short TTM cycles imply short process times: the company can bring its products to market faster. Competitive advantage can be thereby secured (Melzer-Ridinger, 2004: 12). Both factors, opportunity costs and TTM cycle, thus directly impact the company's success.

The analytical verbal model outlined above for the basic model is the starting point for the analysis of the status quo as well as the research approach. The graphical model

shows, as mentioned in subsection 3.1.2, hitherto isolated variables and provides an initial indication of the direction of the relationship among the variables (Athaide, 2010: 83–84). Figure 33 shows the graphical model for the basic model according to Athaide (2010).

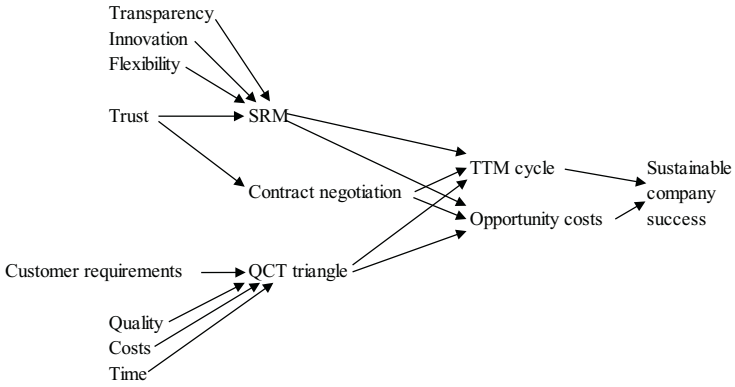

Figure 33: Graphical analytical model of the basic model
Source: Author's illustration based on Athaide, 2010: 84

3.2.2.2 About The Status Quo

This sub-subsection deals exclusively with the purchasing savings perspective. The assertion in the problem that focusing solely on purchasing savings negatively impacts the company's sustainable success is to be tested for logical consistency. A deductive (logical) line of argument is therefore established. Based on the conducted literature review (section 2.1 to 2.6) and subject correlation (see seubsection 2.7.1), the analytical model below can be established for the status quo.

A change occurs if the purchasing-savings factor supplements basic-model variables (see sub-subsection 3.2.2.1). Whereas before the desired win-win situation (Poirier & Quinn, 2003; Christopher, 2005; Schönsleben, 2007) and a partnership existed, now there are simply attempts to pass costs. An effective cost reduction approach (Vollmann & Cordon, 1999: 3) is not implemented.

The partnership situation in which all are equally entitled (Wagner, 2002; Poirier & Quinn, 2003) begins to shift to one party's benefit. Long-term stability within the SC (Busch & Dangelmaier, 2004: 55) is disrupted and the loss of confidence must be reckoned with.

The circumstances just described admit the following logical and causal conclusion: growing distrust and loss of the win-win partnership situation can lead to increased contract-negotiation duration; the SRM quality comes under threat. Separation of the SC partners must be expected in the worst case.

Furthermore, the monetary factor's excessive influence might negatively impact the QCT triangle's remaining factors. This entails the risk of process or quality-related costs being incurred (Dobler, Führer, Kneubühl & Züger, 2009: 75–76), inability to satisfy the customer's needs, or the delivery date not being met. This ultimately leads to companies' sustainable success being negatively affected.

The content of analytical model's verbal statements can also be represented graphically. Following Athaide (2010), figure 34 provides the status quo's graphical model.

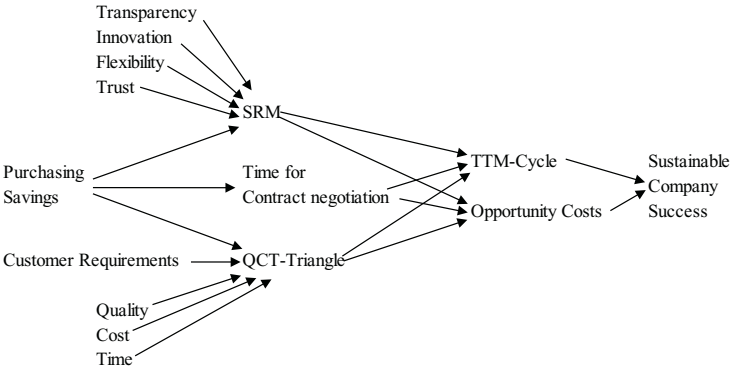

Figure 34: Graphical analytical model for the status quo
Source: Author's illustration based on Athaide, 2010: 84

3.2.2.3 Research Approach

The research approach will be created in the sequel taking the conducted literature review (section 2.1 to 2.6) into account and building on the correlation of topics (see subsection 2.7.1). The focus is particularly on subsection 2.7.3, with its definition of quality in procurement (*Procurement quality means that the procurement organization is able to provide the company within the shortest processing time with the right products, at the right quantity, at the right place, at the right time, the right quality and at the right price).*

The same relationships described in the basic model (see sub-subsection 3.2.2.1) apply to many factors in the research approach. The explanations concerning customer needs, quality, cost, time, and the QCT triangle are affected. Furthermore, the same relationships for transparency, flexibility, innovation, SRM, trust, and contract negotiations already developed in the basic model also apply in the research approach.

The described effects of TTM cycles and opportunity costs on the company's success also retain their validity. The additions and amendments below must be made to the verbal-analytical model if the basic model is extended to include the "procurement quality" variable.

Measuring procurement quality (hereafter abbreviated "PQ" for procurement quality) enables the quality level at which the procurement organization is fulfilling its tasks and achieving its goals to be verified. This can be deduced from the fact that procurement directly influences SRM through supplier-base configuration (Bogaschewsky, 2003: 26; Lysons & Farrington, 2006: 8), sourcing-market analysis (Busch, 1981: 27; Arnolds et al., 2010: 2), and make-or-buy decisions as well as outsourcing (Lysons & Farrington, 2006: 8).

Procurement impacts confidence via configuration of SRM and supplier-relationship maintenance (Corsten & Felde, 2002: 85–93). Procurement contributes to building and maintaining confidence through its own behavior towards the supplier (Weele, 2005;

Lysons & Farrington, 2006; Monczka et al., 2011) thus facilitating transactions such as contract negotiations.

Procurement's impact on the QCT triangle is permanently prescribed, because provision of goods and services is the former's core task. The procurement organization must ensure that quality, cost, and time factors (Busch, 1981: 27; Lamprecht, 2000, p 142; Dickmann, 2008: 27; Fung et al., 2008: 20; Lai & Cheng, 2009: 4) are accounted for through the source process of the prescribe form.

Another task is determining the costs of purchasing of needed goods and services. This can be done through sourcing market research (Busch, 1981: 27), comparison of offers (Arnolds et al., 2010: 2), or target costing (Schulte, 1996; Horváth, 2006; Weber & Schäffer, 2006; Preißler, 2007). It is procurement's task to use the lever “cost” properly through competent action (Lemme, 2009: 7) and to always strive for cost-effective supply (Arnolds et al., 2010: 2).

All of the activities required for task fulfillment or achieving objectives within procurement may also be referred as processes. Thus the TQM concept can also be used with source processes (Binner, 2002: 96–97; Mukherjee, 2006: 40; Bruhn, 2008: 68; Dickmann, 2008: 59–60). Process times (Kaplan & Norton, 1992b; Powell, 1995) and costs for process adjustments for existing process deviations have to be taken into consideration (Welborn & Kasten, 2006: 129; Rashidy, 2009: 113–115).

Long process times and process variations also signifies that resources were not optimally utilized. The resulting costs are to be considered opportunity costs (Schneider, 2010: 192–194) affecting the company's profits (Lysons & Farrington, 2006: 396). The faster procurement satisfies requirements and completes tasks, the fewer opportunity costs are incurred and the more positively TTM cycles are influenced. Shorter TTM cycles and lower opportunity cost enable products brought to market faster and cheaper. As in the basic model, this positively impacts the company's sustainable success.

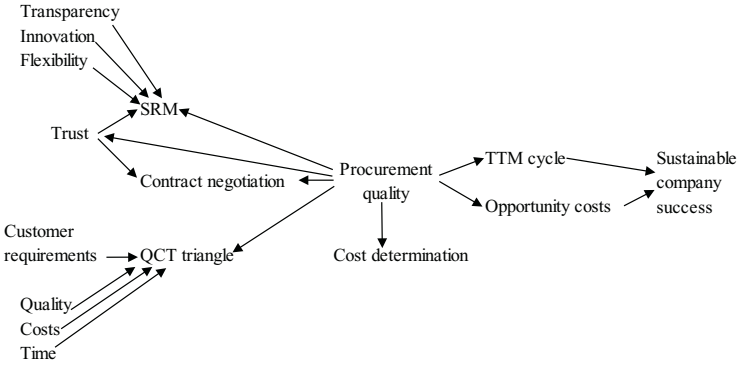

Figure 35: Graphical analytical model for the research approach
Source: Author's illustration based on Athaide, 2010: 84

Conclusions and correlations for the result of this analytical model are derived and illustrated in the remainder of this study.

3.2.3 The Research Question

This subsection treats two categories of questions: in the first category are the actual RQs; in the second, some sub-questions (SQ). The latter support answers to the RQs from a current perspective.

This study's principal RQ is the following:

RQ: How must a measurable method be designed in the procurement context so that, on the one hand, it exercises a positive effect on sustainable company success through declining TTM and opportunity costs and, on the other, can replace the monetary measure of purchasing savings?

It is assumed that the principal RQ can be better analyzed when it is divided. Division produces the following three sub-RQs:

RQ1: Is it possible to transfer the First-Time-Right approach (Mukherjee, 2006), also referred to as the Zero-Defects concept (Crosby, 1978), into the procurement organization?

RQ2: How must a measurable method in procurement be designed to positively affect sustainable company success through declining TTM and opportunity cost?

RQ3: Is the new method able to replace the measurement of monetary purchasing savings as a performance measurement?

The supporting SQs are:

SQ1: What are the prerequisites for implementing and using First-Time-Right?

SQ2: What is the observable variable for measuring PQ?

SQ3: Has PQ measurement impacted TTM cycles and the opportunity costs?

SQ4: Which input parameters does the measurement system need?

SQ5: What market factors affect the company?

SQ6: What are the measurement system's requirements?

3.2.4 Derived Conclusions And Correlations

This subsection is divided into two sub-subsections to preserve clarity. The first develops conclusions and correlations derived about the status quo, and performance measurement in procurement using monetary savings. The second focuses on the research approach. The statements are mapped into a structural model (SM) to better understand the relationships.

3.2.4.1 The Status Quo

Conclusions about the status quo will now be illustrated based on the performed literature review, and particularly on subsection 2.7.2 and the results of the analytical model for the status quo (see sub-subsection 3.2.2.2). This is done to clarify the motivations leading to the conclusion that the monetary measurement of purchasing savings negatively influences sustainable company successes, which ultimately led to the research problem.

One of SCM's fundamental objectives is to achieve long-term cooperation. It is repeatedly pointed out that cooperative behavior and the achievement of a win-win situation are necessary for this to occur (Seifert, 2002; Poirier & Quinn, 2003; Christopher, 2005; Schulte, 2005; Schönsleben, 2007).

Against this backdrop, cost avoidance, cost reduction, and optimization of services targeted under the rubric of "purchasing savings" must be called into questioned. If the right product price has already established and paid, efforts to achieve purchasing savings (procurement success) will result in attempts at one-sided benefit optimization. The partnership situation in which all should have equal rights (Wagner, 2002; Poirier & Quinn, 2003) gets out of balance.

Long-term stability is furthermore threatened. Massive problems can arise, as demonstrated by car manufacturer Opel (Trent, 2007; Rickes & Hassell, 2008; Werner, 2010), since actual costs are not effectively reduced (Vollmann & Cordon, 1999), but simply passed on. The objective of pursuing common interests (Corsten & Gabriel, 2004) is no longer the focus.

The logical result is that distrust increases. The practical experience shows that in situations where mistrust prevails between the parties, processes are slower and less efficient, and the incidence of process deviations increases. This disrupts the supplier relationship; contract negotiations take longer; renegotiations take place, and the QCT triangle's "costs" is massively impacted.

Four conclusions can be derived from these facts:

1: There is a significant negative relationship between purchasing savings and *SRM* quality.

2: There is a significant negative relationship between purchasing savings and *trust*.

3: There is a significant negative relationship between purchasing savings and the *contract-negotiation duration*.

4: There is a significant negative relationship between purchasing savings and the *character of the QCT triangle*.

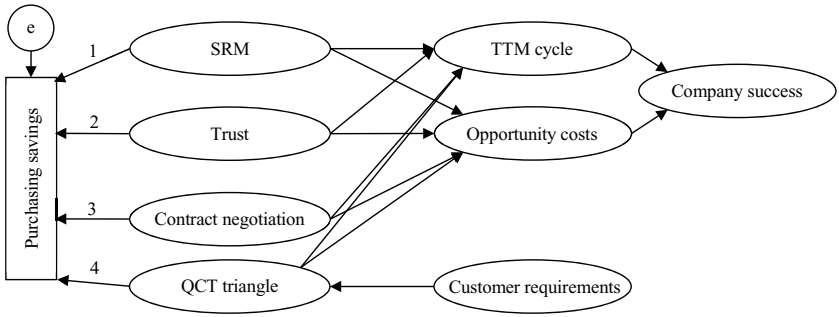

Figure 36: SM for the status quo

Source: Author's illustration based on Backhaus, Erichson, Plinke & Weiber, 1990; Hox & Bechger, 1998; Byrne, 2001; Schumacker & Lomax, 2004; Eden, 2010

It makes sense for a company to replace the purchasing savings factor already assessed as a risk. Its position in the SM highlights the risks described in sub-subsection 2.7.2.4. In accord with the research problem of replacing purchasing savings, reworking the derived conclusions and connections to this effect for the research approach is done in the next sub-subsection.

3.2.4.2 The Research Approach

The SM will be used below to state and visualize the conclusions and connections derived for the research to comprehensively assess procurement's performance. The starting point for this is significantly based on various quality concepts. In addition, objective of efficient and effective processes, an aim also pursued by SCM, enters in (Bowersox et al., 1999; Poluha, 2007; Batten, 2008; Speh, 2008; Schneider, 2010; Werner, 2010).

The first quality concept is that it is better for companies to avoid errors than to fix them (Crosby, 1978; Jain, 2001; Roenpage & et al., 2007; Rothlauf, 2010; Monczka et al., 2011). This characterizes the FTR approach.

The second concept is TQM. It can be applied not only to products but also to services and processes (Cooper & Slagmulde, 1997; Binner, 2002; Scharnbacher & Kiefer, 2003; Mukherjee, 2006; Dobler et al., 2009; Rothlauf, 2010).

The third concept is Six Sigma. From its perspective, every process has an output and a customer (Guptap, 2005; Töpfer, 2007; Roenpage & et al., 2008). Thus, all processes within procurement do to.

In summary, this means that in principle a qualitative assessment can and must be carried spanning all the activities and processes of the service provider "Procurement" (Cali, 1992). This applies both the TQM and FTR as well as to the Six Sigma approach in procurement.

In addition the above-described starting point for the research approach, the derivation of conclusions and connections will also be based on the facts below.

Procurement's tasks and objectives are discussed in many ways in the literature (Kroeber-Riel, 1966; Busch, 1981; Hansen, 1990; Lieberum, 1999; Bogaschewsky, 2003; Van Weele, 2005; Lysons & Farrington, 2006; Lemme, 2009; Arnolds et al., 2010). Various processes must be carried out in procurement to complete the tasks and achieve the objectives (Van Weele, 2005; Lysons & Farrington, 2006; Lemme, 2009; Monczka et al., 2011).

These include, for example, the analysis of the sourcing market and the suppliers, and make-or-buy and outsourcing decisions, which have a direct relationship with the supplier (Busch, 1981; Appelfeller & Buchholz, 2005; Lysons & Farrington, 2006; Büsch, 2007; Lemme, 2009; Arnolds et al., 2010; Monczka et al., 2011). This correlation is the connection or relationship with the supplier that SRM recognizes and ultimately designs and controls (Corsten & Hofstetter, 2001; Barking & König, 2002; Corsten & Felde, 2002; Hildebrandt, 2002; Riemer & Klein, 2002; Liker & Thomas, 2004; Appelfeller & Buchholz, 2005; Lutsch, 2007).

Against the backdrop of qualitative assessment of all processes and activities covered under SRM, it can be said in summary that SRM's quality depends on the efficiency and effectiveness with which procurement carries out those activities and processes. From

these facts, the following conclusion can be derived describing PQ's relationship to SRM:

5: PQ exerts a significant positive impact on *SRM*.

From the foregoing, it is apparent that procurement is responsible for the relationship with suppliers. This immediately brings with it the responsibility to create and maintain trust within the supplier relationship (Arnold, 2004; Appelfeller & Buchholz, 2005; Van Weele, 2005; Büsch, 2007; Monczka et al., 2011). A code of ethics provides support here (Gloor, 2006; Lysons & Farrington, 2006; Rothlauf, 2010).

But practice shows clearly that creating and maintaining trust also demands social skills. These enable procurement to create a framework in which supplier treatment also regulated and steady in difficult situations (Harding et al., 2001; Van Weele, 2005; Lysons & Farrington, 2006; Monczka et al., 2011). The following conclusion obtains if the process of generating and maintaining trust is correlated with the qualitative aspect:

6: PQ exerts a significant positive impact on the *trust* between Procurement and the supplier.

Procurement must also conduct the necessary negotiations if its core task of supplying needed goods and services is to be completed (Hansen, 1990; Lysons & Farrington, 2006; Arnold, 2007). The objective is to achieve supply security for the company with these goods and services (Büsch, 2007; Arnolds et al., 2010; Monczka et al., 2011) while realizing the 6 Rs, which its internal customers specify (Lamprecht, 2000; Dickmann, 2008; Fung et al., 2008; Lai & Cheng, 2009).

Practice clearly shows confidence and competence within procurement affects contract quality, the duration of contract negotiations, the renegotiation effort, and the legal security of contracts. If this understanding is correlated with the quality approaches TQM and FTR, it results to the following conclusion:

7: PQ exerts a significant positive impact on *contract negotiations.*

Procurement has to contribute to the required 6 Rs being realized when satisfying customer requirements (Lamprecht, 2000; Dickmann, 2008; Fung et al., 2008; Lai & Cheng, 2009). Special consideration is given to quality, cost, and time factors. These are in permanent state of tension, since they exert direct, mutual influence (Malomy & Kassebohm, 1994; Thonemann et al., 2004; Brunner & Wagner, 2008; Wannenwetsch, 2005; Dobler et al., 2009; Rothlauf, 2010).

Procurement should not, e.g., tend to focus only on price; otherwise other factors will be adversely affected. The consequence is that the result no longer accords with customer requirements (Dobler et al., 2009).

8: PQ exerts a significant positive impact on the *QCT triangle.*

The cost determination process must be completed before procurement starts contract negotiations with the supplier. Learning the cost of procured goods and services is a preparatory activity for negotiations (Lysons & Farrington, 2006; Lemme, 2009; Arnolds et al., 2010; Monczka et al., 2011).

Internal/External customers' requirements provide the starting point for determining these costs (Horváth, 2006; Preissler, 2007). They define the cost-causing factors. The qualitative requirement must be to conduct this process so that the result of cost determination corresponds to the product's realistic price.

9: PQ exerts a significant positive impact on *cost determination*.

If, during the performance of duties in the procurement, process times (Powell, 1995; Kaplan & Norton, 1992b) are reduced and process adjustments (Welborn & Kasten, 2006; Rashidy, 2009) avoided, costs resulting from inefficient use of resources are also avoided (Welborn & Kasten, 2006; Rashidy, 2009). This means that process efficiency increases, because processes were performed in the shortest time, at the lowest cost, and with the highest quality (Harrington, 1991; Dobler et al., 2009).

This reduces opportunity costs, positively affects the TTM cycle, and supports one of SCM's objectives: efficient and effective processes (Bowersox et al., 1999; Poluha, 2007; Batten, 2008; Speh, 2008; Schneider, 2010; Werner, 2010).

10: PQ exerts a significant positive impact on *opportunity costs*.

11: PQ exerts a significant positive impact on the *TTM cycle*.

The efficiency of the processes involved in procurement therefore influences the company's sustainable success. The objective must be to assess the effectiveness and efficiency of the processes involved in procurement through quality characteristics, e.g., using TQM or FTR.

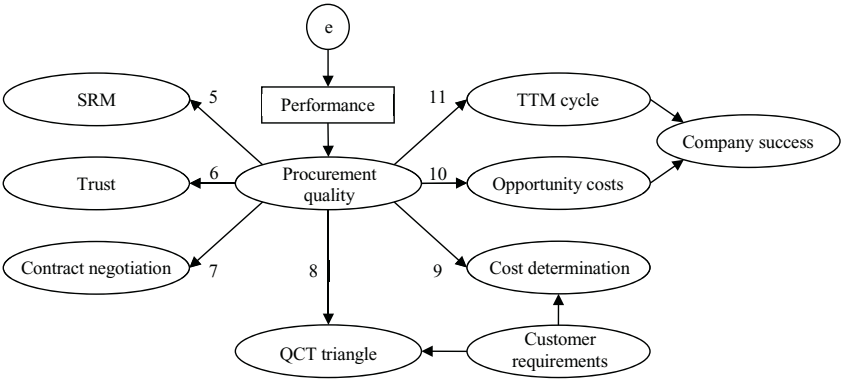

Figure 37: SM for the research approach

Source: Author's illustration based on Backhaus et al., 1990; Hox & Bechger, 1998; Byrne, 2001; Schumacker & Lomax, 2004; Eden, 2010

3.2.5 Objectives

When treating the research problem, the focus should be on a sustainable solution. SCM's basic idea of reaching a cooperative, win-win situation should be the guiding principle during the treatment. The aim is to develop a method with a holistic approach offering the following objectives for the company:

1. Positive contribution to the company's success
2. Reduction of opportunity cost
3. Reduction of time to market

4. Acceleration of the information flow
5. Reduction of contract negotiation time
6. Transparency and measurability of soft-skills/facts in procurement and SRM
7. Optimization of the supplier structure

The company should succeed in achieving a sustainable optimum via the measurable method for PQ: an optimum including not only monetary facts, but also innovative, cooperative, transparent and communicative suppliers as well as motivated procurement staff.

3.2.6 Research Design

The mixed-methods approach has been chosen for the present work (Gilmore & Carson, 1996: 22–26; Hill & McGowan, 1999: 11–12; Carson et al., 2005: 204–215) based on the performed literature review dedicated to research design (see subsection 3.1.5). The mix will include both qualitative and quantitative methods. A case study forms the basis for further study to investigate the new topic specifically and to understand it profoundly in accordance with Tayie (2005), Gravetter and Forzano (2009) and Yin (2009).

The present study is seen as an element of the stage 1 (see figure 32) based Gilmore's and Carson's (1996: 24–26) staged approach. It serves mainly to verify the transacted conclusions. This work will not investigate whether or not these can be generalized and transferred into hypotheses if they are valid. This can be examined at a later in stages 2 and 3 (Gilmore & Carson, 1996; Carson et al., 2005).

At the current stage of the study, the following research design in figure 38 is assumed.

Exploratory Case Study

Type	Method	Objective
Exploratory (qualitative)	Literature research	Formulating problem Developing conclusions and hypotheses Establishing priorities for research
Exploratory (qualitative)	(1) Data analysis	Developing concept
Causal (quantitative)	(2) Laboratory experiment	Creating a solution approach Deriving causal relationships
Descriptive (quantitative)	(3) Sample survey	Formulating specific predictions
Causal (quantitative)	(4) Field experiment	Testing causal relationships Eliminating of other explanations Verifying/Falsifying the stated conclusions/hypotheses

Figure 38: Research design planned for the study

Source: Author's illustration based on Iacobucci & Churchill, 2010: 60–62; Klupp, 2010: 171

Daily business practice was the impetus for this study, the main divisions of which are the literature review and case study. The scientific part is based on a comprehensive literature research. With the help of its exploratory character, it proved possible to set up the research problem, for example, and derive the conclusion and correlations (Iacobucci & Churchill, 2010; Klupp, 2010).

The next step involves transferring theoretical considerations into the reality of the daily business practice. This is done through an exploratory case study. The phenomena derived from theory and practice can be studied intensively this way (Miller & Salkind, 2002; Lamnek, 2005; Tayie, 2005; Karrer, 2006; Yin, 2009; Klupp, 2010).

It is currently assumed that thanks to data analysis (1), a comprehensive understanding as well as sufficient data and information exists to develop a concept for the research problem. A transition from exploratory to causal methodology is now planned.

An initial solution statement should be set up in laboratory experiments (2) based on exploratory research. Causal relationships between variables are thereby taken into account. Predictions be subsequently made with respect to the solution approach by using the descriptive method of sample survey (3) (Iacobucci & Churchill, 2010; Klupp, 2010).

In laboratory experiments, there is the risk of the phenomenon being decoupled from reality (Tayie, 2005; Iacobucci & Churchill, 2010; Klupp, 2010). A field experiment (4) is performed as a last step to avoid this. Thus it is possible to verify under real conditions causal relationships among variables and prediction made. The solution approach and the conclusions developed can be verified or falsified as a result.

It remains to be mentioned that the above methods are intertwined. In the case of deviations or necessary adjustments, this can cause feedback to one of the upstream methods.

3.2.7 Quality Assurance For The Study

The procedures and methods recommended in subsection 3.1.5 and 3.1.6 are being implemented to ensure the quality of this study's research results.

The specific design “posttest-only control group” has been selected for the study's field experiment. Table 5 shows that this promises the greatest validity and thus reliability.

Two groups are considered in the “posttest-only control group” experiment design: the experimental group (EG) receives treatment (X); the control group (CG) does not. However, both groups are measured (O1 and O2) after the EG has received treatment

(Judd et al., 1991: 105–107; Gravetter & Forzano, 2009: 272–298; Bacon, 2010: 264). This design is also called “the static group comparism” in the literature (Churchill, 1995: 212; Judd et al., 1991: 105–107; Iacobucci & Churchill, 2010: 112–113).

EG:	X	O_1
CG:		O_2

Formula 1: Symbolic arrangement for posttest-only control group
Source: Curchhill, 1995; Gravetter & Forzano, 2009; Bacon, 2010; Iacobucci & Churchill, 2010

In an augmentation of the original design, the experiment is carried out using a "randomized posttest-only control group" design. The objective is to leave the group assignment to chance. This should disrupt a potential, systematic relationship between external variables and the independent variables.

The researcher is also eliminated as another potential source of error or manipulation. Randomization increases the research results' validity and the quality even more (Judd et al., 1991; Churchill 1995, Jackson, 2011; Gravetter & Forzano, 2009; Bacon, 2010). Iacobucci and Churchill (2010: 115–116) describe this approach as “After-Only with Control Group Design”.

EG:	R	X	O_1
CG:	R		O_2

Formula 2: Symbolic arrangement for randomized posttest-only control group
Source: Curchhill, 1995; Gravetter & Forzano, 2009; Bacon, 2010

The “Randomized posttest-only control group” design achieves the greatest possible validity and reliability possible for an experiment design (Bacon, 2010: 264). Various methods are used in addition during the overall research process to increase research result quality (Tayie, 2005; Yin, 2009).

3.3 Time Frame And Data Base

The present study was conducted between 2010 and 2012. It takes the latest versions and states of the products, projects, systems, tools, and documents presented and examined into account.

The case study will be conducted in Rheinmetall Defence Electronics GmbH (RDE). RDE is a German defense industry company. It operates as a system supplier in the international market. The German defense market in particular is a system-supplier oligopoly.

RDE is mostly active in the project business. It has no production; instead, it integrates the delivered components to complete systems. With 1298 employees, RDE currently achieves sales of around 373 million euros. Its procurement area's 52 employees handle a purchasing volume of about 155 million euros (RDE, 2011). More detailed information about RDE is given in chapter 4.

4 The Case Study Company

The company in which the study is performed is described in this chapter. The aim is to develop a concept for measuring procurement performance using an FTR approach. Afterwards, the current situation is reflected briefly.

4.1 Current Overall Situation

The company's history and development of the market are presented at the beginning of this section. The internal processes are subsequently introduced and the resulting impacts discussed.

4.1.1 The Company

The “Rheinische Metallwaren- und Maschinenfabrik Aktiengesellschaft” was founded by Heinrich Ehrhardt in Düsseldorf on 13 April 1889. The basis for this was a single government contract with the German War Department to produce rifle ammunition. This was the birth of the Rheinmetall Group, which is currently divided into various business sectors.

The Rheinmetall Defence Division, a leading provider of defense technologies, employs 9200 people. The company's core competencies include armored vehicles of all weight classes and canon-based air defense systems. Weapons, ammunition, and electronics associated with defense technology represent additional division competencies (RDE, 2010).

Rheinmetall Defence Electronics GmbH (RDE) is a division of the Rheinmetall Defence Group. It originated in 1887 when the German Edison Company founded by Emil Rathenau changed its name to AEG. Since then, a wide variety of reputable German industrial companies such as Vereinigte Flugtechnische Werke (VFW), Krupp, ATLAS, and Messerschmitt-Bölkow-Blohm (MBB) have controlled the company's fortunes.

The RDE currently employs about 1298 employees and serves customers in more than 30 countries around the world (RDE, 2011). That the customer base finances its projects via budget or public budgets can be inferred from a consideration of the sales market.

O. Münch, *First-Time-Right Procurement,* DOI 10.1007/978-3-658-08620-6_4,

RDE's site in Bremen is one of the defense and security industry's leading European suppliers. RDE provides a comprehensive product portfolio for the armed forces and for the area of internal security. This include reconnaissance, fire control and guidance systems, as well as sophisticated simulators for training military and civilian customers.

RDE is a project-oriented company. It implements a comprehensive product portfolio of complex products and system solutions in close collaboration with customers (RDE, 2010). Products for the defense and security industry are very different from commercial products. The differences are mainly stricter requirements for environmental conditions and quality as well as an increased focus on functionality, durability, and a high degree of customizability.

Project scopes depend heavily on the customer requirements. Lot sizes are normally small; quantities of more than 100 are very rare. Quantity demanded often ranges up to 10 units. The number of parts interchangeable among different projects is currently very low. There is therefore no mass production in the conventional sense at RDE.

RDE must procure a substantial proportion of its goods and services externally due to its minimal vertical integration. For example, suppliers develop and produce individual components, which RDE then integrates into an overall system. This leads to RDE's heavy dependence on its suppliers.

4.1.2 The Sales Market And Its History

The market for the mentioned product portfolio is a very political market. The customers are without exception governments that occur in the form of procurement departments or authorities. The purchasing power of customers is determined by the public budgets of the government, the defense budget or the budget for new military equipment.

Analysis of the Stockholm International Peace Research Institute's (SIPRI) database shows a sharp decline in the armament market's expenditure trend around 1990. The cold war ended on this date (Mantin & Tishler, 2004: 397–399).

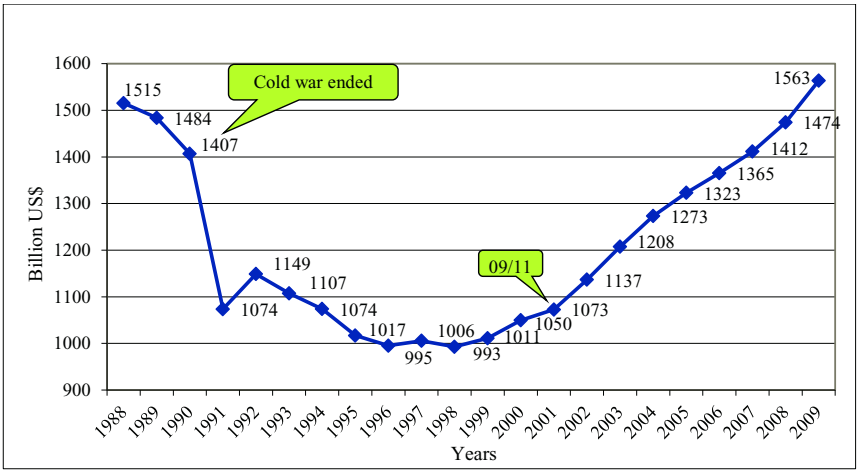

Figure 39: Development of the world military expenditure 1988–2009

Source: Author's illustration; SIPRI, 2011

As for Western Europe and the United States, the “constant threat” in the guise of the Soviet Union vanished. Thus the need for great military strength no longer existed. By the end of the ’90s, budgets had decreased in

- United States by up to 25%,
- France by up to 15%,
- Germany up to 20%, and
- United Kingdom for up to 25%.

The reductions most affected new acquisitions budgets (Thornton, 2007: 297–299). For German defense companies, this meant that defense spending was no longer “a given”.

Customers were primarily European during the cold war. The Federal Office of Defense Technology and procurement accounted for a 70% share of the sales of the company under consideration. Due to the customers' buy-local policy, companies were allowed into projects according to their core competence.

Companies were being paid in full for the development and manufacturing expenses through cost reimbursement prices. The company also received a certain percentage of their total costs incurred as business profits. From the economic point of view, this resulted in inefficient work. The more expensive the development or production was, the more revenue was generated. Overall risk was reduced to a minimum, and resource utilization was secured over years for the companies concerned.

Public opinion about defense spending had changed following the cold war. Elevated spending could no longer be justified to the population. Customers had to reduce costs in the defense sector. The increased focus on costs established known commercial-market mechanisms and intensified competition in the defense industry.

Quantity per order decreased while the sales market was globalized during the same period. Customers expected functional products and were unwilling to pay development costs. Life cycle costs (LCC) became increasingly important. Increasingly, manufacturers had to ensure that their product not exceed a predetermined cost level. In contrast to before, companies therefore needed to work economically.

The customer's requirements changed, because the customer's perspective changed. He no longer wanted to buy products, but skills. They analyzed the mission requirements and derived the required skills to satisfy them. If the customer finds that he lacks a necessary skill, it is the companies' responsibility to bridge the gap with a technical solution. The order is then assigned to the company that can provide the most cost-effective solutions.

Because mission requirements change ever more quickly, products must become ever more quickly available. Time has become much more critical. Companies are forced to reduce their TTM if they want to survive.

This growing trend since 2000 (see figure 39) can be attributed to conflicts in the Middle East and Kosovo. Similarly, the events occurred on 11 September 2001 and its consequences as the war in Iraq and Afghanistan are playing a major role in this development. In 2010 there were worldwide 32 wars and armed conflicts (Schreiber,

2010: 2) and the level of global spending is again at the 1990 level. It is currently US$1563 billion (SIPRI, 2011). Figure 40 shows the distribution.

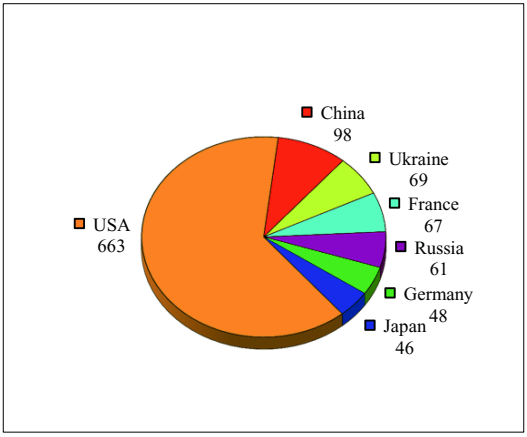

Figure 40: Military expenditure in billion US$ in 2009
Source: Author's illustration; SIPRI, 2011

It can be said in summary that based on intensive market restructuring during the last two decades, defense industry requirements have increasingly approached those of commercial industries.

Increased cost pressures and globalization are two very special drivers found in all industries. For a company to remain competitive, it has to act cost-effectively and internationalize its business. The importance of customer orientation has increased dramatically and the company has to fight in intense competition for a limited number of customers.

4.1.3 Processes And Procedures In The Company

Cost management (CM), value engineering (VE), and SCM are incorporated into procurement management's support process. They are used mainly in the two main processes of value creation: the sales and order processing. The schematic process

diagram shows that the customer's requirements come to the procurement department only indirectly.

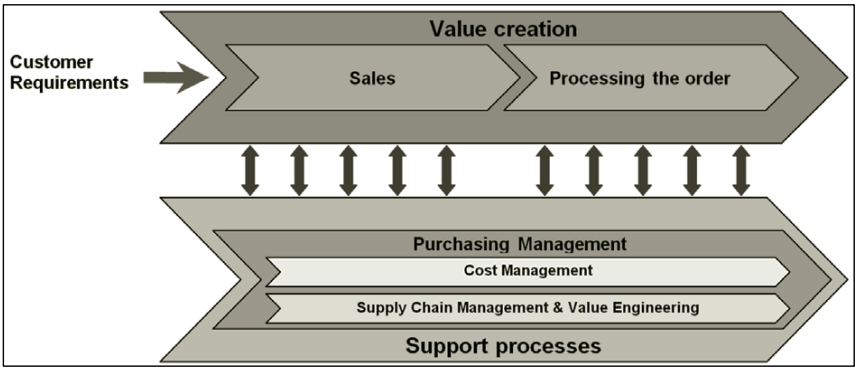

Figure 41: Process mapping of the value creation
Source: Author's illustration; RDE, 2011

The end users' requirements pass through several teams until they reach the suppliers for bid submission. The suppliers must satisfy those requirements and ultimately make a bid.

If unclearness arises during the process, the upstream team has to be worked with until all the necessary information is available to enable intra-team work. This applies to the requirements as well as to the solution concept and price.

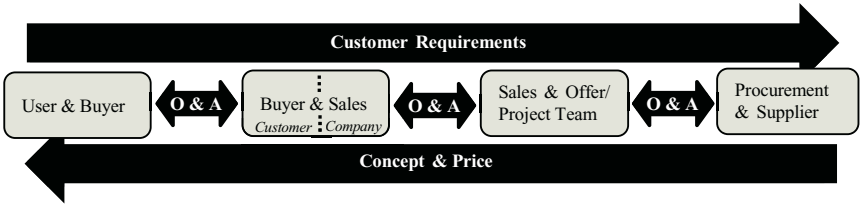

Figure 42: Teams in value creation
Source: Author's illustration

To create the bid for its own customers, pricing third-party services is done in various ways. Thus, so-called “expert estimates” are implemented in partly in development or prices are derived from completed and ongoing projects. The latter method involves

collection so-called ROM bids from suppliers. The acronym ROM stands for “rough order of magnitude”.

In the project phase, pricing is done by soliciting of bids from various suppliers. These bids are then evaluated commercially and technically. Afterwards they are discussed and renegotiated with the suppliers.

Target costing (TC) or benchmarking is not conducted during value creation. Purchasing savings are even permanently incorporated into project's cost estimate in some cases if the customer places the order. Savings calculations are carried out in different ways:

- Difference between the value in the order and the value of the project cost estimate.
- Consideration of designated discounts.
- Difference between the supplier's first and last bid after renegotiation.
- Difference between highest and lowest bid.

According to the process, possible VE and SCM measures to be implemented in the project phase can already be identified during the bidding phase. Only when the order is placed will these measures be planned in detail, with milestones provided and implemented, during the course of the project phase.

PCE is anchored in VE. The former thus is introduced indirectly into value creation through the “purchasing management” support process. The responsible business teams or project teams will decide whether or not it is used.

4.1.4 Findings And Discussion

This subsection is intended to reflect the current overall situation in the company as well as the representation of the current facts on the topic “performance measurement through purchasing savings”.

4.1.4.1 The Current Situation's Weaknesses And Consequences

As figure 42 shows that teams are acting within a kind of island or stand-alone solution. The customer's requirements pass through various interfaces before arrive at the supplier. The risk of distortion or information loss increases as the number of interfaces increases. The result is a slow and sluggish process, which adversely affects processing time and decision-making speed. The process's inertia direct impacts TTM and opportunity costs.

On the other hand, the process also offers many opportunities to reinterpret requirements.

As described in subsection 4.1.3, no benchmarking or TC is performed within the company. PCE is not applied consistently. Comparing PCE results with robust supplier bids results in an average accuracy of ±5%. Here, PCE was applied in companies in various stages of product life cycle. Despite these results, it is currently only applied to about 25% of the whole company's contract volume.

Thus prices are not systematically identified and traceable in the company, but are often based on individual employee's estimates. If those employees rely on on-going or completed projects, the additional risk exists that errors committed in a calculation are transferred into a new project.

The price-determination procedure can be viewed as critical in terms of accuracy and reliability. There are two risks if this procedure is not completed carefully. One is that costs are set too high and in consequence, the customer's order is not placed. The other is that costs are set too low so that additional costs are incurred after the order is placed.

In both cases, pronounced involve opportunity costs. That procurement is not always involved in bid estimation as procedurally prescribed increases the risks. If procurement is involved, the customers' requirements are passed on to the suppliers, who then submit their ROM bid.

If procurement claims to no longer be just an executing institution, then it must demand and assume its creative role (see section 2.3.2). This can be partly achieved by

formulating the source process in such a way that makes the company better and faster. Procurement must ensure that the foreseen procedural involvement in the CM is accomplished. If the Procurement organizational unit wants to acquire a creative role, it must call for that involvement. It is procurement's duty to exercise its own tasks as well as possible and to act for the company's benefit. This means that process interfaces must be kept vibrant.

To support all six success factors of SCM (see subsection 2.1.5) as best as possible, procurement must have an excellent knowledge about the procurement market and must determine and contractually fix the right product prices. This knowledge and skills must be incorporated into the company at the beginning of the product life cycle. It raises the chance that the customer places his order, and that costs and time will be decrease. This results in consequence to a sustained company success.

An appropriate performance measurement system to ensure sustained success potential and support for a corresponding strategy is required. The performance measurement system must be able to constantly review strategies and processes for improvement opportunities (Richert, 2006: 78), including lead-time reductions.

Richert (2006: 38) further states that the measurement system must provide transparency about competitive advantages. It has to optimize interfaces and must make the area's performance transparent.

It should be noted that success nowadays is not just represented in monetary and quantity units. Success has become a multidimensional concept and includes both performance and performance potential. It is past-, present-, and especially future-oriented (Richert, 2006: 26–28). A measurement system that meets these requirements is not present in the affected company.

4.1.4.2 Current-Performance Measurement

After analyzing the company's current monetary performance measurement, it is possible to draw the conclusion that it must be fundamentally called into question. It is

not in a position to reflect procurement's real performance. This is due to the definition of what is considered to be purchasing savings and how they are calculated.

Taking advantage of discounts regularly offered by the supplier in its catalog that mostly depend on quantity purchased should not represent purchasing savings. However, this is currently the case.

Also, pure comparison of the supplier's first and last offer affords no conclusions concerning procurement's performance. An offer comparison's significance suffers under the changing requirements imposed on the product to be purchased coming from the project. If a highly complex component was considered in the original calculation, a very simple one may replace it during the course of the project. However, the resulting cost difference does not reflect any performance attributable to procurement.

It remains to be mentioned, that the reverse case could also occur. If ultimately a more complex and expensive product must be procured, it cannot be concluded that procurement showed a poorer performance.

Procurement performance within individual projects in the company is particularly difficult. Since the subsequent, real purchasing structure is unknown during the bid preparation and at the beginning of the project, structure in the calculation is mostly restricted to the component or subsystem level. Subsequently made make-or-buy (MoB) decisions are not taken into account.

For example, it can turn out that four individual parts must be obtained for a required component during the course of a project. Even if procurement successfully purchases three of the four individual parts, the fourth component can eliminate this purchasing performance if changing requirements cause its costs increase. As in the project calculation, which is the basis for the measurement of purchasing savings within the project, only the component or subsystem occurs. The current total of four items is compared with the originally considered amount. Now the project calculation shows no or, even negative, purchasing savings.

Project lead times of several years reinforce this effect even more. The procurement market situation, for instance, wages and salaries as well as inflation, varies during the

project period. These factors can negatively impact the ability to represent procurement performance.

Although regular cost-to-complete reviews are conducted, the original calculation remains the basis for measurement procurement's performance within the project. The purchase of individual parts, despite planned sub-system purchasing, is an example of a subsequent MoB decision.

This modified purchasing concept will then generate purchasing savings if TCO is not considered. If costs for a subsystem are compared with the total of the individual parts' purchase prices, the purchase of single items seems to have a monetary advantage for the project. However, this overlooks the fact that the subsystem is fully functional, whereas the purchased individual items must be retrospectively integrated, tested, and packaged to attain the same level as the purchased subsystem.

Although the project has prima facie reduced material costs, from the company's perspective, or under TCO, other expenses such as those for integration, testing, warranty, and obsolescence management are incurred. For procurement, this means that any decision affecting costs or requirements coming from the project distorts true Purchasing performance. This problem is therefore based on the fact that the project calculation does not reflect the purchasing level.

Customer specifications regarding the cooperation partner, the ever-increasing proportion of “commercial of the shelf” (COTS) components, and the increasing number of framework contracts greatly influences purchasing volume that can be influenced by procurement within a project. So that procurement is in a position to present its own performance, it can enter the purchasing savings manually into the IT system (SAP).

Because purchasing savings must be stored in the system for each order, data input consumes up to 15% of a buyer's time. The explanatory power of the summable purchasing savings in the system is nonetheless doubtful, because while the value can be entered though the buyers, it is not done consistently.

Therefore various monetary indicators intend to give an indication of procurement's performance in the company. One of the key figures is based on the project calculation the other those entered into SAP. Within the company, these indicators come into conflict at latest when the project cannot meet its monetary targets. Then procurement has to justify and present its own performance in the project or to the executive board based on a detailed cost history.

It was found that in general purchasing savings are not reviewed although they are set at 7% annually within the company. Whether they have actually been achieved and how the 7% was realized, is not shown transparently.

4.2 Conclusion

It is possible to state that procurement's real performance cannot be represented based on the current situation in the company. The way performance is currently measured, causes different behavior among the individuals involved. This fact confirms Becker's statement (2008: 185) that indicators triggers certain behavior in those affected. But the bigger problem is that the triggered behavior might not be that, what was ecpected. If the behavior of a system/human is the opposite, or if the real effect what was caused makes the situation equal or even more badly, it can be considered as the so-called “Cobra Effect” (Siebert, 2001).

The right indicator and measurement method must be chosen very carefully to get the desired effect. Becker further points out that supply chain champions have found that to describe the overall performance, non-monetary dimensions such as time, quality, and flexibility are also required. With non-monetary KPIs, it is possible to measure performance and processes directly and reflect efficiency and effectiveness (2008: 182). This is not given in the current situation in the company.

The consideration of supply chain cycle time (SCCT) is currently also neglected in the company. SCCT describes the time that elapses between the start of a process and the existence of the process results (Thaler, 2007: 75). Against the backdrop of time saving

represents a very important factor due to the speed competition in the current economic life (Krause & Arora, 2010: 225), this deficit must be minimized.

Since SCCT is the sum of lead time, production time, internal storage, packaging, and delivery time (Krause & Arora, 2010: 224), procurement is also responsible for this measure's expression, because it impacts lead time. Procurement's task is to optimize SCCT using lead-time without impairing cost and quality.

Since a unique process landscape including VE and CM exists, it is currently assumed a basis allowing performance measurement within the meaning of PQ also exists in the company. In consequence, it should be possible to transfer the FTR approach, TQM, and the Six Sigma concept into the affected Procurement organization (see subsection 2.7.3).

5 First-Time-Right Procurement

This chapter describes the development of First-Time-Right procurement (FTRP) and its impact on the Procurement organizational unit and the company. Furthermore, possible answers to the RQs from subsection 3.2.3 should be found within this chapter and conclusions (see sub-subsection 3.2.4.2) are evaluated for the first time.

5.1 The Development Of First-Time-Right Procurement

This section describes how the FTR aspect can be implemented into procurement and which steps should be taken into account.

5.1.1 Implementing First-Time-Right In The Source Processes

As previously described in sub-subsection 2.6.3.3, FTR focuses on preventing errors in products and processes (Crosby, 1978; Mukherjee, 2006). This should ultimately prevent costs and reduce time. Thus FTR contributes to the reduction of opportunity cost and TTM. The definition of PQ was developed in subsection 2.7.3 based on the fact that procurement needs to realize the 6 Rs coming from the customer with its processes.

Procurement quality means that the procurement organization is able to provide the company within the shortest processing time with the right products, at the right quantity, at the right place, at the right time, the right quality and at the right price.

As FTR is understood, whether source-process output corresponds to the internal customers' input must therefore be tested. If it is not, then there are basically two possibilities: either an error occurred in the purchasing processes (source-process), or the customers' input was flawed or unrealistic.

A source-process error, for example, can mean that although they were subjected to a realistic standard, the quality requirements or the delivery date cannot be met. An incorrect input from the customer can arise when, for example, a wrong approach was chosen to determine target price, or planned delivery time. In the two briefly described cases in which a deviation between input and expected output exists, procurement and

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customers must perform a root cause analysis to initiate corrective actions, so that the correct output can be achieved.

Ultimately, this approach describes a kind of closed loop control that is widely known in technology and the field of engineering (see Bush, 1929; Sontag, 1998; Wiberg, 1971; Föllinger, Dörrscheidt & Klittich, 1994; Reuter & Zacher, 2008; Unbehauen, 2008; Aström & Murray, 2009). Transferring the closed loop control function into the definition of PQ (see subsection 2.7.3), it can be stated that the input (I) is the internal customer's 6 Rs and the output (O) is the source processes' result.

The disturbance variable (D) arises from the cause of error, which might occur in the determination of the 6 Rs or in the non-optimal management of procurement. The output is measured at measuring point (M) and forwarded to the controller (C). The controller represents the corrective actions that are agreed upon and initiated in the team (internal customer and procurement).

The aim must be to achieve the ratio D = 0. In the above context, D = 0 implies O = I; procurement has fulfilled the 6 Rs.

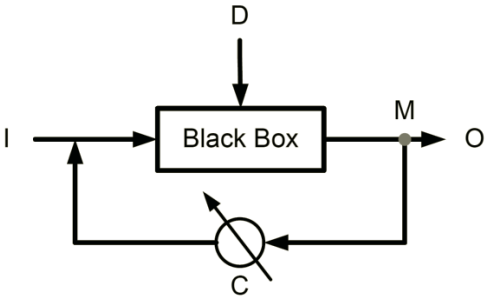

Figure 43: Closed loop control

Source: Author's illustration based on Bush, 1929; Sontag, 1998; Wiberg, 1971; Föllinger, Dörrscheidt & Klittich, 1994; Reuter & Zacher, 2008; Unbehauen, 2008; Aström & Murray, 2009

The conclusion is that such closed loop control could also be implemented in the SIPOC approach from Six Sigma. Since the source process is also subject to SIPOC

considerations, this combination affords the opportunity to consider whether the source processes have achieved FTR.

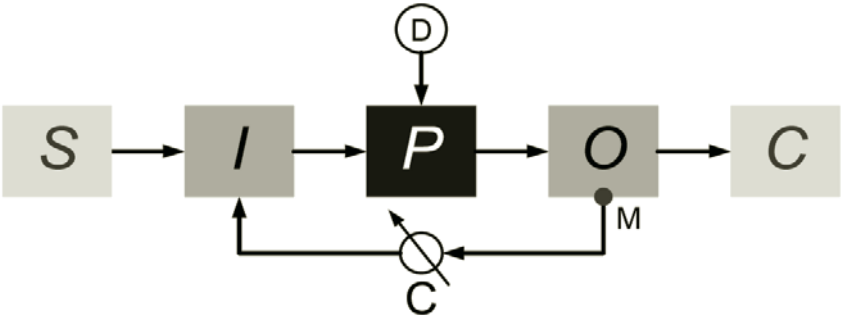

Figure 44: SIPOC-approach with implemented closed loop control
Source: Author's illustration

It is therefore possible to perform a qualitative evaluation using this approach. If procurement has achieved the desired output (O = 6 Rs) after the source processes' initial impetus, then the disturbance variable will be zero (D = 0). This measurement gives an indication of the source processes' effectiveness.

Effectiveness, and thus O = 6 R with FTR, means that procurement has in principle correctly designed the source processes' strategic direction. However, a final statement about the efficiency of the source-processes cannot be made. Efficiency has an operational focus; it aims for an optimal cost-benefit ratio.

However, it can therefore be stated that FTR within procurement can be demonstrated via closed loop measurement in the SIPOC approach. It remains to mention that this approach alone is no indication of procurement's real performance. To achieve this, a measurable variable must be identified and implemented in the measuring system.

5.1.2 Time As The Measurable Variable In FTRP

Time is consistently emphasized as a very important success factor (see Busch, 1981; Lamprecht, 2000; Thonemann et al., 2004; Christopher, 2005; Fawcett et al., 2007;

Brunner & Wagner, 2008; Fung et al., 2008; Lai & Cheng, 2009; Krause & Arora, 2010). Various forms of it find their place in KPI systems (see Abel, 2001; PwC, 2002; Melzer-Ridinger, 2004; Piontek, 2004; Roenpage & et al., 2007).

The focus on the SC lead time and decreasing TTM cycle times plays a significant role. As discussed in the subsections 2.1.5 and 3.2.2, time is one of the identified CSF's (Weber et al., 2000; Thonemann et al., 2004; Wannenwetsch, 2005; Fawcett et al., 2007; Sennheiser & Schnetzler, 2008; Werner, 2010) that, together TTM cycles and the opportunity cost, affect process times (Meyer, 1993; Wangenheim & Dörnemann, 1998; Wiesinger & Housein, 2002).

It is undisputed that a process that runs fast and without errors is more effective and efficient than a slow or defective process. Thus, in addition to the FTR approach, which makes a qualitative statement, the objective is to evaluate source-process efficiency the measurable variable time. Lead times (LT) should be measured to evaluate the cost-benefit ratio.

In the context of FTRP, process lead time (P_{LT}) makes a statement about how much time lies between source-process triggering (t_I) and the existence of the desired result (O = I).

$$P_{LT} = t_O - t_I$$

Formula 3: Calculation of lead time in FTRP
Source: Author's illustration

P_{LT} determination within FTRP therefore begins when the internal customers provides the 6 Rs to the Procurement organization. This submission gives procurement its objectives, which it must achieved the first time through its own processes. As soon as the customer's specifications have been achieved (O = I), D = 0 and the final time measurement (t_O) occurs. The graphic in figure 45 can be drawn if this understanding is added to the SIPOC approach with closed loop control implemented.

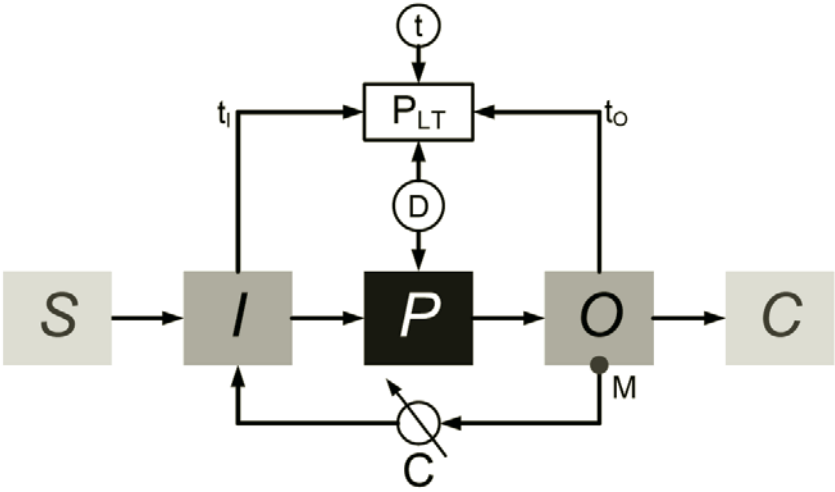

Figure 45: Time focused performance measurement in FTRP
Source: Author's illustration

It is assumed that the above principle can be applied to all processes within a company although the focus is currently on the source process.

5.1.3 Replacing Purchasing Savings With FTRP

As described in subsection 2.1.4, SCM pursues two main objectives: the "maximization of the satisfaction of all SC members" and "the creation of a win-win situation" (Poirier & Quinn, 2003: 41–43). Both should be achieved by increasing the effectiveness and efficiency within the SC (Bowersox et al., 1999; Poluha, 2007; Batten, 2008). If the company pursues sustainable SCM, it must be assumed that a monetary measurement of purchasing savings cannot be performed or is not useful, because a "black zero" will result (see subsection 2.7.3).

Based on the foregoing analyses and statements, at the current state of this study the assumption is that monetary measurement of purchasing savings can be replaced with the help of FTRP. No monetary purchasing savings can be achieved based on target

price if the 6 Rs are used as a realistic input. Thus, a performance measurement predicated on purchasing savings is not possible.

But even in this situation, FTRP can make a statement about procurement's performance through the former's time-focused approach. In addition, FTRP supports SCM's overall objectives. It makes a statement about the source processes' efficiency and effectiveness.

By shortening lead time, FTRP not only contributes to the reduction of the SC's lead time, it further positively impacts opportunity costs and TTM, and thus sustainable company success.

5.2 Putting FTRP Into Practice — The Pre-Implementation Phase

This section describes FTRP's impact on the company and the Procurement organizational unit. It is assumes that condition exist that must be fulfilled so that FTRP can be successfully implemented. It must be emphasized that possibly neccessay changes depending heavily on the actual situation in the company. The points highlighted in this dissertation are predicated on the situation of the company described in section 4.1, in which the case study was conducted.

FTRP is a new approach to performance measurement intended to supersede, at least in part, the old way of measuring procurement performance. Therefore, FTRP's introduction should be considered a project requiring comprehensive change management (see Doppler & Lauterberg, 2008; Paton & McCalman, 2008; Anderson & Ackerman-Anderson, 2010).

Particular emphasis is placed on management support (commitment) as well as on information, communication, and employee involvement. The suppliers are another area that FTRP influences. As the link between the company and the supplier, procurement must involve the supplier in the change.

Since the future approach is far removed from the previous “price negotiation” behavior, informing the supplier about FTRP's objectives is insufficient. The supplier should also be made aware of the advantages, e.g., time savings during negotiations and strengthening of mutual trust between the parties.

The supplier-customer relationship among the various organizational units within the company also needs clear specification. This ultimately governs who has to provide input to whom, which can be controlled via an unambiguous process chain.

Responsibilities can be directly derived from or allocated by such a chain. The illustration in figure 46 results if the SIPOC approach is integrated into such a process chain.

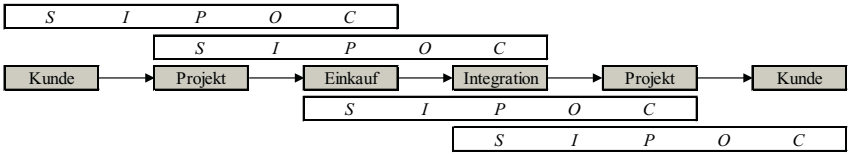

Figure 46: Exemplary representation of a process chain with SIPOC-approach
Source: Author's illustration

The supplier-customer relationship and interfaces in question are clearly defined as a result. The parallels between input and output are also clearly represented.

The question is whether FTRP should be applied from the beginning of each request for quotation. This then includes not only parts and assemblies (called products) that were developed within the company, but also commercial of the shelf (COTS). This problem must be solved within procurement.

Although FTRP's objectives and benefits are clear, it was nonetheless decided in the first step to apply FTRP only to products developed or specified in-house. These are designated as components in the IT system and abbreviated BAUT.

COTS, which are listed in the IT system as raw materials and supplies, were therefore excluded from the first FTRP step. Thus in the first step, FTRP is only used for products in the categories “development and manufacturing according to specification” (design and build) and “according to manufacturing documentation” (build to print).

Especially for these products, the objective must be not only to know the product price, but also to reconcile it with the supplier. Price-influencing factors such as monopoly and

strong market demand should then not be taken into account based on the framework situation.

Defining maximum process lead time (P_{LTmax}) within FTRP is another prerequisite. It is not possible to specify only one P_{Ltmax} in the case study. The range of parts procurement must purchase extends from COTS to simple through complex parts or assemblies from the fields of electronics, optics, or mechanics.

Separate P_{LTmax}'s must be determined as a function product complexity. One possibility is categorization as simple, medium, or complex. A different time horizon within which source processes must be performed exists depending on the category to which the part being purchased belongs.

It should be emphasized, however, that initial time horizons should be regularly reviewed to determine whether or not they are up-to-date and to correct them if necessary. This review should be considered a continuous improvement process (CIP).

Such CIP actions are based on the PDCA principle. Their objective is to keep each category's maximum P_{LT} within a realistic, optimal range. It should be noted that time horizons are market-dependent even with the same categorization. Thus their magnitude may differ depending on the company.

Taking the complexity of the products to be purchased into account, the case study's company defines P_{LTmax} in the first approach as follows:

P_{LTmax} = 2 working days for simple parts or assemblies

P_{LTmax} = 4 working days for medium-complexity parts or assemblies

P_{LTmax} = 7 working days for complex parts or assemblies

Availability of the right supplier portfolio is prerequisite for achieving these P_{LTmax}. Furthermore, the relationship with suppliers must be based on a partnership foundation.

Since FTRP is a new approach to performance measurement, has not been possible to systematically record times t_I and t_O in procurement until now. However, this is

necessary for calculating P_{LTmax} and compared it with the default values. Hence the task was begun with simple data entry into Microsoft Excel.

This approach was chosen to avoid costly programmed solutions before FTRP's benefit has been shown in practice. If traditional purchasing savings are eliminated, the project can't use them compensate for additional costs incurred by other project products (see sub-subsection 4.1.4.2). The result is a need for accurate product price estimation both during the project phase and while preparing bids.

Thus continuous product prices/cost adjustment is necessary for each item each time cost-to-complete analysis is conducted. However, whether a given change is based on changing requirements or incorrect cost estimation must be noted from the FTRP perspective.

The choice of cost determination method is critical. Collectively defining how “the right product price” should be determined was particularly difficult. The bid and project teams want to maintain the already well-established product pricing methods. Accordingly, product prices are still determined by expert estimates, or are derived from completed or on-going projects.

This contrasts with the PCE method available in VE. It offers the opportunity to determine costs via a neutral benchmark or to perform TC. Agreement was finally reached to use PCE as a supporting method: PCE will be used to determine cost for products without experience values, or if a second, independent opinion is needed.

It is basically possible to state that implementing the FTRP approach within the company entails a number of changes and impacts up front. Some of them are only minimal, but they also can be extensive and far-reaching. The topics that had to be organized prior to FTRP's initial implementation are listed briefly below:

1. Internal and external communication about the changes (change management)
2. Definition of responsibilities in a process chain
3. Product portfolio definition for FTRP

4. Categorization of the product portfolio by complexity
5. Definition of PLTmax time horizons for each product-complexity category
6. Enabling PLTmax calculation and presentation
7. Defining the cost calculation method

The following steps must be added after FTRP has been implemented in the company:

8. Continuous FTRP use and PLtmax measurement
9. Regular time horizon monitoring in terms of a CIP measure
10. Adjusting the PLtmax if necessary

5.3 Summary About First-Time-Right Procurement

Various activities and investigations performed in the company during both the preparation phase and FTR implementation in the source processes. Several conclusions could be derived in this phase based on these studies and investigations and on the company's status quo. These conclusions will be briefly presented below in terms of opportunities and risks.

It is assumed that clear links within the process chain will improve individual teams' cooperation in creating value (figure 42). It is further assumed that FTRP in particular will accelerate the information flow. Faster response is expected when P_{LTmax}'s are exceeded, especially with regard to cost determination.

While the monetary-purchasing-savings approach still allows negotiations with supplier, the FTRP approach encourages teams to question product costs already determined. Such being the case, it is not enough for procurement to merely report that it could not find a supplier willing to deliver the required product under the stipulated conditions. The expectation is that the reason for this circumstance will also be communicated.

Assuming the right supplier portfolio and partnership SRM, the supplier is also expected to provide procurement with the reasons why its bid diverges from the stipulated costs. The supplier's information must then be immediately forwarded to the upstream team so

that they can analyze it. On the one hand, it might be necessary to revise the cost estimation for the project; on the other, manufacturing-related reasons might impact other products used in the project.

The use of inadequate request documents might also explain a deviation. Quick feedback promotes higher quality specifications and request documents in a short time. This in turn increases the reliability of supplier quotations and estimated product costs.

The reasons for the above conclusions are seen in consistent implementation of the SIPOC approach, which is combined with closed loop control for FTRP. This closed loop control is on the external interface, and thus, from a procurement viewpoint, at the end of the process chain. The disturbance variable being >0 means that an error has occurred in one of the upstream processes. It is therefore particularly important to analyse what caused the deviations from the 6 Rs (the error).

Reasons can be an incorrect supplier portfolio, problems in the supplier relationship, long negotiations, mistrust, incorrect documents, misinterpreted production efforts, and the like. If the analysis executed, the control loop at the end of the process chain can ultimately detect errors within the process chain, eliminate them, and avoided them in the future.

It is important to understand this as a CIP measure across various interfaces. Its goal is to eliminate errors and speed up processes. FTRP offers the opportunity to assess the efficiency and effectiveness of PQ and of all the processes involved in determining the 6 Rs. The expected accelerated interface communications ultimately free resources. These can be employed to handle additional customer inquiries.

Thus, the company's opportunity to win more bids and ultimately generate more sales grows with the same resources. It is also assumed that introducing FTRP can reduce the aforementioned time, which is related to purchasing savings' data entry (see sub-subsection 4.1.4.2). Procurement employees can use the freed-up capacity to complete other important tasks, or to process more projects with the same resources.

Imprudent implementation or use of FTRP exhibits risks. The importance for implementation of steps 1 to 7 listed at the end of section 5.2 should be made clear once again. If they are not taken into account, there is the risk, e.g., of using FTRP with wrong characteristics for unsuitable products.

The time-consuming TC method, which ultimately provides the input for COTS products, can be given as an example of such an unsuitable use. An improper combination binding resources in an unpropitious relationship was chosen in this case. It is very important to achieve a practical, meaningful combination of factors, methods, and product.

6 Measuring First-Time-Right Procurement

This chapter focuses on developing an FTRP-based measuring system. The first step is to briefly elaborate the theoretical basis underlying performance measurement. Requirements that indicators must satisfy for First-Time-Right procurement measurement (FTRPM) are subsequently defined. Finally, indicators should be developed enabling the FTRP approach to replace monetary purchasing savings in accordance with SCM objectives. The chapter concludes by summarizing and reflecting upon the insights attained.

6.1 Theoretical Background Of Performance Measurement

Spitzer (2007: 2–3) believes that many people have technical aspects (collecting data, calculating, analysis, statistics, etc.) in mind when talking about measuring systems. However, performance measurement is much more than tables of numbers. Such measurement can make use of the numbers, but it's not about the numbers themselves. Rather, it is about perception, understanding, and insight.

Performance measurement done well and properly can have an enormously positive and transforming impact on the organization. One of the main reasons that performance measurement is so rarely able to develop its positive potential is that it is almost never properly socialized. This is because it is not structured so that it can be integrated into the organization's social structure in a positive way. The creation of a positive environment for performance measurement is the missing link between fundamental research, expertly performed measurement, and measurement's truly transformative nature (Spitzer, 2007: 2–3).

Van Weele (2005: 254) emphasizes that there are some significant problems in Procument's performance measurement. He states, for example, that neither efficiency nor effectiveness in procurement are clearly defined. Furthermore procurement performance results from many different activities. Van Weele assumes that no direct input-output relationship can be identified and that procurement may be designed differently depending on the company.

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Despite these issues, the notion exists in the literature that activities (processes) can only be effectively controlled and improved if they are measured (Deming, 1986; Van Weele, 2005; Lysons & Farrington, 2006; Roylance, 2006; Parmenter, 2007; Spitzer, 2007).

A measuring system's objective must therefore be to satisfy the following requirements:

- Make a statement about procurement's efficiency and effectiveness possible.
- Assess procurement's performance as a totality of all activities.
- Create a direct relationship from input to output.
- Be applicability regardless of Procurement's organizational design.

In addition, the distinction between key result indicator (KRI) and key performance indicators (KPI) must be made. Parmenter (2010: 2) states that customer satisfaction and net profitability are examples of KRIs. They result from a variety of activities and provide information about whether in principle the correct direction was chosen, i.e., the right things are being done (effectiveness). KRIs do not make a statement about what needs to be done to improve the outcome and they have long measurement cycles (month, quarter, and year). Spitzer (2007: 71–72) also argues that the most important question is: "Is that what I am doing the right thing?" (effectiveness). This question must be answered even before questioning efficiency, because what good does it do a company to perform an activity very efficiently when it is fundamentally the wrong activity? Performance measurement's task is to focus on what brings added value to the company.

Parmenter (2010: 6) has been able to define seven characteristics for KPIs based on interviews with over 3000 participants:

1. There are no financial measurement variables.
2. Regular measurement in short measurement cycles (daily, weekly, etc.).
3. They are observed by a leadership team.
4. They provide information about which actions are required from the employees.
5. They are key figures linking responsibility to a team.

6. They have a significant impact on, e.g., at least one CSF.
7. They encourage appropriate actions.

Parmenter (2010: 7) believes that when a currency symbol is added to the measured variable, the performance measurement changes into a result measurement. KPIs must have short measurement cycles and should be present or future oriented. Indicators relating to the past cannot be KPIs.

These submissions conform to Spitzer's (2007: 71–76), who summarized by saying "Effectiveness first . . .". As a result, the company focuses on creating value and avoiding its destruction. The organization must focus on the indicators that matter most and draw everyone's attention to them to develop and enhance itself, and not just to survive.

6.2 Performance-Measurement Requirements

Building on the previous section, has to be considered for an FTRP performance measurement now needs to be worked out. The requirements imposed on a performance measurement by Van Weele (2005), Lysons und Farrington (2006), Roylance (2006), Spitzer (2007) and Parmenter (2010) should be considered. As discussed in sub-subsection 3.2.4.2, the objective should be to replace purchasing savings with the FTRP approach as a performance measurement and to evaluate procurement by measuring its effectiveness and efficiency.

To Werner (2010: 25), effectiveness means that the right things are being done. Effectiveness has a strategic focus; it permits conclusions about activities' efficacy. Efficiency makes a statement about whether things are being done properly. It has an operational focus aiming to achieve a favorable cost-benefit ratio.

Taking the above statements as a basis means that two indicators are required. The first captures the strategic aspects (effectiveness) and the second, the operational aspect (efficiency). The requirements for the two indicators for FTRP measurement (FTRPM)

are derived from Van Weele (2005), Lysons and Farrington (2006), Roylance (2006), Spitzer (2007), and Parmenter (2010).

Due to its long-term orientation the strategic indicator has a monetary variable; the operational indicator doesn't. The time horizons/measuring cycles (short- and long-term) in which the key figures are formulated are another crucial aspect. In conclusion,

table 8 shows what requirements affecting the two indicators look like.

Table 8: Requirements to the indicators in FTRPM

What is assessed	Focus	Measuring cycle	Variable	Indicator type
Effectiveness	Strategic	Long term, e.g., yearly	Monetary or not monetary	KRI
Efficiency	Operative	Short term, e.g., daily or per event	Not monetary	KPI

Source: Author's illustration based on Spitzer, 2007; Parmenter, 2010

As described by Parmenter (2010), these requirements also distinguish between KRI and KPI.

6.3 The FTRP Measurement Method

As described in subsection 3.2.5, the FTRPM system should pursue a holistic approach and provide the following objectives to the company:

- Positive contribution to the company's success
- Reduction of opportunity cost
- Reduction of time to market cycle
- Acceleration of information flow
- Reduction of contract negotiation time

- Transparency and measurability of soft-skills/facts in procurement and in SRM
- Optimization of the supplier structure

The source processes' effectiveness and efficiency should be evaluated to achieve this. It is therefore necessary to measure current states, which past activities caused or influenced. Actual state measurement results are subsequently compared with another value. To achieve this, indicators are defined below that enable measurement of effectiveness and efficiency of source processes in a FTRP approach.

6.3.1 Indicator For Measuring Procurement's Efficiency

In sub-subsection 2.6.3.3, it was shown that FTR pursues the prevention off errors in products and processes. The objective is to avoid costs and reduce times (Crosby, 1978; Mukherjee, 2006). FTR therefore contributes to reducing opportunity cost and TTM, which ultimately impacts the company's results positively.

Successful FTR implementation in procurement (see subsection 5.1.1) makes possible a statement about source processes' efficiency. Time is used as the measurement variable for this purpose, as described in subsection 5.1.2.

P_{LT} makes a statement about the amount of time between source-process triggering (t_I) and appearance of the desired outcome (O = I). This measurement, respectively the provision of inputs and outputs, is based on the definition of PQ:

Procurement quality means that the procurement organization is able to provide the company within the shortest processing time with the right products, at the right quantity, at the right place, at the right time, the right quality and at the right price.

Three different time frames have been defined for P_{LTmax} in the first approach by considering the purchased products' complexity (see section 5.2):

P_{LTmax} = 2 working days for simple parts or assemblies

P_{LTmax} = 4 working days for medium-complexity parts or assemblies

P_{LTmax} = 7 working days for complex parts or assemblies

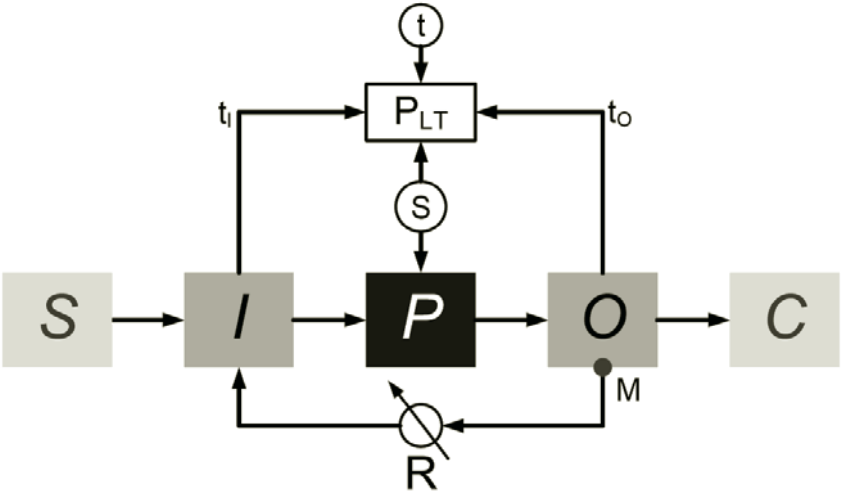

Figure 47: Time-focused performance measurement in FTRP
Source: Author's illustration

The process to be assessed commences when an internal customer approaches procurement with well-defined requirements. If the contract with the supplier is concluded in accordance with customer requirements, the process ends and P_{LT} can subsequently be measured. After measurement, P_{LT} must next be compared with P_{LTmax}. Whether "things were done right" is checked by comparing P_{LT} with the permitted $P_{Ltmax.}$. Whether or not a favorable cost-benefit ratio was achieved can also be derived from this comparison (Werner, 2010: 25).

Finally, it is possible to state that the measurement of P_{LT} has an operational orientation. It is performed for each process and therefore has short measurement cycles. These are, according to Parmenter (2010), the characteristics of a KPI-type indicator.

6.3.2 Indicator For Measuring Procurement's Effectiveness

The indicator for assessing procurement's effectiveness involves verifying whether the right things are being done in procurement. Procurement's fundamental task is ensure the company's supply of necessary goods and services. Procurement has set itself the following tasks and objectives to this end (see also subsection 2.3.1):

- Benchmarking (see sub-subsection 2.5.2.3) and supplier-base reduction (Lysons & Farrington, 2006: 8).
- Exploring, observing, and analyzing the procurement market (Busch, 1981: 27).
- Selecting and evaluating suppliers (Bogaschewsky, 2003: 26).
- SRM (see section 2.2) and make, buy, and outsourcing decisions (Lysons & Farrington, 2006: 8).
- Translating corporate objectives into procurement objectives (Lemme, 2009: 29)
- Transferring market opportunities by providing expertise, know-how, and innovation, while considering quality, quantity, cost, time, date, and delivery (Busch, 1981: 27).
- Building up supplier cooperation and development (Lysons & Farrington, 2006: 8).

Consistent, focused pursuit of these objectives and tasks should enable procurement to reduce purchasing costs and ensure supply security long-term (Gienke & Kaempf, 2007: 204). Confronting these basic conditions with SCM objectives means that cost advantages (Weber et al., 2000: 266) must be achieved while maximizing all SC members' satisfaction and creating a win-win situation (Poirier & Quinn, 2003). It raises the question about how these cost advantages (CA) can be made measurable in the FTRP and SCM context.

Price-stable purchasing volume is one way to obtain information about cost advantages achieved by consistent SCM. For this purpose, purchasing volume that procurement can influence is considered over time. The portion with no price increase is identified in

annual cycles. Comparing this portion with inflation recorded in the measurement year ultimately shows a measurable cost advantage.

For example, a price-stable purchasing volume of EUR 100 million subjected to 2% inflation (inf) in 2011 produces a EUR 2 million CA.

$$CA = PVs * Inf$$

Formula 4: Cost advantage calculation in FTRP
Source: Author's illustration

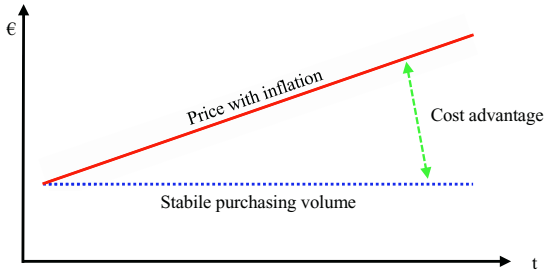

Figure 48: Illustration of the cost advantage in the FTRP and SCM context
Source: Author's illustration

This CA can ultimately be traced back to successful strategically targeted measures in procurement. These measures might cover, for example, framework contracts, VE measures, the right supplier portfolio, or SRM.

The indicator CA describes an annual monetary result. Because of its strategic direction and long-term (annual) measurement cycles, it also exhibits all of the characteristics that Parmenter (2010) attributes to indicator-type KRIs.

6.3.3 Summary Concerning FTRP Measurement

In summary, it can be stated that a measure of procurement's effectiveness and efficiency is possible even in the FTRP context and while consistently pursuing SCM's two main objectives “to maximize the satisfaction of all SC members” and “the creation of a win-win situation” (Poirier & Quinn, 2003). These objectives will ultimately be

achieved by increasing the effectiveness and efficiency within the SC (Bowersox et al., 1999; Poluha, 2007; Batten, 2008).

Procurement is an important SC member. As a supporting function, it plays a major role in the company. Its activities and functions cause procurement to be regarded as an important functional/organizational unit in SCM implementation (Van Weele, 2005: 3–23; Lysons & Farrington, 2006: 3–13).

The indicators developed in section 6.3, PLT and CA, meet the requirements of Van Weele (2005), Lysons and Farrington (2006), Roylance (2006), Spitzer (2007), and Parmenter (2010). They are based on the FTRP approach and have the characteristics described in table 9.

Table 9: Indicator description in the FTRPM system

Indicator name	What is assessed	Focus	Measuring cycle	Variable	Indicator type
CA	effectiveness	strategic	yearly	monetary	KRI
PLT	efficiency	operative	per event	time	KPI

Source: Author's illustration

Since the indicators are based on the developed FTRP approach, they support SCM's main objectives and promote the cooperative partnership described in chapter 5. With assistance of FTRPM, it is thus possible to evaluate source processes efficiency and effectiveness.

However purchasing savings makes no statement about it. It is identified isolation and not compared or contrasted with any other value or indicator. Thus, it is unclear whether purchasing savings achieved are poor or good. It would be necessary to ensure that purchasing savings of the required magnitude are achievable so that they can be evaluated.

If that were so, the question arises about why the products were priced so high in the supplier's initial bid. This ultimately contradicts SCM's main objectives (Poirier & Quinn, 2003) and raises questions about cooperative partnership.

The indicators CA and P_{LT}, particularly in the SCM and FTRP context, offer the opportunity to supersede the measurement of purchasing savings. Their strategic/operational focus enables them to support the assessment of source-processes' effectiveness and efficiency. This assessment enables control and improve of efficiency and effectiveness to support SCM's main objectives (Bowersox et al., 1999; Poirier & Quinn, 2003; Poluha, 2007, Batten, 2008).

7 Case Study Results

This chapter describes the conducted study's results. It initially shows which methods were used to enhance quality and ensure the validity and reliability of the study's results. An explanation of how the data was collected and evaluated for the field experiment follows this. Here some important explanations from earlier chapters, such as those concerning the choice of research design and field experiment, are reiterated in a short summary.

The study's results are presented and the research questions answered based on the data analysis. In the process, the predicted conclusions from subsection 3.2.4 are also briefly discussed.

7.1 Quality Control

Adams und Schvaneveldt (1985: 114) criticize that case studies as often exhibiting deficient representativeness and generalizability. The researcher's bias is also interpreted as weakness.

Rose (1991: 192) traces the criticism back to methodological confusion. He states “In case-study research . . . . it is considered more appropriate to treat representativeness in terms of a qualitative logic for the selection of cases for study, rather than a quantitative logic of sampling from a population . . .”. In addition, Yin (1998: 236) is of the opinion that exploratory case studies should be selected particularly where the available literature or the existing knowledge base provide no indications of the necessary conceptual framework.

Somekh and Lewin (2007: 348) define the reliability of a study's results from the quality perspective. They point to the different meaning of reliability in qualitative and quantitative research, describing reliability as “The truth of the findings has been established by ensuring that they are supported by sufficient and compelling evidence. In quantitative research, it refers specifically to measurement repeatedly giving the same result (being consistent) . . .”.

O. Münch, *First-Time-Right Procurement,* DOI 10.1007/978-3-658-08620-6_7,

As described in subsection 3.1.6, Yin (1998 & 2009) recommends that researchers continuously review case-study design quality. This should be done during all phases of the research process starting with the design phase, during data collection and analysis, and including the study report.

Construct validity, internal validity, external validity, and reliability testing have been firmly established as viable tests for achieving this (Judd et al., 1991; Corbin & Strauss, 2008; Yin, 1998 & 2009; Kirk, 2009). These four tests can be supplemented by the content validity or face validity (Judd et al., 1991; Churchill, 1995; Jackson, 2011; Gravetter & Forzano, 2009; Yin, 2009; Iacobucci & Churchill, 2010; Zalesky, 2010). Following the recommendation and applying the five tests will positively impact the study's the quality. The above-described traditional criticisms of the case study can also be overcome this way (Yin, 1998: 242). Creswell (2009) recommends applying at least two of the methods mentioned to a case study.

Table 10: Applied methods during research design phase

Phase	Test	Methods in case study	Undertaken action in this dissertation
Research design	External validity	Use theory in single-case studies	The theoretical bases of different areas of expertise are the foundation of the investigated topic and developed solution. Specific theory related to the study issue could not be used, because this research's exploratory nature and lack of existing theory regarding the specific issue.
		Use replication logic in multiple-case studies	Not performed: this requires the results of an initial single case study as minimum.

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Denzin & Lincoln, 2003; Flick, 2009; Creswell, 2009 & 2012; modified

Table 11: Applied methods during data collection phase (validity)

Phase	Test	Methods in case study	Undertaken action in this dissertation
Data collection	Construct validity	Use multiple sources of evidence	Use of multiple sources of evidence (books, published articles, presentations, web-sites, etc.) Discussions with multiple informants (internal and external).
		Establish chain of evidence	Multiple evidence sources (datasets) were entered into a customized object-oriented software database. Deductive (logical) chains of arguments are developed based on theory research and structural models.

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Denzin & Lincoln, 2003; Flick, 2009; Creswell, 2009 & 2012; modified

Table 12: Applied methods during data collection phase (reliability)

Phase	Test	Methods in case study	Undertaken action in this dissertation
Data colection	Reliability	Use case study protocol	Same data collection procedure followed for each case (dataset). A consistent set of initial criteria were used in each case.
		Rich and thick description	The data were collected from the IT system and presented in a Microsoft Excel summary. This should give enough information about the results to the reader to allow him or her to evaluate the results' credibility.
		Generate rich data	The data were collected and stored. Its presentation contains all necessary details about the specific and concrete event that was observed. Manually modification was not necessary. This should give as much information as possible about the results to the reader to allow him/her to evaluate the credibility.
		Develop case study database	The data extracted from the IT system is stored in a file. The file contains all relevant information needed to repeat and evaluate the research results.

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Denzin & Lincoln, 2003; Flick, 2009; Creswell, 2009 & 2012; modified

Table 13: Applied methods during data analysis phase (validity)

Phase	Test	Methods in case study	Undertaken action in this dissertation
Data analysis	Content/ Face validity	External business executives review	Other experts reviewed the research results; an advisor and the dissertation committee to examine their validity.
	Internal validity	Pattern matching	Not performed in this research.
		External audits	This research was discussed with several external experts and advisors to examine its credibility. Most of their advice was accommodated in this research. The external exerts and advisors have no link to the research.
		Time series analysis	Not performed in this research, but under consideration as part of follow-up work.
		Multiple informants review study	The research results were reviewed by other experts. None of them were involved in the research.
		Explanation building	Some obvious causal links are identified.
		Addressing rival explanations	Applied in form of showing the risks in purchasing saving and the competition issue between purchasing savings and SCM.
		Logic models	Performed in form of the analytical models.

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Denzin & Lincoln, 2003; Flick, 2009; Creswell, 2009 & 2012; modified

Table 14: Applied methods during data analysis phase (reliability)

Phase	Test	Methods in case study	Undertaken action in this dissertation
Data analysis	Reliability	Triangulation (also researcher/ investigator triangulation)	Different methods were used in the study. The research results of each dissertation phase were discussed with other researchers, experts, an advisor, and the yearly dissertation committee to examine its reliability.
		Peer review or debriefing	This research was supervised by an assistant professor and two business executives who were keen to check the case study and discuss its results with the researcher.

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Denzin & Lincoln, 2003; Flick, 2009; Creswell, 2009 & 2012; modified

Table 15: Applied methods during composition phase

Phase	Test	Methods in case study	Undertaken action in this dissertation
Composition	Construct validity	Key informants reviewing draft of case study report	The case study report was under a permanent review of an assistant professor from a university. Furthermore, it was reviewed three times by a university committee comprising several professors and doctoral-level members. In addition, one conference paper and one journal article based on the case study was reviewed by key informants, experts (internal and external), and several expert editors before publication.

Source: Author's illustration based on Smith, 1978; Maxwell, 1998; Merriam, 2001; Ellram, 2002; Corbin & Strauss, 2008; Yin, 1998 & 2009; Denzin & Lincoln, 2003; Flick, 2009; Creswell, 2009 & 2012; modified

As described in subsection 3.2.6, the specific research design "randomized posttest-only control group" was selected for the study's field experiment. This specific design should achieve the greatest possible validity and reliability that an experiment design can support (Bacon, 2010).

Two different groups are considered with experimental design. The experimental group (EG) receives a treatment (X) whereas the control group (CG) is not subjected to any treatment. Both groups (O_1 and O_2) are subsequently measured (Judd et al., 1991; Gravetter & Forzano, 2009; Bacon, 2010).

EG: R X O_1
CG: R O_2

Formula 5: Symbolic representation of the applied experimental design
Source: Curchhill, 1995; Gravetter & Forzano, 2009; Yin, 2009; Bacon, 2010

During the course of the study, the “treatment” is consistent procedure according to the 6 Rs, which serve as input for the source process. The principle of randomness enhances the research results' relevance and quality, because it excludes the researcher as a possible error source (Bacon, 2010).

7.2 Data Collection

Before the field experiment began, several criteria were defined to enable identification of the datasets to participate in the study (see section 6.3). For the first experiment of this kind, only purchased parts developed within the company (BAUT) were considered at first.

BAUT, which were technically and commercially classified as a low value parts, as well as commercial of the shelf (COTS) were excluded from the first FTRP experiment to keep the number of records to a manageable size. The focus was thereby placed on costly, sophisticated in-house developments, the cost of which the company can influence via self-defined requirements.

Allocation into experimental group and control group was made randomly for datasets meeting the above-described criteria. Dataset with even reference numbers were assigned to the experimental group (EG); those odd reference numbers were assigned to the control group (CG).

Criteria for benchmarking the measured P_{LT} were furthermore defined. For this purpose, the BAUT have been divided into three categories: simple, medium, and complex. The company's experts were of the opinion that the supplier should answer the inquiry for simple BAUT within two working days, for medium BAUT within four working days, and for complex BAUT within seven working days.

This way the company created three maximum P_{LT}'s (P_{LTmax}). Answering means that the supplier submits a viable bid meeting the 6 Rs. Datasets in the EG or CG violating the P_{LTmax} time window are flagged as errors. Feedback was provided to the process input's supplier (internal customer) in the experimental group. A cause analysis was subsequently conducted.

The datasets were recorded Microsoft Excel during the experiment. The Excel file also contained the necessary verifications to assign the datasets to the experiment group (EG) or control group (CG) according to the previously described criteria. P_{LT}'s calculation and its alignment with the P_{LTmax} has also been programmed.

All tests, calculations, as well as analysis and evaluation were fully automatic. The researcher's manual intervention was not required. The database's object-oriented design shielded it from any external influences.

Six hundred twenty-one datasets were collected within a year for the first FTRP field experiment. All these datasets meet the selection criteria described above and could therefore be assigned either to the experimental group or control group. The randomized process allocated 48% of the datasets o the experimental group and 52% to the control group. The following illustration shows only a selection of the datasets in the database.

EG/CG	Ref. No.	Part Complexity	P_{LTmax}	Start Date	End Date	Process Time (Working days)	P_{LTmax} exeeded? Yes= Error
EG	6000019308	Complex	7	Wednesday 12.10.2011	Friday 21.10.2011	7	NO
CG	6000019675	Complex	7	Friday 18.11.2011	Wednesday 30.11.2011	8	YES
EG	6000020820	Complex	7	Monday 19.03.2012	Friday 23.03.2012	4	NO
EG	6000021460	Complex	7	Thuesday 10.07.2012	Friday 27.07.2012	13	YES
CG	6000021627	Complex	7	Thuesday 26.06.2012	Monday 02.07.2012	4	NO
EG	6000020590	Medium	4	Wednesday 29.02.2012	Monday 05.03.2012	3	NO
CG	6000020143	Medium	4	Thuesday 24.01.2012	Wednesday 08.02.2012	11	YES
CG	6000020491	Medium	4	Thuesday 21.02.2012	Friday 24.02.2012	3	NO
CG	6000020143	Medium	4	Thuesday 24.01.2012	Wednesday 08.02.2012	11	YES
CG	6000021019	Simple	2	Thursday 05.04.2012	Monday 09.04.2012	2	NO
CG	6000021019	Simple	2	Thursday 05.04.2012	Monday 09.04.2012	2	NO
CG	6000020597	Simple	2	Wednesday 29.02.2012	Monday 05.03.2012	3	YES
EG	6000021742	Simple	2	Friday 13.07.2012	Friday 20.07.2012	5	YES
CG	6000019371	Simple	2	Thuesday 18.10.2011	Thursday 20.10.2011	2	NO
EG	6000020596	Simple	2	Wednesday 29.02.2012	Monday 05.03.2012	3	YES
CG	6000020091	Simple	2	Monday 16.01.2012	Wednesday 18.01.2012	2	NO

Figure 49: Summary of datasets in Microsoft Excel

Source: Author's illustration

7.3 Data Analysis

In a certain sense, data analysis takes place during a case study's entire research process, because the researcher interacts constantly with the collected data and information. Its flexibility is therefore one of case-study research's advantages. The researcher can adjust the direction of the investigation if the facts or data require it (Tayie, 2005; Gravetter & Forzano, 2009; Yin, 2009).

On the other hand, the essential task of the data analysis is to examine, categorize, and prepare the data after it is collected. The remainder of this section describes how the field experiment's records were processed.

The first step in analysing the records from the experimental and control group was to determine the total number of records per complexity group. Here the datasets allocations into the three complexity groups, resulting from the defined criteria and the randomized distribution, should be shown.

The mean P_{LTmax} was determined for each complexity group based on the sum of all datasets. Whether each individual dataset met the specified P_{LTmax} as a function of part complexity was also examined. Violating P_{LTmax} was flagged as an error.

Each complexity group's error rate has been calculated to complete the experimental and control group evaluation. Tables 16 and 17 present as an overview of the results of the above described analysis for the control group (CG) and experiment group (EG).

Table 16: Analysis result of the CG datasets

	Part complexity		
	Simple	Medium	Complex
Part quantity	249	53	24
Average PLT in working days	4.61	5.67	5.58
Error quantity	114	25	9
Error rate	45.78%	47.17%	37.50%

Source: Author's illustration

Table 17: Analysis result of the EG datasets

	Part complexity		
	Simple	Medium	Complex
Part quantity	220	41	34
Average PLT in working days	2.32	3.14	4.94
Error quantity	62	10	4
Error rate	28.18%	24.39%	11.76%

Source: Author's illustration

Significant differences can be observed when comparing the experimental- and control-group results. The chart below shows the difference between the two groups relative to the experimental group.

Table 18: Deviation from EG to CG

	Part complexity		
	Simple	Medium	Complex
Part quantity	-29	-12	10
Average PLT in working days	-2.29	-2.53	-0.64
Error quantity	-52	-15	-5
Error rate	-17.60%	-22.78%	-25.74%

Source: Author's illustration

Evaluation of the experimental- and control-group result difference shows that in all three of the experimental group's complexity categories, both the mean P_{LT} and the error rate are lower than those in the control group.

7.4 Findings - Interpretation And Discussion

This section describes the observations and collected findings in the company based on the study. The first subsection outlines some examples illustrate negative implications purchasing savings may have for the company. The second subsection considers FTRPM development and implementation. In the final subsection, observations made during the experimental phase will be discussed.

7.4.1 Observations Regarding Purchasing Savings

Although the study focused on developing FTRP and FTRPM, it was easy to find evidence in the company showing that purchasing savings might negatively impact the company's sustainable success. Facts concerning a subsystem procured in a quantity of greater than 1000 units are described briefly below as an example. The example's purpose is to illustrate the risks concealed in purchasing savings.

In the initial situation, 1200 units of a subsystem are being purchased at a per-unit price of EUR 3700.00. The entire quantity is to be delivered in several batches. The subsystem's purchase price also includes, for example, functional testing, packaging, delivery, warranty, and obsolescence management. The supplier bears the costs of any warranty claims or obsolescence.

When the objective was to reduce the purchase prices and generate purchasing savings, the subsystem was ordered from electronics and hardware suppliers as single components and small assemblies. The required items' total cost was calculated based on a bill of materials after all of the required components' purchase prices were available. The cost was EUR 3400.00 per unit.

This new amount was compared with the original purchase price of EUR 3700.00 per unit for the functional, finally tested subsystem. A purchasing saving of EUR 300.00 per unit was reported based on this comparison. The project claimed more than EUR 360,000.00 in total.

Although purchasing savings of EUR 300.00 per unit shown here, various cost aspects were suppressed. Single components are procured for EUR 3400.00 per unit, but not a functional, finally tested subsystem. That means integration, testing, and packaging costs must be taken into account in addition to the EUR 3400.00 purchase price.

Furthermore, the company now bears the risk and cost of defective goods, warranty/complaints, and obsolescence management. In addition to the extra monetary costs and risks, the technical risks should also not be neglected. For the selected procedure to purchase single parts/components, such risks are entirely in-house. When purchasing the functional, finally tested subsystem, this risk is mostly at the supplier.

Added to this comes the fact that the originally planned purchase of one subsystem entailed only one purchase order per subsystem. But now more than 60 orders required, because individual parts are being purchased. Thus the Procurement and Goods Receipt departments' labor and coordination expenditure increases drastically.

From the company's perspective, neither the prices nor the costs were reduced in this example. Ultimately for the companies, additional costs were created and the technical and commercial risk increased. The additional costs, which are created by increased Procurement and Goods-Receipt overhead expenditures, will be borne by all of the in-house projects.

This is because rising costs increasing the company's indirect material cost. In this example, the TCO approach was neither considered nor pursued. As noted at the beginning of the subsection, this situation should serve only as an example demonstrating what may occur when purchasing savings are pursued. It was in fact possible to observe similar situations during the case study.

The study has clearly shown that purchasing savings is defined very broadly not only in the literature but also in this company. In addition to the already-described “purchasing savings”, the generally offered volume discounts were also seen as purchasing savings and systematically recorded.

Against the backdrop of purchasing savings being used in principle to assess procurement's performance (Roylance, 2006), a question arises about the relationship between generally offered volume discounts and good procurement performance. Has procurement rendered appreciable performance here?

The company also interpreted the difference between the highest and lowest supplier bid as purchasing savings (“purchasing success” see subsection 2.3.6). This raises the question about why “success” is spoken of when sometimes procurement doesn't even know the real product price. What performance is there in such an offer comparison?

As stated at the beginning of the subsection, these issues are only an example of what may arise when a company pursues purchasing savings. In fact, even more negative observations could be made about purchasing savings. They will not further be explained or detailed at this point, because this issue is not the study's focus.

7.4.2 Reflection On FTRP And FTRPM Results

The most difficult part was establish understanding and acceptance of the FTRPM approach in the departments prior to its first use. The subject was discussed intensively. Ultimately, however, it was possible to convince each person involved that a “black zero” must be the aim, especially under the SCM aspect (see subsection 5.1.3).

Also there was general agreement that a different performance-measurement approach than purchasing savings needs to be developed for this area. If FTRP and FTRPM were again introduced, explained, and discussed, the departments would recognize and accept its general applicability.

The implementation of the CA and P_{LT} indicators and the ability to determine their values was simple in principle. During the experimental phase, P_{LT} was measured using an uncomplicated manual calculation in Microsoft Excel. If it is decided that this indicator will be more permanent, the calculation can be done automatically in the company's own ERP system.

There is currently no obvious way to calculate the CA indicator. The reason is that in the company in which the study was performed, procurement cannot completely influence total purchasing volume. The decisive factor for this is that, in some projects, the customer dictates the suppliers.

This results in a compulsion to work with certain companies, which in turn inhibits or affects procurement's options for influencing the price/cost structure. The monetary percentage in the purchasing volume, based on the project-supplier combination, must be subtracted from the total purchasing volume. The difference is the percentage of purchasing volume that procurement influence and for which procurement is fully responsible.

P_{LT} indicator has shown increased communication speed at the customer-procurement and procurement-supplier interfaces. For example, if the supplier's bid failed to achieve

determined product price, the information was analyzed and evaluated. This took place in the first step between procurement and the supplier.

If in this conversation revealed for example that the requirements for the product to be delivered bear no reasonable relationship to the parametrically determined product price, this information was given to the customer. Together with this information, procurement's internal customers received notices about the cost drivers in the product requirements. The internal customer or project then evaluated the important new information adjusted and its own cost structure accordingly.

Whether or not FTRP's introduction shortened contract negotiations could not be determined. On the one hand, it is difficult to determine how much time and money is spent on negotiations; on the other, price represents only a marginal share of the contract content that has to be negotiated. But even if no significant effects were observed during contract negotiations, it could be noticed that conducting the procedure by the FTRP approach significantly mitigated the issue of price negotiations.

The company determined the product price independently and accepted it faster than before. Suppliers have perceived this and commented very positively on it. In return, the suppliers started to show their own cost calculations (open book). This can be interpreted as an indication of increasing trust and also lays the foundation for further value engineering (VE) activities such as a technical refinement.

Through procurement it was quickly recognized, that PLT is only kept small when all available information fulfills a qualitative minimum. The technical documents (drawings, data sheets, etc.) enclosed in a request for quote can be mentioned as an example of this. If they are incomplete or of insufficient quality, the questions suppliers have to ask delay the quote.This increases PLT's value.

The supplier portfolio also significantly impacts PLT's value. Extensive investigation and downstream supplier integration must be performed if no suitable supplier is available in the portfolio for the required product, which also increases PLT. It thus has been shown that the better the supplier portfolio is aligned to meet the internal customer's or company's needs, the more PLT's value can be reduced. The need for

increased supply-market transparency, and detailed knowledge of the supplier portfolio and suppliers' competencies together imply growing trust–a positive impact on SRM in general.

The topic of parametric cost estimation (PCE) has to be regarded as a collaborative task. The company uses this type of cost estimation as an additional, neutral way to get a “second independent opinion” in addition to conventional cost estimation via the catalog of tasks.

PCE is generally done in a team, to which the internal customer or project delivers the relevant information. Important parameters needed for PCE could be for example weight, quantity, lot size, added value, technology, development efforts, prototypes, iterations, operating environment, or quality requirements. If the supplier fails to meet the target price determined by PCE, procurement must feed this information back to the team.

The parameters used are subsequently reviewed and updated if necessary. The accelerated information feedback already described therefore also supports the accuracy of the PCE at this point. If critical parameters or product requirements incorrectly estimated, the internal customer or project can immediately take this information into account for its own project planning.

This allows a more robust project management with a more reliable time and cost planning. Since PCE is a collaborative effort, the supplier's exceeding or undershooting the first PCE target price's range cannot be attributed to a single department or individual person.

PCE makes a statement about costs and minimum delivery times from the benchmark perspective. This assertion is based on the various input parameters including quality features and delivery lot. Changing them directly impacts cost and time in the PCE result. Thus, return delivery of information coming from the supplier, through procurement, to the PCE team directly impacts the QCT triangle.

In addition, procurement no longer has the “to push the prices” objective, but the objective to achieve the target price: the product price coming from PCE. Distortion of the QCT triangle in favor of costs and to the detriment of quality and/or time is thus neutralized. Procurement not only completes its main task, the provision of goods and services, via this kind of behavior, it also ensures that quality, cost, and time factors are met in the given expression through the source process (see Busch, 1981: 27; Lamprecht, 2000, p 142; Dickmann, 2008: 27; Fung et al., 2008: 20; Lai & Cheng, 2009: 4).

7.4.3 Observations Made During The Experimental Phase

As described in section 3.2, the present study is exploratory, based on deductive (logical) conclusions, and experimental. The research objective was therefore not to test hypotheses (verify or disprove), but to examine for the first time the specific research problem as well as the theoretical approach to it.

A dataset analysis and a comparison of the results from experimental group (EG) and control group (CG) indicate a significant positive trend in PLT and in the mean error rate within the experimental group. Although randomized distribution placed 29 fewer datasets into the experiment group, it was possible to reduce mean PLT for simple BAUT by about 2.30, for medium BAUT by about 2.53, and for complex BAUT by about 0.64 working days.

An error rate exhibits a similar positive trend. In the experimental group, the error rate for simple BAUT is 17.60%, for medium BAUT, 22.78%, and for complex BAUT 25.74% lower than that in the control group. This clearly indicates that the FTRP approach is yielding significant time savings and reducing errors within the source process.

It must be added that achieving purchasing savings in the experimental group has not been tried; however this was still the case within the control group. Likewise, partial unawareness about product price still existed within the control group.

It was thus possible to confirm that FTRP achieved greater cost and time clarity during the study. More reliable planning could be done, since the 6 Rs were known in procurement or the company when the suppliers inquired. The extent to which the supplier failed to entirely satisfy the 6 Rs was communicated internally in the organization. The fact that the 6 Rs could not be achieved was generally interpreted as an error, because then PLTmax could not be met.

Becoming aware of the error and communicating it enabled requirements to be reevaluated or redefined. This in turn directly impacted cost and time scheduling within the project and company.

A positive “side effect” of FTRP was more open and transparent cooperation with the suppliers. Thus, the suppliers were often willing to attach an “open book calculation” to their offer. As a result, cost drivers could be more easily identified and possible cost-reduction measures worked into the product.

According to initial findings, the most common reasons that the PLTmax was exceeded in the experimental group (error) are quality problems in the specifications/design documents, incorrectly determined product prices due to underestimated product requirements, and suppliers who lack the necessary manufacturing expertise being contacted. In the case of the last case, the reason for non-compliance with the 6 Rs usually lay in the fact that the requested suppliers have indeed made a bid, but it included a double surcharge. Since the requested supplier lacked appropriate manufacturing expertise itself, it wanted to subcontract the part. Thus, manufacturing costs are then surcharged twice: once by the supplier and again by its subcontractor.

Within the control group, several suppliers were usually contacted during inquiries. Bid evaluation and comparison were subsequently performed on scope of supply and services. The sometimes intensive and expensive price-negotiation phase started after a bid was selected. The aim was to keep down procurement costs and/or pass the costs along to achieve the desired purchasing savings.

The time savings in the complexity categories of the experimental group compared to the control group can be explained against this backdrop. It has thus been clearly shown how important it is for companies with changing procured goods and services to know the right product price. This knowledge aids quick, efficient action in a market such as the defense industry's.

It must be added that the intent within the experimental group was not, as in the control group, to achieve purchasing savings. But according to the employees, the total time effort within the project was larger in some datasets from the experiment group than in comparable datasets from the control group. This can be attributed to the effort for exact determination of the 6 Rs, which did not just involve procurement.

Nonetheless, the fact remains that this effort yielded a higher level of transparency and security in cost and time scheduling. This in turn is fundamentally important if the company wants to target its existing resources to avoid costs (opportunity cost). The same applies to reducing extra time expenditure by reworking planning results or answering open questions due to inadequate planning.

7.5 Answering The Research Questions And Predicted Conclusions

Puch (2005: 32–43) distinguishes between research models with and without hypotheses. However, a literature research is conducted first in both models. This way, the research problem can be better defined and the research question formulated.

In a research model without hypotheses (figure 50, top), mostly for qualitative research, the research design is determined afterward. The data are then collected and analyzed. Finally, the research questions are answered.

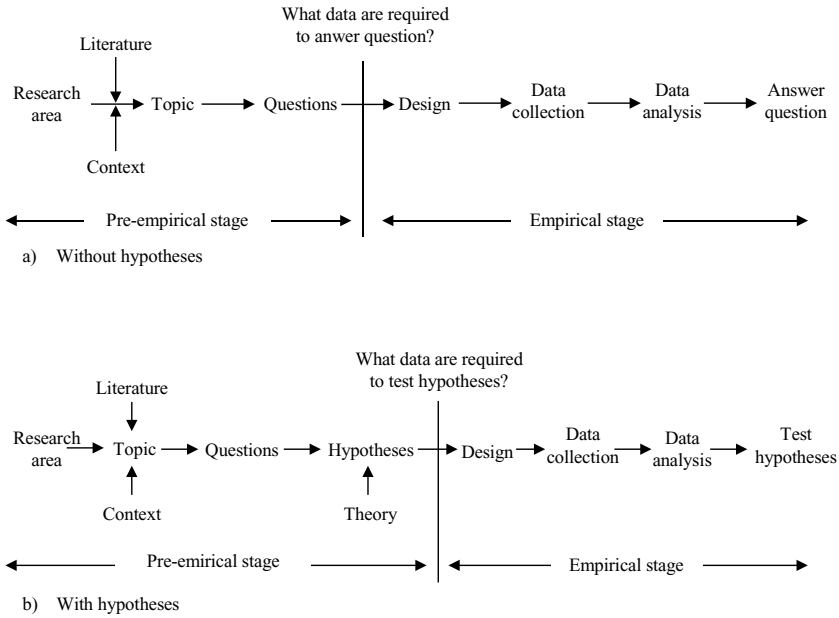

Figure 50: Simplified model of research

Source: Puch, 2005: 40; moditied

For a model with hypotheses (see figure 50, down), the hypotheses are created directly following the research question. They make a clear assumption about the expected result of the empirical study to be conducted. Subsequent research phases such as research design creation, data collection, and analysis are intended to test the formulated hypotheses. The consequence is that the research questions are only be answered indirectly.

Therefore, hypotheses should only be used if the expected responses are highly likely to be true and the predicted hypotheses could be derived from the literature. Whether one operates in a research model with or without hypotheses is irrelevant to research design, data collection and analysis. Research question formulation and development is a very

important, iterative process. Discussions with experts, e.g., can also influence this process (Puch, 2005: 32–43).

In this section, the research questions (RQ1 to RQ3) developed in subsection 3.2.3 are to be answered. The following answers and conclusions must be viewed in and overall context including the literature and results from sections 5.1, 6.3, and 7.4. The text will reference appropriate section or the literature to establish the connection explicitly.

Since in this study, a new approach has been studied, there was a lack of appropriate literature regarding the specific topic. This was one of the main reasons, why no hypotheses were formulate and tested during this study. Instead, based on the literature review and the analytical model of subsection 3.2.2, conclusions were derived. These conclusions will be discussed briefly at the end of this section.

7.5.1 Research Questions

As described in subsection 3.2.3, the following principal research question (RQ) was the basis for this study.

RQ: How must a measurable method be designed in the procurement context so that, on the one hand, it exercises a positive effect on sustainable company success through declining TTM and opportunity costs and, on the other, can replace the monetary measure of purchasing savings?

The principle RQ was divided into three specifically formulated questions to improve analysis and processing: RQ1, RQ2, and RQ3. The answers to these questions will be discussed separately in the sub-subsections below.

7.5.1.1 Answering RQ1

RQ1 is the following:

RQ1: Is it possible to transfer the First-Time-Right approach (Mukherjee, 2006), also referred to as the Zero-Defects concept (Crosby, 1978), into the procurement organization?

The formulated RQ1 can be unequivocally answered in the affirmative. Basic themes from various fields were identified and merged based on the literature (see section 5.1). Due to a strict customer orientation (Guptap, 2005; Roenpage & et al., 2007; Töpfer, 2007) and the definition of quality in procurement (see subsection 2.7.3), it also was possible to examine the source process to determine whether or not the right outcome was achieved in the first process cycle (6 Rs).

Implementation of the control loop from control technology into the SIPOC approach of Six Sigma (see sub-subsection 2.6.3.2) proved particularly useful with this approach (see subsection 5.1.1).

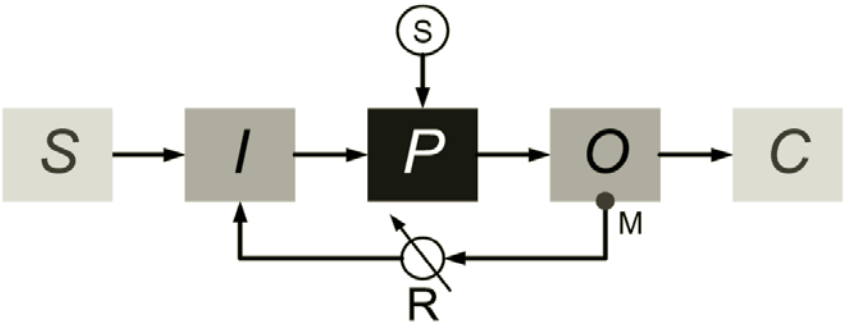

Figure 51: SIPOC-approach with implemented closed loop control
Source: Author's illustration

Only when the desired result is achieved after the first source-process cycle is the totality of all activities and sub-processes effectively designed: the right things are done.

7.5.1.2 Answering RQ2

The second research question (RQ2), which was derived from the essential RQ, is the following:

RQ2: How must a measurable method in procurement be designed to positively affect sustainable company success through declining TTM and opportunity cost?

Also this research question, too, can be answered positively. It is possible to evaluate the FTRP approach by integrating a measurable variable, time. As described in subsection 6.3.1, this review takes place in terms of efficiency, thus in terms of the cost-benefit ratio of the source processes. Are things being done right?

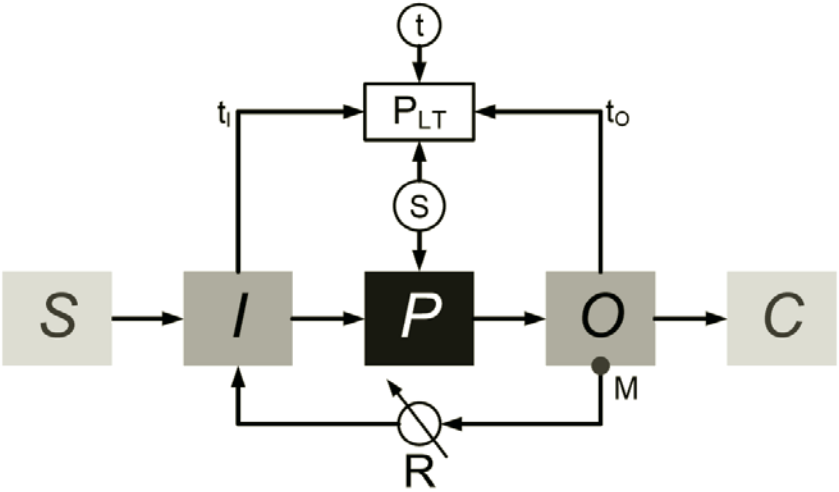

Figure 52: Time focused performance measurement in FTRP
Source: Author's illustration

The results of the experiment with the "randomized posttest-only control group" design described in subsection 7.4.3 has clearly shown that the FTRP approach can significantly reduces time and opportunity costs.

Along with increasing transparency in the inquiries/bids and growing trust on the suppliers' side, it is assumed that the overall context will have a sustainable positive affect on the company's success. The decisive factor in this method was that products prices were identified using the neutral benchmark PCE method (see sub-subsection 2.5.2.4), and that these were afterwards used as target prices (see section 5.2).

7.5.1.3 Answering RQ3

The third research question (RQ3) from subsection 3.2.3 reads as follows.

RQ3: Is the new method able to replace the measurement of monetary purchasing savings as a performance measurement?

Taking into account all of the results obtained and observations made in sections 5.1, 6.3, and 7.4 as well as the answers to RQ1 and RQ2, it can be concluded that by using the developed method FTRP and its measurement (FTRPM), replacing monetary purchasing savings is possible in principle. However, this requires fundamental rethinking.

The company/procurement must be aligned with the SCM's overall objectives (see section 2.1): away from egoism (I) to partnership (we) (Kersten et al., 2003: 8). The procurement's objective is no longer to simply pass on costs to the supplier without effectively having saved them. Rather, as described in subsections 2.7.3 and 5.1.3, procurement must reach the “black zero”. This means that the real product price is known in the company, and this price must be agreed to with the supplier. That is the prerequisite for a long-term and cooperative relationship with the supplier that achieves a win-win situation.

It should be noted that FTRP, and thus FTRPM measurement says nothing extensive or exhaustive about procurement's overall performance. By using this method, monetary purchasing savings can be replaced as one aspect of the general performance measurement for procurement.

7.5.2 Predicted Conclusions

The conclusions derived in sub-subsection 3.2.4.2 for the research approach iare based on the conducted literature review and the analytical model in subsection 3.2.2. They have been illustrated graphically in the structural model (SM) in sub-subsection 3.2.4.2. Since this study is the first of its kind and focused on answering research questions, the following explanations apply only as a tendency. Further research must be performed to sustainably validate them. In this instance, the conclusions must be transformed into hypotheses. These hypotheses must then be verified or falsified accordingly. Therefore,

only a very brief discussion will be entertained about the research approach's assumptions and conclusions.

Conclusion 5 was that “PQ exerts a significant positive impact on *SRM*.” A positive trend in the SRM became apparent during the experiment. This positive trend is recognizable through far more open cooperation, increased transparency, and improved communication with the supplier.

Concerning conclusion 6, “PQ exerts a significant positive impact on the *trust* between procurement and the supplier.”, just a slight tendency was observable during the experiment phase. That is currently attributed to the non-pursuit of purchasing savings. It is believed that growing trust has also positively influenced the result of conclusion 5.

As already described in subsection 7.4.2, no relevant observations that would support conclusion 7, “PQ exerts a significant positive impact on *contract negotiations*.”, was observable during the study.

Strict customer focus through alignment with the 6 Rs enabled confirmation of conclusion 8, “PQ exerts a significant positive impact on the *QCT triangle*.” The factors mentioned in the QCT triangle, quality, cost, and time, are fully covered by 6-Rs content in PQ's definition. PQ positively impacts the QCT triangle, since no factor is at a disadvantage, and all are treated equally.

Conclusion 9, “PQ exerts a significant positive impact on *cost determination*.”, cannot be clearly confirmed after closer examination of the results. As described in subsection 7.4.2, communication speed increased at the interfaces internal customer-procurement and procurement-supplier. However, in terms of cost determination it must be said that PQ only influenced cost-determination quality results as a follow-up. An influence only arose if a supplier was unable to meet the determined product price and requirements were interpreted incorrectly within the company, since the cost structure had been reevaluated. PQ could preventively observe no influence on cost determination.

In particular, the experiment has shown that conclusion 10, “PQ exerts a significant positive impact on *opportunity costs*.”, can be confirmed. Resources were properly

targeted and used via structured procedure according to PQ. As described in section 7.3 and subsection 7.4.3, P_{LT} and the average error rate for the source process in the experimental group both being lower than in the control group demonstrates this.

In addition, as described in subsections 7.4.2 and 7.4.3, reduced downstream effort and more stable cost and schedule during the whole project were observed in the experimental group. Also this leads inevitably to the conclusion that the opportunity costs are lower within the project. The same arguments and conclusions are also valid for conclusion 11 ("PQ exerts a significant positive impact on the *TTM-cycle*."). The source process is faster and the proven time reduction therefore positively impacts the TTM cycle.

8 Conclusion And Recommendations

SCM pursues the goal of long-term cooperation and partnership, in which a win-win situation is to be achieved (Vollmann & Cordon, 1999; Van Weele, 2005), where sustainability is particularly important. In contrast, “purchasing savings'” objectives and definition are not uniformly described in the literature.

In summary, purchasing savings' objectives can be described as cost avoidance, cost reduction, and the optimization of supplier services for procurement (Poirier & Quinn, 2003; Van Weele, 2005; Roylance, 2006). However, real costs are not effectively saved (Vollmann & Cordon, 1999), just passed on to the supplier. Tracking purchasing savings tends to unbalance the cooperative situation sought through SCM, in which all should have an equal footing (Poirier & Quinn, 2003).

Furthermore, it risks long-term stability in the supplier-customer relationship and the supply chain (Busch & Dangelmaier, 2004). As the example of the car manufacturer Opel has shown, systematic purchase-success tracking (purchasing savings) entails an existential threat to the company and its suppliers. The Opel example demonstrates that from a business perspective: purchasing savings must to be considered as risk.

Contrasting purchasing savings' and SCM's objectives enables the observation that purchasing savings' short-term, one-sided objectives compete with SCM's long-term partnership objectives. This raises the question of whether purchasing savings and SCM can coexist at all, or whether they exclude each other.

It was furthermore noted that considering monetary purchasing savings in isolation negatively impacts sustainable, and thus long-term company success. Based on this problem set, the German-defense-industry case study dealt with the question of whether the First-Time-Right quality method (Mukherjee, 2006), also called the Zero-Defects concept (Crosby, 1978) being applied within manufacturing can also be applied to procurement processes (source process).

A measurable method that positively impacts opportunity cost and the time-to-market cycle should be developed based on this. The aim is to address the right supplier in the

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first inquiry and to ensure that the company is supplied with the needed goods and services in the shortest possible time. This should ultimately supplant the measurement of monetary purchasing savings.

The impulse to conduct this kind of study came from daily practice and discussions with experts, but the study's starting point is based on traditional research design. The “grounded theory” qualitative approach was selected as the basis. It is considered an appropriate method of data analysis and interpretation in qualitative research (Glaser & Strauss, 1967 in Allan, 2003:1; Corbin & Strauss, 2008; Creswell, 2012).

This method focuses on developing theoretical approaches and conclusions in this connection. Thus, the foundation for creating research questions is also laid (Puch, 2005: 41). A detailed description of the data base (Merriam, 2001:17) and the information as well as a deductive (logical) line of argument is thus required to ensure traceability. Thus it was possible, based on the conducted literature review, to formulate the study's underlying basis: the research questions in subsection 3.2.3.

As a result, the study has demonstrated that the FTR principle is also applicable to source processes. In addition, it proved possible to develop a measurable method positively impacting opportunity cost and time-to-market. First-Time-Right procurement (FTRP) application has led to time savings and cost avoidance within the concerned company in the experimental group.

Both ultimately arose from the improved application and utility of existing resources thereby positively influencing opportunity cost and time-to-market. In addition, the relationship with the supplier has been improved and intensified. The positive trends in opportunity cost, time-to-market, and supplier relationship are attributed to replacing purchasing savings with the FTRP approach.

Because product prices (= target prices) were known, the customary price negotiations to achieve purchasing savings were not conducted. At the current stage, it is assumed that the events described above as a total constellation will positively and sustainably impact the company's results.

During the study, the experts formed the opinion that it is a kind of philosophical question: either SCM or purchasing savings. Senior management has to make this decision and demand it in consequence. It must not be forgotten that in a fast paced and industrialized time like the present, only sustainability enables long-term success. This also applies in particular to the relationship of the supply chain's members among themselves.

The definition of quality in procurement (PQ) developed at the beginning was discussed again at the end of the study. That customer requirements and satisfaction are the focus of SCM and Six Sigma was the deciding factor. This should have a greater influence on PQ's definition. Adjustment was made within the 6 Rs' section to reemphasize this.

If the company thinks in isolation and only of its own success, then “at the right total cost of ownership” must replace “at the right price”. If the company wants to act sustainably and with a strict focus on the customer, “at the right price” must change to “at the right life cycle costs”. The corresponding definitions for quality in procurement are presented below.

The definition for PQ with the focus on total cost of ownership is:

Procurement quality means that the procurement organization is able to provide the company within the **shortest processing time** with the **right products**, at the **right quantity**, at the **right place**, at the **right time**, the **right quality** and at the **right total cost of ownership**.

If the focus is on life cycle costs, the definition for PQ is the following:

Procurement quality means that the procurement organization is able to provide the company within the **shortest processing time** with the **right products**, at the **right quantity**, at the **right place**, at the **right time**, the **right quality** and at the **right life cycle costs**.

However, in practice, the most important point is to question if it is the right decision to use purchasing savings as a measurement indicator within the company. If a company

uses personal goals and objectives including purchasing savings, to judge about the performance of the employees in procurement, the management should challange this decision by asking the following questions:

1. Are purchasing savings used as a key result indicator (KRI)?
2. Are there other indicators existing to measure the performance of procurement? (Do not forget the characterristics that differentiate KPI from KRI.)
3. Do purchasing savings have a positive effect on the relation and partnership with the rest of the SC members?
4. Do purchasing savings reduce the product's costs and thus the costs in the SC?
5. Is there a win-win situation within the SC although purchasing savings are measured?
6. Is the “Cobra Effect” (Siebert, 2001) eliminated and does the company achieve in long-term view what desired.
7. Does the company achieve the “black zero” without taking purchasing savings into account?
8. Are the empoyees in procurement acting in an ethical way and saving the resources (time and money) in order to reduce the TTM and the opportunity costs?

If the answer to even one of the above questions is “no”, the management should re-think his decision (philosophy) to use purchasing savings as an indicator to measure procurement's performance. Otherwise the long-term and sustainable success of the company might be at risk.

The management should not forget that from the SCM and VE perspective, purchasing savings are deviations from the optimum. Therefore the management must decide either to chase deviations and fix what they caused to the company and the whole SC or to pursue the optimum in processes, costs and resources.

It is the time to replace the paradox purchasing savings by another measurement.

Two major research topics associated with future FTRP-related research are identified from today's perspective. One is durability and the other generalizability. Further studies could investigate the effect FTRP has on the company when used for more than one year. Long-term studies could be used to investigate in detail or to demonstrate the sustainability.

However, it should be noted that even here generalizability is still lacking. To enhance generalizability, similar studies must be conducted in other companies. Based on Gilmore and Carson (1996) it is recommended to first conduct such studies on companies within the same business area. Only if the similar trends as those in this present study emerge should cross-industry studies be conducted as the next step.

Here it must be examined whether, e.g., the industry or the technology plays a crucial role in the successful FTRP implementation. Which products FTRP should be applied to, should also be investigated. Whether or not FTRP only benefits the company for sophisticated in-house developments or even for commercial of the shelf (COTS) products must be examined.

Another task would be to transfer this study's formulated conclusions and deductive assumptions into hypotheses and to verify or falsify the latter accordingly. Holistic hypothesis testing during the course of FTRP could be represented in a structural model (SM) from today's perspective as shown in appendix 10.3.

But topic purchasing savings, identified as a risk in this study, should also be studied in more detail. Interesting fields of investigation are seen in the area of employee behavior and provable impacts as well as the impact on the supplier relation and trust. Currently the question arises which behavior is triggered or prevented in the procurement staff when they have to achieve monetary purchasing savings. Additionally, whether and how monetary purchasing savings negatively influence the TCO/LCC and TTM processes, as well as sustainable company success is not yet decisively demonstrated.

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10 Appendix

10.1 Tables

10.1.1 Selected KPIs For BSC Perspectives

Perspective	Key Performance Indicator	
Financial	• Operation result • Productivity • Turnover • Contribution margin • Profit • Return on equity • Incoming orders	• Material costs • Staff costs • Cash flow • Cost per piece • Revenue per piece • Profitability • Growth
Customer	• Image • Customer loyalty • Market share • Awareness • Customer number • Customer loyalty	• Customer profitability • Number of complaints • Delivery reliability • Response times to complaints • New customer acquisition • Customer satisfaction

O. Münch, *First-Time-Right Procurement,* DOI 10.1007/978-3-658-08620-6_10,

Perspective	Key Performance Indicator	
Internal business processes	• Number of process changes • Continuous improvement implementation • Production time per unit • Time-to-market • Negotiating success • Share "Maverick Buying"	• On-time rate • Number of new product launches • Number of process changes • Production cycle time • Innovation rate • Production efficiency • Orders per employee • Purchasing savings • Purchasing efficiency • Sales from new products • Turnover
Learning and growth	• Qualification index • Training days • Sick leave • Staff productivity • Absenteeism • Sales per employee • Employee satisfaction • Implemented improvements	• Number of management or appraisal interview • Number of suggestion for improvement • Received suggestions • Early involvement of purchasing in R&D • Development projects with external suppliers • Staff turnover rate

Perspective	Key Performance Indicator	
Suppliers	• Delivery times • Service • Quality • Know-how • Price comparison • Quantity scale • Delivery reliability • Complaints • Innovation rates • Number of suppliers	• Develop new suppliers • Price change vs. industry indices • Price stability • Share of punctual deliveries • Number of supplier development activities • Frame contract rate • Discounts • Number of audits

Source: Author's illustration based on Abel, 2001: 11–13; Piontek, 2004: 226–228; PwC, 2002: 22

10.1.2 Selected Tools For DMAIC Phases

Phase	Activity and result	Examples of tools
Define	Define problems, goal, project specifications, influence factors, and planned activities.	• SIPOC (process definition), • voice of the customer (VOC), • project plan, • stakeholder analysis, • critical to quality (CTQ), • etc.
Measure	Measure and verify the existing system.	• Measurement plan, • data acquisition, • data representation, • measurement system analysis, • process mapping, • etc.

Phase	Activity and result	Examples of tools
Analyze	Analyze and understand the system and the reasons for deviation from the target state.	• Value stream map, • process analysis, • FMEA, • correlation, • design of experiments (DOE), • Ishikawa-diagram, • C&E matrix (causes & effect) • Pareto diagram, • lead time analysis, • etc.
Improve	Improve the system.	• Poka-Yoke • simulation, • design of experiments (DOE), • quality function deployment (QFD), • prototyping, • reliability testing, • brainstorming, • etc.

Phase	Activity and result	Examples of tools
Control	Monitor and control the improved system.	• Control charts, • process capability, • reviews, • project completion, • etc.

Source: Author's illustration based on Dickmann, 2001: 65; Roenpage et al., 2007: 16–17

10.2 German Federal Statistical Office Data

10.2.1 Consumer Price Index

Verbraucherpreisindex (inkl. Veränderungsraten): Deutschland, Jahre
Verbraucherpreisindex für Deutschland
Deutschland
Verbraucherpreisindex insgesamt

Jahr	Verbraucherpreisindex	Veränderung zum Vorjahr
	2005=100	in (%)
1991	75,9	.
1992	79,8	5,1
1993	83,3	4,4
1994	85,6	2,8
1995	87,1	1,8
1996	88,3	1,4
1997	90,0	1,9
1998	90,9	1,0
1999	91,4	0,6
2000	92,7	1,4
2001	94,5	1,9
2002	95,9	1,5
2003	96,9	1,0
2004	98,5	1,7
2005	100,0	1,5
2006	101,6	1,6
2007	103,9	2,3
2008	106,6	2,6
2009	107,0	0,4

Source: German Federal Statistical Office, 2011

10.2.2 Producer Price Indexes Of Industrial Products

Erzeugerpreisindizes gewerblicher Produkte: Deutschland, Jahre, Güterverzeichnis (GP2009 2-/3-/4-/5-/6-/9-Steller/ Sonderpositionen)
Index der Erzeugerpreise gewerblicher Produkte
Deutschland
Erzeugerpreisindizes gewerblicher Produkte (2005=100)

GP2009 (2-Steller): Gewerbliche Produkte		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GP09-05	Kohle	73,0	84,7	79,2	73,6	87,5	100,0	103,3	106,3	143,1	126,8
GP09-06	Erdöl und Erdgas	60,3	76,4	69,1	78,0	73,0	100,0	128,0	119,1	151,2	108,0
GP09-08	Steine und Erden, sonstige Bergbauerzeugnisse	98,6	99,5	101,9	102,3	101,5	100,0	99,9	103,1	106,2	109,9
GP09-10	Nahrungsmittel und Futtermittel	94,9	100,0	99,5	99,4	100,4	100,0	101,4	105,6	113,6	108,6
GP09-11	Getränke	93,9	95,8	96,9	98,4	99,9	100,0	101,0	103,4	106,6	106,3
GP09-12	Tabakerzeugnisse	65,8	67,1	72,7	78,3	87,1	100,0	105,4	106,7	107,3	109,2
GP09-13	Textilien	99,3	100,2	100,5	100,6	100,1	100,0	101,3	102,6	104,2	104,7
GP09-14	Bekleidung	100,2	100,9	101,5	100,9	99,9	100,0	100,3	100,5	101,8	102,7
GP09-15	Leder und Lederwaren	96,7	98,7	99,8	99,5	98,6	100,0	100,4	101,7	102,4	103,2
GP09-16	Holz und Holz- Kork- Korb- Flechtwaren ohne Möbel	101,9	101,6	99,5	98,9	98,7	100,0	106,2	114,8	111,8	106,9
GP09-17	Papier, Pappe und Waren daraus	100,5	104,3	103,5	102,2	100,7	100,0	101,6	105,6	107,5	102,7
GP09-18	Druckerzeugnisse, besp. Ton-, Bild- u. Datenträger	103,7	104,6	104,6	103,9	102,1	100,0	99,3	99,1	98,7	96,9
GP09-19	Kokereierzeugnisse und Mineralölerzeugnisse	79,6	78,8	78,9	82,4	87,5	100,0	108,6	111,8	126,5	103,6
GP09-20	Chemische Erzeugnisse	92,6	94,1	92,1	93,6	95,2	100,0	104,3	107,0	112,4	108,7
GP09-21	Pharmazeutische und ähnliche Erzeugnisse	100,9	104,5	103,6	103,5	102,1	100,0	99,9	99,2	97,9	98,8
GP09-22	Gummi- und Kunststoffwaren	96,0	97,1	97,3	97,4	97,9	100,0	101,4	103,0	104,9	102,9
GP09-23	Glas und -waren, Keramik, Steine und Erden	100,9	101,3	100,5	98,0	98,8	100,0	102,0	106,8	109,7	111,3
GP09-24	Metalle	79,2	78,8	77,4	79,5	90,2	100,0	113,1	121,1	125,2	104,7
GP09-25	Metallerzeugnisse	91,9	92,6	93,1	93,7	96,1	100,0	102,4	106,1	109,2	108,7
GP09-26	Datenverarbeitungsgeräte, elektr. u. opt. Erzeugn.	126,1	123,3	122,4	117,4	111,7	100,0	90,5	82,0	75,5	72,8
GP09-27	Elektrische Ausrüstungen	98,6	98,7	98,7	98,9	99,2	100,0	101,7	103,8	105,3	105,5
GP09-28	Maschinen	93,7	95,2	96,6	97,5	98,5	100,0	101,7	104,0	106,4	108,9
GP09-29	Kraftwagen und Kraftwagenteile	94,4	95,3	96,9	97,7	98,4	100,0	100,7	101,4	102,0	102,4
GP09-30	Sonstige Fahrzeuge	95,0	96,1	96,9	97,4	98,1	100,0	101,8	104,6	107,4	108,7
GP09-31	Möbel	92,8	95,5	97,3	97,7	98,6	100,0	100,8	103,3	107,6	110,1
GP09-32	Waren a.n.g.	96,1	96,8	98,8	99,7	99,7	100,0	101,1	102,5	104,4	106,1
GP09-35	Energieversorgung	75,2	85,2	80,9	88,0	88,9	100,0	117,0	114,9	129,8	122,2
GP09-36	Wasser und Dienstleistungen der Wasserversorgung	95,0	94,6	94,7	94,9	97,7	100,0	101,4	102,6	103,6	106,3
GP09-38	Dienstleistungen zu Abfällen und Wertstoffen	-	-	-	-	-	-	-	-	-	-

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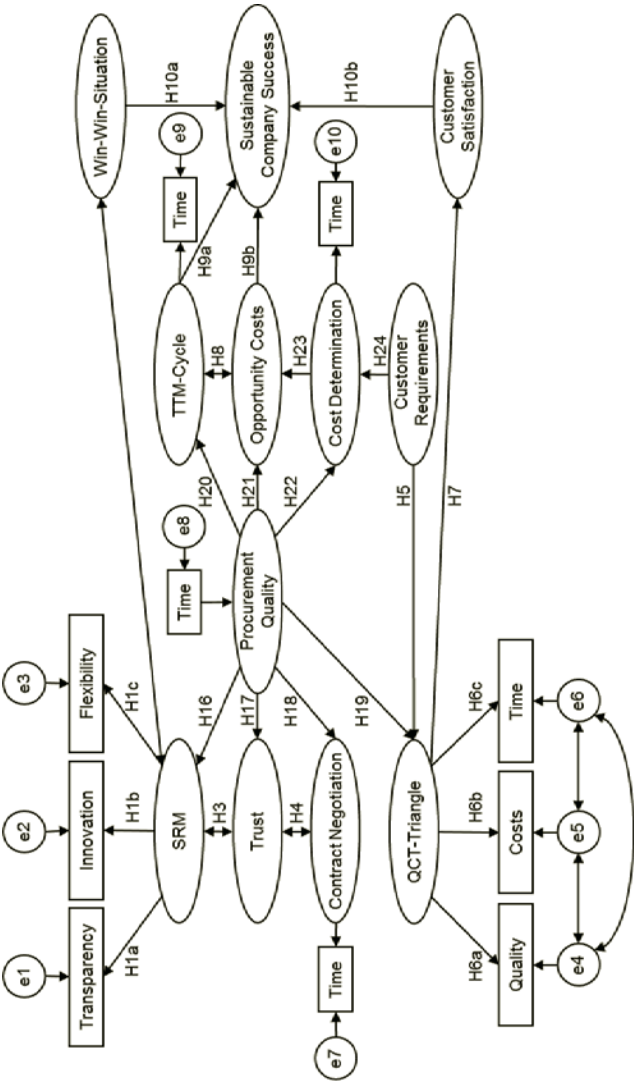
Source: German Federal Statistical Office, 2011

10.3 SM for the holistic hypotheses approach to FTRP



Source: Author's illustration based on Backhaus et al., 1990; Hox & Bechger, 1998; Byrne, 2001; Schumacker & Lomax, 2004; Eden, 2010

10.4 The Common Law Of Business Balance

A meditation on price:

“There is hardly anything in the world that someone cannot make a little worse and sell a little cheaper, and the people who consider price alone are that person's lawful prey. It's unwise to pay too much, but it's worse to pay too little. When you pay too much, you lose a little money - that is all. When you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do. The common law of business balance prohibits paying a little and getting a lot – it can't be done. If you deal with the lowest bidder, it is well to add something for the risk you run, and if you do that you will have enough to pay for something better.”

Attributed to

John Ruskin

Writer, social thinker, and philanthropist

*02/08/1819, †01/20/1900

10.5 Remarks Regarding The Dissertation Text

10.5.1 Anonymity

Research reporting tends to treat essentially and uniquely human activities involving real people doing real work. Recognizing this fact, the dissertation provides its respondents with fictionalized identities. As such, all people referred to or quoted in this dissertation have been fictionalized to maintain their anonymity. Any resemblance to persons or organizations is coincidental; the reader should draw no conclusions about their true identity.

10.5.2 Gender-Specific Language

Gender-specific language in this dissertation has been standardized to non-gender-specific language whereever possible. In cases where this has not been possible for reasons of style or preservation of meaning, masculine pronouns have been used to represent both genders. In cases of oversight where the pronoun “she” or “her” is used, it will also refer to both genders unless the context specifically indicates otherwise.

10.5.3 Language

The spelling and grammar of American English is used in this dissertation. For consistency, all spelling has been standardized to this usage, including that in citations, titles of works, and reference list entries. Hence, words such as “organisation” will always appear as “organization” in this dissertation.

Respondents quoted directly in this dissertation used spoken English as opposed to written English to explain their thoughts and ideas in response to the questions asked. The spoken language has been modified in this dissertation while transcribing it into written form. This includes removing any content that does not directly add to the response's meaning (for example, “ums”, pauses, and conversational grammar).