JÖNKÖPING INTERNATIONAL
BUSINESS SCHOOL
JÖNKÖPING UNIVERSITY

Collaborative materials management

A comparison of competitive and collaborative approaches to materials management in SCM

Master's thesis within International Supply Chain Management

Author: Farzad Khaki Boukani

Soundous Boufaim

Tutor: Helgi-Valur Fridriksson

Jönköping, January 2010

Master's Thesis in International Supply Chain Management

Title:	Collaborative materials management
Author:	Farzad Khaki Boukani & Soundous Boufaim
Tutor:	Helgi-Valur Fridriksson
Date:	2010-01-04
Subject terms:	Materials Management, SCM, collaboration

Abstract

Supply Chain Management (SCM) presents the new paradigm in strategic and operational business management for the 21st century. By offering a cooperative and integrated model of the value-creation process in a cross-organizational perspective, it also places new challenges on business management methods and instruments used, in theory as in practice. In the field of materials management, the new SCM perspective led to major changes in the methods used and in the emphasis of the different process steps. This master thesis presents classical as well as supply-chain-based materials management methods, compares them and draws conclusion on their use in theory and practice.

Materials Management (MM) was long neglected by business management and economic theory. The role of materials management as a secondary activity in the organization and its supportive role to production were encouraged in classical materials management. SCM reevaluated the value chain of whole industries and therefore reemphasized the strategic role of materials management for the supply chain. MM is divided into 5 steps or activity fields: supporting activities, sourcing, distribution, storage and disposal. SCM changed the methods used in each separate step. In supporting activities for example SCM requires multi-dimensional, long-term and dynamic instruments to guide decision-making in materials management, using cross-organizational cooperation to succeed, such as advanced purchasing. In sourcing the strategic role of sourcing was reemphasized by SCM and new tools such as the use of procurement marketing, SCR, green sourcing, TCO, ethical sourcing, PCB, strategic alliances and TPB were introduced, due to the new cooperative paradigm in SCM. In distribution and storage too, cooperative instruments are used to keep up competitiveness, such as VMI and integrated logistics. In disposal, however, SCM provides a totally new philosophy, reducing the focus on waste and enhancing material cycles, environmental programs and new recycling programs, such as reverse logistics. Overall in SCM, the main focus was relocated from scheduling and storage planning that was the main activity of materials management in the classical perspective to strategic sourcing and disposal as the two main processes of materials management.

Concluding, the comparison of classical and supply-chain-based materials management showed, that SCM emphasizes on the strategic role of materials management by offering an integrated and process-oriented perspective on the value-creation process. Furthermore supply-chain-based materials management bases on communication, mutual interdependence and decreasing short-term competition to stay competitive in the long run as an entity, represented by the supply-chain. The long-term, complex and dynamic perspective of SCM and the pursuing of multiple

and conflicting goals in SCM are mirrored in the methods used in supply-chain-based Materials Management. Recapitulatory, SCM reemphasized the strategic role of materials management as a cooperative, process-oriented primary activity within the supply-chain that has major potential for the competitiveness of the supply chain in the long-run.

Table of Contents

Abstract ... 3
Table of Contents ... 5
List of Figures ... 9
List of Abbreviations ... 11
1. Introduction ... 12
2. Background ... 12
2.1. Relevance of the research topic in general ... 12
2.2. Relevance of materials management in SCM ... 13
2.2.1. Definitions and key terms in SCM ... 13
2.2.2. Integration in SCM ... 15
2.2.3. The special importance of relationships in SCM ... 16
2.2.4. Tasks of SCM ... 17
2.2.5. SCM process ... 18
2.2.6. Instruments used in SCM ... 18
2.2.7. Managing risk in the supply chain ... 19
2.2.8. The role of materials management in SCM ... 20
2.2.9. Special requirements for materials management in SCM ... 21
3. Research problem ... 21
4. Purpose ... 22
4.1. Structure of findings ... 23
4.2. Research criteria / Limitations ... 23
5. Research methodology ... 24
5.1. Critical discussion on methodology ... 27
6. Competitive-based Materials Management ... 28
6.1. Introduction ... 28
6.1.1. Definitions and key functions ... 28
6.1.2. Goals and main tasks ... 30
6.1.3. Relevance of materials management in organizational success ... 31
6.2. Supporting instruments in competitive Materials Management ... 31

6.2.1. Standardization 32
6.2.2. Labeling 32
6.2.3. ABC-analysis 32
6.2.4. XYZ-Analysis 34
6.2.5. ABC/XYZ-Analysis 34
6.2.6. LMN- analysis 35
6.2.7 Value analysis 35
6.2.8. Analysis of price structure 36
6.2.9 Product-Quantum-Analysis 36
6.2.10 Conclusion on supporting instruments 37
6.3. Scheduling of materials 37
6.3.1. Demand calculation 39
6.3.2. Inventory calculation 40
6.3.3. Order calculation 41
6.4. Sourcing 42
6.4.1. Definitions and main tasks 42
6.4.2. Planning (preparation) of purchasing 42
6.4.3. Execution of Purchasing 44
6.4.4. After-Purchase Management 45
6.5. Storing and Distribution 46
6.5.1. Definition and main tasks 46
6.5.2. Technical tasks of Storing 47
6.5.3. Economic tasks of storing 47
6.5.4. Materials distribution 47
6.6. Materials disposal 48
6.6.1. Definition and main tasks 48
6.6.2. Avoidance of waste 49
6.6.3. Recycling of waste 49
6.6.4. Removal of waste 50
6.7. Summary on competitive materials management 50
6.8. Conclusion 51
7. supply-chain-based materials management in SCM 53

7.1. Initial situation 53
7.2. Supporting instruments in supply-chain-based MM 54
7.2.1. Portfolio analysis 54
7.2.2. Target Costing 60
7.2.3. Advanced Purchasing 62
7.2.4. Product life-cycle analysis 65
7.2.5. Experience curve analysis 67
7.3. Supply-chain-based concepts in scheduling 68
7.3.1. Management of business interfaces 68
7.3.2. Integrated inventory management 69
7.3.3. Dynamic demand calculation 71
7.4. Supply-chain-based MM in sourcing 74
7.4.1. Sourcing Strategies in modern materials management – An overview 74
7.4.2. Procurement marketing 86
7.4.3. Strategic Sourcing 101
7.4.4. Supplier relationship management 104
7.4.5. Total Cost of Ownership 111
7.4.6. Purchasing Card Buying 112
7.4.7. Third Party Buying 113
7.4.8. Green sourcing 116
7.4.9. Ethical Sourcing 118
7.4.10. Strategic alliances (horizontal cooperation) 121
7.5. Supply-chain-based methods in distribution and storage 127
7.5.1. Vendor Managed Inventory 127
7.5.2. Integrated logistics 128
7.6. Supply-chain-based methods in disposal 128
7.6.1. Circular materials management 128
7.6.2. Environmental management system 131
7.6.3. Reverse logistics 134
7.7. Summary on Chapter 7 136
8. Analysis of competitive and supply-chain-based MM 137
8.1. Comparison of steps in MM 138

8.1.1. Comparison of supporting methods of materials management 138
8.1.2. Comparison of methods in scheduling 138
8.1.3. Comparison of sourcing methods in materials management 139
8.1.4. Comparison of storage and distribution methods of materials management 140
8.1.5. Comparison of disposal methods in materials management 141
9. Conclusion 142
9.1. Theoretic results and review of research purpose 142
9.2. Managerial implications 144
Bibliography 145

List of Figures

Figure 1: Network structure of supply chains (www.argeelogistics.com, 2008) 14
Figure 2: Risk management, adapted from (Kearny, 2003). 20
Figure 3: Perspectives on materials management, adapted from (Sohal & Howard, 1987) 29
Figure 4: Use of ABC-analysis in materials management, adapted from (Flores & Whybark, 1988)..... 33
Figure 5: Lorenz curve in ABC-analysis (www.indoition.com, 2009) 34
Figure 6: ABC/XYZ-analysis, adapted from (Hoppe, 2006)..... 35
Figure 7: Scheduling tasks, adapted from (Wight, 1995)..... 38
Figure 8: Forms of material demands, adapted from (Wight, 1995) 38
Figure 9: Customer-driven demand calculation techniques (Gallego & van Ryzin, 1994) 39
Figure 10: Optimal size of order (www.endurancetrading.com, 2008) 41
Figure 11: Sourcing tasks, adapted from (Lee & Billington, 1993)..... 42
Figure 12: Principles of sourcing, adapted from (Gallego & van Ryzin, 1994; Zipkin, 2000) 44
Figure 13: Contracting process in purchasing, adapted from (Gallego & van Ryzin, 1994)..... 45
Figure 14: Storing and Distribution tasks, adapted from (Wight, 1995)..... 46
Figure 15: Disposal tasks, adapted from (de Coverly, McDonagh, & Patterson, 2008) 48
Figure 16: supply market / corporate strength portfolio (Wind, Mahajan, & Swire, 1983) 56
Figure 17: Supply market attractiveness / competitive advantage portfolio (Wind, Mahajan, & Swire, 1983)..... 58
Figure 18: Risk of shortage / Influence on performance portfolio 59
Figure 19: Target Costing Process, adapted from (Monden & Hamada, 2000, p. 103) 61
Figure 20: Characteristics of Target Costing, adapted from (Monden & Hamada, 2000) 62
Figure 21: Product life cycle (www.trumpuniversity.com, 2008) 65
Figure 22: BCG-Matrix (Hambrick, MacMillan, & Day, 1982) 66
Figure 23: Experience curve (wpcontent.answers.com, 2009)..... 68
Figure 24: Analysis of product range, adapted from (Parveen & Rao, 2008) 71
Figure 25: Dynamic demand calculation, adapted from (Meloch & Plank, 2006). 72
Figure 26: Overview of sourcing strategies, adapted from (Linder, Jarvenpaa, & Davenport, 2003, Veugelers & Cassiman, 1999) 74
Figure 27: Make or buy decision process, adapted from (Veugelers & Cassiman, 1999). 76
Figure 28: Geographic sourcing strategies, adapted from (Kaneko & Nojiri, 2008) 81
Figure 29: Strategies concerning sourcing subject, adapted from (Williamson, 1981) 86
Figure 31: Areas of sourcing constellations, adapted from (Kotler, 2005) 88
Figure 32: Process of potential analysis, adapted from (Kotler, 2005)..... 89
Figure 33: Market forms, adapted from (Kotler, 2005) 91
Figure 34: Process of supplier analysis, adapted from (Kotler, 2005) 93
Figure 35: Process of strategic foresight analysis, adapted from (Kotler, 2005) 98
Figure 36: Procurement marketing mix, adapted from (Kotler, 2005) 99

Figure 37: Structure of virtual markets, adapted from (Hoffner, Facciorusso, Field, & Schade, 2000; Kotler, 2005) 100
Figure 38: Electronic bidding process, adapted from (Jap & Haruvy, 2008) 101
Figure 30: Value chain (Recklies, 2001) 103
Figure 39: The four layers of SCR, adopted from (Hingley, 2001; Handfield & Bechtel, 2002) 107
Figure 40: Process of building a strategic alliance, adapted from (Elmuti & Kathawala, 2001; Vyas, Shelburn, & Rogers, 1995). 111
Figure 41: Types of purchasers, adapted from (Leonhardt, 1988). 114
Figure 42: Hybrid forms of sourcing, adapted from (Leonhardt, 1988). 115
Figure 43: sourcing/outsourcing-portfolio, adapted from (CAPS, 1998; Stinchcombe, 1984) 115
Figure 44: Green purchasing strategies (Min & Galle, 1997, p. 11) 117
Figure 45: Horizontal SA in materials management (Recklies, 2001) 122
Figure 46: Forms of fit, adapted from (CAPS, 1998). 125
Figure 47: Material circle, adapted from (Szekely & Trapaga, 1995) 129
Figure 48: Links between ERP- and recycling-systems, adapted from (Ayres, 1992). 130
Figure 49: Package circle, adapted from (Ayres, 1992; Szekely & Trapaga, 1995). 131
Figure 50: Activities in EMAS, adapted from (EU- EMAS) 132
Figure 51: process of reverse logistics (Srivastava & Srivastava, 2006, p. 527) 135
Figure 52: Summary of methods compared 138
Figure 53: Summary of supporting methods in materials management 138
Figure 54: Materials management methods in scheduling 139
Figure 55: Summary of methods in materials management 140
Figure 56: Summary of discussed storage and distribution methods 141
Figure 57: Methods discussed in disposal 141

List of Abbreviations

APM	After-Purchase-Management
ASEAN	Association of Southeast Asian Nations
BATNA	Best Alternative To Negotiated Agreement
BCG	Boston Consulting Group
BIM	Business Interface Management
CSR	Corporate Social Responsibility
ECOWAS	Economic Community Of West African States
ECR	Efficient consumer response
EDI	Electronic Data Interchange
EFTA	European Free Trade Association
EMAS	Eco-Management and Audit-scheme
EMS	Environmental management system
ERP	Enterprise Resource Planning
EU	European Union
ICN	International Competition Network
ICT	Information- and Communication Technologies
id est.	That means
JIT	Just-in-time
LPP	Linear Performance Pricing
MM	Materials Management
MRO	Maintenance, Repair and Operating
NAFTA	North American Free Trade Association
NGO	Non-Governmental Organization
NPO	Non-Profit-Organization
OECD	Organization for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
PCB	Purchase Card Buying
Per se	By itself
PLC	Product Life Cycle
POS	Point of Sale
R&D	Research and Development
ROCE	Return on Capital Employed
RORAC	Return on Risk-Adjusted Capital
SA	Strategic Alliance
SCM	Supply Chain Management
SCP	Structure-Conduct-Performance
SCR	Supplier-Customer-Relationship
SME	Small and Medium Enterprises
TCO	Total Cost of Ownership
TPB	Third Party Buying
USA	United States of America
VMI	Vendor Managed Inventory

1. Introduction

Materials Management as part of the resource flow processes in business organizations is recently undergoing severe changes in strategic focus and methods used in its management. Main reason for these changes is the increase of SCM models used in business organizations that require a more collaborative approach to management than traditional business management paradigms. Therefore, also the traditional competitive-based materials management theories misfit collaborative perceptions on supply chains. As the existing literature fails to perceive the essentiality of the distinction of materials management methods due to its focus on competition or collaboration, this study aims to define materials management and seeks to establish materials management approaches due to their strategic focus.

2. Background

In this section the basic concepts of material management and its role in SCM are defined to clarify the area of this study. This background will be used to frame the study and discuss its academic relevance. The first part of this section will clarify the relevance of materials management in general while the second section will summarize current knowledge of SCM and give necessary definitions on key terms used in this topic.

2.1. Relevance of the research topic in general

Materials Management as a core function of business management includes inventory management, sourcing, storing as well as distributing materials and waste management. Its importance is increasing since the beginning of the 1990s in business practice and science steadily, since researchers have pointed out the importance of sourcing as one main cost driver of modern business organizations (Lee & Billington, 1993). The number of material-economic reorganization measures in the company and the many publications on this subject furthermore confirm this (Farmer, 1977; Busch, 1988). Additionally, the opportunities to reduce costs and increase profits in other functional areas, especially in sales are largely exhausted or only realizable at high costs (Christopher, 2005). At the same time increasing global competitive pressures occur in the cost, quality and timing of organizational processes. Therefore supply-chain-based mechanisms are also used in materials management. The main purpose of materials management is to supply the business organization reliable and efficiently with materials needed to achieve the organizations strategy and if necessary dispose them ecologically. In this definition three goals are included: the supply problem, the efficiency maxim and the quality goal. This main goal has to be reformulated for each core function and to operationalize the core functions (What is the Role of Purchasing and Materials Management?, 1988).

As SCM manages the material, financial and information flow of organizations (Harrison & van Hoek, 2005), materials management has a special importance in the field of integration of supply chains. This master thesis is examining the role of supply-based materials management methods and compares them with classical competitive-based materials management methods, to explore

the specific factors of supply-based materials management. Therefore it uses literature of both classical and supply-chain based materials management to explore the differences in focus and mechanisms. The thesis therefore is providing an in-depth comparison of classical competitive-based and supply-chain-based materials management, examining the differences in scope and focus of these instruments and deriving conclusions for materials management in both competitive-based and supply-chain-based business organizations.

2.2. Relevance of materials management in SCM

First of all, the relevance of materials management in the field of SCM should be discussed. This is important to clarify the linkages between the research topic and the field of study and to clarify and legitimate the research problem. Therefore in this section the basics of SCM are defined and the relevance of materials management in SCM is discussed.

2.2.1. Definitions and key terms in SCM

The main concept of SCM is the notion of a supply chain. Definitions of supply chains are manifold but all basically share the same main points: a supply chain is about a group of businesses, a supply chain is about collectively producing some value, and at the end of the supply chain lays the consumer. Harrison & van Hoek (2005) for example use the following definition of a supply chain:

"A supply chain is a group of partners who collectively convert a basic commodity (upstream into a finished product (downstream) that is valued by end-customers, and who manage returns at each stage" (Harrison & van Hoek, 2005, p. 7)

Similarly, Wisner, Leong & Tan state that *"... the series of companies that eventually make products and services available to consumers, including all of the functions enabling the production, delivery, and recycling of materials, components, end products, and services, is called a supply chain.*" (Wisner, Leong, & Tan, 2005, p. 6)

Therefore the networks structure and the collective production of a good produced for an end-customer are the main factors explaining supply chains. In Figure 1 the typical network structure of a supply chain is visualized.

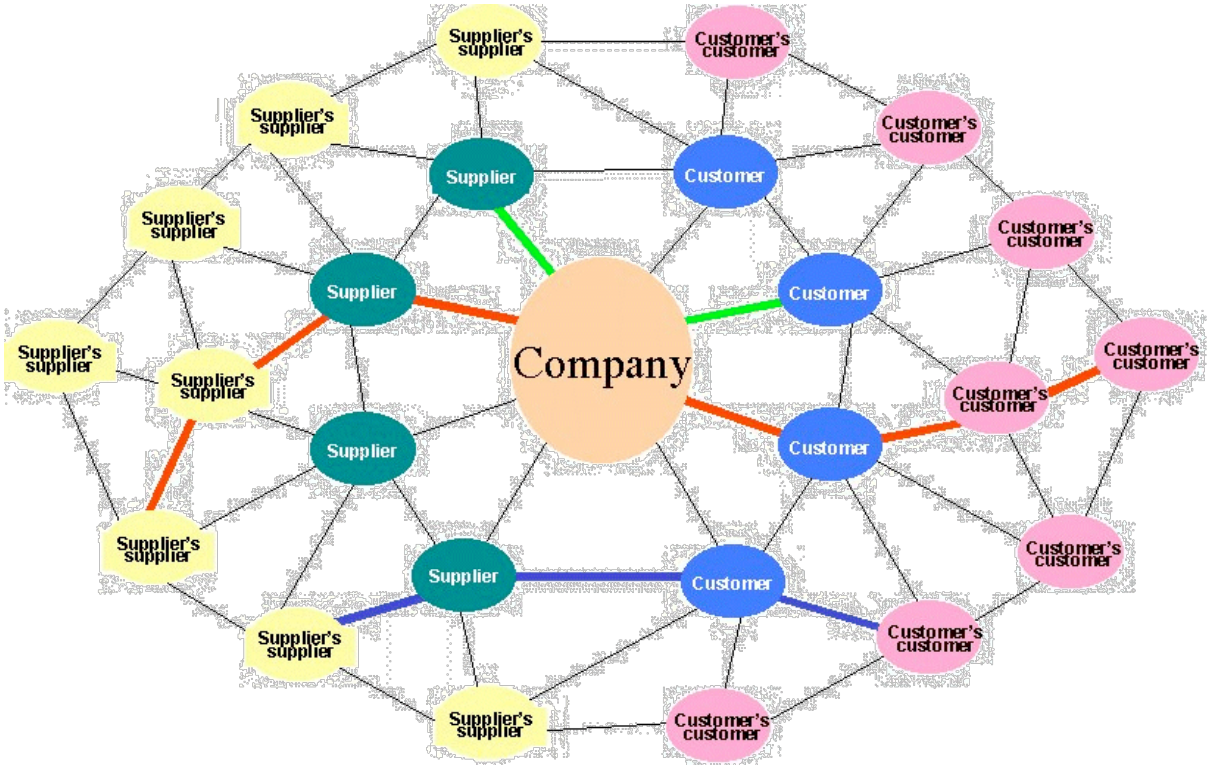


Figure 1: Network structure of supply chains (www.argeelogistics.com, 2008)

Supply Chain Management though "*is concerned with managing the entire chain of processes, including raw material supply, manufacture, packaging and distribution to the end-customer*" (Harrison & van Hoek, 2005, p. 6).

In this perspective Supply Chain Management offers a holistic view on economic production processes. Consequently SCM is concerned with the structure and process within the supply chain, to effectively manage the network of companies within the supply chain and the relationships between them. Essential tasks of SCM have been formulated by Oliver and Weber in 1992 (Harrison & van Hoek, 2005, p. 10):

- SCM views the supply chain as a single entity
- SCM demands strategic decision making
- SCM views balancing inventories as a last resort
- SCM demands system integration

The main contribution of SCM to logistical theories is the focus that SCM gives on competitive strategy. In SCM the main insight is that companies do not solely compete with direct competitors, independent from their value creation process, but that rather production chains compete with each other for the part of the budget of the end-customer.

This new strategic perspective changes fundamentally the way of economic thinking in several ways. First of all, it provides a customer-centric paradigm of business, away from direct customers to the end-customer. The main insight here is that organizations therefore compete

with practically every product for the budget of the customer, called generic substitution (Johnson, Scholes, & Whittington, 2005).

Second, the main mechanisms change from sales-based and cost-sensitive management, to a management of cooperation and trust (Christopher, 2005, p. 5). The importance of cooperation and trust is especially important to achieve the gains from SCM in the long term (Bolton & Dwyer, 2003). Otherwise a successful integration between the organizations in the supply chain is not possible. Trust, thus, is a main concept in SCM to achieve win-win-situations and outperform other supply chains (Wisner, Leong, & Tan, 2005, p. 423).

Third, SCM is about managing relationships instead of operations (Christopher, 2005, p. 5). The essential manageable parameters in a supply chain are the interfaces between the different parts in the SCM, and with that the relationships within the supply chain network.

Last, SCM is about competitive advantage (Christopher, 2005, p. 6), but the benchmark of this competitive advantage is not the direct competitor, but other supply chains delivering similar value for the end-customer. Competitive Advantage can be reached according to Porter, either through delivering value with lower costs, or delivering higher value at the same costs (Christopher, 2005). Porter first of all claimed that often, competition is viewed too narrowly and too pessimistically (Porter M. E., 2002, p. 3). Furthermore a value-chain-based view on the company is preferred here (Christopher, 2005, p. 13). SCM goes even further and promote a value-chain-focus on the whole supply chain. Therefore the concepts of the supply chain (many companies contributing to the end product in a chain of production) and the value chains (examining the value-creating and value-destroying activities of the production process) are combined.

2.2.2. Integration in SCM

The main objective of SCM is an integration of the organizations that represent a supply chain of a certain end-product. Therefore integration, coordination and control of production activities are at the core of SCM. Generally the "need for aligning processes and collaborating between organizations within supply chains" (Harrison & van Hoek, 2005, p. 217) is a new concept fostered by SCM. Contrariwise in traditional business management competition was the main paradigm. Integration in SCM includes the following key issues (Harrison & van Hoek, 2005, p. 218; Mentzer, et al., 2001, p. 3; Bolton & Dwyer, 2003):

- Collaboration in the supply chain
- Efficient consumer response
- Collaboration planning, forecasting and replenishment
- Managing supply chain relationships

2.2.2.1. Collaboration in the supply chain

Collaboration in supply chains generally defines the activities of internal, external and electronic integration of structure and process. Internal integration is concerned with the systematic integration of functions within an organizations own value chain. Here interfaces between

functions should be managed frictionless and mutually reinforcing. Strategic fit is the main instrument leading to an internal integration of the value chain. External integration addresses to the integration of the organizations within the supply chain. Here the actual material, financial and information flows between organizations in the value chain are integrated. The methods addressing to materials management (material and information flows) in SCM are discussed in detail in section 4 starting p. 53. Furthermore electronic integration addresses to the integration of ICT-systems within the supply chain, to ensure fast and correct information flows. Main aim is the compatibility of the systems in the chain. Electronic integration should enable the supply chain to use electronic transactions, share knowledge and information across organizational borders and ensure collaborative planning and strategic management (Harrison & van Hoek, 2005).

2.2.2.2. Efficient Consumer Response

ECR is that part of the supply chain management methods that ensure that the entire supply chain is focusing on the end-customer and meet his demands. Meeting end-customers requirements should be ensured by collaboration throughout the supply chain. Efficient customer response includes category management, continuous replenishment and enabling technologies. Category management balances demands between suppliers and customers in the supply chain towards the end-customer. Continuous replenishment is an inventory concept that allows supplier and customers to manage their inventory efficiently, through joint-inventory management. Last, enabling technologies are used to detect, analyze and implement end-customer needs. (Harrison & van Hoek, 2005)

2.2.2.3. Collaborative planning, forecasting and replenishment

A main task of SCM is collaboration of organizations in planning, forecasting and replenishment. Here collaboration is fostered on strategic and operational levels to ensure competitiveness of the supply chain. The main aim is to improve customer service while decrease costs in inventory management. Therefore the trade-off between efficiency and effectiveness should be resolved by collaboration in planning and implementation between organizations within the chain. (Harrison & van Hoek, 2005)

2.2.2.4. Managing relationships in SCM

The main aim of building a supply chain is to increase coordination between organizations within a value chain. Coordination though requires trust. Trust though is built up in relationships. Therefore the relations within the organizations have to be managed carefully. Managing relationships in SCM includes creating close relationships initial, managing factors that influence the relation in the supply chain and monitor the relationship.

2.2.3. The special importance of relationships in SCM

SCM is about coordination and collaboration and therefore requires relationships of the organizations that are part of the supply chain (Harrison & van Hoek, 2005). Relationship management as a result is a main concept that supports SCM (Christopher, 2005), which will be discussed in detail here.

Main parts of relationship management in SCM include selection of partners; choose a form of partnership and collaboration, rationalization of partners, development of supplier networks, supplier development and implementing partnerships. (Harrison & van Hoek, 2005).

Supplier networks are formal or informal groups who share a common customer. Supplier networks arise in the form of supplier associations, keiretsu or Italian districts.

A **supplier association** basically is an organizational form for the purpose of coordination and development. Through a supplier association the suppliers participating are provided with training and resources for production and logistics process improvements. Furthermore through this form, quality improvements can arise. More frequent communication is another main advantage of this network structure (Harrison & van Hoek, 2005).

Keiretsu is a Japanese business structure, which is recently revised by western researchers. In keiretsu coordination and control is reached through cross-ownership within the supply chain. That ensures mutual objectives and collaboration. In the keiretsu, a lead organization is organizing collaboration. The equity-structure is ensuring that all firms in the supply chain follow the supply chain strategies. (Harrison & van Hoek, 2005)

Italian districts are the supplier networks that are presented by a cluster form and were first discovered by Porter in the Italian ceramics industry (Porter M. E., 1990). Therefore a cluster of an industry is built, if certain factor conditions, demand conditions, supporting industries and firm structure are met. This supply chain network model focuses on geographic proximity and the fit of supplier, demand, supporting industries with firm strategy. Therefore a holistic management of the whole network (the cluster) is necessary.

2.2.4. Tasks of SCM

Due to the high complexity of SCM, the main tasks of SCM are interface coordination, optimization of material and information flows and strategic development of the supply chain. Additionally to these tasks, successful SCM performs the following strategic and operative tasks (Bechtel & Jayaram, 1997).

2.2.4.1. Strategic tasks of SCM

The strategic tasks of SCM are manifold and include development of the supply chain vision and image. According to this vision and image the structure and process of SCM, also including the ICT-systems supporting the supply chain, can be developed. Furthermore contracting and distribution of rights and responsibilities have to be defined. Subsequently make-or-buy-decision and the allocation of the production volume of the supply chain can be managed. Another important aspect of strategic SCM is the distribution of know-how. The formulation of cross-organizational strategies concerning products and processes, as well as integrated recycling is then the result of the main task of the strategic SCM work. Furthermore strategies of mutual production and quality management have to be formulated and implemented. The functional strategies formulated then include the supply and sales strategies for the whole supply chain as well as for the member organizations within and installing an SCR-management. The last

function of strategic SCM is to install an integrated controlling and benchmarking into the SCM to implement and control the strategic integration of efforts within the supply chain.

2.2.4.2. Operative tasks of SCM

The operative tasks of SCM are following the strategic SCM in time and importance. These include materials scheduling and optimization of processes, quality management of production as well as planning, implementing and controlling the necessary ICT-systems that are accompanying the production process of the supply chain. Furthermore procurement market research and supplier evaluation is part of the operative SCM, as well as the following contracting and handling with suppliers. The coordination of interfaces is the main task of an integrated SCM. All activities then are controlled and supervised by strategic SCM's controlling function.

2.2.5. SCM process

Implementation of the SCM concept leads to a certain process design within the supply chain. The main process of SCM includes R&D, production, supply, distribution and disposal (Wisner, Leong, & Tan, 2005).

R&D in supply chains includes the planning of processes and products, product development, product design, simultaneous engineering, team engineering, building of systems and modules, product standardization, reduction of product range, product data management, supplier integration, control of technical feasibility, calculation and quality planning. (Wisner, Leong, & Tan, 2005)

Production in supply chain management includes the scheduling of the production process, production range planning, planning of quantities and qualities, chronological planning, preparation for production, material flow planning, quality management in production and change management. In the production process the SCM includes monitoring of production, monitoring of orders and material supply. (Harrison & van Hoek, 2005)

Supply in supply chain management is concerned with the demands and the supply process defined in materials management, namely scheduling, sourcing, distribution, storage and disposal, including strategic and operative sourcing (Wisner, Leong, & Tan, 2005).

Distribution and disposal are concerned with the transport chain of the supply chain and recycling problems. (Harrison & van Hoek, 2005)

2.2.6. Instruments used in SCM

After the main philosophy, process and mechanisms of SCM are clarified, main instrumental concepts of SCM are defines here, as they are used in the main part of the study.

2.2.6.1. JIT

JIT (just-in-time) is a logistics concept that is describing delivery that is synchronized to production totally. Therefore inventory can be minimized. JIT is a concept used in integrated supply chains (Harrison & van Hoek, 2005)

2.2.6.2. Lead time

Lead time refers to the total time between sourcing materials until the customer receives the good produced. Within the supply chain then the time for certain processes can be calculated and minimized. The concept of lead time first noticed the importance of time-based competition and the existence of economies of time. (Christopher, 2005)

2.2.6.3. Lean thinking

Lean thinking refers to the elimination of waste in all areas of the organization. Therefore perfection in production should be reached, through avoiding costs that arise from waste and value for the customer can be increased. (Harrison & van Hoek, 2005)

2.2.6.4. Agile supply

Agile supply chain is the term that defines very flexible supply chains. Flexibility in the sense of an agile supply chain simply means to be customer responsive and to quickly adopt customer requirement changes within the supply chains structure and processes (Harrison & van Hoek, 2005)

2.2.7. Managing risk in the supply chain

A main challenge in SCM is the management of risk throughout the supply chain. Basically supply chains are considered to be more vulnerable and therefore the respondence to risk rises with integration of the supply chain. This fact is a result of the risks that arise within the supply chain and external from the supply chain. The reason for this vulnerability is the following: (Lambert & Cooper, 2000; Christopher, 2005; Smeltzer & Siferd, 2006)

- Focus on efficiency rather than effectiveness
- Globalization of supply chains
- Focused factories and centralized distribution
- Trend to outsourcing
- Reduction of the supplier base (Christopher, 2005)
- Fragmentation of the supply chain

Risk management in SCM therefore is of special importance. Risk management first of all requires an understanding of the risk profile of a supply chain. The risk for the chain is a product of probability of a disruption and the impact it would have on the supply chain as an entire unit. The various risks in the risk profile include supply risks, demand risks, process risks, control risks and environmental risks (Christopher, 2005). The main steps in evaluating the risk profile are visualized in Figure 2 below, following (Kearny, 2003).

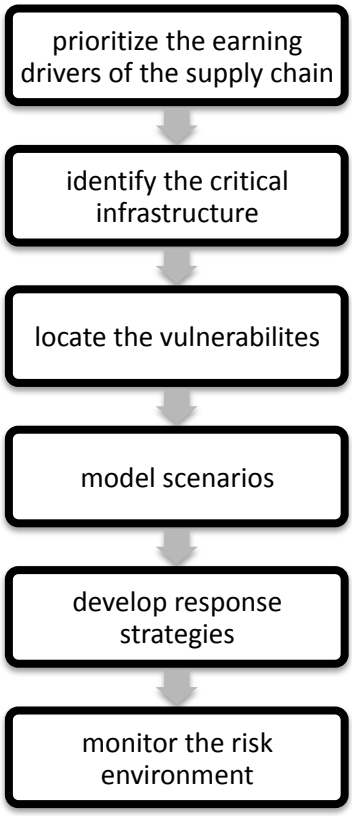


Figure 2: Risk management, adapted from (Kearny, 2003).

2.2.8. The role of materials management in SCM

In this section the role of materials management in SCM is discussed. The first notion on this topic, lies in the essential tasks of SCM stated above, where it says "SCM views balancing inventories as a last resort". For classical materials management though balancing inventories is one of the core purposes. Can that conclude in the irrelevance of materials management consequently? Not, necessarily. That only means that the traditional competitive materials management methods do not fit with the strategic concept of SCM. Basically also with using a SCM perspective on economic transactions, materials management still is important, not only for the single firm but also for the supply chain as a whole. Furthermore the specific network structure of SCM might change the purposes for materials management to other than balancing inventories.

Additionally material flows between organizations within the supply chain have to be managed (Lee & Billington, 1993). As the one of the main aims of a supply chain is to keep up the material flows from raw materials to end customers (Harrison & van Hoek, 2005, p. 12), materials management has a key function in the SCM.

Classical logistics paid only limited attention to materials management. It was considered as "a service to production" (Wisner, Leong, & Tan, 2005, p. 33), and its strategic role was clearly

underestimated. In section 3 the classical materials management will be discussed and there the subordinate role of materials management in business organizations is clearly visible. However newer concepts of business reengineering discovered the vast potentials that lied in materials management, however they concentrated on the cost aspects mainly. In modern SCM though, materials management play a critical strategic role (Wisner, Leong, & Tan, 2005, p. 33) as it represents the manifold interfaces of output and input that a supply chain faces. What materials management is part of purchasing for an organization, for its suppliers represents pure sales. If these processes can be managed frictionless and strategically clever within the whole supply chain, a complex competitive advantage can be created, through a process that is using strategic capabilities.

Furthermore, sourcing decisions as part of materials management play an important role in SCM. Especially the make-or-buy decisions in sourcing affect the structure of a supply chain and therefore also constitute the level of collaboration needed within the chain. Furthermore decisions about the centralization degree of purchasing might affect the configuration of the supply chain, collaboration needs on operative and strategic levels as well as the base of trust needed for processing in the supply chain. Last the scope of materials management might affect supply chain processes (Wisner, Leong, & Tan, 2005).

2.2.9. Special requirements for materials management in SCM

As the main aim in SCM is a continuous and synchronous flow of material, materials management in SCM should consider decreasing interruptions, decrease inventory and stock, increase delivery on time and proper sequence (Harrison & van Hoek, 2005, p. 12). Furthermore Wisner, Leong, & Tan (2005) suggest the tasks of materials management in SCM as managing supplier alliances, supplier relationship management and strategic sourcing (Wisner, Leong, & Tan, 2005, p. 13).

The specific network and cooperative structure of a SCM makes coordination and collaboration especially important. Therefore a careful relationship management not only with customers (downstream) but also with suppliers (upstream) is of importance, as it may increase value for the end-customer and decrease costs due to frictions within the supply chain. Both effects can lead to competitive advantage. As special instruments for supplier relationship management supplier evaluation techniques and supplier certification processes are used (Wisner, Leong, & Tan, 2005, p. 13).

3. Research problem

The main problem that can be derived from reviewing the literature of SCM and materials management is the contradicting focus and strategies. Materials management is a term used for all kinds of strategies used for purchasing activities of material resources. The mainstream approach in this area has been the competitive approach for many decades not only in business reality and consequently in descriptive research but also in prescriptive theory. Supply Chain Management on the other hand uses a very cooperative and holistic approach on all activities of

the organization, focusing on processes. Materials management as the main purchasing activities of business organizations are processes that now in the traditional, competitive-based materials management approach are managed totally contradictive to the supply chain management paradigm. Here a clear contradiction arises, that shows that depending on the strategy of the organization in its supply chain, the materials management has to be adapted to avoid strategic misfit. Therefore two distinct approaches to materials management can be separated, even though existing literature fails to do so, the more traditional competitive approach and a cooperative approach following modern SCM. As existing literature does not differentiate between this approaches and focuses (due to its historical path) on the more competitive approach, the main question of this paper is to discuss the differences of competitive and SCM materials management and to compare its methods and theoretic backgrounds to draw conclusions on how materials management in the 21st century in cooperated supply chains can be managed.

4. Purpose

As discussed above, this master thesis serves the purpose of comparing classical competitive materials management methods with materials management used in Supply Chain Management. In the literature materials management methods were discussed without definite interpretation of the industry context that they arise in. As business environments for supply chains can offer very different levels of competition, integration and cooperation, a distinct analysis of the two extreme forms of competitive and supply-chain-based materials management is necessary, to show that materials management depends highly on the need of companies to either compete or collaborate. In the literature of materials management both methods are discussed alike and the business contexts are not taken into consideration. The instruments used in these two business paradigms differ in many aspects. A comparison of these two paradigms in the field of materials management can help business organizations to improve their materials management, depending on its business situation requiring stronger integration into the supply chain, or stronger independence in gaining competitive advantage. Furthermore organizations can be able to combine methods of both extreme forms to create a unique approach to materials management depending on their individual needs or change material management over time accordingly to changes in the industrial environment. To reach the purpose of providing an in-depth comparison of supply-chain-based and classical competitive-based materials management and to be able to derive conclusions relevant for business organizations, the following sub-topics are going to be discussed:

- Identify main concepts in classical competition-based materials management and discuss them in detail, this task is resolved in chapter 2.
- Identify main concepts in cooperative supply-chain-based materials management and discuss them in detail in chapter 3.
- Compare classical and supply-chain-based methods, concepts and instruments in materials management and draw conclusions in chapter 4 and 5.

To answer these questions will help to examine the differences of competitive-based (classic) and supply-chain-based materials management. In the literature an explicit differentiation into

classic and supply-chain-based materials management is missing. The literature of SCM just discusses that materials management has to be managed “different” and “more integrated” in SCM (Wisner, Leong, & Tan, 2005, p. 9) (Cooper & Ellram, 1993, p. 13). Furthermore the instruments used in SCM for materials management are substantially different than those used in classical logistics literature. Therefore a detailed study on the different paradigms in materials management can help to further elaborate the purchasing process of organizations and supply chains and lead to improvements in this area.

4.1. Structure of findings

The structure of the research report is divided into the following sections: Section 1 and 2 are introducing the topic and giving background information and definitions on the subject area. Section 3 and 4 are defining research problem and purpose derived from the literature review undertaken in section 2. Section 5 is stating the used research methodology. Section 6 is dealing with the first research question defined in the purpose, namely identifying and discussing the competitive approach to materials management. Section 6 is dealing with the second research question, identifying and discussing materials management based on the SCM paradigm. Section 7 is finally dealing with the third and main research problem, comparing the two distinct approaches to materials management, highlight its differences and draw conclusions for SCM. Section 8 is drawing main theoretic conclusions of the research and giving managerial implications.

4.2. Research criteria / Limitations

The sub-objectives will be achieved through the systematic discussion of the concept, objectives, content, functions and the opportunities and risks realized. The identification of the object is based on four criteria:

- This work is focusing on supply-chain-based methods of material management. Furthermore connections to other fields in logistics are reviewed, according to their relevance in the field of material management. Especial importance will lie on the fact that material management crosses the borders to the organizations upstream markets.

- The second criterion is the industry to be investigated. The work investigates industrial companies where material resources are main part of the production process. Anyhow, the findings might also have impact on other industries, as for example the services field.

- The third criterion is the size of the company. In this thesis, principle all sizes are considered. Most of the new design concepts set, however, a certain "critical" in size demands which have to be met. Should a concept only to a certain size be relevant, this will be stated explicitly.

- The fourth criterion is the time considered in the concept. The investigation into the new design concepts is limited to current literature. Only in cases where there is no current

literature available or a concept has not changed significantly, older literature is considered for discussion.

The exact demarcation of the material management of the logistics companies should not the subject of this work. If necessary, logistical problems that concern material management will be discussed within the text.

5. Research methodology

The authors are using hermeneutical text analysis to discuss the variety of design concepts in the field of material management. Hermeneutics represents a research method following an interpretive pattern on text analysis. Hermeneutics are used heavily in social sciences including economics and business research (Prasad, 2002). The main argument for using hermeneutic text analysis in social sciences is "*the ontological belief that knowledge about our reality is gained through language, consciousness and shared meaning*" (Cole & Avison, 2007, p. 820). Hermeneutics is the research method in the field of text analysis which offers the researcher to interpret texts in their context and therefore derive meaning. As knowledge about something needs both information and context, hermeneutics enable to combine both to gain understanding. In social sciences the historical, political, economical and social backgrounds of phenomena have to be analyzed carefully to draw correct and legitimate conclusions (Mir & Prasad, 2002). Therefore hermeneutics uses the combination of information and contexts to create new knowledge and gain further understanding in research (Cole & Avison, 2007). It represents a form of qualitative research (Prasad, 2002). Furthermore hermeneutics is a cyclic research method, which means that full understanding of a certain phenomena need ongoing research and interpretation, as contexts and language might change. Hermeneutics consist of five concepts: the hermeneutic cycle, the hermeneutic horizon, fusion of horizons, rejection of author-intentionality and critique (Mir & Prasad, 2002).

The **hermeneutic cycle** is the main concept of hermeneutics and also includes the main philosophy and ontological framework behind this research method (Prasad, 2002). The main statement of the cycle is that "*'the part' can only be understood from 'the whole' and 'the whole' can only be understood from 'the parts'*" (Mir & Prasad, 2002, p. 96). This notion includes the main philosophy of hermeneutics, that contexts and whole systems are important in understanding and explaining parts and certain phenomena.

Furthermore it includes that analysis of entities also have to include an in-depth understanding about the parts that are included within. Additionally, the hermeneutic cycle asks for interpreting social and economic phenomena in the "*totality of its historical and cultural context*" (Mir & Prasad, 2002, p. 96), which is called the **hermeneutic context**. The hermeneutic interpretation of economic and business phenomena therefore is contextual and the result of such an interpretation also creates a document that gives proof to the historical and cultural context itself. Here the cyclical form of hermeneutics can be followed. Hermeneutics therefore allow any scientific findings to be both a result of research and a starting point as well (Cole & Avison, 2007). Furthermore it forces researchers to think about the situational context and at the same time producing an analysis not only of the research object, but additionally a documentary about the

context itself (Mir & Prasad, 2002). In the case of materials management, the instruments analyzed in the literature do not only interpret and analyze the mechanisms of materials management itself, but also of the business environment that they represent. In case of competitive materials management for example, not only the instruments are discussed, but also the competitive environment has to be part of the analysis.

Fusion of horizons in hermeneutics is considering a mismatch between the context of a certain phenomena, text or instrument and the contextual background of the interpreter (Mir & Prasad, 2002). A mismatch of horizons is presumable in social sciences as business environments and social contexts change perpetually. In hermeneutics such a mismatch is seen as a source of knowledge. The different view of the interpreter on the subject can lead to fruitful discussions and various insights, if the interpreter is aware of a contextual mismatch. Therefore hermeneutics argue for a fusion of horizons, where the contexts are made visible and integrated (Mir & Prasad, 2002).

Rejection of author intentionality is another important concept in hermeneutics which clearly points out that hermeneutics is a form of critical analysis. Hermeneutics does not attempt to offer the meaning of the author and find out, what his intentions where, but instead analyses the text beyond the authors meaning (Mir & Prasad, 2002). Therefore any author intentionality is rejected (which does not mean that hermeneutics do not believe in the existence of intentionality, but rather see it as an unimportant by-product of a text). Therefore "all aspects of the text become subjects of analysis, including critiques of authenticity, of possible bias, and of the ideological elements of the text." (Alvesson & Skoldberg, 2000, p. 79).

Critique as the last concept includes the achieving of actual research findings in hermeneutics. Hermeneutics uses linking of texts and contexts to reveal insights and understanding. Critical analysis of contexts is the main concept used to achieve this ambitious purpose. Therefore critique in hermeneutics is the concept used for interpretation of texts. Critical review of the text and linking it to the historical and social context it was written and the context of the author and the reviewer leads to interpretation and therefore to results in hermeneutics (Mir & Prasad, 2002).

In this work hermeneutical text analysis was used to resolve the problem of competitive and supply-chain-based materials management, its methods and its differences. Actually the term competitive materials management already was chosen to highlight the competitive vs. cooperative business contexts of those methods. When beginning the study, the terms were called traditional/classic vs. modern materials management, but when studying theoretical texts and empirical studies about materials management in an hermeneutical approach, it became clear, that both ways of organizing materials management existed analogously in time and that it is rather a question of contextual business environment, which materials management is followed or if combinations are used. Therefore time as a defining term was rejected and the terms competitive and supply-chain-based materials management was chosen to highlight the main contextual difference between those two streams of materials management.

The process of hermeneutic research includes choice and study of texts, consideration of social, cultural, historical, economic and industrial context, analysis and textual interpretation and

critical interpretation (Mir & Prasad, 2002). Following the four stages contributed in this research project are discussed briefly.

Choice and study of texts: Desk research in scientific and practice books, journals and the internet was used to find texts about materials management, therefore all kinds of scientific literature discussing materials management, Supply Chain management and competitive sourcing were used to discuss the main research problem, explicitly discussing the different task and instruments that materials management is following in competitive as well as in supply-chain-based management. In some fields of materials management texts had to be chosen, as there was enough texts. In this situation, texts were chosen accordingly to their fit into materials management and their ability of contribution to resolve the research problem. In other cases, literature was rare and therefore no choice of texts had to be made. The thesis therefore represents a synthesis of up-to-date scientific knowledge in the field of materials management. The selection of methods in materials management per se was made in accordance to the main purpose. Methods were chosen, depending on their use in practice, their theoretic coverage and their fit within materials management. The work therefore has no claim to provide complete coverage of all present methods in materials management, but will select methods accordingly to their contribution to the discussion. The revised scientific sources (books, journals, and internet) are structured accordingly to the theoretic tasks of materials management. Furthermore all tasks of materials management are discussed using the literature sources. This structure enables the authors to draw an in-depth comparison of the two material management paradigms, backed by scientific studies.

Consideration of contextual information: As already noted above, the analysis of contexts was a primary task in this thesis, as context information actually was the defining term of the two kinds of material management. The main argument of the paper therefore includes the importance of the business and industry context to materials management. Materials management therefore cannot be chosen freely by the company but usually is adapted carefully to the business environment. Depending on the level of competition and cooperation as well as integration within the industry, different mixed forms of competitive and supply-chain-based materials management might be used in practice.

Analysis and textual interpretation: The main part of this thesis is representing the analysis and textual interpretation done by the authors to gain understanding and receive insights into the field of materials management and its role in the logistical processes of business organizations and supply chains. Therefore chapter 6 and 7 represent analysis and textual interpretation within the field of materials management.

Critical interpretation: To gain understanding in the field of materials management, not only analysis and textual interpretation of competitive and supply-chain-based materials management is necessary, but a critical interpretation and linkage of those two methods with its contexts is necessary. Chapter 8 and 9 are representing this step of the research process and therefore also offer the main results of this thesis. Furthermore these chapters are starting points for further discussion in the field.

5.1. Critical discussion on methodology

Hermeneutics is a perceptional method used mainly in social sciences in order to be able to interpret and re-discuss theories beyond their historical and structural (industry) context. Therefore hermeneutics is considered to intentionally use the authors frame of reference to discuss theoretic work and therefore to find out its historic, personal and structural bias. Hermeneutics per se therefore uses the distinct historical and structural context of the author to review literature. Objective perception therefore is the main weakness of this methodology and is at the same time its main strength.

Validity can be addressed similarly. Internal validity of the methods and instruments discussed can be assumed as articles from reviewed journals and strictly academic sources were used. For external validity is addressing to the ability of generalization of the results of this study. Yet, the idea of generalization is strongly contradicted in hermeneutic studies as the main idea of hermeneutics is that all knowledge is biased by historical context, structural background, language, perception and personal background of the author. Therefore in no research, external validity can be proven entirely, according to hermeneutic studies. Consequently this paper is not claiming complete external or internal validity, due to the method used.

A main issue in quantitative research is the ability to duplicate research and therefore test studies according to their external and internal validity as well as the more general task of reliability. The main argument is that reliable and valid research should be duplicable and through duplication the same results should be derived. By using qualitative research methods this duplication is rather difficult as rich and unstructured data is collected. Furthermore in hermeneutics the historic and structural contexts are changed to achieve new knowledge. Therefore a full duplication is impossible and not even desired, as a duplication would lead to different results and therefore to know and deeper knowledge.

6. Competitive-based Materials Management

6.1. Introduction

6.1.1. Definitions and key functions

Business organizations need input factors to produce goods and services, which can be obtained on supply markets for capital, human workforce, information and material. It is the task and responsibility of material management to obtain and handle the input factor material. Material can be defined as all objects, which are used to produce goods and services. Therefore material is a collective term. Material subsumed different material classes, like basic material, additives, supplies, parts, commodities and merchandise, services, investment goods, disposal, tools and implements, and others. As these input factors in an economic sense are rare, they have to be used according to the economic principle. Therefore business is seen as a management task that is using planning, organization and control as instruments to achieve that purpose. To achieve that three management tasks, other functions in the business organization are necessary, namely R&D, production, marketing and material management. (Carder, 1997)

Material management here is an institutional subsystem of the organization that is used to efficiently produce goods and services and assist this process through purchasing and using the input factor of materials, including the necessary planning and controlling actions (Groves & Valsamakis, 1998, p. 1). This definition though not only recognizes the sourcing and economic optimization aspects of materials management but also the functional implications. From a functional perspective another differentiation is necessary, if a narrow, an extended or an integrated approach of materials management is used (Sohal & Howard, 1987).

For classification the sourcing and economic functions (core functions) are used. These include scheduling, sourcing, storing, distributing and disposing of materials. This definition shows clearly that sourcing (or purchasing) is only one of the manifold functions of materials management. (What is the Role of Purchasing and Materials Management?, 1988)

The narrow perspective of materials management only includes the parts of scheduling, sourcing, and storing and inner-organizational distribution. The extended perspective enlarges this definition with outer-organizational distribution. Integrated materials management is the highest development step, as it integrates all core functions. Integrated materials management though is not a universal organizational model, but rather the philosophy of actively and systematic usage of the core functions, independent from its structural allocation (Sohal & Howard, 1987). In this notion the integrated materials management matches the philosophy of business reengineering and lean management concepts. Figure 3 visualizes the overlaps of the three perspectives on materials management. As can be seen in the figure, narrow materials management only include

scheduling, sourcing, storing and internal distribution and do not take into account questions of distribution within the supply chain and disposal.

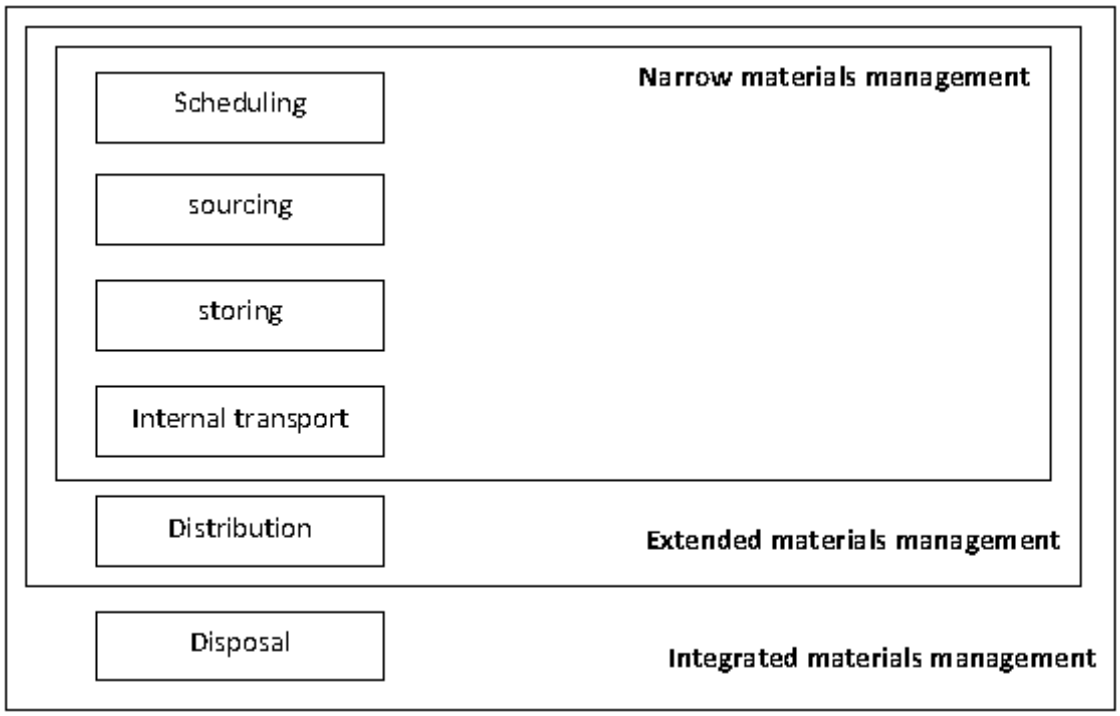


Figure 3: Perspectives on materials management, adapted from (Sohal & Howard, 1987)

Materials Management is the key concept we will discuss in this master thesis. Next to the term materials management, in theory and practice other terms are used as synonyms to materials management. As they are used extensively in the literature to discuss materials management, we will shortly describe them in detail here.

The term sourcing or purchasing for example defines the supplying the business organization with all input factors needed. In this function therefore also workforce, financial sources and immaterial input is included. There is a clear overlap with the term of materials management (Sohal & Howard, 1987). **Sourcing** is characterized through its market reference, while purchasing is part of sourcing, describing the active part of the process. **Purchasing** therefore should supply the business organizations with materials and in this process plan and control the operative activity of the purchasing process (What is the Role of Purchasing and Materials Management?, 1988). Therefore it is clear that purchasing includes operational activities mainly. In practice of the purchasing often is also responsible for buying machines and investment goods, but because of the specificity of these goods, usually the decision does not lie at the purchasing department alone.

The term of **material logistics** though, is not a functional extension of the integrated materials management, but an enlargement of the economic with the technical and IT optimization.

Therefore material **logistics** is enlarging materials management with the logistical and IT aspects (Heinbuch, 1995). To differentiate logistics from material management, it can be stated, that the core of logistics is concerned with the flow of material and information, while materials management is concerned with all managerial aspects of the handling of materials only (Chopra & Meindl, 2002). This separation though is only important for research purposes; in practice a separation is counterproductive as these two functions have to be coordinated clearly. Furthermore the terms of logistics and material management are not without overlaps.

Supply Management is a functional synonym of the term sourcing and therefore part of materials management (Kraljic, 1983). Supply Management though is highlighting the dual relationships in materials management. On the one hand, the organization has to fulfill its own purpose and goals, on the other hand it has to operate on and react to supply markets. Furthermore it focuses on the management activities in the field of purchasing. Materials management therefore represents one part of supply management, the management of materials (and not finance, information and workforce) only. In a supply chain management perspective, supply management also includes a third relationship, the management of relationships within the supply chain. (Leenders, Fearon, Flynn, & Johnson, 2002)

Procurement is a term describing purchasing and extending it with the strategic activities of purchasing. Therefore the special importance of purchasing activities for the organizational strategy is stated (Herbig & O'Hara, 1996).

Supply Chain Management as already stated before, characterizes the primary logistical optimization, including operative and strategic problems of the firm as well as over-organizational logistical activities. Therefore it shows the holistic logistical framework used. Materials management however, is one of the parts of SCM, which is concerned only with the supply side of the value chain and only with materials. The main tasks of SCM are the coordination of business interfaces, coordination of communication and optimization of the core processes. The main purpose of these activities is to align the strategic direction of the whole supply chain (Cox, 1999).

6.1.2. Goals and main tasks

Business organizations define sub-goals and targets for each functional area in materials management (scheduling, sourcing, storing, distribution, disposing). In formulating targets the targets, the main purpose of materials management always have to be focused. Furthermore all sub-goals have to be consistent, otherwise conflicts are indispensable. Primarily goals in materials management are focusing on flexibility and time saving instead of stocks (Hsieh & Kleiner, 1992).

From an external perspective the main purpose of material management is the realization of supply based competitive advantages (or success potentials) for the business organization. Thus the modern material management is using a holistic perspective of all technical and economic tasks. In this perspective, material management has the operative task to allocate the right object

at the right time, the right place, in the right quantity and quality at most efficient conditions (Kraljic, 1983; Hsieh & Kleiner, 1992).

6.1.3. Relevance of materials management in organizational success

As mentioned above, the material management has long-term strategic relevance and therefore also influences the short-term operative success of an organization. Just recently the strategic relevance of materials management was discovered and valued in the field of business management. Generally strategy formulation until the last decade was shaped mainly from a marketing perspective (Greenley, 1989), concentrating on the sales part of the value creation process. Furthermore the financial perspective ever since played an important role in the strategic management process. The importance of other functions in strategy and the holistic view of strategic management is though a new concept. In this new notion, also the strategic importance of supply management in general and materials management in particular was discussed (Teece, Pisano, & Shuen, 1997).Especially through the rediscovery of the resource based view of strategic management, the importance of the materials management for building up competitive advantage was put back in perspective. Furthermore some recent environmental trends fostered this view: the reduction of vertical production, an increase of delivery services for differentiation, increased ecological orientation and the necessity to reduce capital commitments (Mitchelson, 1992).

Furthermore the materials management also influences the short term operative success of a business organization. The relative influence can be measured directly, indirectly or non-quantifiable. Direct measurement of profitability of materials management can be calculated as the share of material costs on sales or net costs. Direct costs of materials management are individual and overhead material costs. Here especially individual material costs are important, as in most industries they make up to over 50 percent of all costs (Teece, Pisano, & Shuen, 1997), while the overhead costs of materials are usually only between 2 and 5 percent. This shows which drastic effect the materials management has on the cost situation of the organization. Indirect measurement of material management costs can for example handled through managing the relationship with suppliers, decreasing overhead costs and several balance sheet approaches. Furthermore not-quantifiable success potential arises from the image of the materials management in comparison with other functions in the organization and external partners, including suppliers, customers, financial partners, shareowners, governments, and the public (Mitchelson, 1992).

6.2. Supporting instruments in competitive Materials Management

After discussing the theoretic backgrounds of the classical materials management, we will discuss in detail the separate functional areas of material management (scheduling, sourcing, storing, distribution and disposing). The next section will describe main supporting instruments or tools used in competitive material management. These instruments are mainly analysis instruments with clear implications on the materials management, and therefore do not represent

an actual function within materials management but clearly are only used to support decisions in competitive Materials Management.

6.2.1. Standardization

Competitive materials management was concerned mainly with standardization processes. The term standardization describes mainly the unification and decreasing diversity of similar processes. In the field of materials management that means mainly standardization of material. Here we can differentiate between standardization of materials and standardization of quantity.

When **standardizing materials**, the chemical, physical or technical characteristics of materials are standardized. As complicated that sound in theory, in practice it is managed in two forms, standardization with norms and standardization of types. In the first approach, elements and parts of products are standardized according to norms (like for example the international norms of ISO). Standardization of types though classifies products depending on their performance, size or form. Therefore standardization of types is also called "product standardization" (Lee & Billington, 1993).

Another possibility is to **standardize according to quantities**, where the materials consumption is unified. In this method a prognosis about the material needs are budgeted ex ante and then the real material needs are compared to it ex post. The difference between the two figures is analyzed later on and this analysis should show where the materials management can be improved (Handfield, 1993).

Overall, standardization is one of the main instruments of planning the material requirements, trying to solve the technical and economic problem of the firm. The main purpose is to achieve a homogenous and clear selection of materials to solve all requirements in the organization. With this, the costs of material management should be decreasing. As already mentioned standardization is one of the main supporting instruments in classic material management.

6.2.2. Labeling

The usage of Enterprise Resource Planning (ERP) systems in materials management has increased lately. The usage of these systems though requires a clear identifiable and systematic management of all kinds of materials. For this purpose company or product names are not useful, as they are not clearly identifiable and there is the risk of confusion. Numbers or combinations of letters and numbers have shown to be best to use in this area. Furthermore the labeling of products should be stored in the ICT of the organization. Most companies use bar codes to label materials, using an identification number and an error checking number (Khaki Boukani, 2007).

6.2.3. ABC-analysis

Another classical instrument in the materials management is the ABC-analysis, first introduced by General Electric in 1951 (Dickie, 1951). It is a rather universal concept to separate all kind of things according to its importance and relevance. In materials management it is used to analyze quantity-value-relations. Therefore it classifies between essential and less-essential materials. Furthermore it can also be used as a means of classifying suppliers. It is based on the principle, stating that only 20% of effort (materials) is necessary to gain 80% of success (value) (Flores & Whybark, 1988). The ABC-Analysis is used in all functions of materials management as shown in Figure 4.

function	criteria	A-	B-	C-materials
scheduling	Value Risk of shortage	Program-oriented calculation Detailed calculation Low security stock Frequent purchase rhythm	Either A or C	Customer-driven calculation Simplified calculation High security stock Long purchase rhythm
Purchasing research	Value Business cycle Sensibility of substitution	Monitoring All sources	Either A or C	Only limited monitoring Secondary sources
Value analysis	Value Sensibility of substitution	Yes	Either A or C	No
Purchasing execution	Value Risk of shortage	Detailed preparation Detailed execution Strict timely control Strict control of invoice Strict control of quantity and quality	Either A or C	Simplified ordering Random timely control Random invoice control Random quality control

Figure 4: Use of ABC-analysis in materials management, adapted from (Flores & Whybark, 1988).

Main contribution of the ABC instrument lies in the classification of materials due to its relevance and therefore it represents an excellent support in setting priorities. This leads to time savings, relieve of routine activities and cost savings. Usually materials are classified into three groups, where A defines materials with little quantity and high value (for example 10% quantity but approximately 60-85% value), B defines materials of little quantity and average value (20-30% of quantity making up for 10-25% of value) and C defines materials of high quantity but low value (for example 70-80% of quantity making up for 5-15% of value) (Flores & Whybark, 1988). Value usually is defined as share of one material on the total value of the end product. The boundaries (%-values) can be set individually by company. To create an ABC-analysis a concentration curve or a Lorenz curve (Lorenz, 1905) is used, as shown in Figure 5.

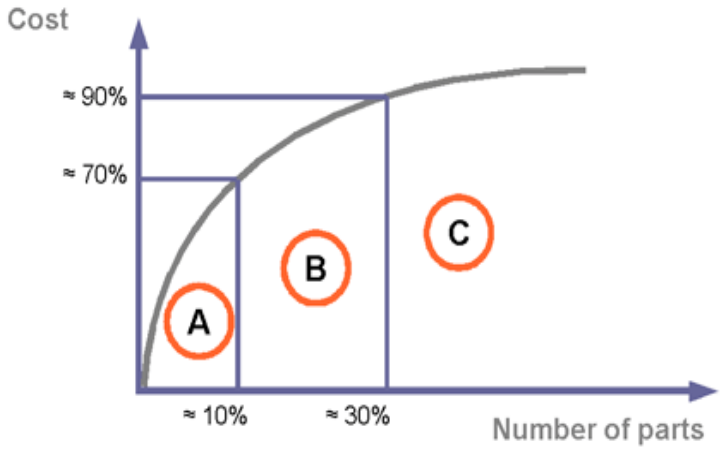


Figure 5: Lorenz curve in ABC-analysis (www.indoition.com, 2009)

6.2.4. XYZ-Analysis

The XYZ-analysis works analogous to the ABC-Analysis as it classifies materials, but the classification is done according to the use of the materials. Therefore three groups of usage are differentiated: X defining materials which are constantly needed and the usage can be predicted exactly, Y defining materials with seasonal or cyclical usage and medium predictability of need and Z defining materials with unpredictable and irregular usage and therefore very low predictability of need (Wittfeld, Helferich, & Herzwurm, 2008) .Based on learning and experience or exact calculations all the materials are separated into this three groups. Therefore different supply methods can be used depending on the predictability and frequency of needing the material. The XYZ-analysis is used mainly in material requirement planning, but also in storing and scheduling.

6.2.5. ABC/XYZ-Analysis

The combination of ABC-analysis and XYZ-analysis is used constantly in materials management. As already mentioned above, the ABC-analysis is used to separate materials according to their relevance in the value creation process, while the XYZ-analysis is used to classify materials according to their frequency of use. When combining both aspects, the

resulting analysis cluster gives valuable insights into the importance of the materials. The resulting two-dimensional combination matrix therefore clusters goods according to the usage behavior of the company and the value of the material. Therefore the organization can also find out which materials can be supplied through JIT (Wittfeld, Helferich, & Herzwurm, 2008). Only AX, BX, CX, AY and BY materials should be purchased through JIT. AX articles have special importance, as they make up for the most value of the end product and are used frequently. The ABC-analysis is shown in Figure 6.

	A-materials	B-materials	C-materials
X-materials	Deterministic planning through secondary demand, timely managed purchasing	Either A or C	Stochastic planning through secondary demand and time managed purchasing
Y-materials	Deterministic planning through secondary demand, stock-based purchasing	Either A or C	Stochastic planning through secondary demand, stock-based purchasing
Z-materials	Deterministic planning through secondary demand, customer-driven purchasing	Either A or C	Stochastic planning through secondary demand, customer-driven purchasing

Figure 6: ABC/XYZ-analysis, adapted from (Hoppe, 2006)

6.2.6. LMN- analysis

In the LMN-analysis another criterion is used to classify materials or suppliers. In this analysis the volume is used, which in the case of materials has implications on the storing and in the case of suppliers has implications on managing the relationship with the suppliers. Therefore the LMN-analysis is used to handle storing volume and transport capacity. Similar to the before mentioned forms of analysis, the LMN classifies into three categories, where L defines large materials (or suppliers with high volumes), M classifies the medium materials (or suppliers delivering medium volumes) and N defining small materials (or suppliers where the organization only sourcing a narrow range of its total purchasing volume).

The LMN analysis can also be combined with both the ABC-analysis and the XYZ-analysis separately or even with the ABC/XYZ-analysis. In this case the result is a three-dimensional cube with 27 fields. This method is especially useful as it combines sourcing and logistical aspects of materials management (sourcing aspect in ABC and logistical aspects in both XYZ and LMN). The three dimensions are relevance, usage and volume. With this instrument also a sourcing concept synchronous to production can be optimized. AXL-materials and materials near this field are especially important and should be sourced synchronic to production, like with JIT or similar concepts (Hoppe, 2006).

6.2.7 Value analysis

Value analysis is the systematic use of established techniques to identify the function of a material or immaterial product, evaluate its functions and find out to realize functionality at minimal overall costs. A heuristic method is used and first was designed by LD Miles at GE to substitute materials due to supply bottlenecks caused by war (Miles, 1954).He found out, that for functionality of a product there are always alternatives. This insight led to the creation of product value analysis, value engineering and value organization. Product value analysis is evaluating the different functions of the end product, while value engineering evaluates different functions at the stage of product development. The later designed value organization is using this principle to evaluate work processes and administrative tasks. Furthermore this method can also be used for processes in the public sector and for services. The value analysis is a method of rationalization materials management. Therefore it is systematically functional-, cost- and team-oriented. The typical process of value analysis includes project scheduling, situational analysis, and description of target analysis, development of alternative solutions, choice and implementation (Pawar, Forrester, & Glazzard, 1993). While value analysis is determining the value of different activities, the next sections are discussing instruments that are analyzing price structures and quantities.

6.2.8. Analysis of price structure

The method of analyzing price structure is used to analyze the purchasing price of a good with the aim of recreate the calculation of the supplier (Stern, 1986). The knowledge about the cost situation of suppliers can then be used in value analysis, for negotiations, for choosing suppliers, for designing conditions and similar questions. In this method the separate cost- and profit-components are analyzed and separated into individual and overhead costs. Price structure analysis is mostly done in form of full cost pricing, considering that suppliers can only stay competitive if they cover all costs in the sales price. In special cases also direct costing can be used to analyze the price structure of the supplier (Stern, 1986). A special form of price structure method is to analyze core costs (for products with relatively transparent production process). In this form only the direct costs of the supplier in ideal production conditions are included. Another form is Linear Performance Pricing (LPP). With LPP the organization tries to evaluate, which price is charged for the most important performance parameter. Furthermore deviations from performance parameters are calculated to draw conclusions on the substitution alternative a supplier has. A determination of cost fractions can be done following experience, quantity lists, catalogue information, industry data, benchmarking with own data and time used for production (Newman, 2007). Reconstruction of supplier's calculation is associated with substantial effort, financial as well as chronological. Therefore it should be used only, when the supplier delivers valuable materials, if purchasing can influence the price and if the predictability is high respectively the analysis leads to a clear result.

6.2.9 Product-Quantum-Analysis

This method is a one-dimensional analysis method, id est that uses a pure product-quantity-perspective. The method originally was used in scheduling, where products where analyzed depending on the volume needed, especially used by organizations with a heterogeneous product program (Garman, 1976).

6.2.10 Conclusion on supporting instruments

Supporting instruments in competitive Materials management have been used heavily in business practice as well as empirical studies exist to show the usage of those methods in business organizations. All of the instruments discussed above support decision-making in a competitive materials management context. Therefore the clear focus on pricing, storage and value can be observed. Main task of supporting materials management in a competitive context is to constantly revise materials management and sourcing strategies in a way that storage costs and security of stocks are maximized at the same time.

6.3. Scheduling of materials

The term scheduling includes all activities that are necessary to supply the organization optimal with the correct form and amount of materials. “Optimal” in this definition characterizes the fact, that a balance between the material goal conflicts of high willingness to supply and low capital commitment and costs has to be achieved. To achieve this optimization, the scheduling is responsible to influence manifold internal and external interfaces. Internal interfaces exist between sourcing, distribution, storing, construction, quality management, planning and production. External interfaces exist between the business organization and its suppliers. Scheduling includes the following main tasks (Hastings, Marshall, & Willis, 1982):

- Demand calculation, gross and net
- Analytical and heuristic identification of economic demand
- Differentiated use of demand strategies
- Material demand identification for new production processes
- Identification of minimum inventory
- Management of delivery and release

To achieve these main tasks, the scheduling uses three methods as shown in Figure 7 below: demand calculation, inventory calculation and order calculation. The result of demand calculation is the gross demand, inventory calculation finds out the net demand and order calculation identifies the economic quantity needed (Wight, 1995).

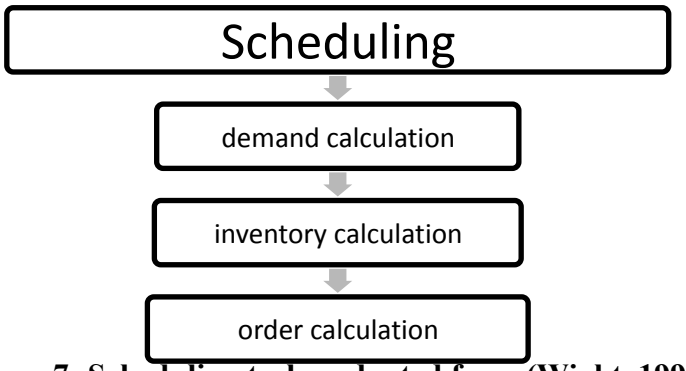


Figure 7: Scheduling tasks, adapted from (Wight, 1995)

Before discussing the calculation forms in detail, the term materials demand is defined. Demand generally determines the identification of the needed materials, its form, quantity and timely need, which are needed for producing a certain good at a certain time. Therefore the demand equals quantity and date.

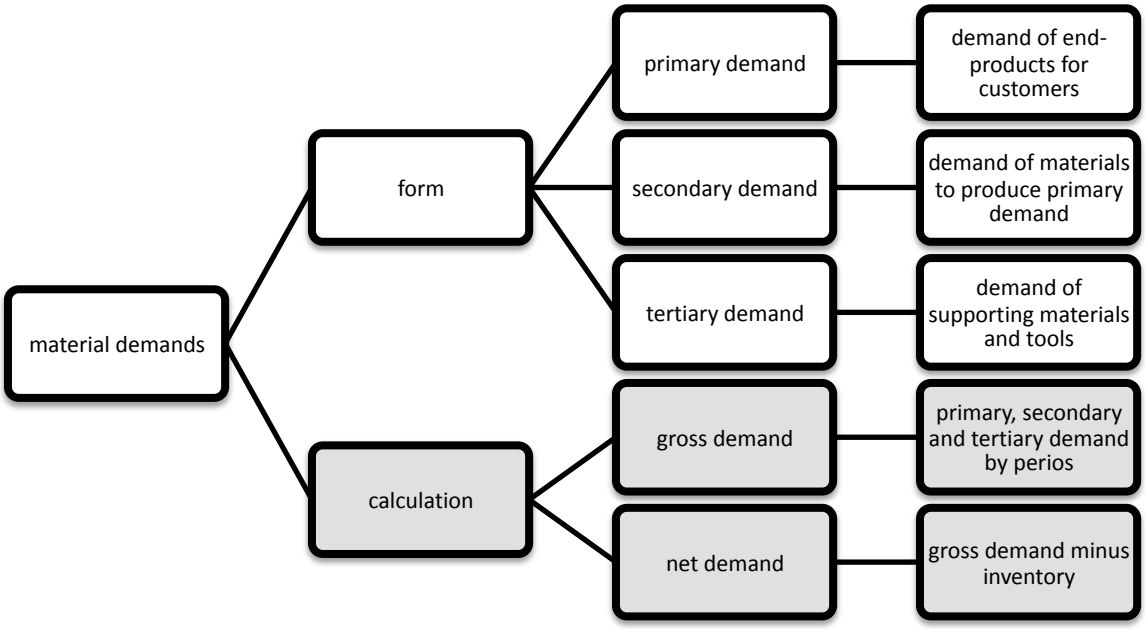


Figure 8: Forms of material demands, adapted from (Wight, 1995)

As Figure 8 above shows, there are different forms of demand that business organizations have. First of all, demand arises from different levels and here we can differentiate primary demand, coming mainly from the market, secondary demand, which includes raw materials, components and parts to produce the primary demand and tertiary demand, which includes supporting materials and tools. Furthermore, as already stated gross and net demand can be differentiated. Gross demand defines the total demand of primary, secondary and tertiary materials in a certain period. Net demand on the other hand is gross demand minus current stock (Wight, 1995). Now the different forms of demand calculation are discussed in detail.

6.3.1. Demand calculation

The result of demand calculation is gross demand. This can be calculated in many ways. Either deterministic (or program-oriented) demand identification, stochastic (or consumption-driven) demand identification or subjective demand estimation are used. The usability of a demand identification method depends on the materials classification mainly.

6.3.1.1. Deterministic demand identification

The program-oriented method of identifying demand is a very exact method that is based mainly on the production programs. In the production program the primary demand is exactly defined in form of customer orders. Therefore through simple multiplication the secondary demand can be identified. For this step a detailed list of needed materials for each product is needed. This is called a "list of items". Calculation methods can be analytical or synthetic. In the analytical calculation the secondary demand is calculated with the list of items top-down. Therefore the list of items presents the main structure of this calculation method. For this method the exact production process and its materials needs has to be evaluated. Synthetic calculation though uses a products production list bottom-up to calculate the needed materials. The result is the same, only another list is used as the primary calculation document (Corbett & Karmarkar, 2001).

6.3.1.2. Stochastic demand identification

The customer-driven method of demand identification is a statistical method, which tries to estimate the future demands. As the name suggests it uses stochastic methods, id est. it extrapolates past demands into the future. Basic method is time series analysis. This method allows for identifying material typical demand cycles. These can be horizontal, trend-based, seasonal or irregular (Gallego & van Ryzin, 1994). The different statistical instruments used in this method are shown in Figure 9.

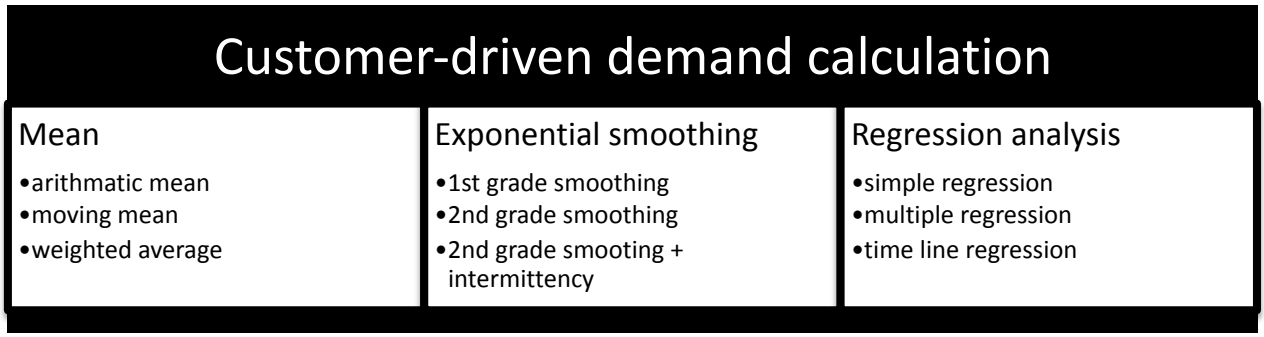


Figure 9: Customer-driven demand calculation techniques (Gallego & van Ryzin, 1994)

As the method suggests, this method is used when the exact orders in the future are not known (like in the deterministic demand identification method), but demand typically arises cyclical or follows a general trend.

6.3.1.3. Subjective demand estimation

This method is used when demand is very irregular and therefore mathematical calculation does not deliver any value to the planning of demands. Therefore in this method two non-mathematical instruments are used, analog estimation and intuitive estimation. Analog estimation uses demand in similar materials as a guideline for the demand of a material. It is used widely in

linked production processes, chemical or physical attributes of materials. Intuitive estimation just uses the experience of the scheduler for estimating the demand in a certain material. This method is used if the demand in a material cannot be calculated through mathematical methods as no past demand exists or if markets are irregular (Lempert, 2009).

6.3.1.4. Conclusion

As can be seen, all three classical methods of demand calculation use past demand or experience of the past as indicators for future demand identification. This method therefore lacks certain dynamism and can only be used in stable and historical grown industries. For new industries, product development or dynamic and competitive industries this methods are suboptimal. Furthermore they concentrate purely on the single firm and do not at all include the whole value chain and certain synergies arising in it. Additionally these methods only limited place a strategic value to the materials management function.

6.3.2. Inventory calculation

Based on the findings of demand calculations and the resulting gross demand, now based on present inventory or stock the net demand can be calculated. The method used in this part should depend on the used demand calculation method, and analogous customer-driven and program-oriented methods exist. Customer-driven method of inventory calculation uses stock- or time-based calculations. Chronological the inventory calculation follows a three-step approach, first the inventory is planned, then the calculation is done and then the actual inventory is controlled.

6.3.2.1. Stock planning

Task of the stock planning is to plan the inventory and its form, quantity and timing. Here various aspects of securing the material supply and capital commitment have to be optimized to realize optimal supply. A number of key figures to plan the stock are used to calculate the supply intervals and dates and the supply amount. Different strategies of optimal supply timing exists, using minimum supply, optimal supply and other limits to examine the perfect timing of supply, depending on material attributes, time of delivery and durability of materials. Therefore the stock planning is deeply linked with demand evaluation (Kelle, 1985).

6.3.2.2. Inventory management

Inventory management as second step of inventory calculation follows the planning of inventory. Usually it is IT-based. The main task of inventory management is to gain timely information about the actual inventory (based on quantity and value) and the demand of materials for production. Inventory management based on quantity uses simple calculations of inflows and outflows. Then the actual inventory through listings is compared. In modern IT-based organizations this is done automatically. Inventory management based on value though needs an evaluation of the actual value of a material. Various economic and tax-based instruments exist in this method. The result then is multiplied with the quantity to evaluate the total value of all stock. The results of inventory management are used not only in materials management but also in Marketing, Controlling and Accounting (Zipkin, 2000).

6.3.2.3. Inventory control

Last step in inventory calculation or evaluation is the control of inventory. In this phase three main tasks are included: control of inflow, control of outflow and control of availability. In this step, again, various key figures are used to examine inventory. Examples are stocking-up period, stock turnover, average inventory, average inventory costs, availability of supply and inventory turnover (Zipkin, 2000).

6.3.2.4. Conclusion

As seen in the discussion above, inventory calculation also follows a strictly planning approach and uses mainly present data to evaluate inventory. As will be seen later, inventory management in supply-chain-based materials management is less strictly planned and uses more accurate data. The usage of present data and the strictly planning approach of classical competitive-based materials management methods in inventory planning lead to inflexibility and high storage costs. Especially in industrial sectors, where sales cannot be predicted exactly, this lead to substantial loss of competitiveness, high capital costs used for storage and inadequate production quantities. Therefore supply-chain-based materials management in inventory management is using different techniques, as will be explained later.

6.3.3. Order calculation

The basis of order calculation is the net demand calculated through a simple subtraction of gross demand (calculated by demand calculation) and inventory (result of inventory calculation). Net demand therefore reflects the technical demand. This has to be translated into an economic demand figure. This can differ drastically, as materials costs depend on supply quantity, timing and other factors. Furthermore transaction costs arise from ordering. These costs have to be compared with the inventory costs that an organization faces. Result of this comparison is the optimal supply quantity, the economic imperative for the purchasing department (Porteus, 1985). This method of order calculation follows a linear approach as shown in Figure 10.

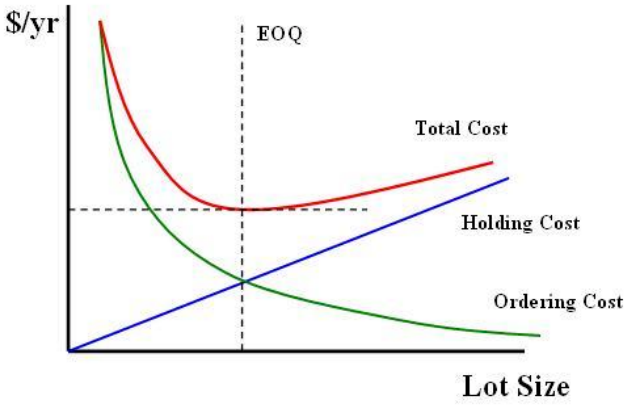


Figure 10: Optimal size of order (www.endurancetrading.com, 2008)

It follows analogous to the before mentioned concepts a clearly mathematical, linear approach of scheduling demand of business organizations. Main result of this three-step approach is to determine the optimal order quantity at a cost minimum (Porteus, 1985).

6.4. Sourcing

6.4.1. Definitions and main tasks

Purchasing is one of the business organizations interfaces and in that notion it represents the relationships to input markets. It is the second core function in materials management. It includes all strategic, controlling and operative activities that ensure an economic, timely and qualitative supply of the organization with its inputs. Supply of materials is concerned with acquisition of property rights. Property rights can be differentiated into four categories, the right to use the product (*usus*), and the right to use a product's "fruits" (*usus fructus*), the right to change a product (*abusus*) and the right to resell a product (Hart & Moore, 1990). Probably not all rights have to be acquired by the company in all cases. Starting point of purchasing is the demand calculated by scheduling. Purchasing too, can be differentiated into three main tasks, as visualized in Figure 11 below. Main criteria are the timely aspects of purchasing. Typically purchasing is prepared, then the actual purchase transaction is executed and after-sales management follows (Lee & Billington, 1993).

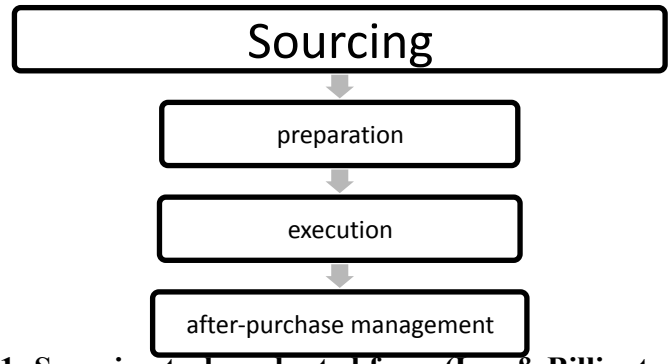


Figure 11: Sourcing tasks, adapted from (Lee & Billington, 1993)

6.4.2. Planning (preparation) of purchasing

Planning of purchasing is the first step in purchasing activities and should assist the purchasing activities strategically. Main purpose is to increase effectiveness of material purchasing (Zipkin, 2000). Main tasks are for example:

- Gaining information about supply markets, products, conditions and prices
- Gaining information about purchasing processes
- Managing suppliers
- Development of cooperation's
- Development of supply cooperation's
- Cross-functional internal and external cooperation's
- Aligning purchasing with Marketing
- Planning of purchasing process, principles of sourcing and channels

6.4.2.1. search of information

To achieve the tasks of information gathering, purchasing uses market research methods in its supply markets. Market research defines the planned and systematic gaining and structuring of information relevant for purchasing decisions including a reliable prognosis of future developments of these markets. Main aim of market research is to make the purchasing decisions more transparent. In market research we can differentiate information concerning its source, survey method (Wight, 1995). Therefore separation into primary and secondary research is essential. Typically business organizations use both sorts of information. Secondary (due to its existence and lower costs of obtaining them) are preferred. Structuring the research is done with IT-methods of selecting, classifying, analyzing, distributing and storing the information (Zipkin, 2000).

6.4.2.2. supplier-customer relationship

The management of supplier-customer relationship is another central task of the purchasing. This includes searching, evaluating, choosing, managing and controlling the relationship with the supplier and if necessary also professional termination of the relationship. Especially suppliers of strategically important materials (A-goods in ABC-Analysis) need continued monitored and the relationship has to be managed carefully over long periods of time. Suppliers of those goods are essential stakeholders and even partners of the firm that generate a large share of the value creation process (Groves & Valsamakis, 1998).

6.4.2.3. purchasing planning

Purchasing planning is mainly concerned with optimization of purchasing processes, planning of purchasing strategy, stating main purchasing principles and planning the purchasing channels. To achieve that a competitive structure and the optimization of organizational processes are necessary, here rules and responsibilities are used to effectively manage the purchasing process in the department (Hastings, Marshall, & Willis, 1982).

6.4.2.4. sourcing strategy

The sourcing strategy is used to plan the realization of the purchasing goals formulated mainly from scheduling. Sourcing strategies can be global, single or system sourcing. The term characterizes the process of purchasing and defines the activities and goals of purchasing.

6.4.2.5. principles of sourcing

The principles of sourcing on the other hand define the principles that guide the sourcing (and not the goal of it). Three forms of principles can be differentiated: single sourcing in case of need, purchasing on stock and purchasing synchronized to production (JIT and similar). The advantages and disadvantages of each sourcing principle are visualized in Figure 12 below (Zipkin, 2000; Heinbuch, 1995; Groves & Valsamakis, 1998; Sohal & Howard, 1987).

Principle	Single sourcing in case of need	Purchasing on stock	Production-synchronous sourcing
process	Sourcing is only executed at the time the material is needed, high match of demand and usage	Sourcing is executed periodically or speculative on stock. Only indirectly customer-driven	Sourcing is synchronized to production, often JIT. Storing only security stock to meet disruptions
advantages	Low capital commitment Low storage costs Limited risk of obsolescence	Fast availability Low transaction costs Best conditions and prices (speculation)	Low capital commitment Low storage costs Low risk of obsolescence In line with demand
disadvantages	High transaction costs High purchase prices	High capital commitment High storage costs High risk of obsolescence	Complex logistical process High need of chronological adjustments
Areas of appliance	Individual production Discontinuous production valuable goods	Series production Homogenous goods Low value of goods	Mass production Valuable goods

Figure 12: Principles of sourcing, adapted from (Gallego & van Ryzin, 1994; Zipkin, 2000)

6.4.2.6. Purchasing channels

Purchasing channels can be direct, indirect or combined systems. The direct purchasing defines a one-step transport of the producer of the input to the business organization and is used mainly for A-materials and investment goods, as the direct contact to the supplier and possible influence on him are especially important. Indirect purchasing then defines if any intermediaries are used, that are responsible for some logistical and economic tasks, like storing, commissioning and bundling. Last, the purchasing for a certain materials can be handled combining both methods simultaneously or situational (Groves & Valsamakis, 1998).

6.4.3. Execution of Purchasing

On the basis of demand requirements of scheduling and preparation of purchasing, the execution of purchasing is one of the main processes of materials management. The execution again is separated into three phases: preparation of contracts and negotiation, signing of contract and settlement of the contract (Herbig & O'Hara, 1996). Figure 13 shows the exact process of purchasing execution.

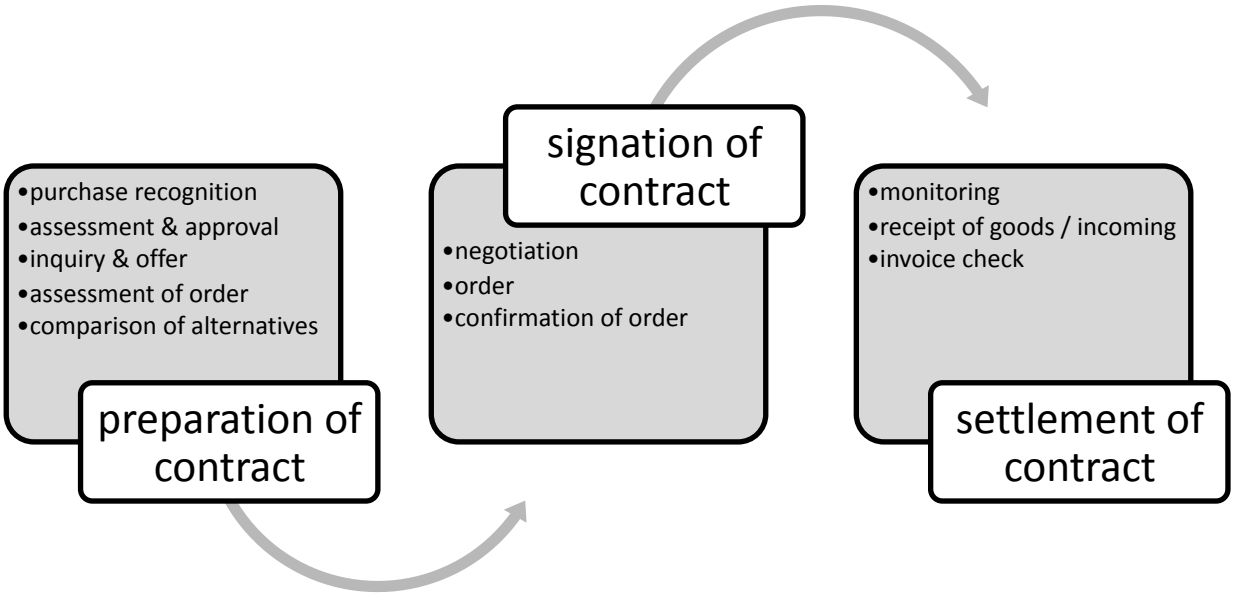


Figure 13: Contracting process in purchasing, adapted from (Gallego & van Ryzin, 1994)

As Figure 13 shows, the execution of purchasing is a complex decision-making process with the main aim of an efficient purchasing process. In this process manifold technical, legal and organizational problems arise (Herbig & O'Hara, 1996; Monczka, Handfield, Giunipero, & Patterson, 2008).

6.4.4. After-Purchase Management

After-purchase management as third task in the material purchasing includes all tasks that arise after the purchase is executed. It includes the permanent analysis of purchasing and supplier performance and delivering insights for purchase planning and controlling. Synonym for after-purchase management often purchases controlling is used.

When analyzing the purchasing performance the main object of analysis is if any cost decreasing potential can be accomplished in the future. Therefore the materials costs of the supplier have to be analyzed in detail and the usage of the material in the organization has to be controlled carefully (Pae, Kim, Han, & Yip, 2002).

Analyzing the supplier performance includes certain evaluation criteria that are used also for searching and choosing suppliers in the first place, to continually improve the performance of the relationship with the suppliers. Furthermore the performance of a number of suppliers can be classified analogous to an ABC-analysis. Therefore a differentiated supplier management can be achieved (similar to customer segmentation in output markets) (Pae, Kim, Han, & Yip, 2002).

6.5. Storing and Distribution

6.5.1. Definition and main tasks

The necessity of a third materials management task, the **storing** results from a timely and quantitative mismatch of material flows on the one hand and security of material stock on the other hand. Therefore inflows and production demand cannot be fully synchronized in classic materials management. (In newer materials management systems, like JIT delivery as will be discussed later, this is indeed possible and managed in practice). A break in material flows though is causing high costs; therefore a puffer to bridge short-term gaps has to be installed. This is called stock, inventory or storage. Storage furthermore is responsible to regulate not only quantitative gaps but also timely gaps between production needs and purchasing. Main task of **storing management** therefore is the building and management of inventory. To achieve this task from an administrative perspective, an economic and a technical sub-task can be separated. These functions are prerequisites to the decision of where to store materials, capacity of storage and organization of storage (Heinbuch, 1995).

Based on the storage of materials, the question of distribution of materials (synonymous logistics and transport) is discussed. The distribution is the fourth core function of materials management and includes both transports within and outside the organization. Transport within the organization is the primarily flow of materials in the organization for production. Inner-organizational transport has to be managed carefully from a timely perspective and to decrease costs should be minimized if possible (Hsieh & Kleiner, 1992). Transport outside the organization is handling the material flows from and to the environment logistically. In this part the material flow with suppliers and customers (as well as others) takes place. In classic materials management transport from and to the organization are viewed only secondary, while in SCM this flows are given prior importance (Wight, 1995).

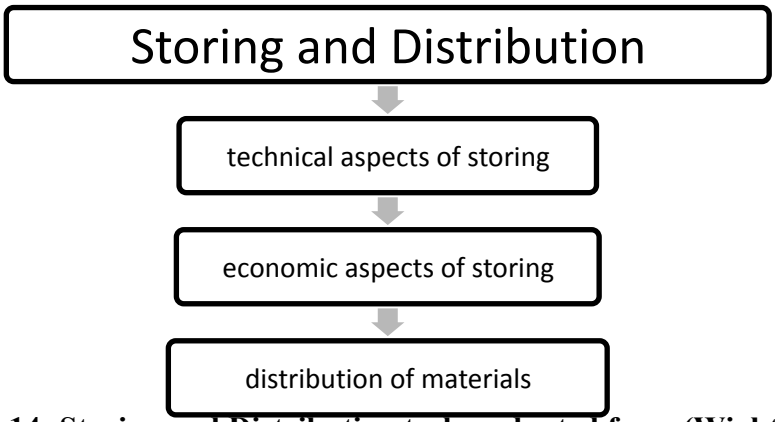


Figure 14: Storing and Distribution tasks, adapted from (Wight, 1995)

Following the structure of this work, storing and distribution can be separated into three steps, a technical perspective of storing, economic tasks of storing and materials distribution, as

visualized in Figure 14 above. Technical aspects of storing are discussed first, based on the insights in this topic, economic aspects of storing are discussed. Finally the distribution of materials is analyzed.

6.5.2. Technical tasks of Storing

The technical aspects of storing include receipt of materials, verification of materials, labeling of materials, control of quantity and quality, unpacking and repacking if necessary or mandatory (legal), transportation to the storage area, storing, commissioning, managing the outgoing through curbside or bring system and end-packaging. Technical aspect of storing are often standardized with norms in the quality management of the organization (Zipkin, 2000).

6.5.3. Economic tasks of storing

Economic tasks of storing are deeply linked to demand management and control of scheduling. These tasks control the information and materials flow from and out of the storage area. In this field especially the storage accounting is used. It includes all materials inventory and flows. Main instrument is the listing. Storage accounting and listing together can be used to develop a storage statistic system that can visualize the storage flows over time. Again storage accounting is used for benchmarking and rationalizing storage activities and decrease inventory. From an economic perspective the stocks of the most organizations are binding capital and therefore are not value creating. For this reason it has to be minimized to the point where its functional necessity is reached (Heinbuch, 1995). Next to minimizing stock other strategies to rationalize storage exist:

- Avoidance of stock by using modern logistical solutions like JIT
- New design of storage and usage of top notch storage methods and IT
- Outsourcing of storage
- Selective storing

6.5.4. Materials distribution

Materials distribution in classical materials is concerned solely with the inner-organizational transportation. This deals with the bridging of geographical gaps between storage area and production area in the organization. When designing inner-organizational transport systems, the type of materials transported, intensity of transport, distance, timing, production process, costs and legal requirements have to be taken into account. To reduce the transportation costs to a minimum, in the phase of constructing the facilities the distance between storage and production has to be optimized (Cox, 1999). Furthermore the intensity of transportation and influence on the total cost of production has to be estimated. Total distance usually has only a limited influence on total transport costs. If facilities are planned, only limited restrictions have to be considered, mainly legal nature. At present facilities though, only limited rationalization is possible through

managing routes. Usually the method of mathematical optimization (as in scheduling demands) is used. Furthermore through the use of different means of transportation, costs can be saved. Change of means of transportation though is considered to require high amounts of investment therefore this possibility is only given a long-term perspective. Furthermore the use of transportation appliances (palettes, repositories and similar) can include a potential for cost savings (Zipkin, 2000).

6.6. Materials disposal

6.6.1. Definition and main tasks

Materials disposition (synonyms are waste, removal and waste removal) is representing the fifth core function. This function results from the fact that in production and usage of materials, due to different reasons products incur which cannot be used in the organization. Therefore the term disposal is used as the recycling and removal of disposal. As the resulting materials cannot be used in the business organization itself, the organization has to manage its removal or recycling and it makes sense to include the disposal in the materials management process. Waste, as a key concept is a collective term used for all kinds of products and materials that are not used for the purpose of the organization and are not produced on purpose (Heinbuch, 1995). Therefore in the perspective of the business organization these materials might be waste, but for other purposes they might classify as inputs or for other uses.

Consequently materials are only classified as waste if the owners want to dispose the material, he has to dispose the material (by law or any other requirements) and the owner actually is disposed. Furthermore waste can be separated into waste for recycling and waste for removal and additionally into waste that has to be monitored and waste that does not need to be monitored. Main task of disposal management is primarily avoiding waste and only secondary recycling and disposal of waste. Next to these main tasks, disposal in materials management also faces a logistical problem. Disposal logistics therefore transports, packages, stores and treats waste (de Coverly, McDonagh, & Patterson, 2008).

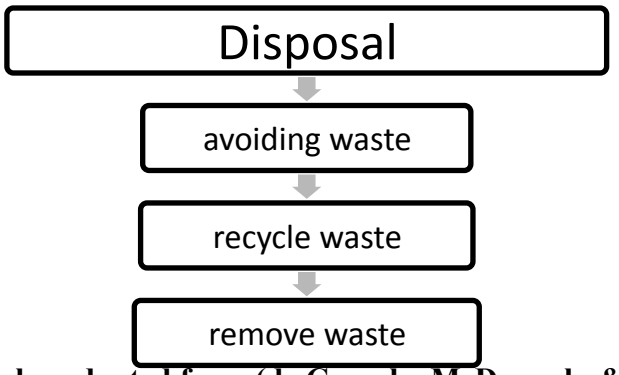


Figure 15: Disposal tasks, adapted from (de Coverly, McDonagh, & Patterson, 2008)

As already mentioned above, materials disposal is structured into three main parts, avoidance of waste, recycling of waste and removal of waste, visualized in Figure 15. Avoidance of waste as

one of the oldest ways to discuss disposal is described first. Based on the findings in this field, the recycling and removal of waste are discussed below.

6.6.2. Avoidance of waste

Waste that is avoided does not cost! That is the main imperative behind materials disposal. Therefore avoidance of waste is the primary task of disposal management. Furthermore waste that is avoided does not imply any external costs on the environment and/or society. The concept of avoidance is also essential, as it solves the problem not through reducing effects but through eliminating the cause. The spectrum of tasks of avoidance of waste can be separated into a quantitative and a qualitative component (Hawken, 1993).

The quantitative component of waste avoidance is concerned with decreasing the waste quantity through several avoidance strategies, like internal circulation, statistical process control of production and low-waste product development (Van Der Ryn & Cowan, 1996).

The qualitative component of waste avoidance is based on substitution of materials through economic and ecologic superior alternatives. Here the avoidance of waste actually influences the production process.

In materials management waste avoidance strategies have to take into account the efficiency of these concepts, higher ecological consciousness and legal requirements (Zipkin, 2000).

6.6.3. Recycling of waste

Recycling means re-using materials, which are classified as waste by the organization. This can be done within the organization or outside. Recycling is secondary, as avoidance should have priority. Compared to removal though, recycling should be prioritized according to the economic principle of rare resources. Recycling is only tertiary to removal if a removal is environmentally friendlier than a recycling process. Environmental friendliness depends on the expected emissions, expected use of natural resources, ratio of used and obtained energy, received harmful substances and potential hazardous waste (Hu, Sheu, & Huang, 2002).

Preliminary to recycling per se, often a preparation of waste is necessary, which include all activities of collecting, treating and storing waste so it can be recycled. Treatment often includes technical and chemical methods, like pressing, bundling, purification and centrifugation.

Recycling itself then defines the extraction of materials or energy from waste. A recycling of materials then produces materials from waste instead of natural resources and therefore a secondary raw material is used. A recycling of energy includes the use of waste as substitute to other energy winning technologies. Often waste is burned to produce energy, which has to be strictly separated from burning waste for the reason of removal (Fleischmann, Bloemhof-Ruwaard, Dkker, van der Laan, van Nunen, & van Wassenhove, 2009).

Inter-organizational Recycling can be handled in three different forms:

- pure reuse of products and materials for the same use (for example deposit bottles)
- reuse of products and materials in the same production process (e.g. plastics)
- reuse of products and materials in different production processes

The costs that arise from recycling can be differentiated into two parts. First one-time costs arise with the administration of recycling and purchasing the facilities and machines for the recycling process (Pohlen & Farris, 1992). Ongoing costs on the other hand include all costs of maintenance, energy and preparative activities necessary for recycling, like sorting and storing (Rogers & Tibben-Lembke, 2001).

6.6.4. Removal of waste

Waste that cannot be avoided or at least recycled has to be removed from the organizational facilities, in a way that society and environment is not affected negatively and no external costs arise. Basically a removal is managed by the organization itself, but it can be outsourced or sometimes the state, communities or other firms or NPO organize the removal. However, the main responsibility for the removal lies at the organization itself, whoever is actually organizing it. Preliminary to actual removal, often preparation is necessary. This preparation is done to reduce quantity and contagiousness of the waste. Within this preparation lie chemical methods, thermal methods, biological-mechanical methods and physical methods (Adamides, Mitropoulos, Giannikos, & Mitropoulos, 2009).

There exists a wide range of methods of disposal (Adamides, Mitropoulos, Giannikos, & Mitropoulos, 2009; Hu, Sheu, & Huang, 2002):

- land-filling of waste
- burning of waste in special facilities
- discharging of liquids
- emission of gases

Especially hazardous waste has to be monitored carefully. Furthermore the method of disposal depends on the waste itself and legal regulation concerning disposal.

6.7. Summary on competitive materials management

Section 7 was dealing with first research question and is identifying competitive materials management theories, methods and instruments and discusses them in detail. The instruments discussed in the traditional and competitive approach of materials management were first divided into five sections, depending on the step of materials management they are used in.

In **supporting instruments** nine instruments were identified as competitive and therefore compatible with the traditional competitive approach of materials management. These instruments include processes like standardization and labeling usually used for the purpose of

cost reduction within the organization as well as classical analysis instruments using a portfolio approach as for example ABC, XYZ and LMN analysis that classify materials depending on value, need and use. Furthermore more qualitative and strategic attempts as for example analysis of price structure, value analysis and product-quantum analysis are used. Altogether supporting instruments play an important role in traditional competitive materials management and they mainly consist on analysis tools that focus on quantitative aspects and costs.

In the field of **scheduling of materials** the traditional competitive approach includes only three instruments, demand, and inventory and order calculation. All three instruments are solely quantitative instruments of price calculation structured similar to calculation models in traditional corporate finance. The focus on costs is the main paradigm in scheduling in the traditional competitive approach of materials management.

Competitive materials management addresses to **sourcing** itself only very limited attention. It focuses on definition of the tasks of sourcing and then the tight planning of the sourcing process as preparation, execution and after-purchase-management. This process-based perspective of sourcing shows the relative unimportance of sourcing in the traditional competitive-based materials management, where sourcing is received as solely operative activity that generates costs and is not a possible source of profit within the supply chain of the organization.

In **distribution and storing** the competitive materials management approach only focuses on technical and economic tasks of storing that mainly include the logistics of storing and costs.

Finally in **material disposal** the traditional approach to materials management focus rather on an internal definition of waste than on a holistic strategy on avoiding, recycling and removal of waste. Basically in this approach is the externalization of the subject to state authorities and customers.

6.8. Conclusion

The sections above are discussing competitive materials management instruments and methods that are used in classical logistics and business management literature. Most of these instruments follow a strictly competitive approach of business management and integration within supply chains is not possible with instruments discussed above. The main focus of materials management in the classical management theory therefore is security of stock, therefore inventory management and disposal are the main activities of materials management in this classical view.

Furthermore this paradigm of security of stock and planned inventories lead to high storage of materials and consequently high storage costs. Additionally, inventories are planned rather fixed for the next period. This is showing a long-term and short-term dimension of classical materials management. On the one hand, materials management is not flexible adjusted to the sales market, but on the other hand, the product life cycle and long-term (over 5 years) implications are not taken into considerations either.

As the next section will show, supply-chain-based materials management methods uses different instruments to resolve this time issue, and provide materials management with the necessary flexibility and short-term mobility as well as long-term instruments maintaining the strategic focus of materials management.

7. supply-chain-based materials management in SCM

7.1. Initial situation

The environmental framework for materials management in industry states are subject to constant change. Hereby not only company-specific but also societal trends and factors play a role. Societal changes recently include (Seshadri, 2006; Carter & Rogers, 2008).

- Rising mobility and increase of transport of goods and people
- Rising ecological consciousness and green strategies
- Rising importance of free time
- Rising live quality and medial development

For economic development aspects such as,

- Usage of ICT for communication and production
- International integration
- Geographic and timely transparency
- Change in workforce / Intrapreneurship
- Increasing competition, force to grow
- Establishment of strategic, vertical and horizontal cooperation's
- Use of ecological and / or recycled products

are changing the competitive situation for business organizations.

Based on the internal and external developments stated above, materials management has to be repositioned. For that it is using new methods or adaptation of old methods to meet these new challenges and realize competitive advantage (Carter & Rogers, 2008). The strategies followed can be focused on one of materials managements core functions ore be holistic in nature.

The following sections present materials management methods used in Supply Chain Management. They differ substantial from competitive-based materials management methods explained in section 3 above, not only in focus, but also in scope and the management of activities. This chapter will be structured the same way as chapter 3, so a comparison at the end of the thesis is possible.

7.2. Supporting instruments in supply-chain-based MM

7.2.1. Portfolio analysis

Portfolio analysis represents a strategic oriented planning method using visualization to define targets and to deduct norm strategies, in our case strategies concerning materials management.

A portfolio generally consists of two dimensions that build a matrix. The two dimension reflect one sphere that the organization cannot influence (environmental dimension) placed on the ordinate, and one sphere that the organization can influence (in internal dimension) placed on the abscissa (Ghemawat, 2002).

The axis can be separated into two or more fields, depending on the grade of detailing necessary. Originally the method was used as planning tool at the stock market, to reach optimal balance between risk and performance as well as growth and stability (Hadley, 2004). This is the main reason, that the method is called portfolio analysis, as it was used to manage stock portfolios.

Later BCG and McKinsey transferred the method to strategic planning for diversified corporations. It was used than to manage the portfolio of SBUs an organization held. The BCG-matrix used market growth (environmental sphere) and market share (internal dimension) to place the different SBUs. Main concept behind was the product life cycle concept. The McKinsey matrix however uses market attractiveness and market position consisting of multiple factors for analyzing SBUs (Hambrick, MacMillan, & Day, 1982).

The process of creating the portfolio can be differentiated into (Wind & Douglas, 1981; Ghemawat, 2002):

1. Selection of strategic object of analysis
2. Determination of the two dimensions
3. Including the strategic object into the matrix
4. Determining insights from the analysis and building strategies

From a methodological perspective the portfolio method is an inexact heuristic method that can increase the probability of choosing an effective strategy, as it eliminates some methodological and systematic errors, but not completely (Ghemawat, 2002). Therefore still some risks exist. The quality of the analysis depends mainly on a correct evaluation and separation of the two dimensions. However, this evaluation is difficult as often experience and intuition have to be used.

Because of its two-dimensionality the risk exists, that beneath the chosen dimensions, more influential factors are not taken into consideration (Wind & Douglas, 1981). This simplification of influence factor to two dimensions brings clarity for management on the one side, but it also bears the risk of wrong decisions due to blind fields in the analysis. This risk though, exists with

almost all tools that are used to assist decision-making as they necessarily try to simplify the complex environmental and internal situation that business organizations and supply chains are facing. Simplification though brings a concentration on the main factors influencing the organization (Hambrick, MacMillan, & Day, 1982). Therefore the risk that other important factors are overlooked, exist constantly.

As materials management importance is increasing, decisions in this field have to include its risks and opportunities to corporate and supply chain strategy. Furthermore strategies in materials management have to include supplier management, process management, material choices and markets. The complexity of decisions in the field of materials management therefore is rising and classical one-dimensional methods of materials management are obsolete. Portfolio method is used constantly to handle the increase of complexity in strategic decision-making as an assisting tool of decision-making (Ghoshal & Westney, 1991). The next sections therefore deal with the portfolio forms that exist in modern materials management.

7.2.1.1. Supply market / corporate strength portfolio

Main argument of this portfolio is that availability of resources and prices of raw materials do influence an organizations performance. This is one of the main problems that materials management in the field of sourcing is dealing with. The environmental dimension of this portfolio therefore is measuring the power of the supply market. To measure this dimensions the following criteria are used (Wind, Mahajan, & Swire, 1983):

- capacity utilization
- break-even-point
- barriers to entry
- logistical stability
- cost structure
- product USP
- market growth
- market size

The external dimension therefore is examining the market power over the organization. It is including the power the market has to influence the organization and the organizations dependence on the analyzed supply market. In a SCM-perspective, this dimension shows how deeply dependent an organization is on the supply chain (Liao & Hong, 2007).

The internal dimension on the other hand measures the relative competitive strength an organization holds on its supply markets for materials. The used criteria are the following (Fu, Lee, & Chung-Piaw, 2008):

- Purchasing volume
- Progression of demand
- Switching costs
- Possibility of backward integration
- Relative market share

The internal dimension therefore examines the power the organization can exceed over the supply market. Therefore its relative position on the supply market and its possibility to influence this market (prices, quality and conditions) are evaluated. In a SCM-view this dimension is evaluating the strength and importance of the own organization in the supply chain network (Wind, Mahajan, & Swire, 1983).

The resulting portfolio consists of nine fields that can be subcategorized into three norm strategies (Wind, Mahajan, & Swire, 1983):

- Active skimming of the market (utilization)
- Selective strategies
- Diversification

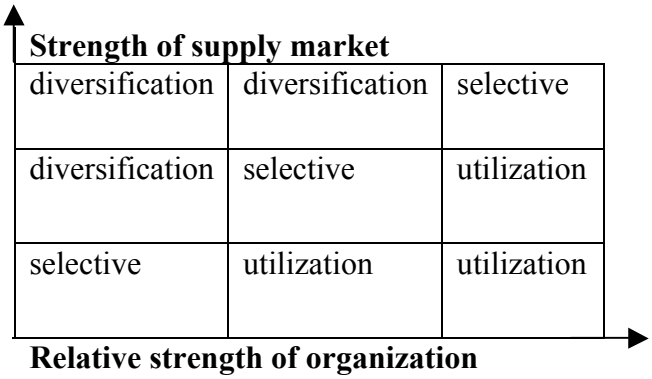


Figure 16: supply market / corporate strength portfolio (Wind, Mahajan, & Swire, 1983)

The criteria used in the portfolio can be adjusted to the situational factors of the business organization. Criteria should be chosen according to their ability to display the strength of the organization resp. the strength of the market.

7.2.1.2. Supply market attractiveness / competitive advantage Portfolio

This portfolio method is based on the assumption that certain determinants and the structure of the supply market combined with the behavior of the sourcing firm can influence the performance of the organization. Therefore not only the power of the market over the organization but the market structure and its factors are influencing performance (Wind, Mahajan, & Swire, 1983).

As main dimension of the environment is the attractiveness of the supply market. The term attractiveness suggests a clear link of this portfolio to industrial economics methods, the SCP-paradigm and Porters five forces analysis determining the attractiveness of markets. The main assumption behind industrial economics and the SCP-paradigm states that the attractiveness of the industry sector and the firms reaction to it, determines the long-term performance of this organization. The main factors of supply market attractiveness are (Panagiotou, 2006):

- Barriers to entry
- Legal restriction of market
- Competitive behavior in market
- Risk of artificial shortage of resources
- Ecological and legal framework

In a SCM-perspective, the attractiveness of a market is shaping fundamentally the structure and processes within the supply chain.

The internal dimension in this portfolio is defined as the relative, supply-based competitive advantage of a firm. This advantage determines the reaction of a firm on certain market attractiveness. The relative supply-based competitive advantage of a firm is characterized through the following determinants (Hannan, 1991):

- Market share on supply market
- Marketing potential on supply market
- Barriers to exit
- Liquidity potential
- Equity base of capital
- Degree of automation
- Technological know-how
- Training

The internal dimension therefore shows the competitive advantage an organization bears on its supply markets. From a SCM-perspective, competitive advantage of single firms in the supply chain can foster one the one hand total competitive advantage of the supply chain network and on the other hand, foster internal competition and therefore increase total competitive advantage (Panagiotou, 2006).

The resulting nine-field portfolio can be clustered in three norm strategies (Wind, Mahajan, & Swire, 1983):

- Risk defense
- Selective strategies
- Influence

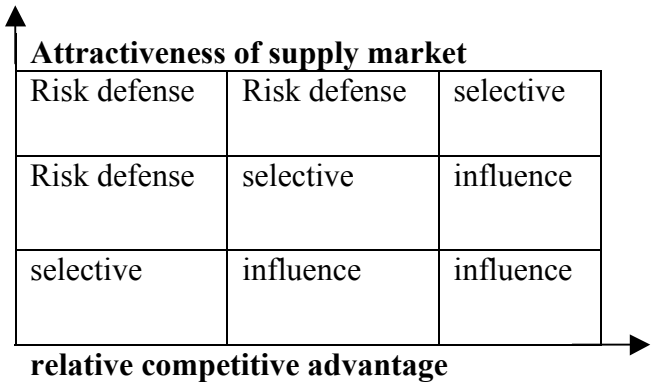


Figure 17: Supply market attractiveness / competitive advantage portfolio (Wind, Mahajan, & Swire, 1983)

As can be seen in the figure above, the norm strategies above are less aggressive in the supply market than in the supply market / corporate strength portfolio. This portfolio rather formulates reaction strategies to the supply market as reactive or active influence. It does not apply to skimming of market or diversifying and therefore replacing suppliers. This strategies can be better aligned with SCM, as in long-term relations with suppliers based on trust, skimming or replacing are not adequate reaction strategies. Therefore the norm strategies formulated by the supply market attractiveness/competitive advantage portfolio is suited clearly better in SCM.

7.2.1.3. Risk of shortage/performance influence portfolio

This portfolio is using the risk of supply as main environmental threat in the analysis. One form of this portfolio is shown in Figure 18 below. Main assumption is that supplied materials have different influence on the performance.

The external dimension is defined by the risk of a lack of supply. The main factors contributing to this criterion are based on market-based disruption (Dolgui, Pashkevich, Pashkevich, & Grimaud, 2008). Those are

- Disruption risk in transportation
- Risk of artificial shortage of resources
- Reliability of supplier

These environmental factors contribute to the ability of the business organization to keep up its supply. In the supply chain this is especially important, as one of the main aims of SCM is to ensure frictionless material flows and to avoid disruptions within the supply chain. Therefore this new method assisting materials management can increase the competitiveness of the entire supply chain network (Finch, 2004).

The internal dimension concerning the organizations capabilities itself, describes the influence on the organizations overall performance. Therefore it describes how much the organization depends on a certain material and the relative effect a shortage of a certain material has on the

performance. It therefore distinguished between essential and non-essential materials and risky and non-risky materials (Fu, Lee, & Chung-Piaw, 2008).

The resulting four fields of the portfolio result in four norm strategies for each combination of materials. The norm strategies are:

- Efficient operation (low shortage risk and little performance influence)
- Skimming of potential (low risk of shortage, but high influence on performance)
- Assure availability (high risk of shortage, but low influence on performance)
- Vertical cooperation (high risk of shortage and high influence on performance)

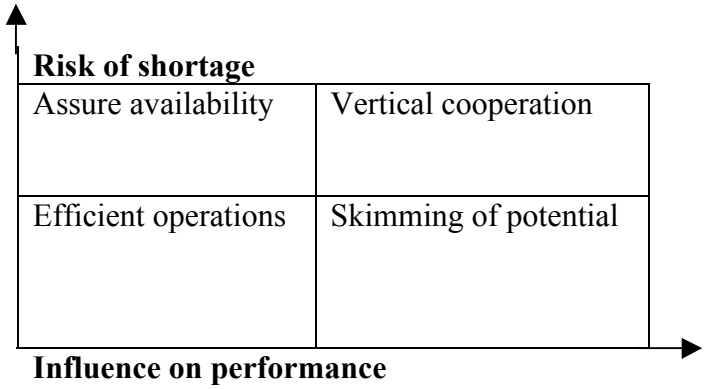


Figure 18: Risk of shortage / Influence on performance portfolio

As the figure above shows, the norm strategies deducted from this portfolio help to set priorities in materials management and guide organizational behavior towards supply markets. These strategies show that the interdependence of a firm on its supply markets depends on the discussed materials, the risk of shortage and its influence in the end-product (Faisal, Banwet, & Shankar, 2006). This represents a perspective of materials management that matches SCM in many ways. First of all shortage risks are a main part that SCM is addressing too. Furthermore it shows the roles of organizations in the supply chain. Last, the portfolio uses strategies that are collaborative for suppliers important for the value creation process (high influence on performance), but reactive or skimming for materials that are less important for the competitiveness of the supply chain. Consequently, this portfolio instrument is a good example of how valuable modern materials management methods fit into the SCM and help to raise competitiveness over the entire supply chain (Groves & Valsamakis, 1998).

7.2.1.4. Concluding remarks on the use of portfolio-based instruments in materials management

Manifold possibilities to use portfolio analysis in materials management exist, even apart from the above presented forms. Any environmental and internal dimension can be compared. In materials management for example, a supplier power/market power-portfolio can be used visualizing the power roles of the actors in the market. Furthermore a supply goods/supply sources portfolio can be drawn, showing if any substitutes, materials- and supplier-based exist.

Furthermore an ABC-analysis can be combined with the risk of shortage, resulting in a similar portfolio than presented in c). A global-sourcing/performance-potential portfolio could help with decisions concerning the regional dispersion of activities. Furthermore resource needs can be combines with SBUs to assist strategic decision making in materials management.

Additionally to other possibilities, it has to be stated, that the above discussed three portfolio methods can be used to analyze suppliers and materials alike. Therefore substitution and strategies on both levels can be deducted from the analysis.

7.2.2. Target Costing

Target Costing (synonym: Design to Cost) is a Japanese cost management concept. It is based on empirical findings stating that 80 percent of costs used for a product are already fixed in the stage of product conception. In this stage, though, the customer value is not clearly formulated yet. Therefore target costing is concentrating on an alignment of functions and costs of products with the market requirements in the product development stage (Monden & Hamada, 2000).

Initial point of this process is the customer need or preference always oriented on a market price. Main backgrounds here are marketing studies stating that customers extensively use the price performance ratio to make buying decisions. The studies showed that customers do not value prices and qualities of products separated and then merge them in the decision, but that they perceive products as price performance ratios itself and do not separate quality from price (Monden & Hamada, 2000). Furthermore it is important to note that this method is concentrating on a customer perspective in product development and not on an engineering view of product development. Therefore it is avoiding over-engineering of products. Central question in target costing is: How much can the product cost at given quality levels? After that the exact functional parameters are fixed. Consequently target costing is a simultaneous configuration and calculation process. The technological design and the economic design of products are not longer separated (Monden & Hamada, 2000).

The process of target costing can be explained in five steps, listed below:

- Prognosis of a competitive sales price (Target Price) by means of conjoint-analysis and determination of adequate profit (Target Profit) by means of intended minimum interest on capital employed,
- Determination of cost maximum (Allowable Costs) without considering present used technologies and processes by simple subtraction of Target Profit from Target Price
- Determination of quantity-independent production costs (Drifting Costs) based on full costing with regard to given production structure
- Determination of Target Costs through aligning drifting and allowable costs through, if necessary, changes in product concept, product functions and
- Breaking down total target costs and separate them according to functional aspects or value aspects.

The determinants influencing this process and the usual process of target costing are summarized in Figure 19.

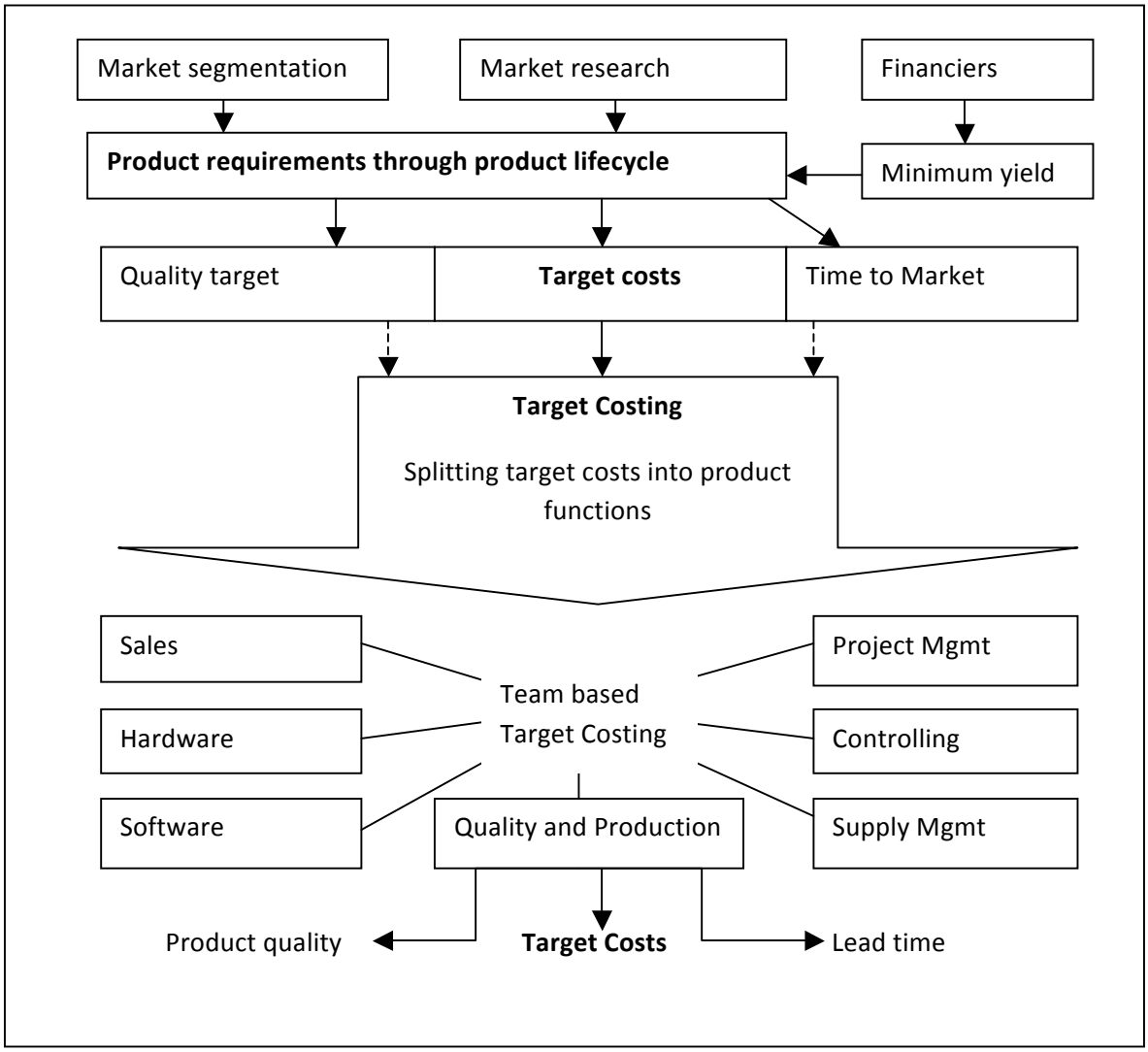


Figure 19: Target Costing Process, adapted from (Monden & Hamada, 2000, p. 103)

Main task of materials management in Target Costing is the analysis of alternative materials and suppliers including its costs already in the phase of product development, to ensure that Target Costing as a monitoring instrument for a purposeful product development can be used. Therefore the availability of alternative materials and suppliers and the preparation of this data are essential for target costing. Furthermore materials management can reduce transaction costs prior to purchasing by professional integration of suppliers. Concerning the process steps of this specific cost-management method, materials management has to fulfill the following tasks (Everaert, Loosveld, Acker, Schollier, & Sarens, 2006):

- Search of information about alternatives of materials on the market, through collaboration with potential suppliers at the stage of conjoint analysis,
- Realization of alternative solutions in collaboration with suppliers during the phase of product development and construction,

- Contribute to the calculation of drifting costs by obtaining offers or searching the database
- Contribute to the breakdown of target costs through determining material prices

The characteristics of Target Costing are summarized in Figure 20 below. They include market orientation, future orientation (foresight), team orientation and life cycle orientation.

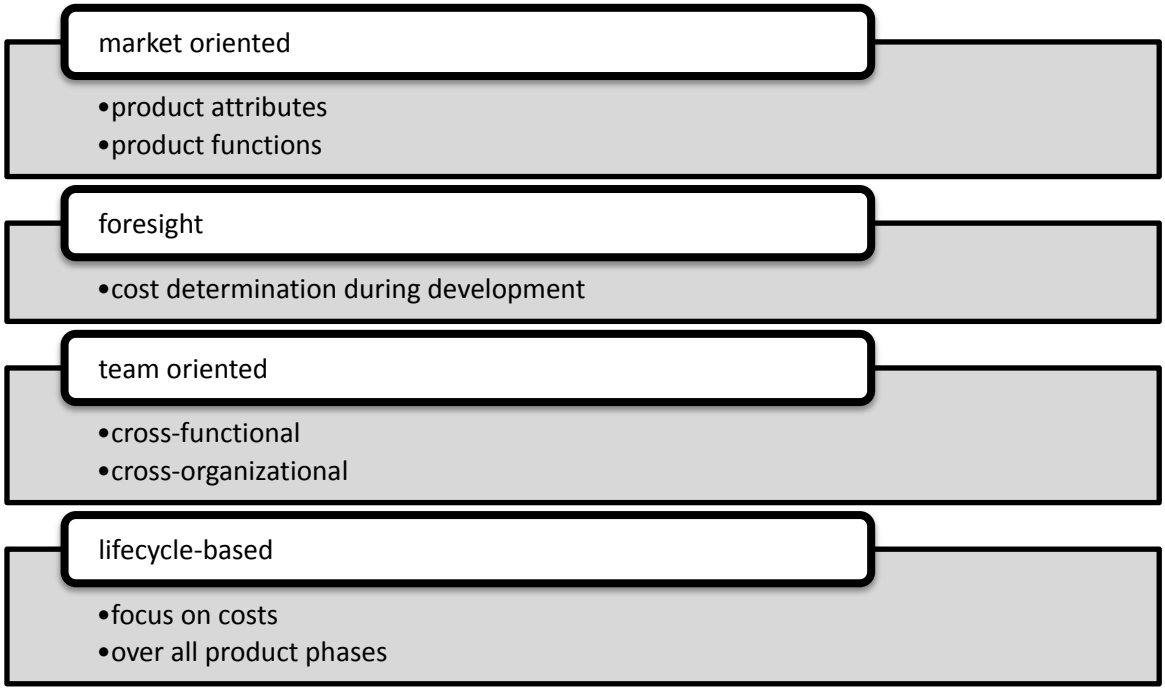


Figure 20: Characteristics of Target Costing, adapted from (Monden & Hamada, 2000)

Especially in producing standardized goods for mass markets and in industry sectors with highly automated and complex production (e.g. car assembly, electronics). Target Costing can be used to prevent over-engineering. The aligning of product functions to the needs of customers at market prices can present a competitive advantage, especially in buyer's markets. Another advantage of target costing is the consideration of all costs relevant for materials management, following a total cost of ownership perspective. A critical view on target costing though shows its focus on costs account of quality. Furthermore it can be used in product development for stable markets, but cannot be used for basic inventions. Furthermore in the field of individual production and for service companies the target costing process has to be adjusted fundamentally to be usable (Monden & Hamada, 2000).

7.2.3. Advanced Purchasing

The term "Advanced Purchasing" (synonyms: Forward Sourcing, Early Supplier Involvement) describes forward-targeted sourcing and is related to simultaneous engineering (Eliasson, 2008). By using forward sourcing at an earliest possible point in time the development process of a development- and part-deliverer should be examined and integrated into planning. Therefore it is

necessary, to integrate the sourcing of a supplier right from the beginning into the design of the product development.

Main assumption of this method is the fact, that over 50% of later product costs are external (materials costs) and that the mean vertical integration lies under 20 percent (Eliasson, 2008). Integration of suppliers is therefore a competitive imperative. Advanced purchasing is delivering an organizational concept that uses this integration intensively. The need of supplier integration in product development was testified empirically (Hendrick T. , 1997).

Advanced Purchasing pursuits three main goals:

7.2.3.1. Reduction of development time

As time to market is crucial in markets subject to competition, in advanced purchasing, several suppliers simultaneously perform research and development for several components. The organization therefore can concentrate on its core competences, lying in special functions of the product important for the customer. At more complex products (e.g. cars) even very big corporations do not bear the personal, timely and financial resources necessary to develop all components. But as various suppliers simultaneously and parallel to the development of the organization itself develop components, time is effectively saved. Time savings increase with number of suppliers included (Bechtel & Jayaram, 1997). Therefore advanced purchasing uses outsourcing to suppliers, who are responsible for certain components, in terms of simultaneous engineering, but advanced purchasing goes beyond outsourcing in production and uses this concept in development of products. Therefore not only time to market can be decreased, but also knowledge of various organizations can be used. Additionally the organization is responsible for coordinating the development of products. This can lead to substantial experience gains used later in production (Murmann, 1994).

7.2.3.2. Reduction of product complexity and development costs

Business organizations nowadays are not able anymore to review all possible and relevant technologies for product development and production, as products and methods increase in complexity. Therefore division of labor with suppliers is essential, as those organizations possess special knowledge and technological knowhow. Suppliers are often able, to produce more flexible, efficient and effective. The result of this division of labor and the outsourcing of development tasks is a reduction of complexity for the business organization itself, as now it is able to concentrate on its core activities. Reduction of complexity leads to lower overhead and coordination costs and increase profitability. In total advanced purchasing lead to fragmented production chains in many industries, which increases the need for SCM as a coordinating activity (Selvaraj, Radhakrishnan, & Adithan, 2009).

7.2.3.4. Reduction of product costs

As 70-80% of later product costs are set in the phase of product conception, an early alignment of construction and productions requirements is necessary. Through integration of suppliers the supplier is able to incorporate his know-how into the conception and therefore lower the cost of production in his organization which leads consequently to lower purchase prices for the organization. Furthermore the existing production equipment and capacity utilization can be included in the conception (Selvaraj, Radhakrishnan, & Adithan, 2009).

An important attribute of advanced purchasing is its use of interdisciplinary and cross-organizational **project teams**, consisting of constructers, suppliers, sales staff, quality managers and production specialists (Selvaraj, Radhakrishnan, & Adithan, 2009). The team-members furthermore are responsible to plan the product development as well as implement it in their own departments. Through this concept double effort is avoided almost entirely.

The **process in advanced purchasing** in product development starts with developing a rough conceptual idea of which services should be supplied externally (Eliasson, 2008). In this context the supply market research has to gather information about the possibilities to outsource parts of the production, select and evaluate this information. Subsequently an allocation of the separate components to its suppliers has to be carried out. Supplier choice then is organized in a buying center and is oriented mainly at the innovation potential of possible suppliers. Further integration of suppliers depends on technical complexity of the component. There suppliers of systems/modules, made-to-order parts / components and standardized parts can be differentiated. Suppliers of systems have to be integrated from the beginning, but only receive general instructions and target costs at the beginning of the phase, to ensure maximum flexibility in development. For a detailed construction the supplier collaborates with the organization. Furthermore the coordination of sub-suppliers in R&D is coordinated by the supplier of systems (Selvaraj, Radhakrishnan, & Adithan, 2009).

Besides product development, advances purchasing can be used in other areas, for instance in quality management, logistics and cost engineering. In the case of **quality management** a shared planning of quality can be used to achieve absolute defect-free production. This is ensured not through strict income controls (as in classical materials management), but through shared quality management (van de Water, 2000). Here advanced purchasing already includes quality aspects in the phase of supplier selection. Furthermore quality assessments of suppliers and technologies and quality management audits are used here. Main advantage of the method here is to use the specific know-how of suppliers to address at quality aspects of production.

In using advanced purchasing for **logistics**, forward sourcing is used at the end of the product development to plan the necessary logistics within the production process. Core aspects here are transportation, information, container and delivery flows that have to be planned carefully to ensure a frictionless flow within the entire supply chain (Kolchin, 1990).

Advanced Purchasing in **cost-engineering** is based on target costing with the inclusion of suppliers. Therefore target costing is used mainly but suppliers are included at all stages, especially for the breakdown of target costs to product functions, as suppliers may possess additional knowledge in that areas and more alternatives of production can be extracted. The cost-view here is focused on product costs, costs of prototypes, development costs, facilities usage, logistical costs, disposal costs and the extent of warranty (McGinnis, 1998).

The relevance of this new method in materials management increases as the use of SCM as a logistical perspective is used. Advanced Purchasing is a modern tool in materials management that can be used to fulfill the SCM needs. As already stated above, coordination with suppliers in this method are used in the development phase, in quality management, in logistics and cost-

engineering. Furthermore this method is actually constructed for integrated supply chains. This shows the relevance of materials management in SCM and especially of new forms of materials management, as represented by Advanced Purchasing.

7.2.4. Product life-cycle analysis

Product life-cycle analysis is based on the assumption, that competition rations and market growth are results of cyclical movements. Therefore the stage in the cycle has to be examined, as it has deep consequences on the sales of products and therefore influences indirectly material managements and sourcing of relevant materials (Short, 1985). Main advantage of this method is the differentiation of activities in materials management and therefore more effective management. Complex and cost-intensive methods like ABC-analysis, portfolio-analysis and value analysis of materials can be derived from the product lifecycle and be used in later stages. Until recently the influence of the product life cycle on supply materials (and therefore sales goods of suppliers) where not considered in materials management (Flores & Whybark, 1988) (Short, 1985). An ideal-typical life cycle is shown in Figure 21.

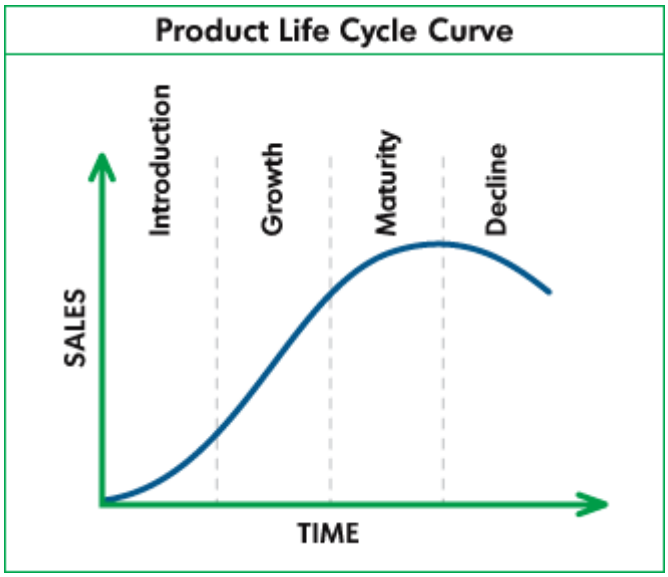


Figure 21: Product life cycle (www.trumpuniversity.com, 2008)

This life cycle then can be used to build the classical market growth / market share portfolio including the strategy used by the supplier. Figure 22 shows the BCG-matrix and how the concept of product lifecycle is used in it. Typically products at the introduction stage are question marks (or poor dogs). When they grow in sales over time, they become star products, as the market is growing and market share can be obtained. With maturation, the product turns into a cash cow and decline in sales usually indicates low (or even negative) market growth and decline in market share due to competition and imitation. Therefore the position of a product in the BCG-matrix usually follows its lifecycle. This product lifecycle therefore helps to understand the BCG matrix and to evaluate potential deviations (Hambrick, MacMillan, & Day, 1982).

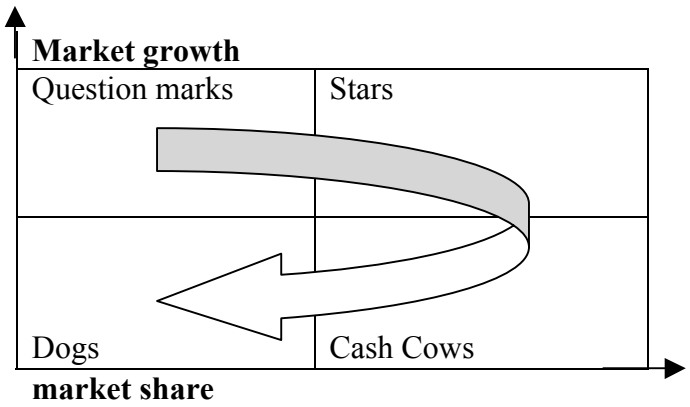


Figure 22: BCG-Matrix (Hambrick, MacMillan, & Day, 1982)

In materials management the product lifecycle concept can be used to examine the position of a supplied material in the lifecycle to examine the future price development and potential shortages besides general availability. Information about the position of materials are especially important in single sourcing strategies or in long-term cooperation's (as in integrated supply chains), as here active supplier management is crucial (Kumaran, Ong, Tan, & Nee, 2001).

The evaluation of an integrated product lifecycle includes the following stages (Asiedu & Gu, 1998):

1. Monitoring of the economic and technological environment
2. Product development (reanimating the product life cycle or develop alternatives)
3. Managing the market cycle analogous to the product life cycle

Already in the **monitoring stage**, market research has to be conducted systematically and additionally instruments of corporate foresights have to be used. Instruments of corporate foresight include scenario analysis and the monitoring of weak signals.

In the **product development stage** the supply should be actively influenced through the organization. Possibilities to influence suppliers are manifold and exist especially in the case of advanced purchasing, target costing and supplier promotion. Especial importance lies in a market-based product development and future security of supply. Contracts with suppliers should be flexible concerning supply quantity and quality requirements, to consider following market stages in the lifecycle.

In the **market stage** the product is available on the market. Here the actual product life cycle management is taken place. The first phases of market introduction and penetration, the demand is growing rapidly and often disproportionate. In using long-term contracts, disruptions in supply and shortages in this stage can be avoided (Asiedu & Gu, 1998). Furthermore alternative supply sources should be established, to avoid a monopoly of a supplier and potential capacity restrictions or artificial shortage. In market maturity materials management has to optimize TCO, as quantitative shortage of supply is not probable. In market decline of a material, qualitative and

quantitative alternatives of supply have to be allocated in time and integrated in the production process. Furthermore the change from one material to another should be managed in a way that no frictions, no quality problems for end-customers and no procedural errors arise. Usually in the phase of material substitution, shortage of supply and cost problems has to be taken into account. Furthermore the stock of old material should be decreased constantly (Ellram, 1995).

The product life cycle method clearly represents a long-term oriented view on materials management and therefore contributes to SCM, as it manages the inevitable changes of materials over time carefully. Therefore product life cycle in sourcing can be used to decrease frictions and deviations in the production of the supply chain arising from material changes within the production network. To critically also show the negative aspects of product life cycles, first of all the long-term orientation can be discussed. Long-term orientation in materials management is useful in a strategic perspective, but in operational materials management a more short-time approach might be better equipped to undertake changes in sourcing behavior. Furthermore product life cycles can only be estimations upfront and can only be drawn exactly in retrospective. Therefore product life cycles can be used in post-analysis for strategic matters but are less able to support materials management prognosis and planning matters.

7.2.5. Experience curve analysis

The concept of the experience curve (synonym: learning curve) is based on the assumption, that through doubling the cumulated production quantity, average cost per unit can be decreased by 20-30 percent (Day & Montgomery, 1983). This effect though does not necessarily occur, but has to be reached through standardization, rationalization and automation. The concept of experience curve was first empirically tested by BCG in the 1960s (Henderson, 1966). Considering the task of material supply the following consequences for materials management arise:

(1) The price of one charge of production should not be accepted for following orders. A doubling of sales quantity of a supplier should decrease his prices between 20-30 percent. If prices are not decreased by that amount, the supplier is increasing its profits drastically due to experience curve effects. Consequently in perfect competition, new suppliers will enter the market and prices will drop due to competition.

(2) Are prices not falling analogous to costs, smaller suppliers are often more willing to offer under the average market price, as for them winning of market share is a main aim. Due to experience curve, higher market price will lead to cost advantages. Therefore for small players winning market share often is preferred to cost disadvantages. Therefore through gaining market share the position of the small suppliers through experience gains is improved and profit/cash-flow is increased due to economies of scale.

(3) If alternative suppliers and substitute materials exist, it is sometimes useful, to purchase first more expensive materials, which is still in the beginning of its experience curve and therefore extensive price decreasing potential arises with such material. The short-term cost disadvantage then in the long-term can be over-compensated due to experience gains and

price concessions by the supplier. Investments into new materials at higher prices shows the loyalty of the organization and according to reciprocity theory this loyalty will pay off later, through better prices, superior conditions or priority if shortage arises.

Below the ideal-typical progression of an experience curve is shown, besides a linear version of the curve is visualized.

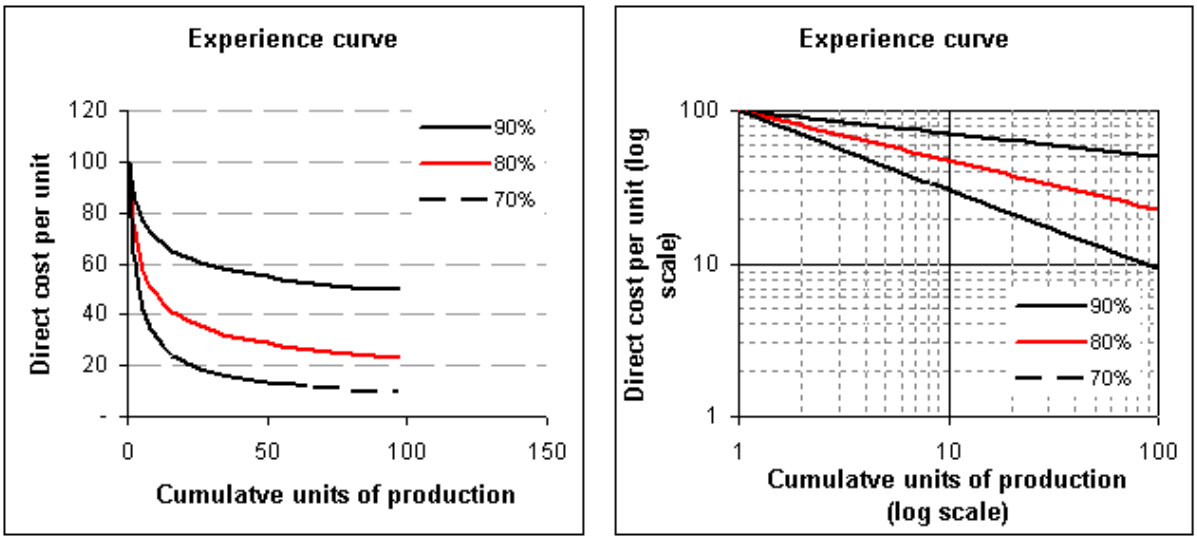


Figure 23: Experience curve (wpcontent.answers.com, 2009)

7.3. Supply-chain-based concepts in scheduling

7.3.1. Management of business interfaces

An important aspect of material management lies in the appropriate management of interfaces with upstream and downstream business organizations. Furthermore this topic is concerned also with other interfaces of the business organizations and its environment. Business interfaces generally result from division of labor. Division of labor and with that, specialization, as one of the most basic principles of economics raises advantages that are manifold for the business organization. On the other hand, it brings one main disadvantage, the need for coordination of the dispersed activities. This topic becomes even more important in the light of rising dispersion of value chains. Specialization and Coordination of activities are mirrored in a business organizations structure. Here the different subsystems are defined and separated. This separation though can lead to dominance of a subsystem, which often can lead to lack of orientation, missing framework for action and micro politics (Carder, 1997). All of these problems are addressed with coordination mechanisms, as already mentioned above.

Business Interfaces within the borders of the organization, which are concerned with the interaction of individuals or organizational subgroups, need special attention and coordination,

called interface management, defined as the set of activities, that designs relationships between process or activities leading to a unified system, but deriving from different subsystems (Carder, 1997)

Beneath this general coordination of internal functions, the business interface management is necessary in all areas, where subsystems have to be coordinated but a direct supervisor is missing. In this case the BIM system is replacing hierarchy. This is especially the case in disposition, as in this process, the organizational production uses outside subsystems that have to be coordinated. Problems in this area can arise from interaction deficits and goal conflicts.

Interaction deficits are rooted in a lack of information and communication across the various subsystems. A special communication problem arises between functional subsystems, e.g. between production (engineers) and procurement (business people), because process and market knowledge in this areas build on different ''language'' (Nguyen-Vuong, Agoulmine, & Ghamri-Doudane, 2008).

Business interface management of disposition does resolve these problems through systematic and effective design of communication relationships, to increase quantity and quality of the information exchange.

To achieve this goal, business interface management uses three instruments (Carder, 1997) (Nguyen-Vuong, Agoulmine, & Ghamri-Doudane, 2008).

- Uni-personal coordination institutions (one person is responsible) – product-, process- or segment managers
- Multi-personal coordination institutions (a group of people is responsible) – project teams or work groups
- Plural coordination institutions (all categories of management work together and are responsible) – category units or task forces

Exemplary for the plural form of business interface management, the Working Council concept will be discussed. This concept is used to bundle and consolidate supply of separate organizations with decentralized production and procurement organizations. To outbalance the effect of rising egoism of the decentralized procurement, the procurement process in the Working Council is structured in teamwork. Therefore the advantages of decentralized procurement and strategic orientated central procurement should be combined (Carder, 1997).

7.3.2. Integrated inventory management

Facing the high costs of capital commitment and storage in many organizations, reducing stock while keeping up supply security and increasing flexibility is a main mechanism used to improve performance and liquidity. The cost arising from storage is determined by stock size, interest rate and average inventory capital. Besides the cost of storage also the aspect of risk has to be discussed when storage decisions are discussed. On the one hand supply has to be secured and therefore a certain amount of stock is necessary, but on the other hand, with increasing storage,

the risk of obsolescence increases, especially facing dynamic and fast-changing markets and shortening product life cycles (Zipkin, 2000).

Factors influencing stock amount are manifold and often ambiguous or not quantifiable. Basically the following problem fields should be considered:

- High security inventory and times connected with functional centricity,
- Unclear and undifferentiated prognosis of sales and not timely information about changes of market developments
- Weaknesses in structural and procedural organization
- Weak quality of scheduling and
- Large range of products, exceptional products and product models

To address to this very common problem fields in materials management, the integrated inventory management concept resolve them. Basically, integrated inventory is integrating inventory responsibility at the functional level at scheduling only. Therefore shared responsibility of materials management in different areas of purchasing, production and sales is avoided and an optimum of efforts in materials management can be reached. Furthermore competing sub-goals in those areas do not interfere anymore with the low-stock purpose of scheduling. This organizational integration is important, as on every interface within the organization, flow of material and information is hindered (Parveen & Rao, 2008).

Integrated inventory management covers the following tasks:

- Develop and adjust production plans
- Release and conduct inner-organizational demands
- Ensure supply for production
- Coordination of component production and assembly
- Inventory management
- Regulation of sales

Main purpose of inventory management is to shorten lead time, ensure supply security, and optimize supply while decreasing stock in general. To ensure this aim, integrated inventory is taking the following actions (Zipkin, 2000):

- Reduction of diversity of models and materials with standardization of norms or types (short-term) or through standardizes sales policy (long-term),
- Investment in flexibility of technical capacity and workforce
- Use of value-analysis to investigate cost reduction potential in purchasing
- Improvement of replacement strategies through logistical concepts or avoidance of double storage
- Only market launch of fully developed products
- Shortening of scheduling cycles and therefore downsizing of minimum inventory level, reduction of risk, improvement of reaction time through effective ERP-systems
- Shortening of wait time and maintenance time in the production process through more exact production planning and the use of maintenance-free tools and facilities

- Downsizing unplanned, uncontrolled storage in the production area and reduction of maintenance puffers
- Geographic segmentation of inventory for end products and replacement parts
- Cooperation's with suppliers and the employment of virtual warehouse concepts

Besides these activities, controlling is one of the core elements of inventory management. Controlling is based on a careful analysis of the product range (see Figure 24) and determining necessary key figures.

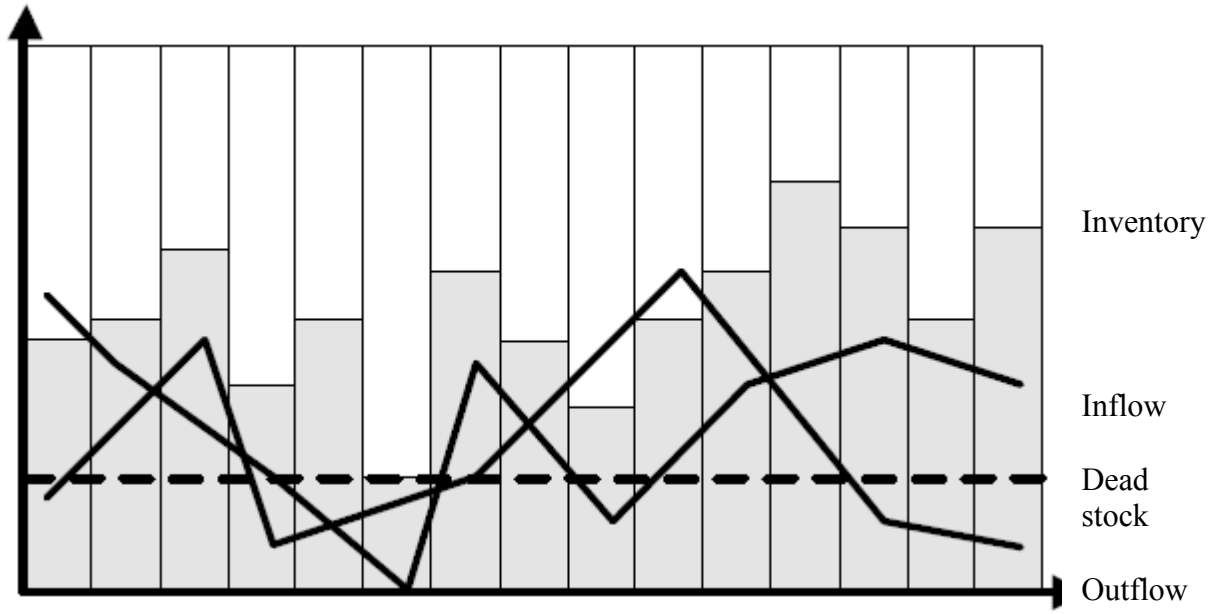


Figure 24: Analysis of product range, adapted from (Parveen & Rao, 2008)

Analysis of product range starts with an inquiry of inflow, outflow and development of inventory of each product over all periods (Parveen & Rao, 2008), as shown in Figure 24. Afterwards all articles are analyzed separately using ABC/XYZ-analysis to identify relevance of an article on a value basis and usage development. Additionally inventory turnover, average inventory reach and the age structure of inventory is displayed. Furthermore dead stock is computed. This key figure symbolizes the cost reduction potential that can be reached through integrated inventory management. To compute dead stock dead stock analysis is used. The dead stock principle can be seen in Figure 24. Furthermore an analysis of value gain in storage can be used to analyze inventory at different production steps. Based on the results of these instruments, then the optimal scheduling method can be chosen and key figures can be calculated. The key figures usually are computed through the ERP-system and have to be updated at regular intervals (Zipkin, 2000).

7.3.3. Dynamic demand calculation

As is shown in the discussion of classic materials management, demand and order calculation is based in classic materials management on constant average demand. This makes the calculation simpler and operational. However, constant demand does not reflect reality in modern supply chains, especially with dynamic environmental developments to cope with. Therefore dynamic demand calculation is used to ensure a more realistic evaluation of fluctuating demands. Therefore the planning horizon is usually limited and separated in certain periods (months, weeks, days) depending on the degree of demand fluctuation. Within the periods, the demand is given as constant, as in classical materials management. But between periods, the demand can fluctuate (Carter & Rogers, 2008), as shown in

Figure 25.

The line in the middle here is showing the demand calculated by classical scheduling calculation methods, assuming that the average demand is equally distributed and therefore assuming constant demand. The dotted curve shows the actual demand, following a cyclical trend, comparable to business cycles. This shows the amount of materials that the organization demand, depend on its own sales, following cyclical moves. Dynamic demand calculation now uses smaller periods to calculate demand (visualized by the permanent line) and therefore matches the real demand more closely (Meloch & Plank, 2006).

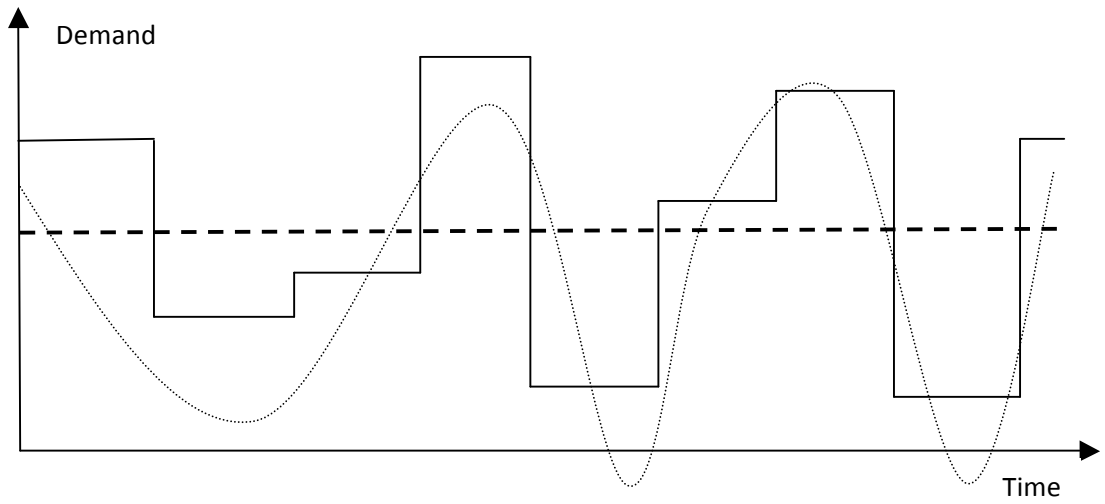


Figure 25: Dynamic demand calculation, adapted from (Meloch & Plank, 2006).

The target function of the dynamic method minimizes all relevant costs, analogous to classical materials management, but it does so not in calculation statistical optimization over all periods, but using an iteration process of step-by-step and periodical computation of demands for each period separately.

The dynamic demand calculation can be separated into exact methods and approximate methods (heuristics), depending on which calculation process is used. Approximate methods are not able

to determine the minimal costs and therefore are suboptimal. If possible, exact methods of dynamic demand calculations should be used.

Dynamic demand management has the advantage of lower storage cost and less risk of obsolescence. Therefore a more flexible approach is used in modern materials management. The superiority of dynamic approaches to demand management is though not naturally given. On the contrary the increasing use of this method is a result of changing environmental factors, including shorter product life cycles, unpredictable demand from end-customers, fierce competition and acceleration of time. D'Aveni (1994) first defined the term "hyper-competition" for this phenomenon of fast-changing environments and the new competitive reality that business organizations face in the 21st century. (D'Aveni, 1994)

Dynamic demand management though also has drawbacks. First of all, it is best used in unstable situations, if demand is stable over time, a classical approach of demand calculation can be used to decrease costs. Second, it can be used only if trust with suppliers exists, as otherwise security stocks are absolutely necessary. Therefore this method can be used in dynamic environments and with cooperative suppliers. This is especially the case in agile supply chains, and one of the reasons, why dynamic demand management is highly used in SCM (Thomas & Griffin, 1999).

7.4. Supply-chain-based MM in sourcing

7.4.1. Sourcing Strategies in modern materials management – An overview

First of all, the strategy-based methods used in sourcing are presented in this section. A sourcing strategy defines the long-term direction that should be achieved in materials management in the area of sourcing. Sourcing strategies therefore follow corporate strategies and material management strategies. Sourcing strategies can be differentiated based on manifold criteria (Linder, Jarvenpaa, & Davenport, 2003). In Figure 26 below the main sourcing strategies are presented.

Criterion used	low	"Mid"	high
Value Creation	Insourcing		Outsourcing
Number of suppliers	Single sourcing Sole sourcing	Dual sourcing	Multiple sourcing
Geography	Local sourcing	Domestic sourcing Regional Sourcing	Global Sourcing International Sourcing
Sourcing object	Unit sourcing		Modular sourcing System sourcing
Place of value creation	External sourcing		Internal sourcing
Time	Stock sourcing	Demand-tailored sourcing	JIT
Subject	Individual sourcing		Collective sourcing

Figure 26: Overview of sourcing strategies, adapted from (Linder, Jarvenpaa, & Davenport, 2003, Veugelers & Cassiman, 1999)

In practice the extreme types shown in Figure 26 above are not used, rather a strategy mix is used, to achieve multiple sourcing goals simultaneously. To combine several sourcing strategies two time-based levels have to be separated. First, the subject of value creation (insourcing or outsourcing respectively "make or buy") has to be discussed and decided. This question is of major strategic importance, as it influences overall performance of the business organization. Then, in the case of outsourcing decisions concerning the other sourcing strategies can be made. This second step has to be decided separate for each material. Furthermore some combinations of strategies are beneficial, while others are fundamentally impossible. For a complex material sourcing process with high specify and value for example, a mix of single sourcing with modular

and system sourcing, local sourcing, individual sourcing, internal sourcing with JIT is beneficial (Veugelers & Cassiman, 1999).

In the next section the different strategy options in the different fields are discussed separately. Following the two-step approach of first deciding over in-house production or outsourcing and then modeling the strategy mix, we will start with discussing the make-or-buy decision and the following strategic options.

7.4.1.1. make-or-buy decision

The main decision that has to be taken in sourcing is about insourcing or outsourcing and therefore the discussion about in-house-production (make) or purchasing per se (buy). Make-or-Buy is concerned with the question of designing the scope of activities per se, including range and depth of activities that are conducted by the business organization itself. In supply chains, the make-or-buy decisions of every single firm constitute the fragmentation of the supply chain.

Outsourcing and Insourcing in this context only determines one special characteristic of the make-or-buy decision, namely the resource aspects of the decision. This decision lies in the field of materials management. Outsourcing is defining the possibility to outsource specific parts of production on a long-term basis. Insourcing on the other hand, to integrate activities formerly purchased on markets constantly into the organization. (Veugelers & Cassiman, 1999)

Outsourcing is a term that includes outside, resource and using. The concept of outsourcing bears fundamental advantages for the organization. Main advantage lies in the use of external know-how, decrease of capacity shortages, concentration on core business, decrease of costs, improvement of return on capital employed (ROCE) and on return on risk-adjusted capital (RORAC), decrease of fixed costs, lower development costs, risk diversification, high quality and flexibility through specialization, economies of scale and so on. Outsourcing though needs high levels of coordination and trust to function adequately. Therefore it works in highly fragmented supply chains which already have experience with such fragmentation (Parsley, 1995).

Main disadvantages of outsourcing are low secrecy in product development (and conversely high transparency), high costs for securing technologies, interface problems with suppliers, chronological mismatches, coordination problems, loss of authority, monitoring and control-problems as well as dependence on business partners

Figure 27 shows the process of a make-or-buy decision. First a make-or-buy decision is taken at the corporate level, usually by top management. Furthermore the decision about out- or insourcing is prepared through a detailed problem analysis derived from make-or-buy decision, determination of the outsourcing parts, searching for supplier alternatives and then a detailed evaluation of quantitative and qualitative aspects. After this analysis phase, the actual decision about out- or insourcing is made (Veugelers & Cassiman, 1999).

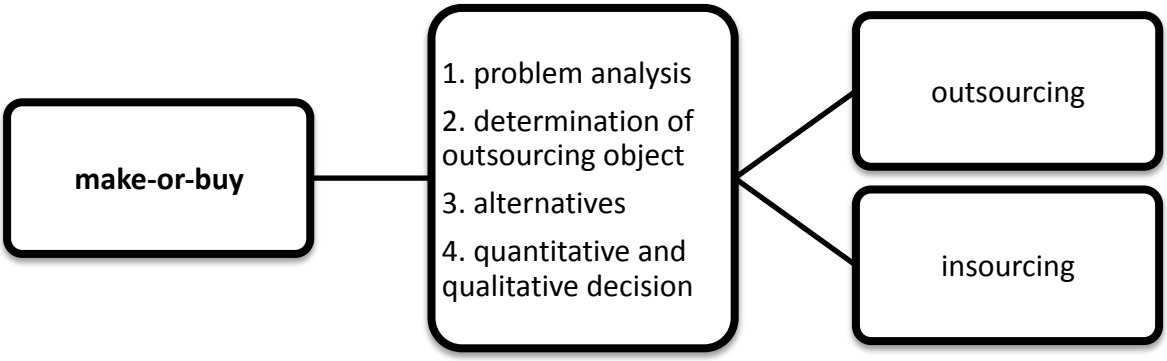


Figure 27: Make or buy decision process, adapted from (Veugelers & Cassiman, 1999).

7.4.1.2. Strategic decisions concerning the number of suppliers

The separation of sourcing strategies concerning the suppliers used for a certain material leads to single-, sole-, dual- and multiple sourcing strategies.

Single sourcing
Single sourcing is a concept, where a customer for a certain material only uses one supplier. This leads to high vertical coordination, for example in form of strategic alliances between supplier and customer and therefore eliminates competition temporarily.

The collaboration with suppliers of A-parts often already starts in the R&D, when the supplier is integrated through simultaneous engineering or advanced purchasing and persists over the entire process. For B- and C-materials the concept can be used to lower transaction costs. The supplier in single sourcing is viewed as a long-term resource with potential to increase performance.

Single Sourcing is based on trust and therefore especially used in highly integrated supply chains. Main reasons for using a single sourcing strategy lie in its qualitative and price-based advantages. Furthermore advantages can arise through bundling of quantities, decrease of transaction costs and increase of transparency in material flows.

Main risks of using single sourcing are arising from its high dependence of the organization on the relationship to the supplier and usually vice versa, legal restrictions due to competition law and missing out on innovations.

In integrated supply chains that are producing complex and highly technological goods, single sourcing is used extensively between A-components suppliers and customers. Often this method is combined with advanced purchasing and just-in-time delivery (Swift, 1995).

Sole sourcing
Sole-sourcing is a special form of single-sourcing, describing the situation of a monopoly (through legal regulation, exclusive property rights, market concentration) of a supplier (Cooke, 2004). Therefore a customer is forced to supply from a certain organization. The negotiation power in this case is one-sided. Therefore this situation cannot be compared with voluntary single-sourcing based on strategic reasons and trust. In the case of sole-sourcing the cooperative form of a strategic alliance cannot be used by materials management. The supply has to be ensured through long-term frame contracts with fixed prices. Furthermore materials management is concerned with constant search of substitutes or can actively build up new suppliers (Chiang & Benton, 2006).

Dual sourcing
Dual Sourcing (synonym Double-sourcing) is a solution between single and multiple sourcing. Here the advantages of both forms are combined. The demand for a material in dual sourcing is been split up between two suppliers. Therefore a price and quality competition between this two suppliers emerging and on a short-term basis, the quantity can be split up depending on the delivered quality and prices. But still the organization can integrate the suppliers into the operations, while keeping up a certain "competition" (oligopoly) in the market (Chiang & Benton, 2006).

Main risk in this method is the risk of price agreements between the suppliers. Cooperative agreements between organizations are quite common in oligopolistic markets (Chiang & Benton, 2006). Game theory can be used to develop reaction strategies for such cases. Furthermore contracts should be timely limited, as then competitive strategies for the suppliers are more beneficial than in the case of long-term contracts (Gibbons, 1992).

Multiple Sourcing
Multiple sourcing describes sourcing of a certain material from more than two suppliers (Treleven & Bergman Schweikhart, 1988). Main condition for this method is that enough productive, efficient and qualified suppliers exist in a certain market. That is, especially for valuable A-materials, often not the case, as markets in the long term tend to concentrate.

Main aim of the multiple sourcing is to reach independence from single suppliers. Therefore in multiple sourcing the following two rules of thumb exist:

- For A-materials and B-materials only purchase up to 30% from one supplier,
- The capacity of a supplier should be made up only by max. 40% of own demand

Main mechanism used in multiple sourcing to reach independence is to enhance competition and consequently increase productivity, quality and the price performance ration.

Main advantage of multiple sourcing lies in the great mutual independence and risk diversification. Change of supplier can be executed fast and with low costs for standardized materials. For specific and customized articles change of supplier even in multiple sourcing is difficult, here redistribution of volume is used to pressure suppliers, similar to double sourcing. (Inderst, 2008)

Discussion of sourcing strategies concerning number of suppliers
Both double sourcing and multiple sourcing strategies foster competition and therefore decrease the trust in the relationship between supplier and customer. Therefore it can be used only in low-integrated supply chains or for services that are not integrated in the supply chain at all, which mostly consists of low-value goods that are less important for the end product. In highly integrated and agile supply chains trust is the main concept of competitive advantage, and therefore double and multiple sourcing are used only in a very limited set. Generally through the use of SCM, the trend in many industries is to shift sourcing from multiple sourcing strategies to single sourcing. However, in industries that face sole sourcing, an increase in competition might be desirable, and therefore own development of suppliers or fostering competition are used in the medium-term to escape from the monopolistic situation in the sector.

7.4.1.3. Geographic sourcing strategies

The geographic segmentation of the sourcing strategy differentiates into local sourcing, domestic sourcing, regional sourcing, international sourcing and global sourcing. These strategies will be discussed separately below.

Local Sourcing
Local Sourcing is characterizing the situation where materials are purchased from (geographically) near areas. The term "near" here means suppliers are located in the same industry park, city or community or at least federal region (Wagner, Fillis, & Johansson, 2005).

Main advantage of local sourcing lies in the optimal logistical security of supply, low risk of shortages, low transaction costs as well as low transportation costs, possibility of orders at short-notice, good will gains within the region and decreasing environmental costs. Furthermore small quantities can be recalled in short frequency or flexible, a main condition of JIT-systems. Due to low distance, a vertical integration and cooperation's with suppliers can be organized well. Furthermore trust can grow, if suppliers and customers are also geographically near.

Porter first empirically tested the emergence of local clusters of suppliers and production firms and their competitive advantages. The advantages of little distance in his analysis are factor conditions (the existence of raw materials, trained workforce, suppliers), supporting industries, demand conditions (experienced and demanding customers) and industry structure (Porter M. E., 1990). Therefore geographic proximity make up for three of four conditions formulated by Porter. Factor conditions for the production organization as well as demand conditions for the supplier increase competitive advantage of the entire supply chain. Furthermore supporting industries (complementary products and so on) increase the competitiveness of the supply chain. (Song, 2002)

Even though the world seem to get smaller in times of high global integration, local proximity still has advantages for business organizations, especially in highly-integrated supply chains that build on trust and a high degree of coordination. The field of science engaged in discussing the trade-off between proximity and dispersion of activities in business organizations is called economic geography or transport geography. In this field, scientists have tested on several

occasions the superiority of local concentration or dispersion. The results have been ambiguous and inconclusive. It depends mainly on the industry structure and the produced good if concentration or dispersion is increasing lately. With new technologies generally, dispersion can increase in importance, as coordination among vast distances becomes easier. Examples of local sourcing and therefore economic concentration can be observed in container ports (Song, 2002) and electronics industry (Bowen & Leinbach, 2006) in Southeast Asia.

Domestic Sourcing

Under the term domestic sourcing all sourcing strategies are summed up, where the source of supply lies within the national borders. Therefore it describes that only suppliers from within the same nation state are used.

Main advantage of domestic sourcing lies in logistical security of supply with known legal conditions (which even are the same for the own organization), avoiding cross-border trade (which leads in reduction of accounting costs and tax advantages) and a relatively broad range of suppliers (depending on industry of course). This method therefore offers greatest legal security and a range of tax advantages, while reducing sourcing complexity and administrative costs. (Jin, 2004)

Regional Sourcing

Regional sourcing describes the supply through suppliers within a certain regional free trade area, common market or continent. In the case of Europe, regional sourcing is described as European Sourcing, considering the sourcing within the Schengen area (including the EFTA-states) or more narrowly the area of the common market in the EU. In North-America regional sourcing is defined as sourcing within the NAFTA (US, Canada, Mexico). Similar agreements exist in Asia (ASEAN), South-America (Mercosur) and Africa (ECOWAS) (Mattli, 1999).

The main advantage of regional sourcing arises from similar legal, taxation and logistical standards. This advantages increase as regional integration increases. In political unions, economic unions and common markets this advantages are especially high and regional sourcing is quite competitive to domestic sourcing, as in the case of the EU. Regional sourcing furthermore provides good to medium security of supply combined with a vast selection of suppliers. Furthermore in regional sourcing, low-cost-areas for production can be used similar to global sourcing, but with the advantage of high legal security. Therefore regional sourcing is determining a mixed form trying to combine the advantages of both domestic and global sourcing strategies (Crone & Watts, 2003).

International Sourcing

International Sourcing describes sourcing from the entire world market. To get access to the separate markets and suppliers, so-called International Procurement Offices, which are established in the markets of the triad (US; Asia, Europe). These offices have similar functions as supply intermediaries. Besides this offices other forms of international sourcing (indirect import, direct import, outward processing, sourcing through owned supply offices, use of local corporations, etc) similar to entry modes in international business (Forsgren, 2002).

The main advantage of international sourcing is the maximum of selection of qualitative, efficient and productive suppliers. Furthermore the dependence on national suppliers is decreased and competition is fostered (Birou & Fawcet, 2006).

The security of supply though depends on situational aspects, geographical distance and the used transportation route, but is lower in the case of international sourcing. JIT-supply in small quantity and high frequency are mostly not realizable in international sourcing. The transportation time and costs as well as the exchange rate need to be considered carefully. Further risks lie in the legal uncertainty, the political instability, cultural differences, quality problems and the risk of brain drain (outflow of know-how) (Fraering & Prasad, 1999).

International Sourcing strategies do not include (opposed to global sourcing) strategic tasks, it is only a geographical enlargement of sourcing. (Fraering & Prasad, 1999)

Global Sourcing

Global sourcing refers to source on a global basis, like with international sourcing, but with global sourcing a systematic sourcing strategy should be realized. Global sourcing includes besides the functions of international sourcing also a strategic dimension. This strategic dimension consists of the generation and protection of competitive advantages through global sourcing. Competitive advantages in sourcing can be reached for example through an international sourcing marketing, vertical integration, logistical concepts or R&D management. Basically global sourcing uses the local advantages to create synergies and spillovers that can be transferred to the organization. If a certain geographic area has for example the most competitive components suppliers of a certain material, it is sourced from there. Other materials are sourced in other areas. Therefore in global sourcing it is sourcing from the best (Kotabe & Helsen, 2009).

Main advantages of global sourcing can be based on trade policies, lower supply prices, strengthening competition, create access to modern technologies, creation of new sales markets and risk diversification, as well as know-how transfer, creation of synergies, technological spillovers and knowledge creation.

Main disadvantages of the concept lie in the cultural and organizational differences that are faces, the different definitions of quality and standards, high logistical shortage risk, high transportation and storage costs and highly administrative costs. Furthermore global sourcing might have negative good will effects and transfer a negative image of the organization.

In global sourcing high integration of ICT and careful management of the relationship between buyer and seller is essential. Global sourcing is highly used in supply chains that produce technological products, where the centers of excellence for different components are spread all over the globe. An integration and coordination though is always problematic. (Jin, 2004)

Conclusions on geographic sourcing strategies

In Figure 28 all geographic sourcing strategies are shown, and integrated depending on their geographic orientation and their strategic scope. As the figure shows, international sourcing and local sourcing are operative sourcing strategies (even though also local sourcing can be used in a strategic context, as for example in clusters, therefore the separation depends on situational

factors), while domestic, regional and global sourcing are usually strategic oriented strategies. Which strategy is chosen depend on many factors including the fragmentation of the supply chain, importance of a certain material, logistical concept of production integration and the availability and location of suppliers. High fragmentation of supply chains speak for high geographical dispersion of sourcing and therefore for Regional, International or Global Sourcing. Examples of high global dispersion can be found in air travel, production of aircrafts (Kaneko & Nojiri, 2008) and the car assembly of OEM (O'Connor, 2003).

worldwide	International sourcing	Global sourcing
national	Local sourcing	Domestic sourcing Regional sourcing
	operative	**strategic**

Figure 28: Geographic sourcing strategies, adapted from (Kaneko & Nojiri, 2008)

7.4.1.4. Strategies concerning the amount of materials

One of the main decisions in sourcing strategies is to separate into unit-sourcing and modular/system-sourcing depending on the characteristics of the materials purchased and how many materials needed for a certain production stage.

Unit-Sourcing (synonym Particular-Sourcing)
In unit-sourcing parts and individual aggregates of materials are purchased that are characterized through low complexity and low value (C-materials) for the supplier. The concept is focused on securing the fit of a certain material into the end product. The end product is assembled mainly at the organization and the low-value parts delivered are standardized in a way they perfectly fit into the end product.

Main advantage of unit sourcing is low supply costs, high value creation in the own facilities, purchasing goods on highly competitive commodities market, high independence of suppliers and high control over the operations.

Disadvantages of unit sourcing lie in the low integration of this method between suppliers and customers. Furthermore the knowledge that suppliers bear cannot be transferred to the production process of the customers.

Unit-Sourcing is less used in integrated supply chains as it lacks the amount of trust and collaboration necessary to achieve a competitive advantage. Additionally it is used rather for commodity materials and low-value-products in industry sectors which use less technological products, due to the disadvantages stated above. (Essig, 2000)

Modular-/Systems sourcing (component sourcing)
Modular- / Systems Sourcing is describing the supply of complex components that already contain high value (in terms of material and assembly costs as well as scheduling of parts) and are only assembled in the production process of the customer. Prominent example of this sourcing strategy is car assembly, that purchase components of cars (motor blocks, battery, frame, etc.) from a set of suppliers and only assembles the car. The main value is created through the coordination and assembly of the end product. In this sourcing strategy, modules and systems have to be differentiated.

Modules in the assembly are spatial separated and specific components, for example the door of a car. Main aim of building modules and therefore modular sourcing is the reduction of complexity (as smaller range of sourcing) and the reduction of suppliers. A modules supplier delivers labor-intensive assembly, as he assembles parts of upstream suppliers into a component that only has to be fitted in the end product and is geographically separated from other components. (Gadde & Jellbo, 2002)

Systems on the other hand are technological or functional components, which might be geographically separated in the end product, like braking systems, ABS or illuminating. Main focus of systems sourcing therefore lies in the development, production and assembly of highly integrated systems. Main purpose is to reduce vertical range and concentrate on core competences. A systems supplier (synonyms are for example direct supplier or first-tier-supplier) is heading the suppliers and collaborates densely with the customer (assembler) through simultaneous engineering and advanced purchasing as well as with his own suppliers. In collaboration with other suppliers, systems suppliers often overtake responsibilities in coordination of preproduction and development, called system integration. Systems suppliers therefore represent important hubs in a value chain as well as assemblers.

System and modular sourcing are used intensively in highly integrated supply chains, and in industries facing fragmentation of production and technological complexity. Additionally this sourcing strategy is usually combined with single sourcing, local sourcing and advanced purchasing, all methods striving for higher integration within the supply chain and eliminating competition within the chain to increase competitiveness towards other supply chains and networks. (Swamidass & Kotabe, 1993)

7.4.1.5. Strategies concerning the location of value creation

Depending on the location of value creation of supply, external sourcing and internal sourcing can be separated.

External Sourcing
External Sourcing represents the traditional value creation concept used as a basis in classical materials management. In this sourcing strategy the value creation of a certain material (or component) takes place at the facilities of the supplier. After the material is produced, it is delivered to the purchasing organization. This organization uses the material in its own production process. External sourcing therefore represents a geographical separation of supplier

and customer, that is connected by the act of purchasing and delivering (transporting) the materials (Fraering & Prasad, 1999).

Main advantage of this sourcing strategy is the independence of supplier and customer and the lack of transparency / high secrecy of own cost structure. Main disadvantage are transportation costs and lower integration of operations. This method is used when independence and secrecy of production is important and cooperative integration is subordinate. (Veugelers & Cassiman, 1999)

Internal Sourcing

Internal Sourcing then represents a higher integration degree of the relationship of the supplier and the customer, as the supplier comes into reach of the customer. Basically it represents some form of local sourcing, where the supplier has its facilities in direct reach or even produces its materials within the facilities of the customer. Depending on the degree of integration, three forms of internal sourcing can be differentiated.

First, internal sourcing with the lowest degree of integration is represented by the foundation of an industry park through the customer. In this industry park the main modular and systems supplier are integrated. Main advantage lies in the reduction of shortage risk, denser relationship between supplier and customer and reduction of transportation cost, while still maintain some form of spatial separation. (Murray & Kotabe, 1999)

Second, internal sourcing can be managed as a „Factory within a factory"-concept, where the main modules and systems suppliers are located directly within the production facilities of the customer. This method strives for higher integration than the first alternative, but still maintains some form of functional and resource separation, as resources and workforce stay at the supplier, although giving up the spatial separation (Arnold, 2000).

The third form of internal sourcing and also the strongest form of spatial integration is not only production within the facilities of the customer but also assembly of the produced materials into the end-product. In this form the supplier takes responsibility for the whole assembly of his components, from producing them until the fit into the end product. Main advantage is the use of supplier-specific know-how and high collaboration. Main disadvantages derive from the high interdependence of the supplier and the customer (Arnold, 2000).

Internal Sourcing is a method used mainly in integrated supply chains in the car and electronic industries. It requires total collaboration of supplier and customer and therefore high trust and dependence. In internal sourcing usually the customer is the only customer for the supplier as well as the supplier is the only supplier of a certain system or module for the customer. It is highly interrelated with advanced purchasing and simultaneous engineering, single and "local" sourcing. This method is used for important module and systems suppliers in highly technological sectors, as only here the advantages of the method outweigh the strong disadvantages of dependence and risk. (Veugelers & Cassiman, 1999)

7.4.1.6. Strategies concerning timing

Concerning the timing of sourcing strategies, stock-sourcing, demand-tailored-sourcing and JIT-concepts can be distinguished.

Stock sourcing
Traditional stock-sourcing as the main method of classical materials management uses large stocks and storage to secure supply and avoid the risk of shortage. With this concept the sourcing is separated from production as a means of division of labor. To achieve this separation a storage area is set up. The concept bears high storage costs and requires high capital commitment.

The concept is suited basically for C-materials and materials with high shortage risk or if supply prices fluctuate dramatically and unpredictable. It is unsuitable for A-materials (due to high capital commitment), in dynamic and flexible production processes and for materials facing high risk of deterioration (grocery, certain raw materials, energy). (Essig, 2000)

Demand Tailored Sourcing
Demand Tailored-Sourcing is re-coupling sourcing and production again as it adjusts supply between supplier and customer. This strategy can be differentiated into two forms, either individual sourcing in case of need or production synchronous sourcing.

Individual sourcing in terms of need describes a strategy where materials are just ordered in case of need after an order of customers has reached the organization. Then in the case the material is needed in production it is ordered from the supplier. Main advantage of this method is the low storage costs and short capital commitment, facing the disadvantage of high prices, long times and high risk of shortage as well as low degree of routine. This method is used basically in individual or customized production and for producing exceptional goods. (Jin, 2004)

Production synchronic delivery on the other hand uses a high degree of routine and an intense supplier/customer relationship to achieve synchronous delivery. Main prerequisite for this method is a regular need of a material over a long period of time, which is given for planned series and mass production. In this concept the buyer and the supplier sign a long-term frame contract. Here the supplier commits to supply the needed materials for a given production plan at a certain date. In this form, the supplier eliminates shortage risk for the buyer and builds, if necessary, the inventory. Important to notice in this concept is the fact that the production plan is given upfront and the delivery of supplied materials is synchronized to a stable and regular production process. (Essig, 2000)

Just-In-Time
JIT describes production-synchronic delivery in situations where planned production processes and regular demand are not given. Therefore it goes beyond the before discussed concept of production-synchronic sourcing. In JIT the relationship with the supplier also is way denser than in demand tailored sourcing. Basic idea of JIT is still the adjustment of supply with upstream production of suppliers (called pull principle) (Das & Handfield, 1997). In this method though, suppliers are directly integrated in the planning of production and implementing the know-how of suppliers. Furthermore production plans are more of short-term character, as demand usually

fluctuates for organizations using JIT. Basically in this model information is replacing stock. JIT enables for low shortage risk through a complete synchronization of material flows. Therefore inventory and lead time can be reduced to a minimum level.

Main characteristic of JIT is vertical cooperation and therefore creation of a trustful partnership between supplier and customer, reaching high flexibility in production, zero-error-strategy (for example using Six Sigma (Khaki Boukani, 2007)), installation of cross-organizational information systems, integration of ICT and ensuring logistical quality. Customer and supplier share projects and functions as quality management, inventory management, and material flow planning, transportation and distribution management and spatial decisions.

The JIT concept is only suitable for A-materials and partially for B-materials with relatively constant (not frequent!) demand. Disadvantages can arise mainly in the area of communication, quality of materials, logistics and strategic management between the two partners. Furthermore high interdependence arises through the use of JIT.

Like other high-integrative forms of sourcing strategies in materials management, JIT is used mainly in highly integrated supply chains that foster trust and collaboration at the price of independence and competition. (Monden, 1998) JIT offers great integration within supply chains. On the other hand it certainly does reduce agility and flexibility of the supply chain (Prater, Biehl, & Smith, 2001), as such highly-integrated processes cannot be changed flexibly. JIT is a concept that reduces speed of changes and flexibility of changes in the logistical processes of the supply chain (Schönsleben, 2000). In the field of materials management agility is reduced by JIT through reducing the speed and flexibility of sourcing (Prater, Biehl, & Smith, 2001). Additionally a complete JIT coordination throughout the supply chain increases vulnerability of the system (Prater, Biehl, & Smith, 2001). Additionally JIT as it reduces agility also make postponement strategies more unlikely to be managed by the organization (Stevenson & Spring, 2007). This has to be taken into account when designing JIT systems, as postponement is rather important in many industries (like ICT) and therefore agility of the supply chain and robustness as well as flexibility and innovativeness might be more important for a certain organization than full integration of logistical processes done by JIT.

7.4.1.7. Strategies concerning the subject of supply

Strategies can also be separated depending on the subject of supply, leading to a separation into individual-sourcing and collective-sourcing. This differentiation is based on the idea that transactions of goods and the distribution of supply potential can be realized with different concepts. Basically sourcing can be managed by the organization itself or through a purchasing cooperative. The main concept behind the idea is the concept of markets, cooperation's and hierarchies first introduced by Williamson (1981). In his theory he basically questions the idea of organizations in a world of perfect competition. Rooted into that assumption, he then derives the idea of transaction costs responsible for the existence of other forms of organizing economic transactions, namely hierarchy (organizations). He states that the market and the organization are the principal instruments of organizing economic activities and between those two extreme forms a range of cooperation's exist. This theory can be transferred to sourcing. As transaction costs in modern supply chains and due to modern ICT are declining in many industries, organizations use

forms of sourcing more oriented on the market and in forms of cooperation's, instead of remaining the sourcing process within the organization. The forms of strategies are shown in Figure 29.

Hierarchy	**cooperation**			**market**
Sourcing by organization individually	Mutual sourcing organization	Mutual sourcing and bundling	Mutual use of conditions	-
◄———	◄———————————		———►	
Individual sourcing	**Collective sourcing**			

Figure 29: Strategies concerning sourcing subject, adapted from (Williamson, 1981)

Therefore, individual-sourcing describes if the sourcing process is individually organized by the organization, while collective sourcing is using a form of horizontal cooperation or alliance to satisfy supply for the organization. The main advantage of collective sourcing lies in economies of scale and lower purchase prices, lowering transaction costs, achieving better conditions, decrease of shortage risk and gaining market power in supply markets. (Williamson, 1981)

7.4.2. Procurement marketing

7.4.2.1. Definition and main tasks

Marketing is a concept that was first used in the sales area, but generally just describes the focus of all activities of an organization (the value chain) towards the customer. Therefore it is a theory previous to supply chain management. In marketing though all activities of one organization are focused towards customer value. Therefore marketing is not only a functional area (as marketing is often used as a synonym for sales) but an organizational philosophy that emerged in the 1950s when markets turned from supplier into buyers markets. In this situation the bargaining power of the customer became the ruling imperative and all functional areas of the organizations were reengineered to focus on customer value.

Supply chain management used this philosophy and transferred it to the extended organization, the entire process of value creation in the supply chain. Therefore the entire supply chain has to adjust their activities towards the end-customer. This means a marketing-perspective at its heart. This marketing philosophy therefore was transferred to other areas of the organization than sales, where its primary focus lied (as there the interface with the customer is located), to internal marketing (towards employees), investors marketing (towards investors) and basically towards all kinds of stakeholders, called generic marketing. The supplier as the main partner of the firm in the supply chain view therefore also has to be managed through a marketing perspective and the activities that lie in materials management and are organized following a marketing philosophy are called procurement marketing.

Sales marketing and procurement marketing follow the same principle mechanisms. Consequently instruments and methods in procurement marketing are rooted in empirical tested mechanisms of sales marketing. But as procurement marketing organizes exactly mirrored

situational aspects, sales marketing cannot be copied to procurement marketing. Rather a transfer of knowledge and methods and adjustments if necessary were used to create the field of procurement marketing by using knowledge spillovers from the sales function. Furthermore in the situation of buyers markets, the purchaser holds a main power position towards suppliers. But as complex production processes exist in the supply chain, the purchaser has to deal with conflicting demands between his own organization and the requirements of the supplier. These demands have to be balanced in a way overall profitability in the supply chain is increasing. Furthermore sales marketing and purchase marketing follow diametrical targets. For sales marketing it is important to decrease or even eliminate competition, while for procurement marketing more competition between suppliers is favored to increase quality and decrease prices. This shows that between classical sales marketing and procurement marketing theoretic analogies are possible, but procurement marketing is an independent concept following a different path.

Procurement Marketing (or Reverse Marketing) here is defined as the sum of all activities that are focused on actively shaping the supply market, given a knowledge of relevant information and pursuing the goals of the organization and the supply chain. Main focus here is the active operating on supply markets instead of reacting to them (like in classical materials management.

Main tasks of procurement marketing lie in analyzing the situational, demand, market and supplier conditions. To achieve such an analysis, information search is essential. This part of the marketing process is called market research. Based on findings in the field of market research, procurement marketing has to make decisions concerning demand, market and suppliers. Furthermore integration of early warning systems into market research and the integration of ICT into the field of sourcing are topics that have to be discussed in procurement marketing. In the next chapters this different fields of procurement marketing are discussed in detail. (Kotler, 2005)

7.4.2.2. Situational analysis

Situational analysis is examining the background for decisions in sourcing systematically. Therefore the various external and internal factors are collected and evaluated concerning their relevance. External factors are representing the supply constellation an organization is facing while internal factors are representing the sourcing potentials. (Kotler, 2005)

Sourcing constellations

Sourcing constellations are complex conditions and states of the supply market that can influence the action framework of sourcing positively (then they are called chances) or negatively (risks). This chances and risks interact dynamically and can affect the organizational immediately or in the long-run. The determinants characterizing a chance or a risk can be unchangeable (given) or changeable by the organization. Figure 38 below shows the areas that a situational analysis of constellations for materials management include.

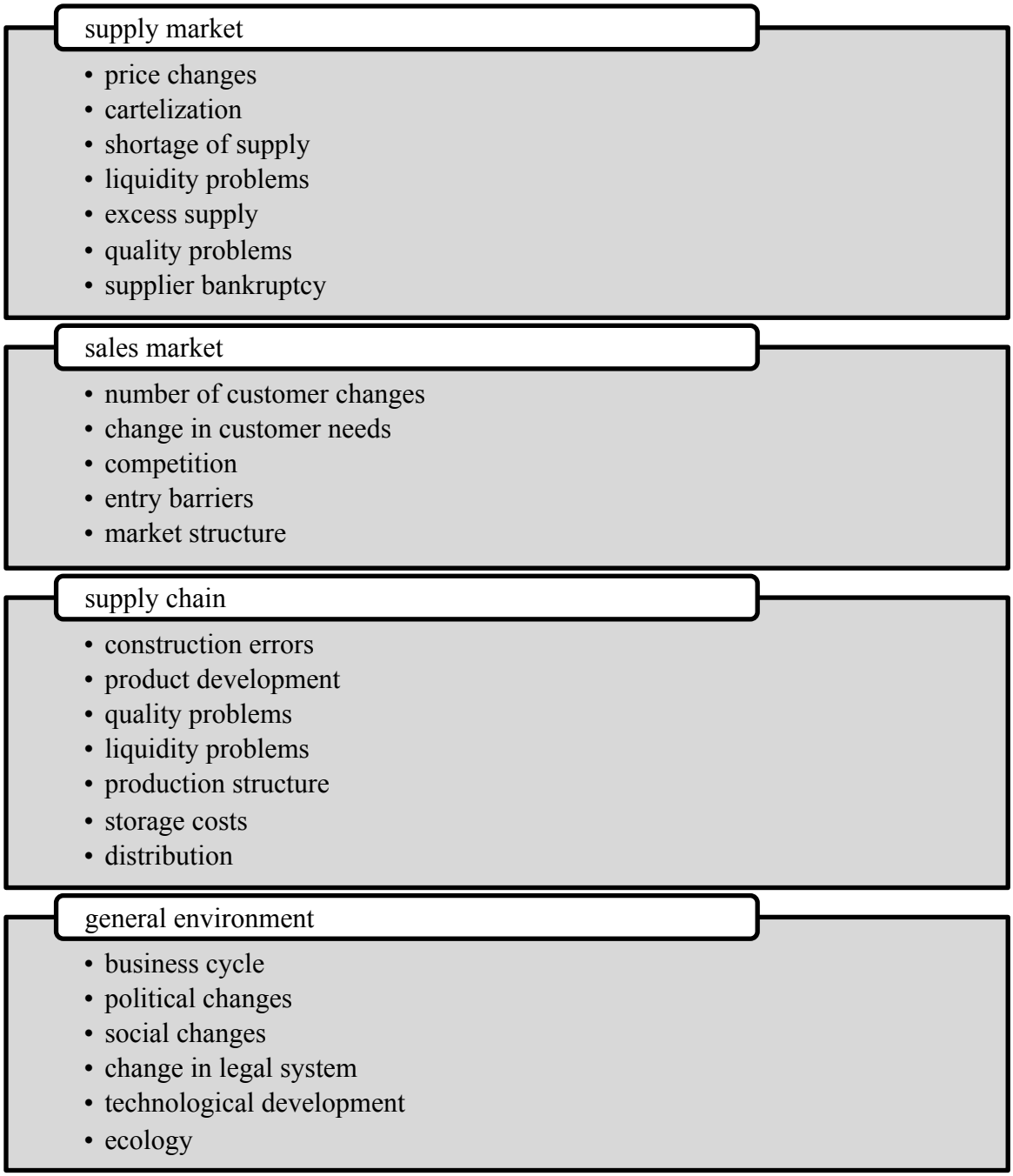


Figure 30: Areas of sourcing constellations, adapted from (Kotler, 2005)

A structure of constellations is shown in the figure above. The structure used for organizing constellations though influences the conclusions of the analysis.

Basically the organization is influenced by sourcing constellations in the following ways (Kotler, 2005):

- Changes in offered services (through technological trends, new suppliers, legal changes),
- Changes in quantities (raw material shortage, artificial shortage of materials)

- Changes in prices (changes in cost structures, changes in competitive structure)
- Changes in timing (capacity shortage, quality problems, infrastructure available) and
- Changes in location (bankruptcy of suppliers, import quota)

The procurement department can meet these changes with a change of targets or strategies, with adjustment of demand, change of supply markets or suppliers or changes in marketing instruments (product, price, distribution and communication) strategies. For those determinants that are changeable, furthermore an active influence on the market can be used. With such strategies, the sourcing can eliminate or soften certain threats and strengthen or build up chances upfront. (Kotler, 2005)

Sourcing potentials

Sourcing potential is defining the qualitative and quantitative possibility (resources) to react to sourcing constellations or to actively influence them. In a short-term perspective this potentials limit the activities that can be set by an organization on its supply markets. In the long-run the organization has to decide if those potentials are increased, decreased or reorganized. In relation with decreasing potentials, outsourcing decisions have to be taken into account.

To determine the potentials in sourcing an analysis of strengths and weaknesses or portfolio analysis methods discussed before can be used (Kotler, 2005). The process of potential is visualized in Figure 31.

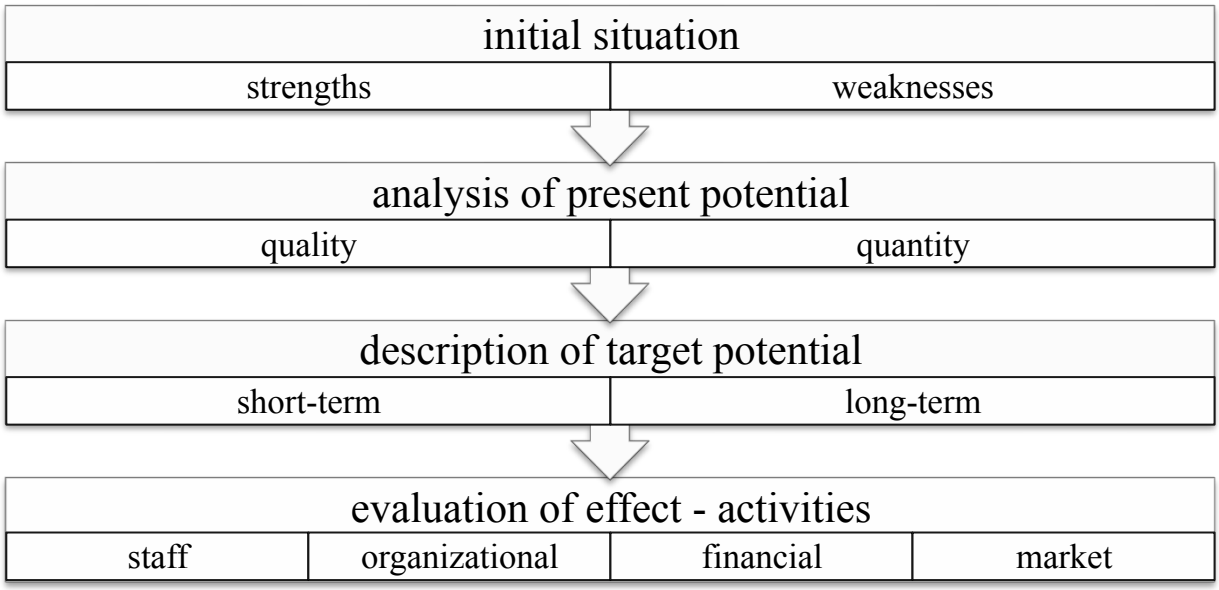


Figure 31: Process of potential analysis, adapted from (Kotler, 2005)

Sourcing goals

Procurement marketing is based on the goals formulated for the procurement area. Sourcing goals though have to be transferred into targets for the different dimensions, including the object of sourcing, the scope and the timing aspects. Furthermore this targets have to measurable, to ensure controlling at the end of the process. (Kotler, 2005)

Procurement strategies
Based on the procurement targets defined, the strategies to reach these future states have to be formulated. A procurement strategy here includes a bundle of activities in sourcing to achieve the supply-chain targets and the targets of the procurement area. The activities chosen should have synergetic effects and fit into the overall corporate strategy. (Kotler, 2005)

7.4.2.3. Analysis of demand

Based on the insights derived from situational analysis and the demand requirements given, the organization now has to analyze the structure of demand, evaluate it and plan it. Here scheduling was only with the operational planning of quantities and time. From a strategic perspective though those materials are of interest with have potential influence on the supply chains competitiveness and strategic capabilities. A systematic and exact analysis of demand and its planning is especially important as strategically wrong estimation of demand cannot be compensated by scheduling or operational sourcing. The three phases of this process are discussed below. (Kotler, 2005)

Demand analysis
In demand analysis the main purpose is to determine the present structure of demand of materials. Therefore the materials are separated and clustered into homogenous groups by using various classifications. This requires a three-step-approach:

- Selection of characteristics for classification
- Scaling of characteristics
- Clustering of materials according to classification

The resulting clusters represent decreased complexity and increased transparency for sourcing decisions. Furthermore it allows concentrating on strategically important materials. (Kotler, 2005)

Demand evaluation
The evaluation of demand decides if the analyzed present structure determined by demand analysis is capable of reaching the strategic sourcing targets and ensuring resp. creating potentials for the organization. If the present structure of procurement is capable, than it is maintained, if it is not capable, an adequate demand structure has to be planned and implemented. (Kotler, 2005)

Demand planning
Demand planning now is in charge of developing activities to support the strategic sourcing targets. These activities are first tested concerning their applicability and an estimation of their effects. Especially difficulty arises from assessing the effect of different bundles of activities. The chosen activities are bundled into a “catalogue”, which serves as main strategy for the demand structure and activities taken by the organization. (Kotler, 2005)

7.4.2.4. Market analysis and selection

Situational analysis and demand analysis were mainly concerned with internal aspects of procurement marketing. As sourcing though represents a form of interface between organization and environment, market analysis is focusing on external determinants of procurement marketing. Here the focus is the market – the meeting of supply and demand – as an overall system consisting of separate elements (mainly suppliers). (Kotler, 2005)

Criteria

To analyze markets, the following criteria are used:

- Dimension of subjects (market actors, economic market forms)
- Dimension of objects (interaction or transaction materials)
- Market dimension (size and scope of market)

Forms of demand \ Forms of supply	monopoly	oligopoly	polypoly
monopson	Monopoly-monopsony	Oligopoly-monopsony	Polypoly-monopsony
oligopsony	Monopoly-oligopsony	Oligopoly-oligopsony	Polypoly-oligopsony
polypsony	Monopoly-polypsony	Oligopoly-polypsony	Polypoly-polypsony

Figure 32: Market forms, adapted from (Kotler, 2005)

In the dimension of subjects, nine basic forms of markets can be distinguished, as shown in Figure 32. Each form is characterized through specific power constellations that have to be integrated into the strategic sourcing. The forms monopoly, oligopoly and polypoly describe the amount of suppliers in the market. A monopoly is a market, where only one supplier exists. In an oligopoly a few (2-5) suppliers exist, and polypoly describes the situation of many suppliers, similar to perfect competition. The forms monopsony, oligopsony and polypsony are analogous concepts but describe numbers of customers in the market (Kotler, 2005).

As can be seen in the figure above, different power positions of suppliers and customers meet and therefore nine basic forms of markets exist. The shades of grey show the threat potential of a situation for the customer. The more the market moves to the left-bottom corner, the less power the organization has and the more power the supplier holds. In the form of a monopoly supplier

meeting many customers, the power lies solely at the supplier. Contrastingly a polypoly of suppliers meeting a monopsony of the organization being the only demander of the material, the organization holds the power over prices, qualities and conditions. In the long term markets tend to settle down in the middle diagonal with similar numbers of buyers and sellers facing each other. But through sourcing and sales strategies of the parties as well as legal frameworks also other forms can be maintained over long periods. (Baldwin & Cave, 1999)

Detailed analysis
After analyzing the general market, a more detailed analysis of market conditions is following. Important attributes in procurement market analysis can be separated into

- Benefits (productivity, quality, flexibility, knowledge, logistics infrastructure, technology, R&D, ecological standards, communication, knowhow)
- Costs (prices, maintenance costs, logistics costs, capital costs, others)
- Risk (climate, dependence, political and economic instability, risk of striking, substitution alternatives, speculation)

Are all relevant supply markets of the organization separated and classified, they have to be evaluated concerning their strategic importance. This market analysis is preparing for a selection of submarkets, as an efficient operation on supply markets have to be differentiated. The selection of markets can be based on their relevance for strategic development. (Kotler, 2005)

7.4.2.5. Analysis of suppliers
Other external determinants in procurement marketing are suppliers. After selecting relevant markets, now the main task is to select appropriate suppliers in the relevant markets. From a strategic sourcing perspective, two main steps of supplier selection can be differentiated: in the first step, the decision is about integrating a new supplier for a certain material. The second step is representing operative supplier choice, it follows chronological the first step and decide about concrete material quantities within scheduling.

The process of supplier is summarized in Figure 33 and contains five steps. All these steps can also be managed with ICT, which leads to an improvement of the process. (Kotler, 2005)

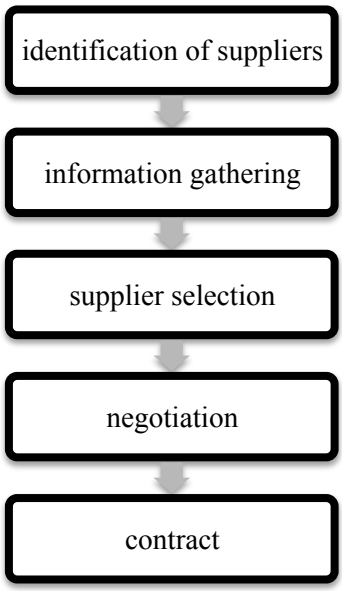


Figure 33: Process of supplier analysis, adapted from (Kotler, 2005)

Identification of suppliers
Identification of suppliers is used to define the potential suppliers and systematically limit choice, without using requirements to evaluate them. As main filter the material that is needed is used, included the quality attributes, the industry sector and technological minimum requirements. (Kotler, 2005)

Information gathering
Main aim of this phase is to contact the identified suppliers to access information. Usually information gathering is standardized, as comparability of results is the main priority. Different research methods can be used in information gathering.

Procurement market research may use questionnaires using standardized questions, knock-out-criteria and other questions about main sourcing requirements. Later not only the answers from these questionnaires are analyzed but also the speed of answering, precision of answers and completeness of the answer can give valuable insights into the qualification of a certain supplier.

Another method of gathering information is through qualitative research and visiting the supplier's facilities. Especially in integrated supply chains this forms of audits are used not only in the supplier selection step but later on as forms of constant quality control through qualitative questioning and visiting the supplier, the organizations shows interest and gets a more detailed picture of the entire organization of the supplier and its internal processes. Furthermore a first socializing is happening which can be valuable in later stages of negotiation and relationship management. The visits though should be prepared carefully and to a certain extent standardization is useful, for the purpose of comparison. (Kotler, 2005)

Supplier selection
Based on the demand requirements, information and research on suppliers and own market monitoring, a first selection of a few suppliers is undertaken. With these suppliers negotiations are started. To support selection, several methods of classic decision-making are used, such as:

- Scoring-models
- Polarity profiles
- Pole diagrams
- Portfolios
- Checklists
- Grading systems
- Cost-benefit-analysis

Depending on situational aspects, the criteria used in these models can be chosen freely. However, a balance between strategy-based criteria of effectiveness (long-term aspects of decisions, synergy potentials, R&D potentials, price value ratio, willingness to cooperate) and operation-based criteria of efficiency (price, adherence to schedule, and flexibility) should be achieved. It is especially important to evaluate the criteria concerning their future development, to get a dynamic picture about the supplier. Furthermore the requirements of the supplier on the own organization should be integrated into the selection criteria.

Besides those criteria-based models, also alternative forms and methods can be used to select suppliers. Here quantitative and qualitative methods can be distinguished. Quantitative selection methods use mainly key figures and analysis of accounting information to reach a decision. Qualitative methods on the other hand include expert opinions and other soft factors. Qualitative methods in selection are for example analytical hierarchy (using a hierarchical analysis of suppliers, similar to the scoring model) and the matrix-approach (a scoring model that is executed by experts instead of internal staff). Recapitulatory these alternative methods try to outbalance the subjectivity of the usual methods by either using comparable key figures or expert opinions. (Kotler, 2005)

Negotiations with suppliers
After a selected set of suppliers is determined, negotiations about prices, quantities, qualities and conditions can be started. Main content of these negotiations is the marketing-mix presented later. In this marketing-mix the main characteristics of products concerning product attributes, prices and conditions, distribution and communication are included. The content of this mix is presented later. In this section the main characteristics of the negotiation itself are discussed.

The main purpose of a successful negotiation is to achieve a win-win-situation with minimal overall costs for both parties, if the organization intends to build up a long-term relationship with the supplier. The negotiation requires intensive factual, organizational, tactical and individual preparation of all participants.

Factual preparation includes a definition of the negotiation goal (demand specification, quantity, price limits, and marketing-mix) and weighting them according to their importance. Furthermore sound argumentation for each sub-goal has to be formulated, that is used to achieve optimal negotiation results. Additionally the negotiation goal of the supplier, their cost situation and their argumentation should be estimated, to formulated counter-arguments. As last part of the factual preparation the BATNA (best alternative to negotiated alternative) has to be

formulated (Brett, Pinkley, & Jackofsky, 1996). This is the alternative to negotiation with the supplier and should lead the negotiation style, argumentation and the use of tactics.

Organizational preparation is defining the number of participants (the purchaser alone or a buying-team) and the exact configuration of the buying center. Furthermore all participants have to be informed to have similar knowledge levels in respect of factual knowledge. Furthermore it is useful to set the role allocation within the team and distribute the arguments analogous between the team. Another aspect of organizational preparation is the choice of location, a very important aspect of negotiation.

Tactical preparation is concerning with the question of how a participant will formulate an argument. Here especially certain psychological tactics are used. Additionally tactical preparation includes the use of nonverbal tactics in negotiation, including space, silence, facial expression and eye contact.

Personal preparation includes the study of psychological principles and study of the individual negotiation partner. Information about the personality, motives and the character of the negotiation partner should be gathered. Furthermore the systematic observation of body language, attitude, hobbies and the use of language might give insights. (Fisher, Ury, Patton, & Guyer, 2006)

Additionally to these preparation areas, in the case of regional, global or international sourcing, the cultural differences and their influences on the negotiation should be analyzed as part of the preparation. Especially no-goes in the specific culture, behavioral rules and negotiation style should be examined carefully. A detailed study on multicultural negotiation is given by Adler (Adler, 2008).

After the preparation phase, the actual negotiation is carried out. Starting point is often a specific offer of the supplier, which is examined by the customer. Through this first step, usually the positions of the two partners can be examined step-by-step. Usually negotiations especially with systems suppliers are undertaken in several rounds, going from very general negotiations into details. The participation in the different rounds is often adjusted, with hierarchical higher managers involved in the beginning, shortly before signing the contract and especially at formal signature of contract. In the other phases, the negotiations are often about very detailed conditions and therefore experts of suppliers and customers (the functional users of the product later on and engineers from the side of the supplier) are involved in these steps. Basically in the negotiation the selling and sourcing mix are adjusted. From the customer's perspective, he is trying to converge as far as possible to the price minimum of the supplier.

In the actual negotiation a set of negotiation tactics are used, including question techniques, listening, argument, mirroring, presentation, silence, body language and the use of first offers. While negotiating each party test if the foreseeable compromise is acceptable and is a superior to the BATNA.

The last step of negotiation is the post-processing phase, where the results are documented and the signature of contract is prepared. Furthermore problems while the negotiation phase are

documented and analyzed to gain knowledge and experience. The signature of contract often includes a formal, symbolic act of reaching an agreement, that can be of legal nature (notarial deed) and official meeting of top management of both negotiation parties. (Fisher, Ury, Patton, & Guyer, 2006)

Supply contract
Main outcome of the negotiation process is the supply contract. Usually it consists of frame conditions concerning the marketing mix and is of long-term nature.

7.4.2.6. Procurement market research

To actually realize the task of situational, market and supplier analysis, information about external as well as internal factors have to be collected. In this notion information about the present situation as well as the historic development and expected future development is necessary. Especially data concerning supply markets is of interest in procurement marketing. Hence market research has to be conducted in the field of procurement, especially with the use of new ICT. ICT include the internet, intranet, extranet, audio and visual methods, new forms of sharing data and similar concepts. Through ICT often excess supply of data exists and the main aim of market research lies in systematization of this data. Market research methods using ICT are discussed in detail below (Malhotra & Peterson, 2001). Classical market research methods will not be discussed here, for an overview see Kotler (2005).

Mailing lists
Mailing lists that archive frequently asked questions (FAQ) about certain aspects. Economic agencies and industrial unions offer such mailing lists and also archive industry analysis and general data there. Mailing lists exist for several materials.

Newsgroups
Newsgroups are a form of discussion forum, where a certain topic is discussed and news in this area is posted. First designed for private use, recently it is used also in industries (especially in high-technological sectors, like IT, electronics, and mechatronics) and in science.

Search engines
Search engines represent a substantial improvement of data search, especially for secondary data, but usually they lead to an “information overload”. Specialist search engines can tailor the search to certain areas, like for example scientific articles, to certain sectors or certain geographic areas. Furthermore the newest generation (adaptive search) engines are based on experience, and it documents the results that are actually used and bases new searches on that information. Therefore results are improved with time. (Malhotra & Peterson, 2001)

Offline browsers
Offline browsers search the internet and save the result on the hard disk, the actual analysis can be conducted offline. Furthermore with this instrument the search and the analysis parts of research can be separated. (Weerawarana & Houstis, 1997)

Web catalogues
In a web catalogue several homepages are separated due to their topics. Furthermore a hierarchy is built, showing the degree of conformity with a certain topic. Therefore the user can systematically search by topic. Web catalogues are also used by libraries. (Malhotra & Peterson, 2001)

Databases
Databases represent a collection of specific information. In databases search can be organized hierarchical (similar to web catalogues) or through an index search. The main advantage of databases lies in the fact, that mostly they are maintained by an institution possessing the necessary personal and financial resources to improve the database. One such database is for example the CIA fact book, storing up-to-date statistical data about most countries of the world (CIA Factbook).

Info broker
Info brokers are service organizations that undertake the information search via the internet for the organization. In this method the market research is outsourced to a market research agency. (Horstmann, Timm, & Mertens, 1998)

7.4.2.7. Strategic foresight

Strategic foresight (or corporate foresight) is a method that integrates a constant monitoring of external factors to proactively identify changes in the organizational environment and on supply markets, to be able to formulate adaptive strategy timely and implement them upfront. Concerning procurement marketing, especially supply markets and suppliers are monitored, regarding potential threats and opportunities alike. A main metaphor describing strategic foresight is the radar (Costanzo, 2004).

New instruments of strategic foresights concentrate on the identification of weak signals. Weak signals though cannot be proven by a trend line or extrapolation. Therefore weak signal identification is not based on the traditional statistical methods used in strategic prognosis, but has to be based on interpretation of symptoms, subjectivity, speculation, experience, intuition and marginal trend evaluation. Frequently weak signals can be deducted from the interplay of various data from different environmental areas. Traditional foresight methods were base on key figures or early learning indicators that lead to the formulation of a trend.

The steps in the process of strategic foresight analysis are represented in Figure 34 below. Especially in the fields of analysis and prognosis experienced and skilled experts should be used. (Kotler, 2005)

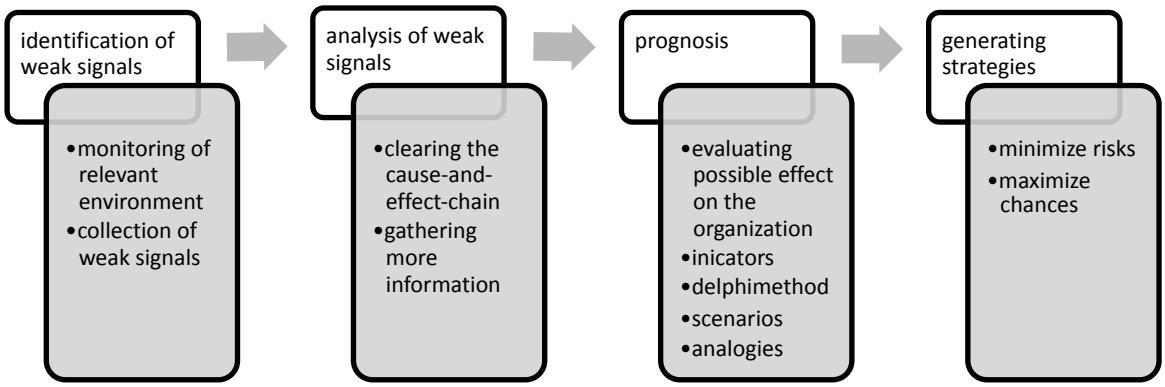


Figure 34: Process of strategic foresight analysis, adapted from (Kotler, 2005)

7.4.2.8. Procurement marketing mix

The marketing mix represents the optimized bundle of procurement activities given a certain procurement strategy used in supply markets. The instruments are analogous to the instruments used in sales marketing. Within the instruments though, the specific nature of procurement marketing is met. The marketing mix in procurement consists of five main areas, product, price and conditions, services, distribution and communication. Furthermore additional instruments can be integrated into the marketing mix, as for instance information policy, supplier policy, competition policy, market policy, ecological policy, quality management and internal marketing.

The instruments though are not used separately but have to be combined to reinforce each other. Special attendance has to lie on potential conflicts within the marketing mix. The marketing mix therefore is rather the bundle of marketing instruments, than separate policies.

Additionally the instruments have to be adjusted to situational aspects (supplier power, market trends and general environment) and demand requirement. The mix-planning therefore faces multiple requirements, goals and problems that have to be balanced and decision is usually made under uncertain and dynamic conditions. Therefore experience is an important concept in the decision of the marketing-mix. The separate instruments and the subsequent areas of decisions of policy are shown in Figure 35 below. (Kotler, 2005)

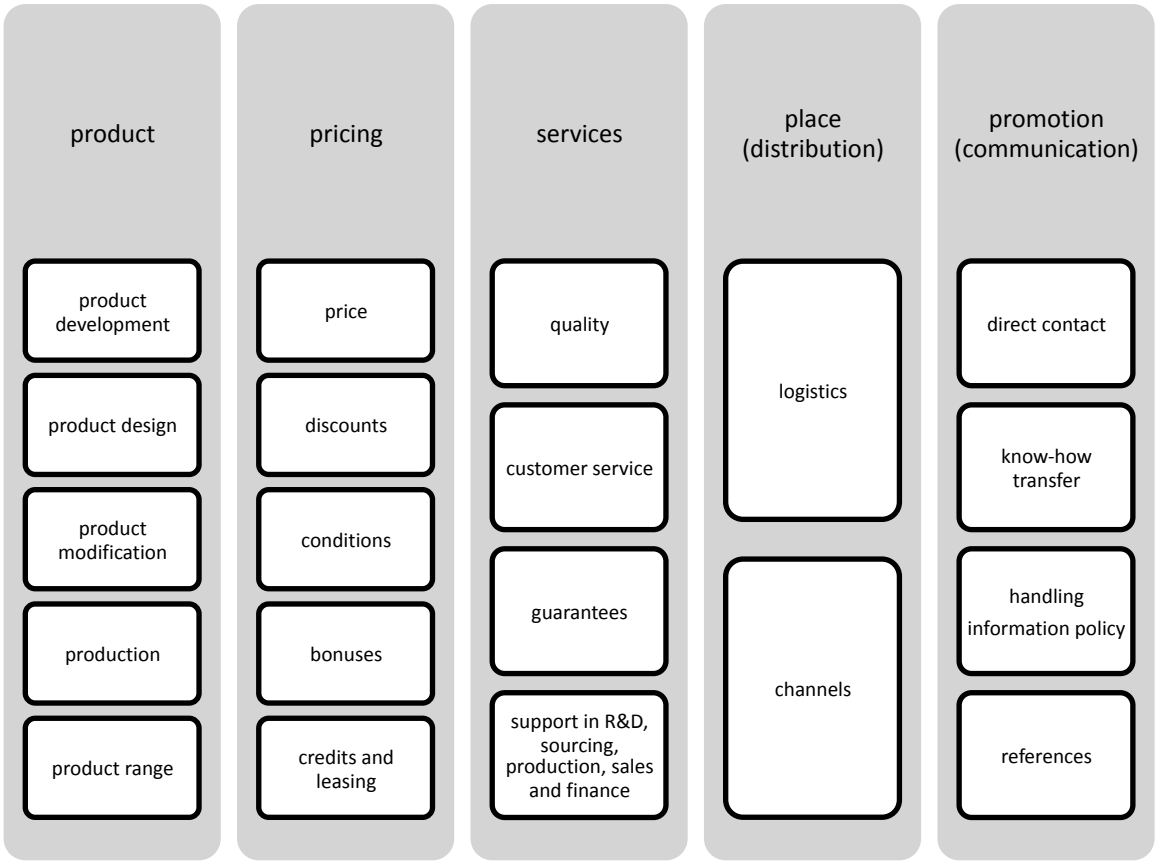


Figure 35: Procurement marketing mix, adapted from (Kotler, 2005)

7.4.2.9. Electronic markets and auctions

In procurement electronic markets (virtual markets) and auctions are used as biding mechanisms. Therefore these methods will be discussed shortly here.

Electronic markets

Electronic markets are electronic media that enable business partners to organize an economic transaction independent from the location. This is especially important in global markets where customer and supplier are located geographically far from each other. Therefore the use other media than spatial proximity and other communication means than face-to-face meetings. In terms of media, the use of electronic media is enforced, consisting of three components, canal, logic and organization, represented by hard and software components. The combination of modern information systems (like ERP) and ICT (internet), information is globally available, but still secured.

Figure 36 shows the structure of electronic markets and its components and required IC-technologies.

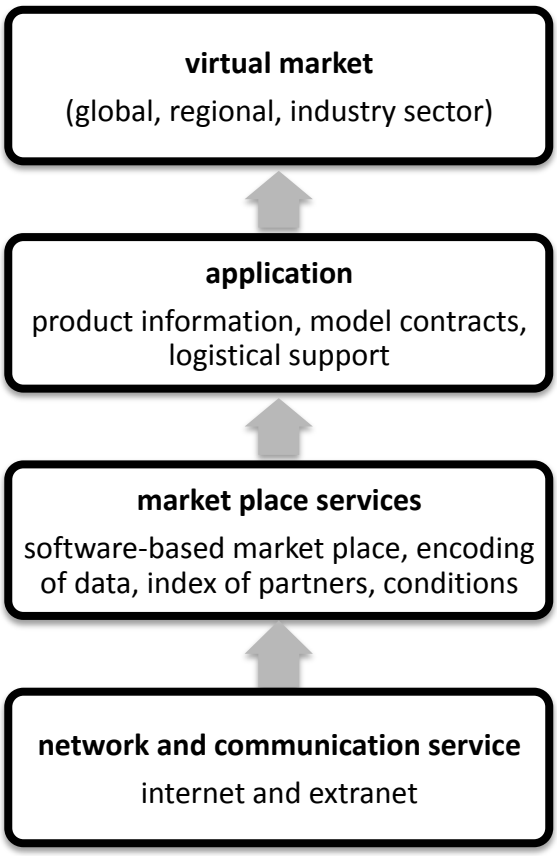


Figure 36: Structure of virtual markets, adapted from (Hoffner, Facciorusso, Field, & Schade, 2000; Kotler, 2005)

Electronic markets bear the potential to change supply chains fundamentally, therefore a systematic analysis of the usability of such markets in the supply chain and in the procurement marketing is essential in SCM. The potential is a result of the ability of virtual markets to decrease transaction costs. Therefore a fragmentation of supply chains, a restructuring of the chain or even the elimination of certain value creation steps (intermediaries) is possible. Furthermore the advantages of economies of scale and scope, higher lead time of transactions and transparency of markets and prices can be utilized.

The pricing mechanisms in virtual markets works along pricing in stock markets and therefore represents perfect competition (assuming that speculation is excluded, especially important facing the recent development on financial markets). Especially commodity materials are traded through virtual markets. These markets are considered by economists to be the markets with most perfect competition appearing in reality. Virtual markets can be used to support the entire sourcing process and therefore change the structure and process of materials management. (Kotler, 2005)

Electronic bidding

With the use of the internet also another form of electronic transaction developed – electronic auctions (electronic bidding or competitive bidding). Figure 37 shows the step in electronic bidding.

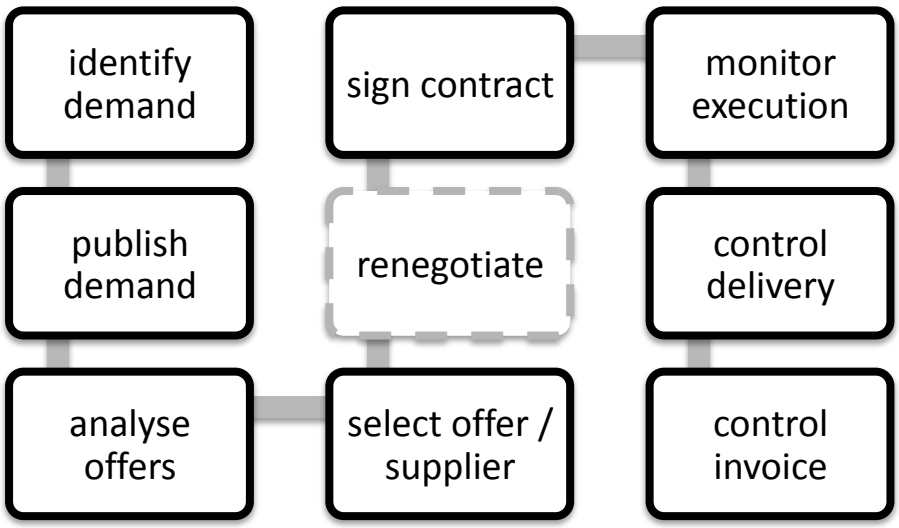


Figure 37: Electronic bidding process, adapted from (Jap & Haruvy, 2008)

Electronic bidding works similar than tenders, using simultaneous offers and price bidding. Main aim is to realize low prices and increase of market transparency. The concept is based on global and multiple sourcing. For electronic bidding are used mainly for materials that are highly standardized, like raw materials listed on stock exchanges as well as standardized components, but also for continually used services. Furthermore this method is used for materials that do not require maintenance, so a constant change of suppliers is possible. (Jap & Haruvy, 2008)

7.4.3. Strategic Sourcing

As already mentioned earlier, in supply-chain-based material management the strategic importance of sourcing is emphasized. The concept of sourcing used in supply-chain-based materials management therefore is called “strategic sourcing” to show its strategic focus.

7.4.3.1. Management task in strategic sourcing

In Strategic sourcing the task of materials management includes besides the traditional routine tasks of sourcing also tasks of scheduling (planning of demand, negotiation with suppliers, designing of IT-systems). This shows that in the field of sourcing also activities of planning, monitoring and controlling are included. Therefore scheduling as a task of top management is replaced to the sourcing activities and the responsible sourcing department (Gottfredson, Puryear, & Phillips, 2005).

Furthermore in sourcing management all tasks of supply with data, planning sourcing targets, monitor the sourcing process and controlling are included. Consequently strategic sourcing is representing a holistic concept of sourcing. Main aim of strategic sourcing in the supply with materials through transaction and transfer and through this process support the strategic development of the firm. In strategic sourcing though, the responsibility for the strategic dimension sourcing lies at the purchasing department. (Teece, Pisano, & Shuen, 1997)

7.4.3.2. Strategic dimension

Now the term "strategic" will be discussed in detail, as it is the main concept in strategic sourcing. As already mentioned before, the strategic tasks of sourcing are mainly located in scheduling. Strategic tasks include planning, implementing and controlling. These tasks arise from the characteristics of a strategy, which will be discussed below.

Basically the term strategy is derived from the Greek "strategos" meaning army. The military roots of strategy are still present today in modern works of strategic management. The discussion about a strategic management of the firm first arose in the 1960s (Chandler, 1997). At that time researchers and business managers realized that operational optimization is not the main driver of organizational success, but the long-term development of organizations are driven by general framing principles. This shows the basic characteristics of strategies as instruments to shape the long-term direction of the firm. Different definitions about strategies exist, but all include the long-term focus and the development scope of it. Strategic as a characteristic therefore determines if an activity is influencing the organizational development widely and has long-term focus.

Furthermore strategies include the focus on success potentials. Success potentials arise, when internal capabilities of supply chains meet market requirements. In strategic sourcing success potentials develop from all processes that do not only focus on the supply of the organization, but also constantly evaluate the internal and external influence of these processes. (Mintzberg, 2000)

7.4.3.3. Strategic relevance of sourcing

Scientific discussion about the "strategic" characteristic of sourcing started in the 1990s and therefore sourcing was one of the last functions in business management, where strategic issues were introduced. Comparable for example the strategic importance of marketing (as a mirror to sourcing) was already acknowledged from the start. The interconnectedness of marketing and strategy is still stressed in science. Therefore it is surprisingly that the strategic importance of sourcing was not explored until the 1990s as sourcing represents a mirror of marketing from the customers' perspective. Researchers mainly justify this development with the classical notion of sourcing as a "supporting activity for production". In this notion sourcing is not acknowledged as a primary activity upstream to production but is more or less defined as a secondary activity that is only supporting function, comparable with HRM and IT. The strategic importance of sourcing in the value chain can be derived from Porters value chain.

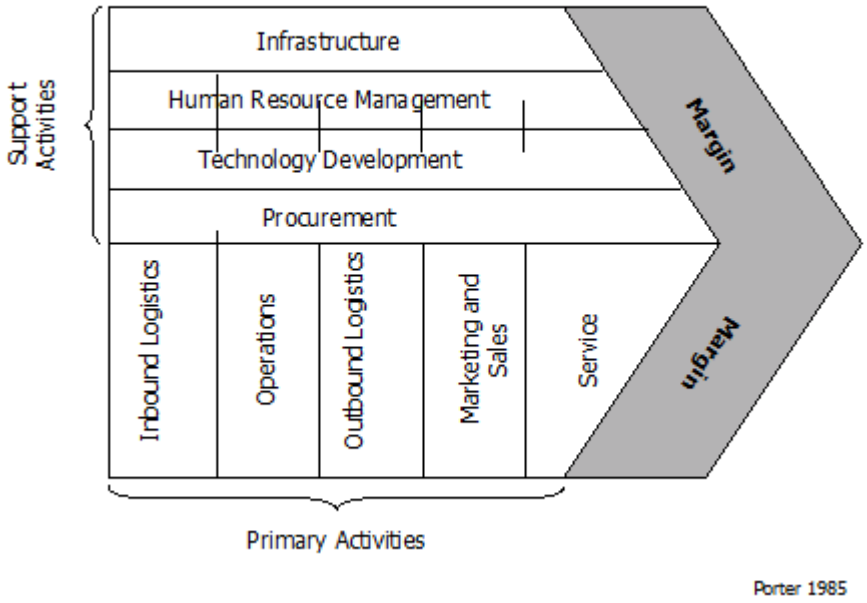


Figure 38: Value chain (Recklies, 2001)

As you can see in the visualization of the value chain above, sourcing is both, a primary activity (here called inbound logistics) and a secondary activity (procurement).

Similarly in practice interest in the strategic components of sourcing increased since the 1990s. Therefore in many organizations strategic purchasing departments were built up. Mainly strategic sourcing is a combination of strategic management at the top level of the organization and the materials management as a function in the organization. (Inderst, 2008)

7.4.3.4. Characteristics of strategic sourcing

As strategies are concerned with the use of success potentials of organizations, strategic sourcing is concerned with the strategic impact (on internal capabilities and external factors) of sourcing decisions. Therefore the following characteristics of strategic sourcing can be identified (Nishiguchi, 1994):

- Long-term nature concerning reaching organizational purpose and manage potential
- Developing of potential and utilization of capabilities
- Development of sourcing strategies supporting overall performance
- Development of competitive advantages in sourcing
- Integration of sourcing into the strategic management of the organization
- High uncertainty of decision due to its long-term nature

7.4.3.5. Separation of operative and strategic sourcing

Sourcing is facing changing societal and economic conditions, as explained above. Furthermore cost and profit potential have to be increased continually to ensure the competitiveness of the supply chain. Materials management reacted to these external and internal factors through the

design of scheduling as the main area of strategic decisions for sourcing and as supporting and upstream activity. But strategic relevance of sourcing and materials management continued to increase from the 1990s on. Therefore scheduling alone is not able to cope with the complexity and scope of the activities arising from increased strategic scope in materials management. Furthermore increased training and education of the workforce is necessary to cope with increased quality of decisions and complexity of tasks. Consequently in materials management a separation of strategic and operative activities arose.

Strategic sourcing management (economic dimension) therefore is concerned with the strategic sourcing, its *effective* realization of success potentials. Operative sourcing (technical supply) on the other hand is transferring the results from strategic sourcing into reality, id est the implementation of strategies into transaction and transfer processes and the *efficient* realization of it. The separation of these areas was manifested through organizational separation into separate structure and processes that meet the different qualitative requirements. In this context, strategic sourcing is separated from its operative implementation (Gottfredson, Puryear, & Phillips, 2005).

The separation of strategic planning from implementation roots in the main work on strategic management, who first separate strategies into a formulation and an implementation (besides a controlling) set of activities. Even though the separation of these activities is purposeful for the aim of research, the separation of formulating and implementing strategies is questioned in theory and in practice. Therefore separation in practice needs to be considered carefully and if a separation is used, coordination and integration mechanisms have to be installed to ensure effective and efficient implementation. (Mintzberg, 2000)

7.4.3.6. Strategic sourcing in SCM

Strategic sourcing in SCM is especially important, as now materials management has to consider not only sourcing goals of the own organization (reduction of shortage risk, low prices, etc.) but also the effect that its own sourcing strategies and behavior has on the competitiveness of the entire supply chain. Furthermore the supply chain has to use strategic sourcing to evaluate success potentials in its own sourcing and strengthening strategic sourcing and ensure a frictionless material flow within the supply chain. (Tan, 2001)

7.4.4. Supplier relationship management

In supply-chain-based materials management the main focus lies on trustful relationships within the network. Therefore relationship management as a concept has main importance. The specific characteristics of supplier relationship management are discussed in the next section.

7.4.4.1. New cooperative paradigm

In modern supply chains, a systematic management of costs is not sufficient, additionally strategic potentials in the field of innovation, quality and time have to be optimized. Through a changing competitive environment organizations are forces to redesign collaboration with

suppliers. Supply Chain management as a holistic theoretic paradigm arrived, as economic independency is a situation getting more difficult, especially with scarce financial and personal resources and even more differentiated and demanding customers (Mentzer, et al., 2001).

Environmental changes
The necessity of reorganization of the supplier-customer-relationship (SCR) can be explained based on the following developments in organizational environments in most industries (Comer & Zirger, 1998):

- Multiplication of product models as a result of intensified customer orientation. That has an effect on the scope of the SCR and ultimate increase of costs. An efficient management of product range in end products as well as materials can decrease costs. Efficient management of product range though requires collaboration in materials management.

- To reach beneficial spatial factors, organizations often transfer production abroad. Tracing of suppliers enables to sustain the relationship, international knowledge spillovers and use of location advantages.

- Suppliers and producers reduce their vertical range of production and concentrate on their core business (a trend coming from competence-based view of strategic management (Rinehart, Tzong-Ru, & Page Jr., 2008)), which leads to a pyramid value structure. Analogous to vertical range in production, also R&D and logistics are outsourced, if they are not part of the core competences. This leads to even more fragmentation of supply chains and therefore stronger needs for integration and coordination.

- Through international integration and the worldwide trends of decreasing protectionisms and foster free trade as well as the development of logistical systems, organizations are able to efficiently use global sourcing even in supply chains. Therefore competition on all value levels is increased.

Restructuring of functional areas
The trend of collaboration with efficient suppliers leads to changes in functional structure and processes. Main focus of the restructuring is R&D, quality management and logistics.

Within the increase of production range and supply of modules and systems**, R&D activities** are outsourced to suppliers or shared (simultaneous engineering). Furthermore also product development is mutually contributed (advanced purchasing). In the case of R&D the final producer is responsible for the overall design of the end product, the definition of interfaces, quality control and testing of components of the end product. Suppliers are integrated in a simultaneous engineering team. (Burgel, 2009)

Quality management has to be implemented at both customers and suppliers. But the quality management systems have to be integrated, to prevent and avoid double efforts. For this reasons often audits are used. In audits, the supplier is implementing a quality management for his products and the customer instead of using quality controls of inflows; audits are used to check the quality management of the supplier directly. Therefore control at the interface can be

reduced. This principle can be used in all processes, from development, production till distribution. Here again, the responsibility of quality management is transferred to a systems supplier and the coordination of suppliers is either organized at a main supplier or at the producer (Heinbuch, 1995).

In restructuring the **logistics** conception the factors flexibility and time are the main components, as they influence the flow between the organizations. Therefore logistics is contributing a main source of competitive advantage. Logistical design of procedural and structural organization and interface management is used. Another possibility is the outsourcing of logistics to service organizations that not only overtake transportation, handling and storage, but also organize assembly, accounting and arrangement of dates (Sanyal & Cohen, 2009).

Location of execution
Besides a restructuring of functional areas, also the location of execution of several functions is questioned, to detect potentials to decrease transaction costs. In this area for example in-house assembly can be used, as well as other methods of forward purchasing.

7.4.4.2. Management of the relationship

The structure and management of the relationship to suppliers is one of the main sources of strategic competitiveness for the organizations and the entire supply chain (CAPS, 1998).

Sources of conflicts
However, the relationship between supplier and customer is affected by a special constellation of tensions and conflict that has to be respected in all kinds of management decisions. This conflict can be characterized by three dimensions:

First, the main core of conflict is the supply relation, which represents the mutual interdependence between customer and supplier. The customer needs materials and services and the supplier need to sell the produced materials. The dependence is increasing with specificity of materials and frequency of demand. (Chen & Hall, 2007)

Second, the economic relation between the partners is an area of conflict as the two partners usually have diametrical objectives, arising from maximization of own success. Therefore the distribution of benefits is a main issue in the relationship. Furthermore the benefit of collaboration has to be distributed; usually this distribution is managed through pricing. One possible solution to manage the distributional conflict is to achieve a win-win-situation that only partly resolves the distributional aspects of SCRs (Bradford & Weitz, 2009; Chen & Hall, 2007).

The last dimension defines the insecurity inherited in an SCR. Insecurity here means mainly insecurity about environmental factors and the behavior of the partner. Insecurity bases on information asymmetries of involved parties. These information asymmetries generally have a negative and endangering effect on the SCR, and foster competitive behavior (Mishra, Heide, & Cort, 1998).

Levels of SCR

Based on these specific characteristics of SCR, now the four levels or layers of SCR are be specified in Figure 39. The SCR consists therefore of a value relationship, where the functional and operational relationship is situated. Main focus in this area lies on the value creation and achieving a competitive advantage through integrating the value creation processes between customer and suppliers. The second layer is the flow area, defining the various logistical processes in the SCR, including the material flow, financial flows and the information flow. The legal level of SCR is describing the legal bases of the relationship lying in its contractual structure (Groves & Valsamakis, 1998). Furthermore the social level has especial importance, as successful long-term relationships depend on multiple relations and integrating the social and cultural systems of two formerly independent organizations. The further the integration goes, the more important a successful management of the social level of the SCR becomes (Helper & Sako, 1997; Groves & Valsamakis, 1998).

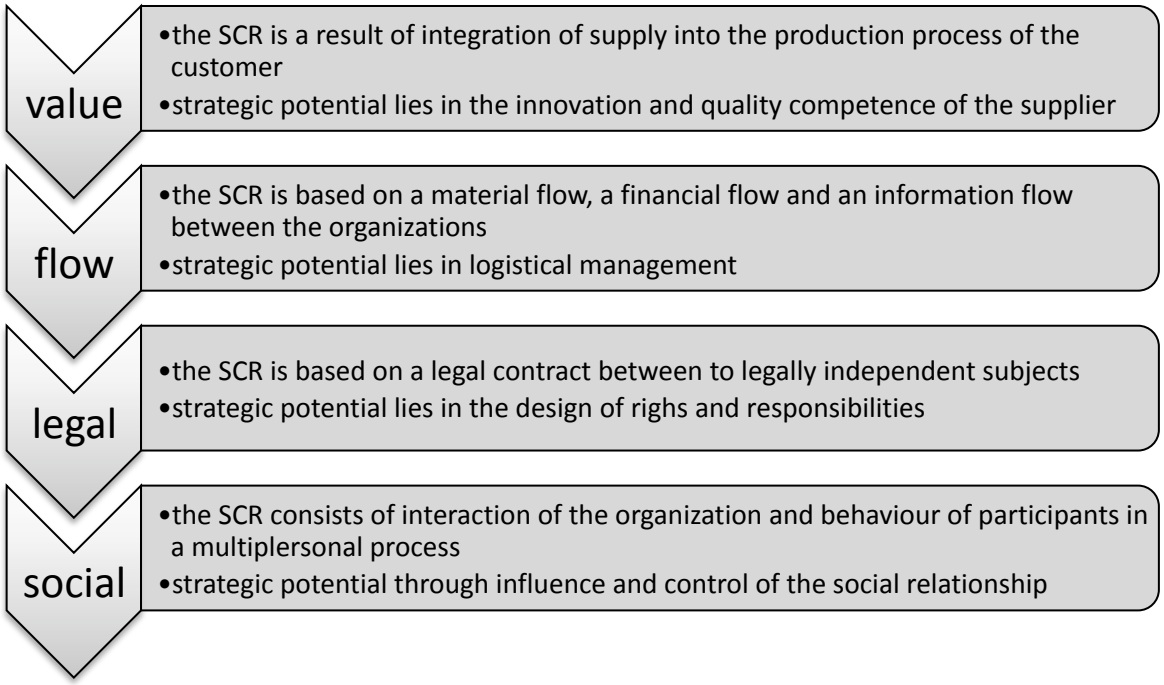


Figure 39: The four layers of SCR, adopted from (Hingley, 2001; Handfield & Bechtel, 2002)

Steps in SCR

Analogous to product life cycle theory, in SCR the following phases can be distinguished:

1. Search and selection of suppliers
2. Building of a relationship
3. Relationship phase
4. Termination of relationship

Step 3 and 4 are the core tasks of a strategic relationship management.

Problems in SCR
Basically the main focus of managing SCRs is the question, what to do, when the SCR is not working frictionless. In this situation the customer has two possibilities: changing supplier and with that termination of the relationship or controlling the supplier (Hingley, 2001).

Termination of SCR consequently involves the termination of contracts with the supplier and the termination of all supply from this supplier. Therefore mainly the flow and legal levels of the relationship are concerned. An abrupt or subtle termination of suppliers can be distinguished. Termination of the relationship might be problematic, especially in situations of high dependence (knowhow, legal, specific tools, maintenance of materials). Reasons for the determination include serious misconduct, negative benefits or reduction of supplier numbers.

The **control of the SCR** can be viewed as active influence and planning, especially of employees and managers of the supplier through the managers. Therefore this possibility is placed mainly at the social level of the SCR. Here the information asymmetries are reduced and trust is built to improve the relation. The necessity of controlling the SCR arises if a termination is either too costly or even impossible. Possible activities in controlling the SCR can be either managed by the customer (active control) or by the supplier himself (self control). In the second situation, the customer just informs the supplier of problems he experiences and expects the supplier to come up with satisfying solutions. (Helper & Sako, 1997)

One subtask of CSR control is supplier support, where all activities are summarized, that can improve the performance of the supplier undertaken by the customer. Support of supplier usually includes financial support or staff exchange. Therefore the selection of suppliers that are supported depending on the effect of support and the probability that support will positively affect the organization. Usually a portfolio using supplier potential and success potential is used. Furthermore extensive controlling of support and legal regulation is necessary. The concrete activities include for example providing materials for the supplier, providing facilities, overtaking of administrative tasks or providing consulting for quality management (Ndubisi, Wah, & Ndubisi, 2007).

Another subtask of SCR control is supplier development and defines all activities, where the customer builds up a supplier or helps an already established supplier to develop in a certain market segment. Supplier development is usually used only if no suppliers for a certain material exist or in monopoly markets. Here the customer supports the supplier in all steps until he is able to manage the operations himself (Groves & Valsamakis, 1998).

7.4.4.3. Strategic alliances (and vertical cooperation's) in SCR

The term strategic alliance generally defines the collaboration of at least two legally, financially and economically independent business organizations with the aim of significant long-term competitive potential in certain SBUs and markets. This form of collaboration is used in highly integrated supply chains to reach knowledge spillovers and optimal coordination of activities (Walters, 2003). This form of collaboration uses the concept of synergies (economies of scope). Strategic alliances furthermore are built up to ensure long-term profitability through developing complementary capabilities and interaction with partners. In the fields of SCR management,

strategic alliances are used between one or more suppliers and the customer and therefore it represents a form of vertical cooperation. The term vertical cooperation therefore defines the cooperation of business organizations on different levels of the value creation process. Therefore cooperation in SCR defines cooperation between suppliers and customers. If the customer uses strategic alliances with many suppliers, the term strategic supplier network is used. Such networks represent a mixed form between market and hierarchical structure (Williamson, 1981) and therefore constitute a hybrid governance structure of the firm. This leads to coordinated top management and governance of the firms in the networks. Main producing organizations at the centre of such networks are called "hubs" and overtake main coordination and monitoring activities for the entire network. Therefore a double-pyramid form structure develops in industries using this method, as for example the car industry. There the OEM represents the hubs with assembling the end product, while manifold suppliers and customers (distributers) exist. (Mason, Lalwani, & Boughton, 2007)

Relevance in practice

Strategic alliance in vertical form is seen as a competitive weapon implemented in supply chains to improve coordination within the chain. Increase of implementation is explained with the following reasons (Walters, 2003):

- Increase in competition – global competition
- Increase in market and competition drive decrease of development times and shortens product life cycles
- Force to use cost sensitive solutions and increase inefficiency lead to a redistribution of tasks between supplier and customer
- Decrease of transaction costs
- Simultaneous engineering
- Knowledge-transfers
- Increase of flexibility and speed
- Reactions to market opportunities
- Concentration of financial and personal resources
- Economies of scale and scope

Besides these advantages of strategic alliances also problems and risk exist. First, mutual dependence is the main disadvantage concerning strategic alliances. This dependence makes it almost impossible to change suppliers and increases costs to do so. Another disadvantage lies in the decoupling of the organization from market pricing and technologies. Third, the development of collaboration normally is dominated by one partner, leading to negative effects in SCR and a shift of the market-hierarchy-constellation resulting in suboptimal transaction costs. Therefore the balance of the cooperation could be reversed. Another disadvantage is the legal fixation of rights and responsibilities and therefore inflexibility in the form and intensity of collaboration. (Mason, Lalwani, & Boughton, 2007)

Forms of strategic alliances

Strategic alliances can be built in many forms using long-term supply contracts or direct and indirect supply organizations, using contractual forms such as tandem contracts, barters, parallel

contracting, compensation deals, and contractor bargaining (Elmuti & Kathawala, 2001). A special form is the production network as already discussed before.

Selection of partner
The selection of an appropriate supplier is one of the main factors influencing the success of a strategic alliance. Main criteria in choosing suppliers for an alliance are structural and strategic fit of the organizations involved. Fit addresses to the compatibility of structure, process and culture of the organizations. Besides fit of strategic targets other criteria such as:

- Logistics,
- Industry sector,
- Reliability,
- Financial situation,
- Image,
- Development potential,
- Market share,
- Knowhow,
- Quality standards and
- Reliability

should be considered.

Strategic alliances are usually built up with important systems suppliers and suppliers of A-materials. (Elmuti & Kathawala, 2001) (Vyas, Shelburn, & Rogers, 1995)

Areas of collaboration
Areas of collaboration in strategic alliances include R&D, technology, sourcing, production, systems and modules production, quality management, process security, logistics, sales, environmental protection and pollution control, cost reduction, kaizen, pricing, coordination of contracts and communication policy (Elmuti & Kathawala, 2001).

Process of strategic alliances
Strategic alliances are usually timely limited forms of cooperation's (Elmuti & Kathawala, 2001). The process of building strategic alliances is visualized in Figure 40. First adequate partners are searched and selected, then a strategic alliance is built up and maintained and after changes in the environment a disintegration and termination of the alliance might be necessary. In this case new partners might be needed or the organization also might stay independent (Vyas, Shelburn, & Rogers, 1995).

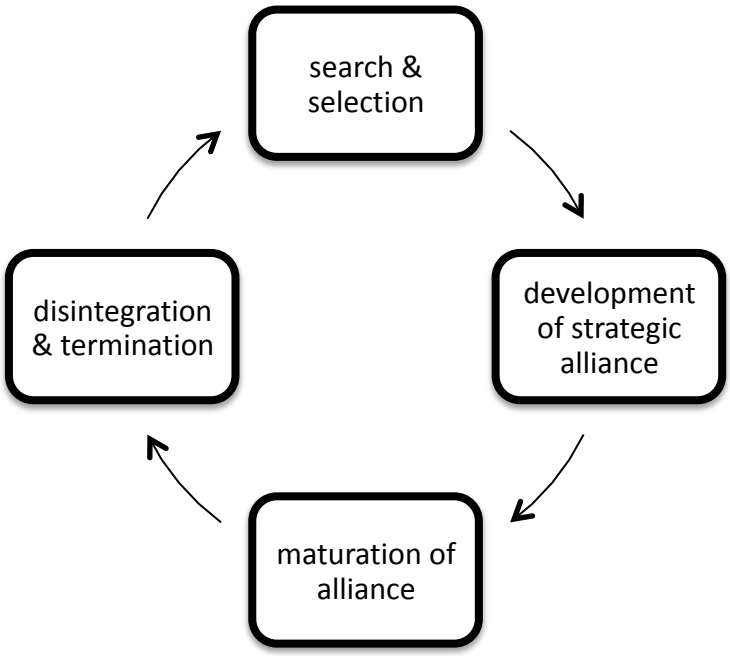


Figure 40: Process of building a strategic alliance, adapted from (Elmuti & Kathawala, 2001; Vyas, Shelburn, & Rogers, 1995).

7.4.5. Total Cost of Ownership

Total cost of ownership (following TCO) is a philosophy that tries to understand all relevant supply-chain-related costs of undertaking business with a certain supplier for a certain material (Degraeve, Labro, & Roodhooft, 2000). This includes costs of acquisition, use, administration, maintenance until disposal of a certain material which arises for the customer. TCO offers a certain form of structuring the cost components of a material into three broad areas:

- **Pre-transaction components**, including costs for identifying the demand, investigating and qualifying sourcing, adding suppliers to internal systems, educating the supplier, training, negotiations and the contracting)
- **Transaction components** consisting of prices and costs for order placements, preparation of orders, delivery, transportation, tariffs and duties, billing and payment, monitoring, return of parts, follow-up and corrections.
- **Post-transaction components**, including costs for line fallouts, defective materials, field failures, repair & maintenance, replacement, loss of goodwill & reputation and disposal.

This systematization of cost components shows, that price is only one part of real costs of material for a firm. The quantitative difference between price and costs can be quite extensive and costs can reach up to three times the price (Ellram, 1995).

Consequently TCO supports materials management mainly in their make-or-buy decision, value analysis and cost reduction programs. It calculates systematically the total cost of a material and therefore is a main concept of decision on sourcing. As prices and costs differ it helps to find the supplier serving with the lowest cost, and that is not necessarily the supplier offering the lowest

prices. Furthermore TCO can be used as a basis for negotiations, for recreating the SCR (as the process of the relationship influences costs!), a basis for Activity Based Costing and more generally for structuring and developing the SCM. In a competitive SCM, TCO are reduced. The selection of suppliers with the TCO method is more transparent, objective and sound than with traditional selection methods (like for example the scoring model) as it already includes all effects of the SCR, quantified through the cost arising for the customer. Additionally conflicts in the process and relationship of the separate cost elements can be analyzed and therefore essential improvements in cost management can be reached. (Degraeve, Labro, & Roodhooft, 2000)

7.4.6. Purchasing Card Buying

Purchasing Card Buying (PCB) is a modern form of sourcing, where the ordering is directly released through the use of a purchasing card (similar to a credit card). Therefore the financial transaction is directly managed through the purchasing card. The material flow is released immediately. Therefore costs in financial transaction can be reduced and the risk of creditworthiness is reduced to a minimum and taken over by a financial intermediary. Furthermore order time is reduced and even eliminated (CAPS, 1998).

7.4.6.1. Purpose

Main aim of this concept is a recreation of process flows and automation of certain processes within the transaction. Therefore the sourcing process is faster and more direct and costs are reduced significantly (CAPS, 1998).

7.4.6.2. Use

Purchasing Card Buying is used mainly for unproblematic goods and materials that are not specific, have a low value and low risk of shortage. With such goods the handling and order costs are not proportionate (the TCO ration is especially high) and therefore a cost-intensive sourcing cannot be justified, neither financially/economic nor ethically. Main examples of a use of PCB are therefore maintenance, repair and operating (MRO), small materials and office supplies (Nothaft, 1999).

7.4.6.3. Process

The process of sourcing with a Purchasing Card is separated into three steps, explained in detail below.

First step is the release of an order. Here the order is transferred directly through telephone or fax using the card number. Usually PCB is combined with product catalogues where the purchase just has to find the order number to release an order. Furthermore the first step can often be done online, where the card is releasing the order automatically. Financial transactions are shifted as a result by the financial intermediary.

The second step is defining the control of the order by the supplier. Mainly he is controlling if the supplier is authorized to use the card. This control is mainly done through the card-number,

identification and control numbers and the control is usually managed as transferring the data to the financial institute. After the financial instate confirms the order, the second step is finished.

The third step defines the accounting of the transaction. Here the customer checks the inflow and then confirms it. Afterwards the financial institute is releasing the financial flow. Usually invoices are summed up and then a total invoice is sent frequently (once a month or even year). (CAPS, 1998)

7.4.6.4. Regional relevance of the concept

Purchasing Card Buying is used since a decade in the US and UK successfully. Usually the financial intermediary is a credit card firm, as experience in transfer and security of data and standardization of the process is essential to build up a PCB-process (National Association of Purchasing Management, 1998).

7.4.6.5. Use in SCM

PCB offers multiple advantages for business organizations and supply chains, especially in the sourcing of homogenous, low-value materials. Here the TCO can be reduced drastically through standardization of the sourcing process by using a purchasing card. Furthermore the costs arising in the information and financial flow are partly outsourced to a financial intermediary that also is responsible for the elimination of credit risk.

7.4.7. Third Party Buying

In Third Party Buying (TPB) the sourcing process for particular materials is outsourced. Therefore an independent organization is undertaking several sourcing activities and the entire sourcing process of certain goods. This concept therefore is a form of sourcing strategy, where the production range in the area of sourcing is reduced. Therefore sourcing per se becomes a subject in the make-or-buy decision (Leonhardt, 1988).

Main reason for the outsourcing of certain sourcing areas is the evaluation of core competencies in the field of sourcing. If a concentration on core competencies is a strategic necessity, than sourcing generally is evaluated depending on its strategic relevance. If sourcing represents a core function, than it is kept inside (insourcing), if sourcing though is not a core but only a supporting function, than it can be subject to outsourcing, depending on certain cost structures. In the second situation either core competencies in sourcing are built up, or sourcing is outsourced (Melkin, 1988).

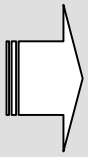
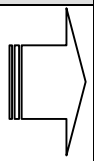
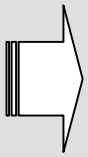
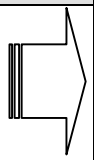
Types of purchasers	decisions		Grade of competence
administrator	Top management frames decisions Only routine sourcing		Sourcing as part of operational business
provider	Purchasing department sets the frame Detailed sourcing		Sourcing as contribution to core competence
manager	Scheduling and sourcing in purchasing department		Sourcing as contribution to core competence
entrepreneur	All relevant sourcing decisions undertaken in department Sourcing also for other organizations in the SC		Sourcing as core competence

Figure 41: Types of purchasers, adapted from (Leonhardt, 1988).

The main assumption behind TPB is the insight that different types of buyers exist, as summarized in Figure 41 above. These buyer types represent how the purchasing in the customers organization is structured and organized. This determines mainly to which degree sourcing contributes to core competencies or even is a core competence, as in the case of entrepreneur buyers. In this case, the organization has a core competence in sourcing and therefore even takes over sourcing services for other organizations. The sourcing competence of such organizations is based on the performance of employees in materials management. Usually such organizations are called sourcing service providers, purchasing service providers or procurement service providers, as they are able to offer sourcing as a service on the market (Leonhardt, 1988).

TPB is a hybrid organizational form and can be separated into cooperative procurement and third party procurement. The main difference here lies in the location and legal separation of the service provider (Melkin, 1988). In the case of cooperative procurement the purchasing activities are outsourced to a service provider that is owned by the corporate group, while third party procurement defines purchasing through service providers outside the corporate group. Third Party Procurement can further be separated into external sourcing service providers and sourcing spin-offs. In the case of external sourcing service providers, existing firms operating on the market are used to outsource the sourcing activities. A sourcing-spin-off is a situation where the sourcing department of the organization (and eventually sourcing departments from other partners in the supply chain or external organizations) is separated from the current structure and

legally forms an independent firm that now overtakes the sourcing activities. The hybrid forms of sourcing are visualized in Figure 42 below. (Leonhardt, 1988)

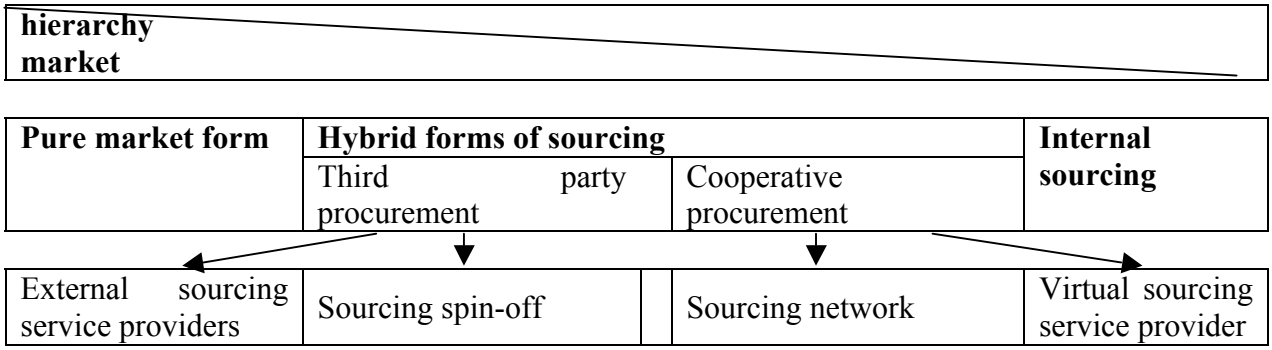


Figure 42: Hybrid forms of sourcing, adapted from (Leonhardt, 1988).

After the form of TPB is decided, the materials and processes used for TPB have to be selected. Main selection instrument is the sourcing-outsourcing-portfolio shown in

Figure 43 below.

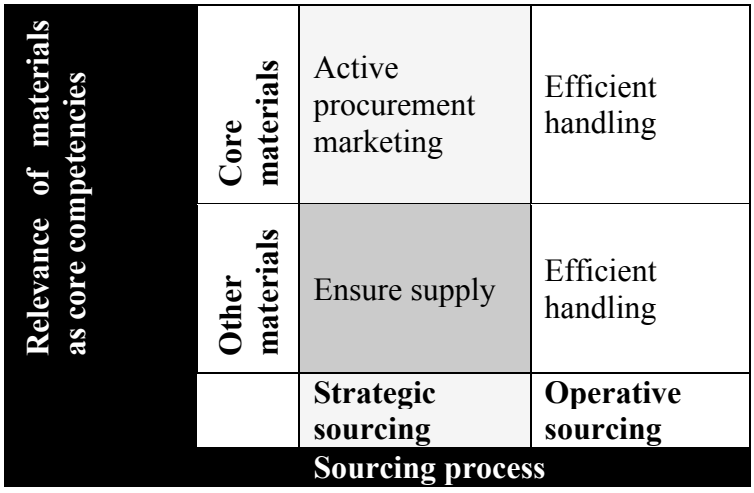


Figure 43: sourcing/outsourcing-portfolio, adapted from (CAPS, 1998; Stinchcombe, 1984)

The portfolio separates the materials into core materials (A- and B-materials, X- and Y-materials) and other materials (CZ-materials). Furthermore it includes the sourcing process used and separates between strategic sourcing and operative sourcing. Outsourcing of sourcing activities can be maintained mainly in the areas of other materials and if strategic sourcing is used (Stinchcombe, 1984). In the figure above, the dark-grey shaded area is the area where TPB is used. Other areas of the portfolio are managed through procurement purchasing, PCB or ecommerce. Sporadic TPB for other materials in operative sourcing or international sourcing is used (CAPS, 1998).

Recapitulatory the implications of the portfolio on outsourcing strategies are (Leonhardt, 1988):

- Strategic sourcing of core products is only outsourced in exceptional cases

- Outsourcing of strategic sourcing of other materials bears substantial optimization potential
- Operative sourcing can be improved through other methods (PCB, eCommerce)

Main advantages of the use of TPB are:

- Higher flexibility
- Use of expertise, experience and know-how in strategic sourcing
- Decrease of process costs
- Reduction of number of suppliers
- Lower prices (due to bundling of quantities)
- Use of additional services

7.4.8. Green sourcing

As environmental consciousness in the society is rising in most countries, also the need for environmental-friendly products is rising. In supply chain management therefore the need to integrate environmental strategies is increasing. This green thinking is increasingly present in all steps of the materials management process and not only in disposal, where green thinking has its main area (Min & Galle, 1997).

7.4.8.1. Relevance in materials management

Green logistics is a result of the recently developed awareness that logistical processes influence the environment fundamentally. Through the fragmentation of value chains, pollution became a main problem for the world's society. Furthermore resources are getting scarcer and therefore efficient materials management is a necessity in modern business organizations. Recently the existence of environmental consciousness of end-costumer transferred to industrial production and the responsibility for green thinking spread to all industry areas at all value-creation steps (Björnland, Persson, & Virum, 2003, p. 156).

In materials management green sourcing and disposal management are the main areas were environmental topics are of interest. Furthermore logistics and transportation have to be evaluated depending on its impact on the ecological environment. Green sourcing in industrial production is especially a topic due to integrated supply-chain-thinking. As in SCM end-customer requirements transfer through the whole value-chain, also green needs (environmental requirements and wishes) of the end-customer are important for upstream organizations. Therefore an organization has to install certain green sourcing to ensure these needs, if the end-customer of his products is environmentally conscious (Björnland, Persson, & Virum, 2003, p. 157). Green purchasing strategies can come in many forms as shown in Figure 44 below. In this part of the paper tough, only green sourcing strategies are of interest, as the other strategies represent strategies in the field of disposal.

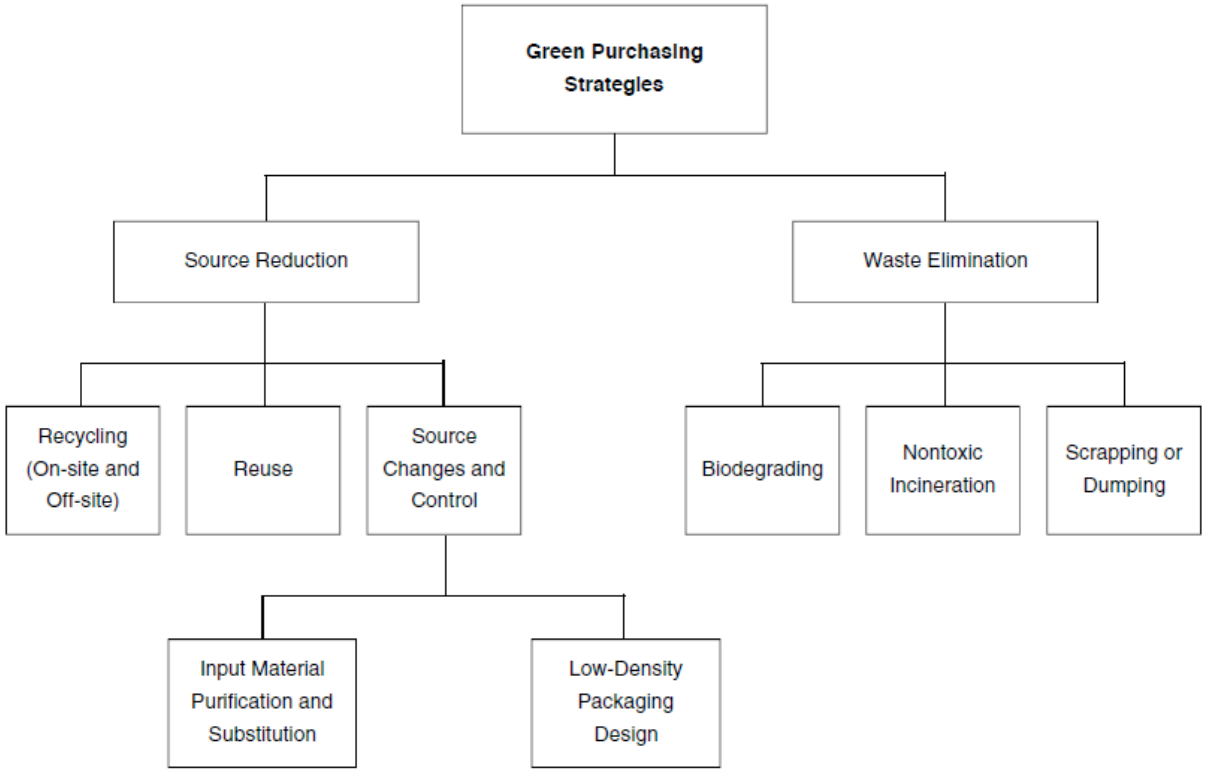


Figure 44: Green purchasing strategies (Min & Galle, 1997, p. 11)

7.4.8.2. Obstacles and chances of green sourcing

Green sourcing therefore is always oriented towards the end-customer. Green purchasing strategies though can be problematic, as they usually result in higher material costs and furthermore suppliers are limited for green materials (Min & Galle, 1997). The higher material costs of green sourcing though have to be compensated by savings in disposal, higher sales prices or higher consumer satisfaction. Therefore green sourcing is an easier strategy for organizations with high purchase volumes, as here other economies of scale can compensate for the costs of green materials (Galle & Min, 2001). The three main obstacles to green sourcing are "high cost of environmental programs, uneconomical recycling, and uneconomical reuse" (Min & Galle, 1997, p. 15) of materials. Main gains of green sourcing are economic performance increases and competitiveness. Empirical results show that the advantages of green sourcing usually outbalance the obstacles (Galle & Min, 2001).

Main obstacle to implementation of green sourcing though is integration with suppliers necessary for this strategy. To achieve a greens strategy throughout the supply chain, integration and overall control is necessary (Björnland, Persson, & Virum, 2003), as materials cannot be controlled fully about their environmental impact at the inflow interface.

7.4.8.3. Components of green sourcing

Green sourcing includes the following components:

- Check if the materials are composed of environmentally-friendly materials
- Check if the materials have been produced environmentally-friendly
- Maximize supply quantities to reduce pollution by transportation
- Local sourcing to minimize pollution by transportation
- Check if materials can be recycled

Several points of this list cannot be controlled fully by the organization, if no integration within the supply chain is organized. Integration of SCM therefore is absolutely essential when implementing a green strategy in sourcing. In green sourcing the production organization has to control green requirements upstream until the extraction of raw materials. The control and integration of green requirements within the supply chain causes especially problems for global supply chains, as here different legal requirements regarding environmental protection have to be integrated. Green sourcing is easier to implement in Italian districts / regional clusters due to geographic proximity and keiretsu, as the ownership structure is ensuring control over the operations within the supply chain.

7.4.8.4. Activities in green sourcing

The main activities in green sourcing include (Rao & Holt, 2005):

- Training of purchasing department concerning know-how in environmental technologies, products, materials and packaging
- Selection of adequate green strategy for the supply chain
- Implementation of adequate control of suppliers regarding green requirements (audits, reporting, certification, standardization)
- Evaluating the state influence on green sourcing requirements
- Evaluation and selection of green materials
- Coordination with suppliers regarding the development of materials and waste reduction
- Implementation of adequate ICT-systems including green dimensions

7.4.8.5. Empirical results concerning green sourcing

Galle & Min (2001) empirically tested green purchasing strategies in the US and explored, that costs of green sourcing are the main obstacles to this strategy (Galle & Min, 2001, p. 1235). As the costs arise immediately and pay-off of green strategies are long-run and uncertain, this obstacle becomes almost insuperable, especially for SMEs. Rao & Holt (2005) tested performance impact of green strategies and conclude that green sourcing strategies directly positively affect the economic performance of business organizations and indirectly influence competitiveness positively through green sales (Rao & Holt, 2005, p. 911). Therefore green sourcing has a two-way positive effect on economic performance (Rao & Holt, 2005).

7.4.9. Ethical Sourcing

Another aspect of sourcing including an external stakeholder perspective is the concept of ethical sourcing (Crane, Matten, & Moon, 2004). Ethical sourcing is an aspect of Corporate Social Responsibility that is dealing with the social behavior of the firm (Roberts, 2003). CSR of organizations fundamentally influence good will and reputation of organizations and indirectly also influence the organizations positions on various markets (sales market and workforce market mainly) (Roberts, 2003).

Ethical behavior addresses to correct behavior of organizations not only according to the law, but also to ethical requirements set by society. The relevance of ethical sourcing therefore steams clearly from increased consciousness for the effects of unethical behavior of business organizations (de Bakkeri & Nijhof, 2002). Main examples of industries that were recently forced to include ethical sourcing into their supply chains, due to end-consumers needs and requirements are the retail clothing industry (Pretious & Love, 2006) and the furniture industry (de Bakkeri & Nijhof, 2002). Ethical sourcing might include environmental issues, if a green sourcing strategy is not formulated separately in the supply chain.

7.4.9.1. Definitions

One main concept in ethical sourcing is sustainability. The definition of sustainability was given by Brundtland as following: "*to meet the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland, 1987), and initially was used mainly in environmental issues. Since the 1990s the concept of sustainability in business was transferred from ecological to broader social and ethical issues.

Another main concept is business ethics. Business ethics is concerned mainly with applied ethics and morality in business management. Ethics is "*designed to set moral standards beyond those set by law, the market and common morality*" (Beamon, 2005, p. 222). Business ethics is therefore the main area of CSR.

Ethical sourcing can be defined though as "*the acquisition of goods and services through supply chains and subcontractors in a responsible manner, with consideration of the conditions under which goods and services are made and delivered and a strategy that promotes improvements*" (Lillywhite, 2004).

7.4.9.2. Purpose

The main objective of ethical sourcing is to contribute to increasing business responsibility and sustainability, greater cohesion of social and environmental programs and to achieve sustainable business goals (Blowfield M. , 2000). The main assumption between these purposes is the notion that organizations need to deliver value on a financial, social and environmental basis (Blowfield M. , 2000).

By using ethical sourcing, the organization is accepting the following principles (Blowfield M. E., 2005):

- Accepting responsibility for the behavior of suppliers
- Willingness to be held accountable for suppliers behavior
- Willingness to actively impose ethical behavior on suppliers and set limitations

This three principles show the main aim of ethical sourcing. As the organization is held accountable for not only its own ethical behavior but also of its suppliers, this sets limitations and requirements to the selection of suppliers and the SCR-management.

Additionally this main principles show that ethical sourcing can only be implemented in some form of integration of the supply chain, as here active influence of organizations on their suppliers is the main instrument to implement the concept. Furthermore a consequence is the loss of independence in using the concept for the supplier, as he has to give up secrecy, increase transparency and allow for control and monitoring through customers. Furthermore ethical sourcing includes "oversupply", the concept of ethical product design (Beamon, 2005).

7.4.9.3. Instruments

The main instruments of ethical sourcing have the aim to impose ethical behavior on suppliers, set limitations on suppliers and monitor ethical behavior of suppliers. For this aims, a multi-instrumental set of activities also used in other areas of SCM can be implemented, including mainly codes of conduct for suppliers, auditing and monitoring and interaction (Blowfield M. E., 2005).

Codes of conduct: one of the main instruments used in ethical sourcing is codes of conducts (Blowfield M. , 2000), representing company-wide rules that guide all behavior within the organization (Webely, 2007). Codes of conduct usually address to two main areas of SCR-management. First codes of conduct guide behavior towards suppliers, usually in the form of fairness and honesty guidelines. Second, codes of conduct include a certain set of ethical requirements that suppliers have to fulfill including consequences of failure (Webely, 2007).

The main areas covered by codes of conduct are working conditions (including working safety, a ban on child labor, minimum wages, ban on inhuman treatment and harassment and maximum working hours), customer service, behavior towards subcontractors, legal behavior and social matters including the treatment of minorities, as well as CSR programs (Webely, 2007). Other areas include illegal behavior, bribery and corruption, production of weapons and drugs.

Consequences include usually encouragement to follow the codes of conduct, monitoring and control, financial payments, cuts in quantities until determination of the relationship (Webely, 2007).

Codes of conduct are used especially in global supply chain to stream different legal conditions (on workforce, customer and supplier management, discrimination laws, CSR requirements) between nations within the supply chain. As in domestic supply chains the law is setting the minimum requirements for suppliers, in global and regional supply chains the code of conduct is undertaking this task (Magnan & Fawcett, n.d.). Another aspect of codes of conducts is its role as part of the risk management in the supply chain. It is the main instrument to decrease reputation risks within supply chains (Magnan & Fawcett, n.d.).

Main advantage of codes of conduct is its voluntary implementation by the organization and therefore its basically voluntary nature. Furthermore the requirements for suppliers are explicitly stated and therefore consequences of failure can be executed easier. Additionally the codes of

conduct are used throughout the supply chain, and therefore fairness between suppliers is guaranteed. Main disadvantage of codes of conduct is seen in the force used to impose CSR on suppliers of the business organization (Pearson & Gill, 2001). Another main point of criticizing codes of conducts lie in their nature of streaming ethical requirements between nations and therefore the accusation of cultural imperialism (Pearson & Gill, 2001).

Auditing as an instrument of ethical sourcing is the main instrument of control in the method. As codes of conduct are installed to define the requirements a supplier must fulfill, audits aim for the control if these requirements are effectively fulfilled in the organization of the supplier. Audits are used with other reporting instruments to fulfill this control and monitoring task. In auditing monthly or quarterly reports about fulfillment of the codes of conducts are transmitted. Furthermore inspections and visits of customers to the supplier's facilities are usual practice in auditing codes of conducts (Blowfield M. E., 2005). Additionally to the report of the inspectors and the audit reports, usually social balance sheets are used (Blowfield M. , 2000).

Social labels can be additionally used in ethical sourcing to ensure requirements and effectively communicate them to customers throughout the supply chain. Social labeling is used mainly to inform consumers that certain standards are met in the entire supply chain (Pearson & Gill, 2001). Such a label is for example the fair trade label, informing customers that coffee producers in south America are treated fair and can price their production quantity at a price that is meeting the effort used, while at the same time margins of commerce is reduced (Fair Trade). Social labels appear in forms of self-labeling (branding) of organizations (e.g. Body Shop) or labeling through NGOs or even by supranational institutions (Zadek, Lingayah, & Forstater, 1998).

7.4.9.4. Conclusions

Ethical sourcing might come in different forms, but always aims to stream minimum requirements throughout the supply chain. This is especially important as the consciousness of customers regarding the ethical behavior of organizations is rising. Furthermore especially operations abroad are under suspicion of unethical behavior. Therefore especially fragmented and global supply chains have to install certain ethical sourcing strategies into their SCM. Ethical sourcing through codes of conducts, social labels and auditing ensure that ethical requirements of end-customers are met and therefore reputation loss can be avoided and economic performance of the entire supply chain is increased.

7.4.10. Strategic alliances (horizontal cooperation)

Strategic alliances are one of the main concepts in supply-chain-based materials management. Generally strategic alliances can occur as vertical or horizontal cooperation's. Vertical strategic alliances describe cooperation's between two organizations on different value-creation levels in the supply chain, id est the cooperation of customers and suppliers. Horizontal alliances on the other hand describe the cooperation on the same value-creation step in the supply chain, and therefore describe cooperation's with competitors, complementary producers and producers of substitute products. (Elmuti & Kathawala, 2001)

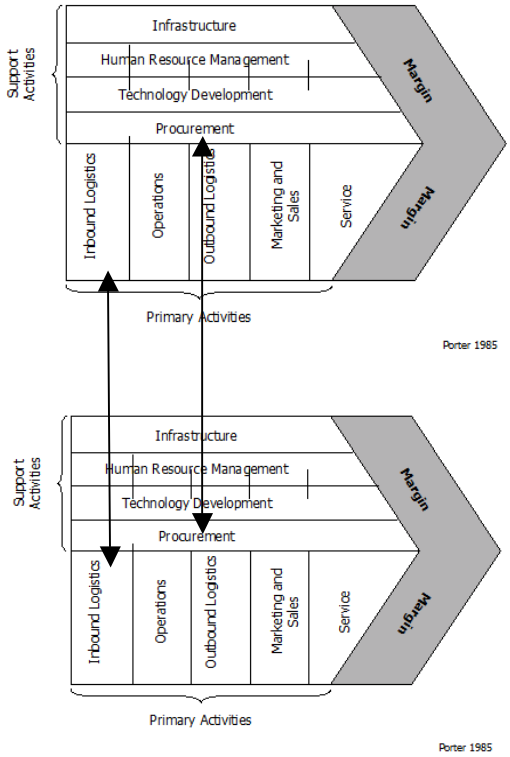


Figure 45: Horizontal SA in materials management (Recklies, 2001)

7.4.10.1. Term and relevance

Basically a strategic alliance is a hybrid form between market and hierarchy, defined by transaction cost theory (Williamson, 1981). The term horizontal strategic alliance therefore means that at least two legally, financially and economic independent organizations from the same value creation step are cooperating. The organizations can be direct competitors or operate in different industry sectors. A horizontal cooperation in materials management is here only one form of horizontal strategic alliance, synergies through horizontal cooperation can also be utilized in sales and production, as well as research, market and resource access, cost and time advantages, and utilization of knowhow-spillovers.

A strategic alliance in materials management can be utilized in different intensities. Cooperation's in sourcing and materials management is not a new concept, in handcraft and commerce this concept has been used for a long time. SCM now transfers this concept to industrial production to stream material flows within the supply chain (Vyas, Shelburn, & Rogers, 1995).

The relevance of strategic alliances as horizontal cooperation's in materials management arise from the paradox, that more competition naturally demands more cooperation. Especially small and medium sized organizations can develop potential in such cooperation's due to bigger purchase volumes and demand. Through cooperation with similar organization, the market situation can be reversed. Through a limitation of cooperation just to the area of materials management and procurement, it is possible that organizations of the same value step

collaborate, even though they are competitors in the sales area. The autonomy of organizations here is ensured and therefore a loss of independence can be avoided. Another reason for increasing relevance of procurement cooperation's lies in increasing concentration to core business. As already discussed before, this leads to substantial outsourcing potential of the procurement area. (Elmuti & Kathawala, 2001)

7.4.10.2. The sourcing cooperation

Here the economic and technical aspects of sourcing cooperation's are discussed, while in section 3 the legal aspects of horizontal cooperation's are discussed.

Forms

For the situation of cooperation's in sourcing manifold synonyms exist, that will be systematized below:

Cooperative Purchasing is defining a sourcing cooperation in the public sector, as for example the health sector or education, and a cooperation of NPOs. The intensity of cooperation here is dense, and usually separate sourcing organizations are founded, that are organizing the strategic sourcing. One example of cooperative purchasing is the E&I (Educational & Institutional Cooperative Service), the biggest sourcing cooperation in the USA, including over 2000 universities, high-schools and hospitals. The purchasing organization employees more than 200 employees and administrates about 80 sourcing contracts. (NEAP & E&I, 2009)

Consortium Purchasing defines the collaboration of industrial organizations, which cooperate solely in the procurement area, but apart from sourcing stay independent. Here organizations might be direct competitors. The concrete realization of the cooperation can reach from simple information exchange about materials, prices and conditions until the foundation of independent sourcing organizations (Elmuti & Kathawala, 2001).

Group Purchasing or Conglomerate Purchasing is characterizing the cooperation of legally independent subsidiary organizations within a corporate group. Here the advantages of centralized quantity bundling and decentralized scheduling and operative sourcing are combined (Elmuti & Kathawala, 2001).

Pooled Purchasing is the term summarizing all above discussed forms of sourcing cooperation's. Here the pooling concept of financial management is used to describe a mutual sourcing process. (Vyas, Shelburn, & Rogers, 1995)

Objectives

Main objective of a sourcing cooperation is the elimination of competition through the development of a syndicate on the supply market. Furthermore an improvement of economic conditions and competitiveness of structurally discriminated organizations can be reached. This factor is especially important for SME. The possibilities of cooperation's can be achieved in a continuum of the two extreme forms (Vyas, Shelburn, & Rogers, 1995):

- **Gentlemen's agreements** are defining a concrete pricing agreement. Main instruments here are market separation (geographical, timely, factual), restriction of demand, agreements about services and conditions and mutual market information.
- **Shared institutions** are to outsource the mutual cooperation into some form of institution. This can be designs with or without founding a legally independent organization, with or without purchase commitments and with or without mutual capital commitments.

The actual form of collaboration might represent a form in between these two extremes. Both extreme forms are based on syndicate instruments and aim to build a syndicate. They just differ in the degree of organization of the sourcing syndicate (Vyas, Shelburn, & Rogers, 1995)

Main advantages of building a sourcing cooperation in form of a strategic alliance are lower purchase prices, improved conditions through bundling, use of collective sourcing-know-how, product standardization, the ability to push through standards, avoidance of markups for small quantities, implementation of a shared logistics concept, lower costs for market research, market development and market cultivation and the possibility of benchmarking. All this advantages work in two-ways. First a strengthening of market position and gaining of market power in the supply market leads to an improved cost situation and therefore improved competitiveness towards direct competitors. Second, a cooperation of sourcing through bundling of quantity increases market power towards suppliers, whose scope is decreased through concentration on their sales markets. Therefore horizontal cooperation increases the competitive situation on the supply market and the sales market alike.

The disadvantages of a horizontal cooperation in sourcing are the loss of sourcing know-how in the long-run and the direct contact with the supplier. Furthermore organizational secrecy is decreased and transparency in materials management is increased. Furthermore syndicates using price agreements might be illegal and goodwill and reputation of the organization might suffer. Additionally societal costs arise from the decrease of competition in the market. This leads to suboptimal allocation of goods and services and higher prices for end customers. (Carter C. , 1998)

Cooperation management

The main process in horizontal strategic alliances is called cooperation management that can be structured in three phases and represents the basis of successful implementation of mutual sourcing.

The first phase of cooperation management is **planning**. Here adequate cooperation partners are selected and the objectives of cooperation are defined. At the selection of partners, the main criterion is the fit of partners. Fit means similarity or strategic coherence. In Figure 46 the forms of fit are summarized. First fundamental fit has to be reached, and then strategic fit is the criterion for selection of partners. Furthermore cultural fit has to be considered and consequently sourcing fit represents the final selection criterion (CAPS, 1998).

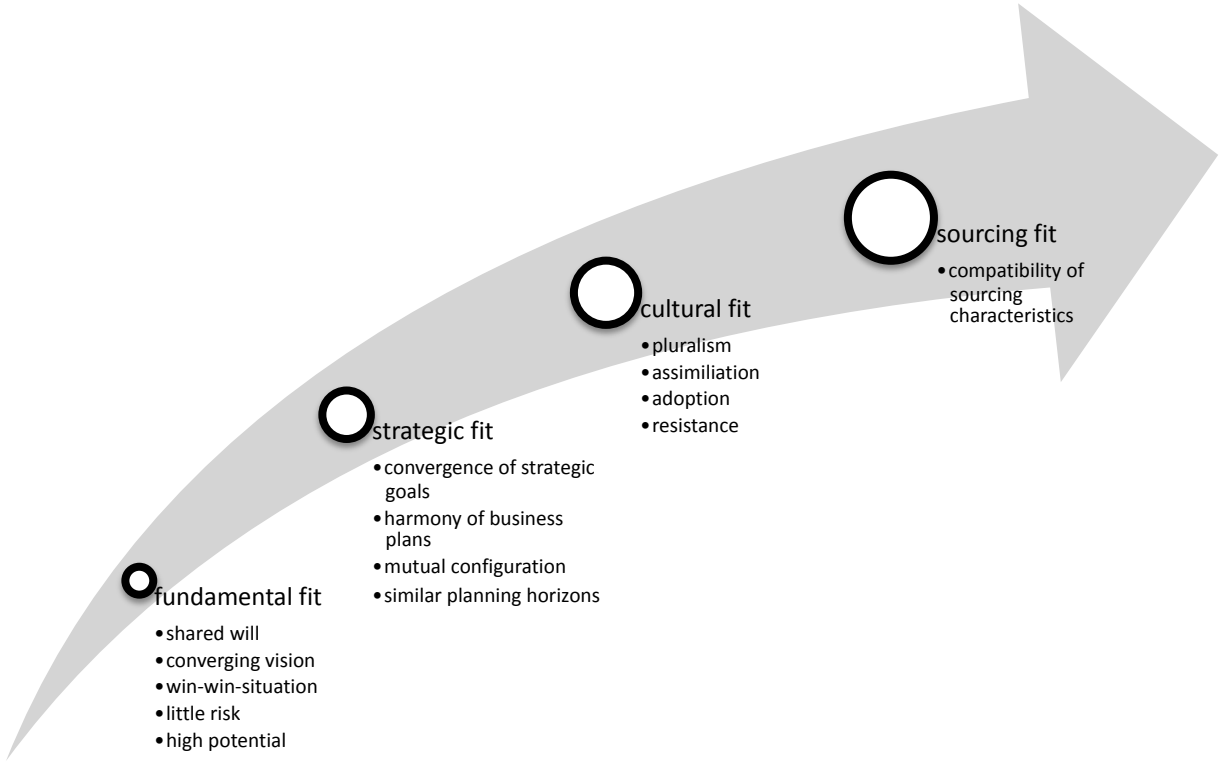


Figure 46: Forms of fit, adapted from (CAPS, 1998).

The second phase of cooperation management is the **implementation** of the cooperation. Here a structural and procedural organization is built. To organize the tasks of the cooperation systematically, the entire project is separated into packages of tasks, which are based on materials and goods groups. Implementation therefore includes several activities concerning the selection of coordinators, selection of material groups, development of criteria catalogue for supplier selection, tendering, analysis and interpretation of supplier information, negotiation with suppliers and contracting (Drazin & Van de Ven, 1985).

The last step of cooperation management is control. Here cost efficiency has to be monitored effectively. Main objective of control in horizontal cooperation's is to prove, that individual sourcing is more costly than the cooperation. The measuring of performance is though not easy, as the determinants are complex and reinforcing. Furthermore in the situation of cooperation, the situation of individual sourcing can be only simulated and actual costs cannot be measured. Basically control includes process control (control of effectiveness of cooperation structure and process using a permanent monitoring) and performance control (control of efficiency as comparison of results with simulated results in individual sourcing used as benchmarks) (Witcher & Chau, 2007).

7.4.10.3. Antitrust law and legal aspects of horizontal cooperation's

Horizontal cooperation's in the field of materials management are constantly viewed negative in the public as the tendency of building syndicates exist and this is always accompanies by a decrease or elimination of competition. Therefore sourcing syndicates are connected with the disruption of the economic balance. This goes as far as syndicates are suspected to endanger the

market economy as institution per se. Otherwise sourcing syndicates can be healthy for competition, if they are installed to compensate structural discriminated organizations. Therefore the decision if syndicates are enforcing or decreasing competition depends mainly on the market form. (Jorde & Teece, 1990)

Economic theory mainly assumes a balance of market power between supply and demand that is never given in reality. Syndicates that enforce competition try to rebalance the economic balance in a market, as they compensate SMEs in the supply market with mutual market power. Therefore the balance of market forces should be reached (Hu & Korneliussen, 1997).

Antitrust laws are installed to eliminate, decrease and regulate syndicates that outbalance the economic balance in a market. These syndicates are gaining market power through concentration and therefore attack the market economy. Therefore antitrust laws in most countries generally ban such syndicates. In most antitrust laws though sourcing syndicates that are built by weaker market parties to overcompensate discrimination are except from regulation. Sourcing syndicates are also privileged in many legal directives, as they reach market power towards suppliers and not towards customers, who enjoy special protection. Therefore sourcing syndicates of SME are accepted from antitrust law if the following requirements are fulfilled (Hendrick T. E., 1996) (Essig, 2000)

- Privileged is mutual sourcing of materials and services. Sourcing in antitrust law is including all strategic and operative tasks of purchasing including procurement marketing, negotiation and invoicing.
- The sourcing activity has to be part of a contract. Therefore a syndicate contract has to be installed. This ensures the ability of legal monitoring of the syndicate and transparency. Furthermore the contract has to be formulated in written form.
- The participants of a sourcing syndicate must not underlie a purchase commitment and the enforcement of certain purchase quantities. This includes legal and factual lock-ins.
- The main objective of the syndicate is to outbalance a structural disadvantage of SMEs towards big corporations. This requires a substantial and sustainable economic advantage of the syndicate.
- The syndicate is effectively fostering competition and no constraint of competition is allowed. Market dominance is the main concept that should be decreased by the development of the syndicate.

Main aim of antitrust law is to make syndicates visible, control and monitor them and if necessary eliminate them. Main institution in the EU is the European Commission and there the Directorate-General for Competition (European Commission) (Main legal documents are Article 81 and 82 in the Treaty of the EC (http://ec.europa.eu/competition/antitrust/overview_en.html). In the US the department of Justice's anti-trust division and the federal trade commission is organizing the antitrust law. Additional to national antitrust law, international antitrust law is established by supranational alliances as in the case of the OECD and the ICN (International Competition Network)

7.5. Supply-chain-based methods in distribution and storage

7.5.1. Vendor Managed Inventory

In the concept of Vendor Managed Inventory (VMI) the supplier is responsible for the entire inventory of the customer. Therefore he is responsible for transport and storage of materials that are supplied from him. This includes the entire task of planning and operational execution of inventory. Schorr (1998)states that in VMI „*the supplier takes over the entire responsibility for planning and replenishing the inventory*" (Schorr, 1998, p. 150). Additionally the supplier has to guarantee security of supply. The conditions of VMI are defined in a frame contract that fixed the service level necessary.

7.5.1.1. Requirements

VMI requires dense coordination between supplier and customer. Especially a constant information flow about demand and stock has to be installed (using EDI or internet), as the supplier needs continuous information about the sales- and demand development of the customer. Furthermore standardization is used to ensure a frictionless flow of materials between the organizations (Dong & Xu, 2002).

7.5.1.2. Advantages

A main advantage of VMI is the development of integrated production. As the supplier knows the demand development of the customer, he can adjust his own production to it. This results in advantages for the customer and supplier alike. The advantages for the supplier include an improved customer relationship, dependence of the customer on the supplier (short-term technological lock-in) and therefore elimination of competition in the short- and medium-run, development of switching costs for the customer and better information about the developments of the sales markets. The advantages for the customers are decreased costs of storing, scheduling, procurement and distribution. Furthermore a high service level is guaranteed and the risk of shortage is practically eliminated. In the beginning of the cooperation, the supplier needs security stock to ensure VMI, which can be reduced quickly through adaptive production and scheduling (Dong & Xu, 2002).

7.5.1.3. Disadvantages

Main criticism of VMI lies in the mutual dependence of the parties involved. Basically, the supplier always decides suboptimal concerning the stocks of the customer, the customers has to optimize the use of suppliers in VMI and the entire inventory (as each supplier only optimizes his stocks), a supplier can use VMI only for a limited set of customers (maximum five customers) and that the customer perceives the materials as consignments after a certain time (Disney & Towill, 2003).

7.5.1.4. Relevance

VMI was first used in commerce chains serving end-customers. Here certain suppliers were responsible for the inventory of their product lines until the shelves and even displayed their goods in the commerce shops. Here the POS-marketing can be monitored effectively by the

supplier. Recently the concept has been transferred to industrial production especially in integrated supply chains using collaborative approaches of inventory. A collaborative special form of VMI is the Co-Managed Inventory, where the responsibility for inventory is shared between the partners, eliminating the disadvantages discussed above (Dong & Xu, 2002).

7.5.2. Integrated logistics

The share of logistics costs in TCO is quite high, especially with the use of modern logistics concepts (JIT, VIM), where a large part of the entire value creation is undertaken by logistics. This leads to increasing logistics costs and consequently a potential of rationalization and cost reduction in distribution and storage. This potential can be utilized with an integrated logistics concept. Characteristic for integrated logistics is the integration of all materials and information flows within the value chain of an organization. As the logistic system of an organization not only undertakes operative tasks of efficient flow optimization, but also strategic potentials are developed and secured by logistics, the effectiveness of logistics has to be considered equally (Shapiro, 1992).

As logistics is not the main focus of this paper, no detailed discussion about logistics and its methods is undertaken. Here only the importance of logistical developments for materials management is discussed. The developments in logistics that are relevant for materials management include (Shapiro, 1992):

- Simplification and standardization of product design
- Change in production structure
- Segmentation in production
- Transition to flexible materials and employees
- Harmonization of capacities
- Outsourcing of logistics / reengineering of material and information flows
- Establishment of logistical chains in the supply chain
- Using uniform containers throughout the supply chain
- Using simulation methods to plan and schedule logistics
- Using integrated CAD-systems jointly with ERP and PPS

7.6. Supply-chain-based methods in disposal

7.6.1. Circular materials management

Circular materials management primarily includes logistical and scheduling problems that resolve disposal problems in the organization. The material circle is the main concept behind circular materials management. A material circle describes the entire material flow of a certain material from extraction/exploitation and production to distribution, consumption until disposal

of the material (Szekely & Trapaga, 1995). A typical circular model is shown in Figure 47 below.

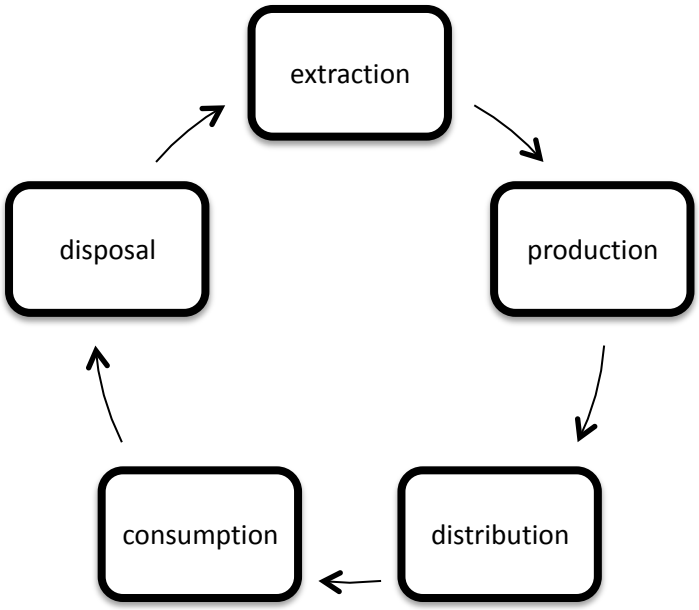


Figure 47: Material circle, adapted from (Szekely & Trapaga, 1995)

The material circle solves two basic problems, the logistical and the planning problem. The logistical problem includes the flow within the circle. The planning problem though uses the concept for all the materials used in the organization and therefore increasing the complexity of the issue fundamentally.

The basic process is separated into two areas, supply logistics being responsible for extraction, production, distribution and consumption, while disposal logistics is concerned with the disposal of materials. Traditional disposal methods lack the integration of the entire material flow and both supply and disposal flow. In the planning area, several methods are used to increase the circulation of the flow (Ayres, 1992):

Recycling-oriented product design for example uses high compatibility of materials, a construction that is easy to de-assemble, reduction of volumes and exact labeling of components to ensure that the products can be recycled as far as possible and therefore a high rate of disposal that can be used as input again is produced.

An integration of the material circle can also be reached with modern ICT. In this area different systems exist that follow the circular model including environment information systems, recycling-oriented ERP, material flow management and disassembly systems.

Environment information systems contribute to environmental consciousness planning and monitoring, are including balance sheet approaches as material balance sheets and effect balance sheets used for evaluation and analysis of the use of materials. Furthermore the information are stored in a database and include information about recycling and disposal as well as pollution

information, external costs, legal requirements, disposal exchanges, environmental statistics and activities that can be undertaken to reduce pollution and disposal (Szekely & Trapaga, 1995).

Recycling-oriented ERP-systems result from the integration of production planning, recycling planning and monitoring activities. Requirement for an integration of recycling into ERP is a shared information base about the structure and the decomposability of products, as for example through components analysis, recycling graphs, recycling structure and disassembly plans. The main link between production and recycling are shown in Figure 48.

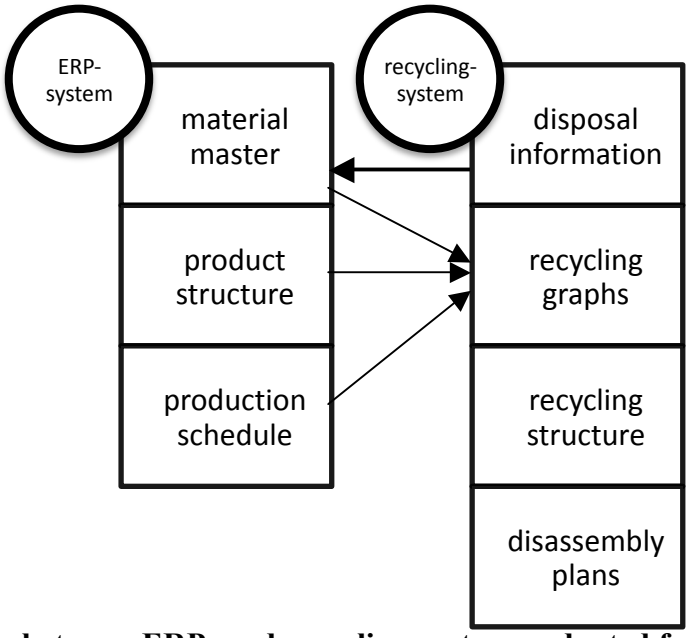


Figure 48: Links between ERP- and recycling-systems, adapted from (Ayres, 1992).

A disassembly system is covering questions regarding the process of disassembly and if certain recycled materials can be re-used and how. Furthermore a re-assembly plan is defining the economic optimal steps of disassembly and give insights into the optimal recycling.

Another example of a materials circle is the package circle. Here the package material is reused in producing new package material. This system is used especially in consumer markets in many countries using returnable and reusable packaging including collection points and recycling facilities (Ayres, 1992). As the package circle represents an optimal example of almost full recycling and a complete material circle, it is shown in Figure 47 below.

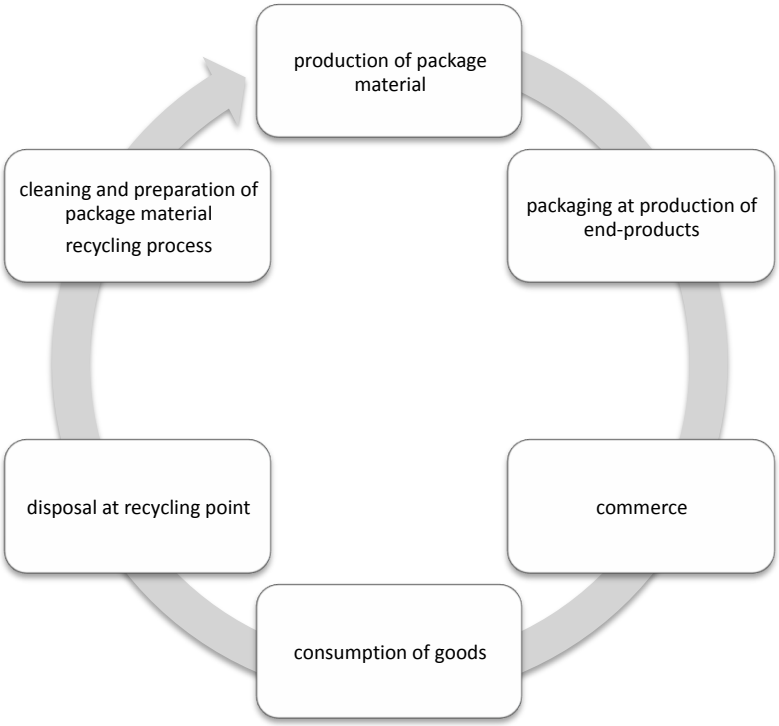


Figure 49: Package circle, adapted from (Ayres, 1992; Szekely & Trapaga, 1995).

7.6.2. Environmental management system

Environmental management systems combine the specific aspects of environmental management with the integration aspect of a system. Therefore the relationship between different elements of environmental management and the integration into a holistic system, synergies between the separate parts is emphasized (Santos-Reyes & Lawlor-Wright, 2001).

One environmental system is represented by the EMAS-regulation. EMAS means Eco-Management and Audit-scheme and represents a guideline for organizations to build up an environmental management system. The main activities in the environmental management system of EMAS are visualized in Figure 50 below (EU - EMAS).

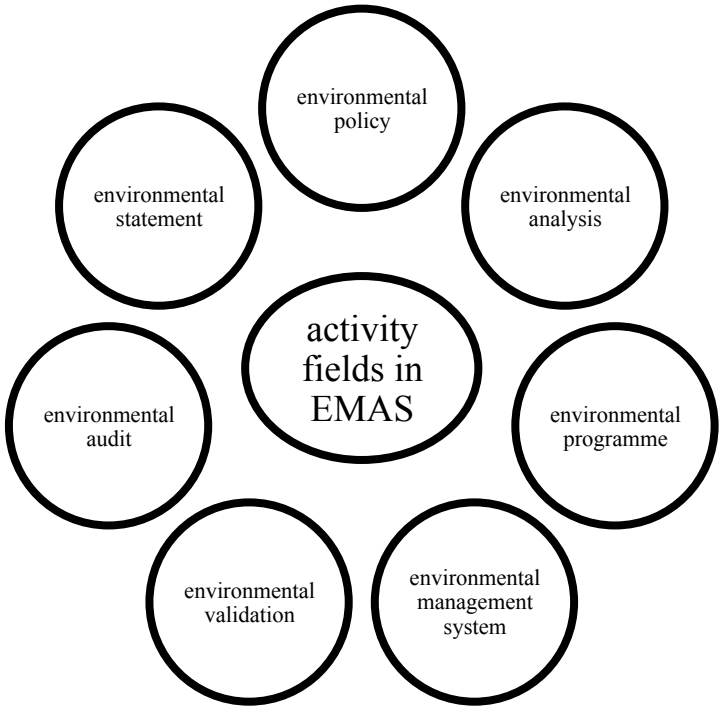


Figure 50: Activities in EMAS, adapted from (EU- EMAS)

7.6.2.1. Environmental policy

In **environmental policy** the ecological objectives of the organization are defined and operationalized, to ensure later control. Main objectives include adherence to economic laws and directives, continual improvement of environmental protection, use of environmental-friendly products and so on. Operationalization of objectives is essential to ensure control at the end of the process (Klassen & McLaughlin, 1996).

7.6.2.2. Environmental analysis

Usually simultaneously to the definition of an environmental policy the present environmental situation of the organization is analyzed. Here especially the adherence to legal directives, the existence of security data and factual pollution, disposal and external costs are calculated. Furthermore a technical assessment of the production facilities is used to examine environmental impact of the production process per se. Furthermore an input-and out-put analysis is conducted, that quantifies the material flows within the organization. Last, a cost-benefit-analysis can be withdrawn from the collected data, examining the external costs and benefits that arise from economic behavior of the analyzed organization or even supply chain (Santos-Reyes & Lawlor-Wright, 2001).

7.6.2.3. Environmental program

The data of environmental policy and environmental analysis are used to formulate an environmental program. The program describes the actions that are taken to achieve the before-defined objectives. Therefore an environmental program includes the strategies concerning the ecological development of the firm (Santos-Reyes & Lawlor-Wright, 2001).

7.6.2.4. Environmental management system

To implement and monitor the strategies within the organization, a management system is implemented. This EMS is responsible for the following functions (Santos-Reyes & Lawlor-Wright, 2001):

- Constant monitoring and adjustment of the environmental policy, environmental objectives and the development of the environmental program
- Distribution of responsibilities and authorities of employees
- Ensuring communication
- Planning, implementation and documentation of environmental audits
- Collecting data about environmental impact of sourcing, production and the product
- Evaluation of environmental impact (environmental validation)

7.6.2.5. Environmental audit

Following the implementation of an EMS, environmental audits are used to monitor and control if the environmental objectives are reached. First of all eco-controlling is controlling, if the EMS is conform to the environmental policy. Furthermore the degree of target achievement is measured (Florida & Davison, 2001).

7.6.2.6. Environmental statement

If the audit is positive, id est the EMS conforms to the environmental policy and all environmental targets are reached, the organization can produce an environmental statement. Environmental statements are used mainly for communicating with stakeholder, environmental groups, media and environmental experts. Furthermore they make EMS more transparent to the public and ideally result in increased reputation and good will. Environmental statements can be even given in extended forms as in sustainability reports or environmental reports (Florida & Davison, 2001).

7.6.2.7. Certification of EMAS

Basically the EMS in EMAS can be certificated. Main advantages of certification are (Florida & Davison, 2001) (Santos-Reyes & Lawlor-Wright, 2001):

- Showing big customers that societal requirements are met
- Eco-strategic product and process development
- Development of ecological know-how
- Goodwill gains
- Adherence to legal directives
- Motivational effects
- Synergetic effects (if supply chain uses the same certified EMS)
- Some business partners might require an EMAS certification, due to their green sourcing strategy

Disadvantage of certification are the high costs of maintaining the EMS and the costs for auditing and certification.

7.6.3. Reverse logistics

7.6.3.1. Term and relevance

Reverse logistics is the management of recycling from a logistical perspective. This is a recently developed theory about how to organize effective recycling (Tibben-Lembke, 2002). Therefore reverse logistics is the process of returning end-of-life products from costumers back to producers (Reverse logistics, 2003). Even though recycling issues are not new to business management, the notion of dealing with returned goods in big amounts and through fragmented supply chains becomes especially important. All in all reverse logistics became a topic that managers cannot afford to ignore in SCM (Bernon, Cullen, & Gorst).

The need for reverse logistics first arose in the area of retailing, presenting the actual customer interface. Here sales people and other staff at the customer interface faced customers asking how and where to return products that are not needed anymore (Tibben-Lembke, 2002). After some organizations started to organize take-backs of goods, the potential of returned goods became visible. This trend was enforced through increased environmental consciousness, especially facing the waste of electronic products, including hazardous parts (Hanafi, Kara, & Kaebernick, 2008). Reverse logistics though can be found in all industry sectors, including car industry (Srivastava & Srivastava, 2006), the mobile phone industry (Chan & Chan, 2008), electronic industry, furniture and IT hardware (Srivastava & Srivastava, 2006).

7.6.3.2. Drivers

The main drivers increasing the need of reverse logistics are of economic, regulatory and consumer-pressure nature (Srivastava & Srivastava, 2006). Economic drivers represent the huge potential that can be gained in materials management by re-using returned products for maintenance and components production. This can decrease the pressure felt by supply markets and prices of raw materials. Regulatory pressures can be felt by legal institutions in the fields of consumer rights, stating in many countries that organizations have to take back certain products or that customers have the right to bring the product back. Furthermore legal enforcement of recycling itself can be given, depending on the industry and country the organization is located. Last, consumer pressures can lead to the need of a reverse logistics system, as consumers might want to bring products back. Additionally, usually consumers try to trade returned goods with the purchase of new ones (Srivastava & Srivastava, 2006). This process can also be underlined by laws regulating the returning and trading of returned goods (Tibben-Lembke, 2002).

7.6.3.3. Reverse logistics in SCM

Figure 51 below shows the process of reverse logistics within a supply chain. Here the concept of recycling is fulfilled not by the producer who has to install a separate process of picking up products (like in the recycling of paper and glass), but through the already existing chains, just in the reverse direction. The consumer simply returns the product where he bought it, the distributers than send them back to the manufacturer where they are disassembled and the raw components are sent back to the suppliers who prepare the materials again for production (Srivastava & Srivastava, 2006).

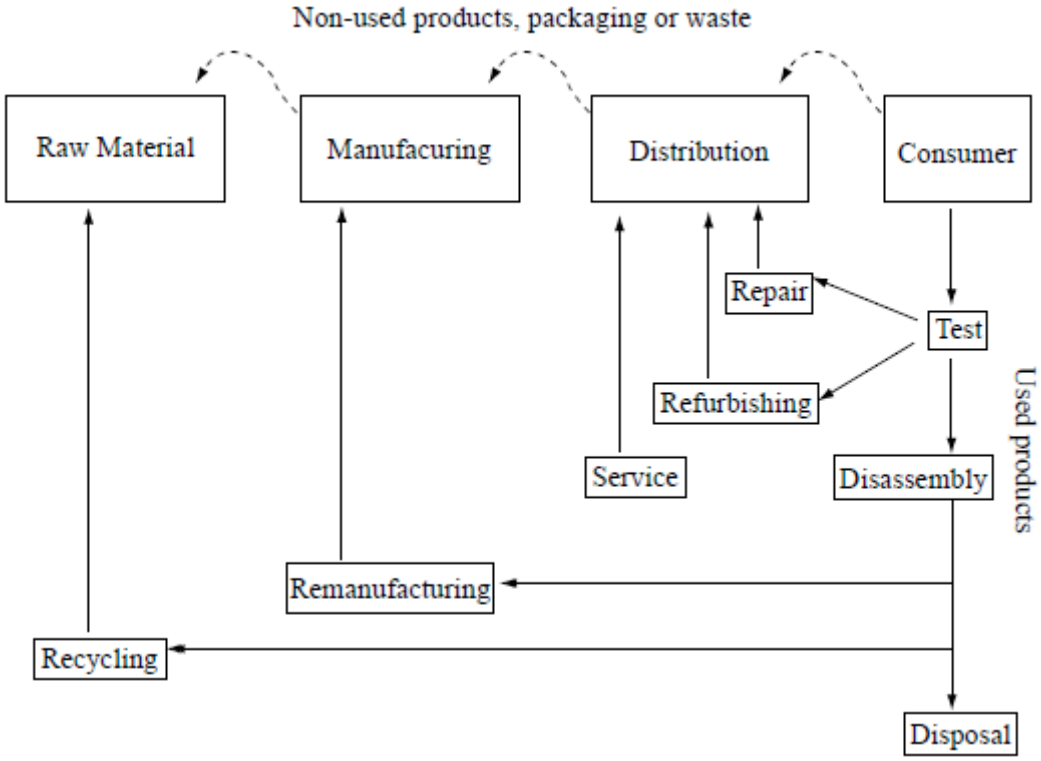


Figure 51: process of reverse logistics (Srivastava & Srivastava, 2006, p. 527)

Additionally to the management of the reverse flow, labeling the reverse articles, sorting and preparation of materials, other additional cost might arise from increase in customer contact, administrative costs and transport costs. Furthermore a time-lag between production and usage of the primary product and the reverse flow has to be considered. Therefore returned products in late life-cycle-stages might not be used to produce the primary product but might be sold on secondary markets or used for more developed products (Tibben-Lembke, 2002). Reverse logistics might be organized using standardized packaging and ICT-systems based on a two-way flow of products (for example RFID) (Lee & Chan, 2009). Reverse logistics might not only consider products but also additional components and especially packaging (Lee & Chan, 2009).

7.6.3.4. Forms of reverse logistics

Many forms of reverse logistics systems exist, depending on the process of returning articles. The above shown process is classical reverse logistics, where each supply chain basically organizes its own reverse logistics process through the POS. Other forms are for example switching pool systems, were several supply chains work collaborate in picking up and distributing the returned goods, but each supply chain uses their own containers. A second form of mutual reverse logistics is systems with return logistics, where the containers are also owned by a central agency that coordinates distribution between the supply chains within the industry. Therefore reverse logistics can be organized in a large continuum of possibilities, between direct return, transfer systems, depot systems and rental systems (Kroon & Vrijens, 1995).

7.7. Summary on Chapter 7

Chapter 7 was dealing with the second research question, namely to identify and discuss the main instruments of a supply-chain-based materials management approach. The structure followed chapter 6.

In area of supporting instruments of materials management substantially different instruments are used in the collaborative approach to MM. The main instruments used there are portfolio analysis methods consisting of all kinds of factors used, modern target costing, advanced purchasing and holistic approaches as for example product-life-cycle analysis and the experience curve. These instruments cover a range of multiple factors analyzed in materials management and show the plurality of the field. Furthermore holistic approaches to analyzing as for example the PLC were used.

Scheduling in the collaborative approach of SCM-MM include the management of interfaces, integrated inventory management and dynamic demand calculation and go far beyond the traditional calculation methods.

Sourcing is the main focus in material management in the SCM paradigm of materials management, as it constitutes the main process in this area. Therefore various sourcing strategies, procurement marketing, strategic sourcing and even relationship management methods are used. The use of this instruments mirror the seller's market where similar instruments are used in the marketing area of the firm. Additionally collaborative materials management use innovative collaboration models in sourcing as for example total cost of ownership, purchasing card buying, third party buying and even includes topics of corporate strategic and governance issues as for example green sourcing and ethical issues. Different forms of strategic alliances last are also tasks of sourcing in the collaborative approach of MM.

Disposal in the collaborative model decreases importance and additionally to the classic methods, circular instruments are used to manage the disposal of materials management, including holistic environmental management systems and reverse logistics.

8. Analysis of competitive and supply-chain-based MM

In Figure 52 a summary of all methods discussed in this master thesis in the five steps of materials management in both sections of classical and supply-chain-based materials management is presented. Please note that competitive materials management is also used in supply-chain-based materials management. Supply-chain-based materials management as shown in the figure below only shows the instruments which are used additionally to competitive materials management instruments. Furthermore business organizations use unique combinations of the methods discussed in this paper, depending on the business environment.

Classical materials management	**Supply-chain-based materials management**
Supporting instruments	
Standardization Labeling ABC-Analysis XYZ-Analysis ABC/XYZ-Analysis LMN-Analysis Value Analysis Analysis of price structure Product-quantum-Analysis	Portfolio methods Target Costing Advanced Purchasing Product-life-cycle analysis Experience curve analysis
Scheduling	
Demand Calculation Inventory Calculation Order Calculation	Interface Management Integrated Inventory Management Dynamic Demand Calculation
Sourcing	
Preparation Execution After-Purchase-Management	Sourcing Strategies Strategic Sourcing Procurement Marketing Supplier Relationship Management TCO Purchase Card Buying Third Party Buying Green sourcing Ethical sourcing Strategic Alliances
Storage & Distribution	
Technical storing Economic storing Distribution	Vendor Managed Inventory Integrated logistics
Disposal	
Avoid waste Recycle waste Remove waste	Circular material management Environmental Management system Reverse logistics

Figure 52: Summary of methods compared

As Figure 52 above shows, the methods used in supply-chain-based materials management and classical materials management differ significantly. Now, a comparison of methods is done, first separated by the activity fields in material management and then the concluded comparison is developed.

8.1. Comparison of steps in MM

8.1.1. Comparison of supporting methods of materials management

Classical as well as supply-chain-based materials management use manifold instruments for supporting the materials management of the organization. Both forms of materials management use analysis instruments, but differ significantly in the use of instruments. Classical materials management uses mainly one-dimensional analysis methods (ABC, XYZ, LMN, except ABC/XYZ representing the only two-dimensional concept in classical materials management) based on costs, prices and quantity. Furthermore standardization and labeling is used to straighten and smooth out the material flows within the supply chain. Supply-chain-based materials management uses classical supporting methods and adds two- and three-dimensional analysis methods, based on quality and prices alike. Furthermore dynamic perspectives to materials management are added (product-life-cycle analysis) and collaborative (advanced purchasing) and new economic (experience curve) methods are integrated. The methods discussed in this paper in the supporting method section are summarized separately in Figure 53.

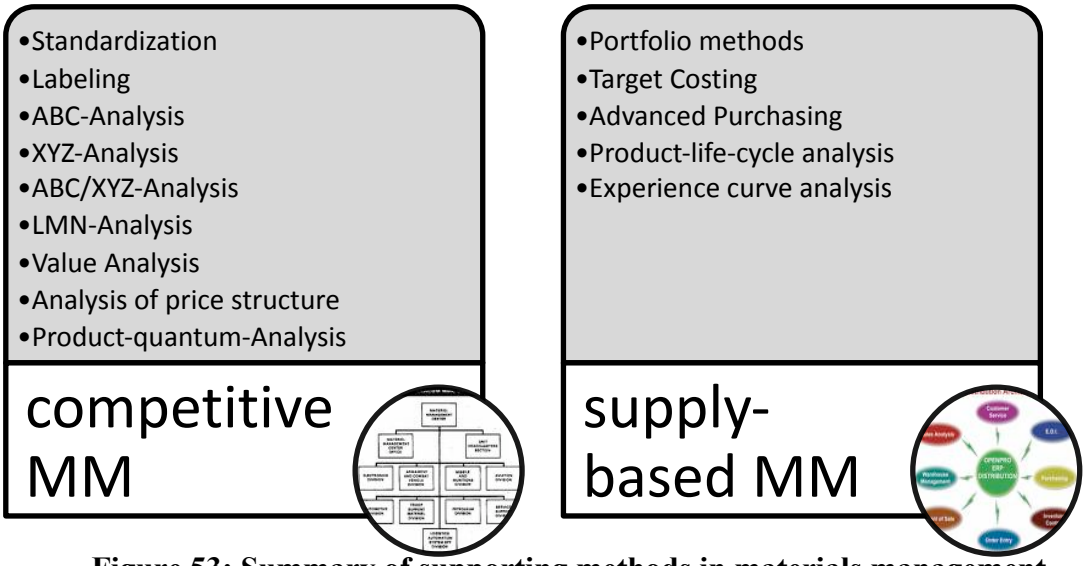


Figure 53: Summary of supporting methods in materials management

8.1.2. Comparison of methods in scheduling

Scheduling is the main area of strategic work in classic materials management, while the other steps (sourcing, distribution, storage, disposal) are only concerned with operative

implementation in classical materials management. This separation does not exist in this degree in supply-chain-based materials management. Furthermore classical materials management uses scheduling in a chronological process perspective, where order, inventory and demand calculations are done step-by-step. Classical materials management in scheduling therefore performs the strategic task through detailed calculation. Therefore only quantitative demand is included in classical scheduling. In supply-chain-based materials management uses more dynamic and integrated methods in scheduling and also integrated interfaces within the organization into the scheduling process. The methods discussed in scheduling are summarized in Figure 54 below.

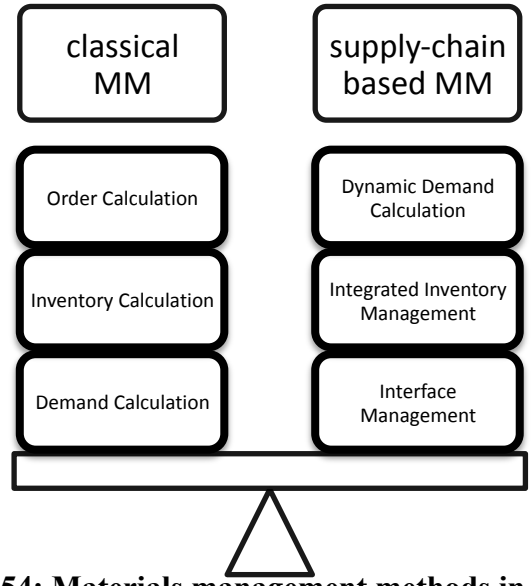


Figure 54: Materials management methods in scheduling

8.1.3. Comparison of sourcing methods in materials management

Sourcing in classical materials management is only a subordinate field, the scheduling of supply, distribution and storage are the main areas of interest. In classical MM scheduling follows a strictly chronological approach including preparation, execution and APM. Sourcing in classical MM is concerned with the actual transaction and negotiation. Main methods therefore are preparation of orders and negotiations. Supply-chain-based MM here represents a clearly long-term, strategic perspective on materials management. Sourcing is seen as a main part of materials management with strategic importance for the entire supply chain. Furthermore the selection of suppliers and managing the relationship with the supplier is at the core of sourcing in SCM, one separate transaction is subordinate to the strategic importance of supplier relations. Integration of sourcing throughout the organizations within the supply chain is another area where classical and supply-chain-based MM differs. Supply-chain-based sourcing considers high degrees of integration, while classical MM is based on independence and competitive sourcing. The discussed methods are summarized in Figure 55.

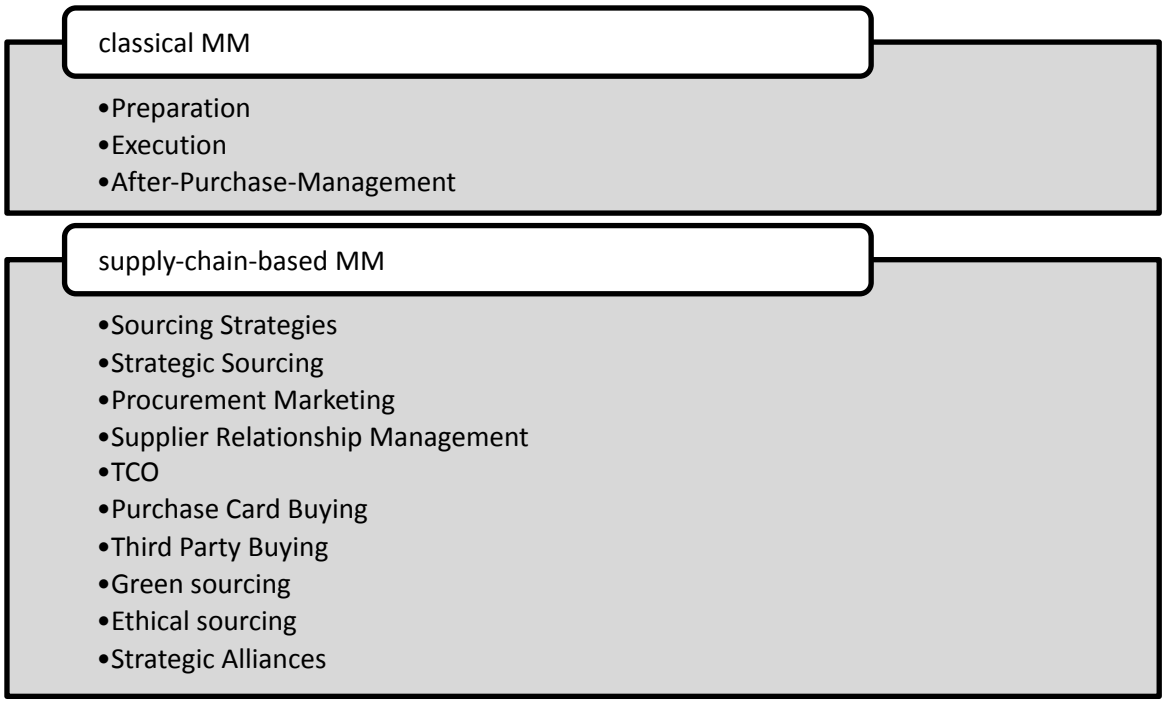


Figure 55: Summary of methods in materials management

8.1.4. Comparison of storage and distribution methods of materials management

Competitive materials management puts especial emphasis on storage and inter-organizational distribution. Especially the optimization of inventory is a main task of classical materials management. Independence here is the main objective. In supply-chain-based MM on the other hand more integrated concepts are used, and inventory is only of special importance, as it is avoided. Collaboration is given priority compared to independence. Furthermore the distribution task is enlarged to cross-organizational distribution within the supply chain. The used methods are summarized in

Figure 56 below.

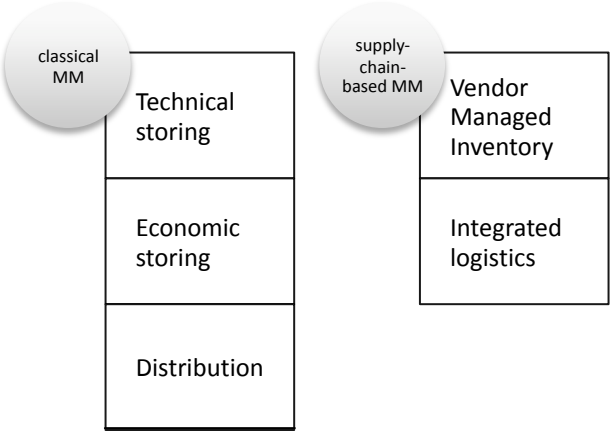


Figure 56: Summary of discussed storage and distribution methods

8.1.5. Comparison of disposal methods in materials management

Classical materials management in the field of disposal was focused on waste only, while supply-chain-based materials management uses a more holistic approach of environmental materials management. Furthermore supply-chain-based disposal management perceives environmental issues as circular and two-way flows within the supply chain, while classic approaches are one-dimensional and one-way approaches. The methods discussed in this master thesis in the disposal section are summarized in Figure 57 below.

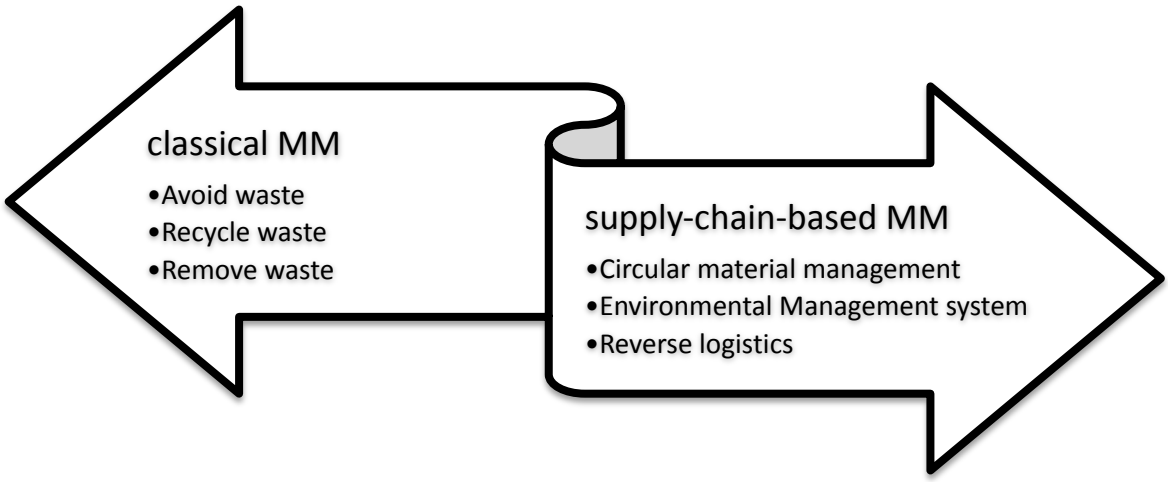


Figure 57: Methods discussed in disposal

9. Conclusion

9.1. Theoretic results and review of research purpose

The main research purpose of this thesis was to discuss materials management based on its industrial contexts and to differentiate between a traditional competitive approach to materials management and a collaborative supply-chain-based materials management. Therefore literature in the field of materials management was analyzed using hermeneutical text analysis to discover the differences of material management methods depending on their industrial context. It became obvious to the authors, that materials management methods in theory and practice differ widely and the main reason for the differences is the business environment and here especially industry structure and dynamics. Therefore the two extreme forms of market contexts "competition" and "cooperation within supply-chains" were differentiated and the methods used in each field are discussed. In reality each business organization though has to carefully analyze its own industrial context and based on the findings to combine both forms of materials management to adjust its own processes to the business environment. Below the main findings of the study are summarized:

The first and second research question dealt with identifying methods and instruments used in competitive and collaborative materials management and discuss them in detail. This research question was answered in chapter 6 and 7 respectively.

As for competitive materials management the main instruments of analysis were identified as standardization, labeling, ABC-, XYZ-, LMN-analysis, value analysis, price structure analysis and product-quantum analyzing. Within scheduling the competitive materials management approach differentiates between demand, inventory and order calculation. Sourcing plays a subordinate role and focuses on the economic and technical tasks of storing as well as on logistics of distribution. In disposal a strictly linear approach is used and the three methods used in this field in competitive materials management are waste avoidance, recycling and removal.

Collaborative or supply-chain-based materials management uses different instruments in all five fields of materials management. In supporting instruments for example, more strategic tools for analysis are used as for example portfolio analysis, target costing, advanced purchasing, PLC and experience curve. In scheduling the approach focuses on business interfaces and integrated inventory management completed by dynamic calculation models. Sourcing is the main area of importance in collaborative materials management and includes all kinds of sourcing strategies, procurement marketing to mirror the seller market, strategic sourcing, relationship management as well as innovative forms of purchasing as for example TCO, PCB, third party buying and strategic alliances in sourcing. Additionally ethical and environmental issues of sourcing are discussed within the field of sourcing per se. In distribution and storage, vendor-managed and integrated models of logistics are used to supplement the collaborative nature of SCM. Last, in

disposal not only linear but also circular methods of disposal are introduced into the literature as for example EMS or reverse logistics.

Research question 3 was dealing with comparing these two distinct approaches of materials management and deriving conclusions and business implications from this comparison. The main differences between classical and supply-chain-based materials management can be previously seen in the different steps of materials management. However, a more in-depth discussion is necessary to perceive the entity of differences to show the specific individuality of supply-chain-based materials management. The main specifics of supply-chain-based MM are discussed below.

Supply chain-based materials management is offering an integrated perspective on materials management. This integration includes an integration of different functional aspects of materials management. Therefore the five steps of materials management are not separated that strict in supply-chain-based MM. Furthermore the separation between strategic management at the top management level and the operative materials management is eliminated in supply-chain-based MM.

Additionally supply-chain-based MM offers a cross-organizational approach, which is defining sourcing alongside the upstream side of the supply-chain. The integration of suppliers on various levels is a specific characteristic of supply-chain-based MM.

Supply-chain-based MM is emphasizing the strategic role of sourcing within the organization as a primary and secondary activity, while classical MM perceives sourcing as a supportive, operative activity. In supply-chain-based MM communication between suppliers and customers is the foundation of most methods. Supply-chain-based MM is furthermore less control-based than classical materials management methods and therefore increase the risk incorporated for the organization.

A main objective of classical materials management is independence and competition on supply markets, while supply-chain-based MM are decreasing or eliminating competition and enforcing mutual interdependence. In supply-chain based MM the focus lies on long-term cooperative relationships with suppliers, while classical MM enforces a transactional perspective.

Supply-chain-based materials management methods are providing business organizations with collaborative forms of materials management and therefore offer bigger choice for organizations. The outsourcing of materials management parts is basically possible in supply-chain-based methods.

Complexity and dynamism are the main environmental factors underlying supply-chain-based materials management. Therefore the methods used in supply-chain-based materials management are also complex and dynamic in nature and are hence able to cope with the complexity and dynamism in supply chains.

In classical materials management unitary and coherent objectives are assumed in the methods discussed, while in supply-chain-based materials management multiple and conflicting objectives are usually the norm in fragmented supply chains.

Supply chain-based materials management are using the insights of competitive materials management and combine them with recent empirical and theoretic insights and therefore create flexible instruments that can be used to integrate and collaborate within supply-chains and lead to overall competitiveness.

9.2. Managerial implications

The practical relevance of collaborative materials management is beyond questioning. Many business organizations (depending on their historical path and industry) are undergoing severe changes on how they organize their materials management as supply chains are getting more integrated over time. Therefore a specific differentiated approach to materials management can help managers to focus on the specific situation they face in integrated supply chains and the methods that can be used to respond to collaboration needs in this interface with the purchase market.

Recapitulatory the specific dimensions of supply-chain-based materials management are:

- Integrative nature (integration over functions and organizations)
- Process-oriented approach
- Strategic orientation of materials management
- Communication-based
- Mutual interdependent and risky
- Decreasing competition and fostering collaboration
- Focusing on long-term relations instead of transactions
- More choice of methods
- More complex and dynamic instruments and use of instruments
- Following multiple and conflicting objectives
- Adjustment and integration of classical materials management into SCM philosophy

These main findings underline the main research purpose and resolve the research problem the following: Industrial context is a main factor in the design of logistical processes in general and especially materials management in business organizations. Therefore the methods and instruments used in the field of materials management are adjusted to different forms of competition and supply-chain integration. An analysis of those instruments therefore has to reconsider these different contexts carefully to provide insights for theorists and practitioners. As for business organizations, the design of materials management has to be adjusted to the industrial context including competition and integration within the supply chain to increase effectiveness and efficiency in this field. Furthermore materials management methods each individually contribute to a business organizations success, but only if it is used in the right context. Therefore materials management in business organizations also has to be changed over time, if the context of competition, the scope of business activities and the dynamics of the industry change.

Bibliography

(n.d.). Retrieved from Fair Trade: http://www.fairtrade.org.uk/

(n.d.). Retrieved 08 13, 2009, from European Commission: http://ec.europa.eu/dgs/competition/index_en.htm)

Adamides, E. D., Mitropoulos, P., Giannikos, I., & Mitropoulos, I. (2009). A multi-methodological approach to the development of a regional solid waste management system. *The Journal of the Operational Research Society , 60* (6), 758-770.

Adler, N. J. (2008). *International dimensions of organizational behavior* (5 ed.). Mason, Ohio: Thomson South-wertern.

Alvesson, M., & Skoldberg, K. (2000). *Reflexive methodology: New vistas for qualitative research.* London: Sage Publications.

Arnold, U. (2000). New dimensions of outsourcing: a combination of transaction cost economics and the core competencies concept. *European Journal of Purchasing & Supply Management , 6* (1), 23-29.

Asiedu, Y., & Gu, P. (1998). Product life cycle cost analysis: state of the art review. *International Journal of Production Research , 36* (4), 883 - 908.

Ayres, R. U. (1992). Toxic heavy metals: Materials cycle optimization. *Proceedings of the National Academy of Sciences of the United States of America , 89*, 815-820.

Baldwin, R., & Cave, M. (1999). *Understanding Regulation: Theory, Strategy, and Practice.* Oxford: Oxford University Press.

Beamon, B. M. (2005). Environmental and Sustainability Ethics in Supply Chain Management. *Science and Engineering Ethics , 11*, 221-234.

Bechtel, C., & Jayaram, J. (1997). Supply Chain Management - A strategic perspective. *The International Journal of Logistics Management , 8* (1).

Bernon, M., Cullen, J., & Gorst, J. (n.d.). Supply Chain management. *Financial Management* , 42-43.

Birou, L. M., & Fawcet, S. E. (2006). International Purchasing: Benefits, Requirements, and Challenges. *Journal of Supply Chain Management , 29* (2), 27 - 37.

Björnland, D., Persson, G., & Virum, H. (2003). *Logistik för konkurrenskraft - ett ledaransvar.* Lund: Wallin & Dahlholm.

Blowfield, M. E. (2005). Operations and supply chain management. Going global: how to identify and manage societal expections in suppyl chains (and the consequences of failure). *Corporate Governance , 5* (3), 119-128.

Blowfield, M. (2000). Ethical Sourcing: A contribution to sustainability or a diversion? *Sustainable Development , 8*, 191-200.

Bolton, J. M., & Dwyer, K. (2003). Achieving supply chain alignment through behavior change. In J. L. Gattorna, *Gower Handbook of Supply Chain Management* (5th ed., pp. 603-618). Hants: Gower.

Bowen, J. T., & Leinbach, T. R. (2006). Competitive Advantage in Global Production Networks: Air Freight Servics and the Electronics Industry in Southeast Asia. *Economic Geography , 82* (2), 147-166.

Bradford, K. D., & Weitz, B. A. (2009). SALESPERSONS' MANAGEMENT OF CONFLICT IN BUYER--SELLER RELATIONSHIPS. *Journal of Personal Selling & Sales Management , 29* (1), 25-42.

Brett, J. F., Pinkley, R. L., & Jackofsky, E. F. (1996). ALTERNATIVES TO HAVING A BATNA IN DYADIC NEGOTIATION: THE INFLUENCE OF GOALS, SELF-EFFICACY, AND ALTERNATIVES ON NEGOTIATED OUTCOMES. *International Journal of Conflict Management , 7* (2), 121-138.

Brundtland, G. H. (1987). *Our Common Future: The World Commission on Environment and Development.* Oxford: Oxford University Press.

Burgel, H. D. (2009). Reorganisation and restructuring methods in R&D. *International Journal of Technology Management , 40* (4), 278-293.

Busch, H. F. (1988). Integrated Materials Management. *International Journal of Physical Distribution & Logistics Management , 18* (7), 28 - 39.

CAPS. (1998). National Association of Purchasing Management NAPM/AT Kearney: The future of purchasing and supply,. *Center for Advanced Purchasing Studies CAPS.* Tempe Arizona: Center for Advanced Purchasing Studies CAPS.

Carder, P. (1997). Interface managment: A fictional case study. *Bradford , 15* (5), 142-149.

Carter, C. (1998). Ethical issues in global buyer-supplier relationship. *Center for Advanced Purchasing Studies CAPS.* Tempe Arizona: Center for Advanced Purchasing Studies CAPS.

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: moving toward new theory. *International Journal of Physical Distribution & Logistics Management , 38* (5), 360 - 387.

Chan, F. T., & Chan, H. K. (2008). A survey on reverse logistics system of mobiel phone industry in Hong Kong. *Management Decision , 46* (5), 702-708.

Chandler, A. D. (1997). Strategy and structure. In N. J. Foss, *Resources, firms, and strategies: a reader in the resource-based perspective* (pp. 40-52). Oxford: Oxford University Press.

Chen, Z.-L., & Hall, N. G. (2007). Supply Chain Scheduling : Conflict and Cooperation in Assembly Systems. *Operations research , 55* (6), 1072-1089.

Chiang, C., & Benton, W. C. (2006). Sole sourcing versus dual sourcing under stochastic demands and lead times. *Naval Research Logistics , 41* (5), 609 - 624.

Chopra, S., & Meindl, P. (2002). *Supply Chain Management: Strategy, Planning and Operation.* Springer Netherlands: Prentice-Hall.

Christopher, M. (2005). *Logistics and Supply Chain Management. Creating Value-Adding Networks* (3rd ed.). Harlow: Pearson.

CIA Factbook. (n.d.). Retrieved from https://www.cia.gov/library/publications/the-world-factbook/

Cole, M., & Avison, D. (2007). The potential of hermeneutics in information systems research. *European Journal of Information Systems , 16* (6), 820-833.

Comer, J. M., & Zirger, B. J. (1998). Building a supplier-customer relationship using joint new product development. *Industrial Marketing Management , 26* (2), 203-211.

Cooke, J. A. (2004). A case for sole sourcing. *Logistics Management , 43* (10), 32-35.

Cooper, M. C., & Ellram, L. M. (1993). Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy. *The International Journal of Logistics Management , 4* (2), 13-24.

Corbett, C. J., & Karmarkar, U. S. (2001). Competition and Structure in Serial Supply Chains with Deterministic Demand. *Management Science , 47* (7), 966-978.

Costanzo, L. A. (2004). Strategic foresight in a high-speed environment. *Futures , 36* (2), 219-235.

Cox, A. (1999). Power, value and supply chain management. *Supply Chain Management: An International Journal , 4* (4), 167 - 175.

Crane, A., Matten, D., & Moon, J. (2004). Stakeholders as Citizens? Rethinking Rights, Participation, and Democracy. *Journal of Business Ethics , 43*, 107-122.

Crone, M., & Watts, H. D. (2003). The Determinants of Regional Sourcing by Multinational Manufacturing Firms: Evidence from Yorkshire and Humberside, UK. *European Planning Studies , 11* (6), 717 - 737.

D'Aveni, R. A. (1994). *Hypercompetition: Managing the Dynamics Strategic Maneuvering.* New York: Free Press.

Das, A., & Handfield, R. B. (1997). Just-in-time and logistics in global sourcing: an empirical study. *International Journal of Physical Distribution & Logistics Management , 27* (3/4), 244 - 259.

Day, G. S., & Montgomery, D. B. (1983). Diagnosing the Experience Curve. *The Journal of Marketing , 47* (2), 44-58.

de Bakkeri, F., & Nijhof, A. (2002). Responsible Chain Management: A capability assessment framework. *Business Strategy and the Environment* , 63-75.

de Coverly, E., McDonagh, P., & Patterson, M. (2008). Hidden Mountain. *Journal of Macromarketing , 28* (3), 289-303.

Degraeve, Z., Labro, E., & Roodhooft, F. (2000). An evaluation of vendor selection models from a total cost of ownership perspective. *European Journal of Operational Research , 125* (1), 34-58.

Dickie, F. E. (1951). ABC Inventory Analysis Shoot for Dollars, not Pennies. *Factory Management and Maintenance , 109*, 92-94.

Disney, S. M., & Towill, D. R. (2003). The effect of vendor managed inventory (VMI) dynamics on the Bullwhip Effect in supply chains. *International Journal of Production Economics , 85* (2), 199-215.

Dolgui, A., Pashkevich, A., Pashkevich, M., & Grimaud, F. (2008). Forecasting risk analysis for supply chains with intermittent demand. *International Journal of Risk Assessment & Management , 9* (3), 1.

Dong, Y., & Xu, K. (2002). A supply chain model of vendor managed inventory. *Transportation Research Part E: Logistics and Transportation Review , 38* (2), 75-95.

Drazin, R., & Van de Ven, A. H. (1985). Alternative Forms of Fit in Contingency Theory. *Administrative Science Quarterly , 30* (4), 514-539.

Eliasson, G. (2008, may 12). *http://ideas.repec.org/p/hhs/ratioi/0119.html#author.* Retrieved may 20th, 2009, from http://ideas.repec.org/: http://www.ratio.se/pdf/wp/ge_spillovers.pdf

Ellram, L. M. (1995). Total cost of ownership: an analysis approach for purchasing. *International Journal of Physical Distribution & Logistics Management , 25* (8), 4-23.

Elmuti, D., & Kathawala, Y. (2001). An overview of strategic alliances. *Management Decision , 39* (3), 205 - 218.

Essig, M. (2000). Purchasing consortia as symbiotic relationships: developing the concept of "consortium sourcing". *European Journal of Purchasing & Supply Management , 6* (1), 13-22.

Essig, M. (2000). Purchasing consortia as symbiotic relationships: developing the concept of “consortium sourcing”. *European Journal of Purchasing & Supply Management , 6* (1), 13-22.

EU - EMAS. (n.d.). Retrieved from EMAS: http://ec.europa.eu/environment/emas/about/summary_en.htm

Everaert, P., Loosveld, S., Acker, T. V., Schollier, M., & Sarens, G. (2006). Characteristics of target costing: theoretical and field study perspectives. *Qualitative Research in Accounting & Management , 3* (3), 236 - 263.

Faisal, M. N., Banwet, D. K., & Shankar, R. (2006). Mapping supply chains on risk and customer sensitivity dimensions. *Industrial Management & Data Systems , 106* (6), 878 - 895.

Farmer, D. H. (1977). Why Materials Management? *International Journal of Physical Distribution & Logistics Management , 8* (2), 100 - 110.

Finch, P. (2004). Supply chain risk management. *Supply Chain Management: An International Journal , 9* (2), 183 - 196.

Fisher, R., Ury, W., Patton, B., & Guyer, M. (2006). *Getting to Yes: Negotiating Agreement Without Giving In.* New York: Recorded Books LLC.

Fleischmann, M., Bloemhof-Ruwaard, J. M., Dkker, R., van der Laan, E., van Nunen, J. A., & van Wassenhove, L. N. (2009). Quantitative models for reverse logistics: A review. *European Journal of Operational Research , 103* (1), 1-17.

Flores, B. E., & Whybark, C. D. (1988). IMPLEMENTING MULTIPLE CRITERIA ABC ANALYSIS. *Engineering Costs & Production Economic , 15* (1-4), 191-195.

Florida, R., & Davison, D. (2001). Gaining from Green Management: Environmental management systems inside and outside the factory. *California Management Review , 43* (3), 64-65.

Forsgren, M. (2002). The concept of learning in the Uppsala internationalization process model: a critical review. *International Business Review , 11* (3), 257-277.

Fraering, M., & Prasad, S. (1999). International sourcing and logistics: an integrated model. *Logistics Information Management , 12* (6), 451 - 460.

Fraering, M., & Prasad, S. (1999). International sourcing and logistics: an integrated model. *Logistics Information Management , 12* (6), 451 - 460.

Fu, Q., Lee, C.-Y., & Chung-Piaw, T. (2008, march). *http://bschool.nus.edu.sg/.* Retrieved may 20th, 2009, from http://www.bschool.nus.edu.sg/staff/bizteocp/PRM_March2008.pdf

Gadde, L.-E., & Jellbo, O. (2002). System sourcing—opportunities and problems. *European Journal of Purchasing & Supply Management , 8* (1), 43-51.

Galle, W. P., & Min, H. (2001). Green purchasing practices of US firms. *International Journal of Operations & Production Management , 21* (9), 12221238.

Gallego, G., & van Ryzin, G. (1994). Optimal Dynamic Pricing of Inventories with Stochastic Demand over Finite Horizons. *Management Science , 40* (8), 999-1020.

Garman, M. B. (1976). Multi-Product Economic Order Quantity Analysis Under Minimum Inventory Valuation Constraints. *Operational Research Quarterly , 27* (4), 983-989.

Ghemawat, P. (2002). Competition and Business Strategy in Historical Perspective. *The Business History Review , 76* (1), 37-74.

Ghoshal, S., & Westney, D. E. (1991). Organizing Competitor Analysis Systems. *Strategic Management Journal , 12* (1), 17-31.

Gibbons, R. (1992). *Game Theory for Applied Economists.* Princeton, New Jersey: Princeton University Press.

Gottfredson, M., Puryear, R., & Phillips, S. (2005). Strategic Sourcing: From Periphery to the Core. *Harvard Business Review* , 1-10.

Greenley, G. E. (1989). An Understanding of Marketing Strategy. *European Journal of Marketing , 23* (8), 45 - 58.

Groves, G., & Valsamakis, V. (1998). Supplier-Customer Relationships and Company Performance. *The International Journal of Logistics Management , 9* (2), 51-64.

Hadley, S. W. (2004). A MODERN VIEW OF inventory. *Strategic Finance , 86* (1), 30-35.

Hambrick, D. C., MacMillan, I. C., & Day, D. L. (1982). trategic Attributes and Performance in the BCG Matrix--A PIMS-Based Analysis of Industrial Product Businesses. *The Academy of Management Journal , 25* (3), 510-531.

Hanafi, J., Kara, S., & Kaebernick, H. (2008). Reverse logistics strategies for end-of-life products. *International Journal of Logistics Management , 19* (3), 367-388.

Handfield, R. B. (1993). The Role of Materials Management In Developing Time-Based Competition. *INTERNATIONAL JOURNAL OF PURCHASING AND MATERIALS MANAGEMENT , 29* (1).

Handfield, R. B., & Bechtel, C. (2002). The role of trust and relationship structure in improving supply chain responsiveness. *Industrial Marketing Management , 31* (4), 367-382.

Hannan, T. H. (1991). Foundations of the Structure-Conduct-Performance Paradigm in Banking. *Journal of Money, Credit & Banking , 23* (1), 68-84.

Harrison, A., & van Hoek, R. (2005). *Logistics Management and Strategy* (2nd ed.). Essex: Pearson.

Hart, O., & Moore, J. (1990). Property Rights and the Nature of the Firm. *Journal of Political Economy. , 98* (6), 1119-1158.

Hastings, N. A., Marshall, P., & Willis, R. J. (1982). Schedule Based M.R.P.: An Integrated Approach to Production Scheduling and Material Requirements Planning. *The Journal of the Operational Research Society , 33* (11), 1021-1029.

Hawken, P. (1993). *The ecology of commerce: a declaration of sustainability.* New York: HarperBusiness.

Heinbuch, S. E. (1995). A case of successful technology transfer to health care: Total quality materials management and just-in-time. *Journal of Management in Medicine , 9* (2), 48-56.

Helper, S. R., & Sako, M. (1997). *http://dspace.mit.edu/handle/1721.1/7577.* Retrieved 05 24, 2009, from http://dspace.mit.edu/: http://dspace.mit.edu/handle/1721.1/7577

Henderson, B. D. (1966). *http://search.bcg.com/search?q=experience+curve+&entqr=0&output=xml_no_dtd&client=bcgsite&ud=1&oe=UTF-8&ie=UTF-8&site=bcgsite&proxystylesheet=bcgsite&proxyreload=1&filter=0&x=14&y=13.* Retrieved may 20th,

2009, from http://www.bcg.com/: www.bcg.com/impact_expertise/publications/files/Experience_Curve_II_History_1973.pdf

Hendrick, T. E. (1996). *Purchasing Consortiums: horizontal alliances among firms buying common goods and services. what? who? why? how?* Retrieved from capsresearch.org: http://www.capsresearch.org/publications/pdfs-public/hendrick1997es.pdf

Hendrick, T. (1997). Purchasing consortiums Horizontal alliances among firm buying common goods and services What? Who? Why? How? *Center for Advanced Purchasing Studies CAPS.* Tempe Arizona: Center for Advanced Purchasing Studies CAPS.

Herbig, P., & O'Hara, B. (1996). International procurement practices: a matter of relationships. *Management Decision , 34* (4), 41-45.

Hingley, M. (2001). Relationship Management in the Supply Chain. *The International Journal of Logistics Management , 12* (2), 57 - 71.

Hoffner, Y., Facciorusso, C., Field, S., & Schade, A. (2000). Distribution issues in the design and implementation of a virtual market place. *Computer Networks , 32* (6), 717-730.

Hoppe, M. (2006). *Inventory Optimization with SAP.* SAP Press.

Horstmann, R., Timm, U. J., & Mertens, P. (1998). *Concept and Realization of an Internet-based.* Erlangen: FORWISS.

Hsieh, P.-J., & Kleiner, B. H. (1992). New Developments in Inventory and Materials Management. *Logistics Information Management , 5* (2), 32 - 35.

Hu, T.-L., Sheu, J.-B., & Huang, K.-H. (2002). A reverse logistics cost minimization model for the treatment of hazardous wastes. *Transportation Research , 38* (6), 457–473.

Hu, Y., & Korneliussen, T. (1997). The effects of personal ties and reciprocity on the performance of small firms in horizontal strategic alliances. *Scandinavian Journal of Management , 13* (2), 159-173.

Inderst, R. (2008). Single sourcing versus multiple sourcing. *Journal of Economics , 39* (1), 199-213.

Jap, S. D., & Haruvy, E. (2008). Interorganizational Relationships and Bidding Behavior in Industrial Online Reverse Auctions. *Journal of Marketing Research , 45* (5), 550-561.

Jin, B. (2004). Achieving an optimal global versus domestic sourcing balance under demand uncertainty. *International Journal of Operations & Production Management , 24* (12), 1292 - 1305.

Johnson, G., Scholes, K., & Whittington, R. (2005). *Exploring Corporate Strategy.* Prentice Hall.

Jorde, T. M., & Teece, D. J. (1990). Innovation and Cooperation: Implications for Competition and Antitrust. *Journal of Economic Perspectives , 4* (3), 75-96.

Kaneko, J., & Nojiri, W. (2008). The logistics of Just-in-Time between parts suppliers and car assemblers in Japan. *Journal os Transport Geography , 16*, 155-173.

Kearny, A. (2003). *Supply chains in a vulnerable, volatile world.*

Kelle, P. (1985). Safety stock planning in a multi-stage production-inventory system. *Engineering Costs and Production Economics , 9* (1-3), 231-237.

Khaki Boukani, f. (2007). *Overcoming logistical problems in organizations: The case of Elicom AB.* Skövde: University of Skövde.

Klassen, R. D., & McLaughlin, C. P. (1996). The Impact of Environmental Management on Firm Performance. *Management Science , 42* (8), 1199-1214.

Kolchin, M. (1990). Purchasing in the industrial and institutional sectors. *Center for Advanced Purchasing Studies CAPS.* Tempe Arizona : Center for Advanced Purchasing Studies CAPS.

Kotabe, M., & Helsen, K. (2009). *The SAGE Handbook of International Marketing.* London: SAGE Publications Ltd.

Kotler, P. (2005). *Principles of Marketing.* New Jersey: Prentice Hall.

Kraljic, P. (1983). Purchasing must become supply management. *Harvard Business Review* (No. 83509), 1-12.

Kroon, L., & Vrijens, G. (1995). Returnable containers: an example of reverse logistics. *International Journal of Physical , 25* (2), 56-68.

Kumaran, D. S., Ong, S. K., Tan, R. B., & Nee, A. Y. (2001). Environmental life cycle cost analysis of products. *Environmental Management and Health , 12* (3), 260 - 276.

Lambert, D. M., & Cooper, M. C. (2000). Issues in Supply Chain Management. *Industrial Marketing Management , 29* (1), 65-83.

Lee, C., & Chan, T. M. (2009). Development of RFID-based Reverse Logistics System. *Expert Systems with Applications , 36*, 9299-9307.

Lee, H. L., & Billington, C. (1993). Material management in decentralized supply chain. *Operations Research , 41* (5), 835-847.

Leenders, M. R., Fearon, H. E., Flynn, A. E., & Johnson, P. F. (2002). *Purchasing supply management.* Singapore: McGraw-Hill Education.

Lempert, P. (2009). Meeting the Demand of 2009: The Shopper's Experience. *Progressive Grocer , 88* (2), 20.

Leonhardt, T. W. (1988). Buying direct vs. third party buying. *Library Acquisitions: Practice & Theory , 12* (2), 259-260.

Levina, N., & Su, N. (2008). Global Multisourcing Strategy: The Emergence of a Supplier Portfolio in Services Offshoring. *Decision Sciences , 39* (3), 541-570.

Liao, K., & Hong, P. (2007). Building global supplier networks: a supplier portfolio entry model. *Journal of Enterprise Information Management , 20* (5), 511 - 526.

Lillywhite, S. (2004). *Responsible supply chain management. Ethical purchasing in practice.*

Linder, J. C., Jarvenpaa, S. L., & Davenport, T. H. (2003). Toward an Innovation Sourcing Strategy. *MIT Sloan management review , 44* (4), 43-49.

Lorenz, M. O. (1905). Methods of Measuring the Concdentration of Wealth. *Publications of the American Statistical Association , 9* (70), 209-221.

Magnan, G. M., & Fawcett, S. E. (n.d.). *Managing Reputation Risk through Supplier Codes of Conduct: Organizational and Implementation Challenges.* Paper ID 46.

Malhotra, N. K., & Peterson, M. (2001). Marketing research in the new millennium: emerging issues and trends. *Marketing Intelligence & Planning , 19* (4), 216 - 232.

Mason, R., Lalwani, C., & Boughton, R. (2007). Combining vertical and horizontal collaboration for transport optimisation. *Supply Chain Management , 12* (3), 187-199.

Mattli, W. (1999). *The logic of regional integration: Europe and beyond.* CAMBRIDGE : CAMBRIDGE UNIVERSITY PRESS.

McGinnis, M. (1998). Purchasing and supplier involvment. *Center for Advanced Purchasing Studies CAPS.* Tempe Arizona: Center for Advanced Purchasing Studies CAPS.

Melkin, A. (1988). Third party buying vs. buying direct. *Library Acquisitions: Practice & Theory , 12* (2), 225-227.

Meloch, ,. M., & Plank, R. E. (2006). Hypercompetition and Strategic Planning in the Retail Food Industry. *Journal of Food Products Marketing , 12* (2), 1-13.

Mentzer, J. T., DeWitt, W., Deebler, J. S., Soonhong, M., Nix, N. W., Smith, C. D., et al. (2001). Defining Supply Chain Management. *Journal of Business Logistics , 22* (2), 1-25.

Miles, L. D. (1954). *Value Analysis in Purchasing.* Schenectady, New York: Pacific Purchasor.

Min, H., & Galle, W. P. (1997). Green Purchasing Strategies: Trends and Implications. *International Journal of Purchasing and Materials Management* , 10-17.

Mintzberg, H. (2000). *The rise and fall of strategic planning.* New York: Pearson Education.

Mir, R., & Prasad, A. (2002). Digging Deep for Meaning: A Critical Hermeneutic Analysis of CEO Letters to Shareholders in the Oil Industry. *Journal of Business Communication , 39* (1), 92-116.

Mishra, D. P., Heide, J. B., & Cort, S. G. (1998). Information Asymmetry and Levels of Agency Relationships. *Journal of Marketing Research , 35* (3), 277-295.

Mitchelson, M. (1992). Materials Management in Capital-Intensive Industries. *International Journal of Physical Distribution & Logistics Management , 22* (3), 15-20.

Monczka, Handfield, Giunipero, & Patterson. (2008). *Purchasing and Supply Chain Management.* Cengage: South Western Educational Publishing.

Monden, Y. (1998). *Toyota Production System: An Integrated Approach to Just-in-time* (3 ed.). Cambridge: Engineering & Management Press.

Monden, Y., & Hamada, K. (2000). Target costing and Kazien costing in Japanese Automobile Companies. In Y. Monden, & Y. Monden (Ed.), *Japanese Cost Management* (pp. 97-122). Tsukuba: World Scientific.

Murmann, P. A. (1994). Expected development time reductions in the German mechanical engineering industry. *Journal of Product Innovation Management , 11* (3), 236-252.

Murray, J. Y., & Kotabe, M. (1999). Sourcing Strategies of U.S. Service Companies: A Modified Transaction-Cost Analysis. *Strategic Management Journal , 20* (9), 791-809.

National Association of Purchasing Management. (1998). Procurement card guide. *Purchasing Today , 03*.

Ndubisi, N. O., Wah, C. K., & Ndubisi, G. C. (2007). Supplier-customer relationship management and customer loyalty: The banking industry perspective. *Journal of Enterprise Information Management , 20* (2), 222 - 236.

NEAP, & E&I. (2009, May 12). *http://www.purchasing.upenn.edu/about/*. Retrieved may 25, 2009, from http://www.purchasing.upenn.edu/.

Newman, R. W. (2007). Linear performance pricing: A collaborative tool for focused supply cost reduction. *Journal of Purchasing & Supply Management , 13* (2), 152-165.

Nguyen-Vuong, Q.-T., Agoulmine, N., & Ghamri-Doudane, Y. (2008). A user-centric and context-aware solution to interface management. *Computer Networks , 52*, 3358–3372.

Niebuhr, R. E., & Adams, F. P. (1989). Evaluating and Developing Materials Management Personnel. *International Journal of Physical Distribution & Logistics Management , 19* (9), 31 - 35.

Nishiguchi, T. (1994). *Strategic industrial sourcing: the Japanese advantage.* New York: Oxford University Press US.

Nothaft, M. (1999, 10 10). Orchestrating a succsessful Cost Management Program in: Purchasing Today. 33-40.

O'Connor, K. (2003). Global air travel: toward concentration or dispersal. *Journal of Transport Geography , 11*, 83-92.

Pae, J. H., Kim, N., Han, J. K., & Yip, L. (2002). Managing intraorganizational diffusion of innovations: Impact of buying center dynamics and environments. *Industrial Marketing Management , 31* (8), 719-726.

Panagiotou, G. (2006). The impact of managerial cognitions on the structure-conduct-performance (SCP) paradigm: A strategic group perspective. *Management Decision , 44* (3), 423-441.

Parsley, M. (1995). The Rorac revolution. *Euromoney* (318), 36-42.

Parveen, M., & Rao, T. (2008). Managing quality improvement, setup cost and lead time reductions in a just-in-time integrated inventory model. *International Journal of Information Systems and Change Management , 3* (2), 147-156.

Pawar, K., Forrester, P., & Glazzard, J. (1993). Value Analysis: Integrating Product-Process Design. *Integrated Manufacturing Systems , 4* (3), 14-21.

Pearson, R., & Gill, S. (2001). New Hope or False Dawn? Voluntary Codes of Conduct, Labour Regulation in a Globalizing World. *Global Social Policy , 1*, 49-78.

Pohlen, T. L., & Farris, M. T. (1992). Reverse Logistics in Plastics Recycling. *International Journal of Physical Distribution & Logistics Management , 22* (7), 35 - 47.

Porter, M. E. (2002). How Competitive Forces shape Strategy. In D. Faulkner, *Strategy. Critical Perspectives on Business and Management* (pp. 3-17). London: Routledge.

Porter, M. E. (1990). *The competitive advantage of nations.* Macmillan.

Porteus, E. L. (1985). Investing in Reduced Setups in the EOQ Model. *Management Science , 31* (8), 998-1010.

Prasad, A. (2002). The Contest Over Meaning: Hermeneutics as an Interpretive Methodology for Understanding Texts. *Organizational Research Methods , 5* (1), 12-33.

Prater, E., Biehl, M., & Smith, M. A. (2001). International supply chain agility: Tradeoffs between flexibility and uncertantiy. *International Journal of Operations & Production Management; , 21* (5/6), 823-839.

Pretious, M., & Love, M. (2006). Sourcing ethics and the global market. The case of the UK retail clothing sector. *International Journal of Retail & Distribution Management , 34* (12), 892-903.

Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance. *International Journal of Operations & Production Management , 25* (9), 898-916.

Reverse logistics. (2003). *Work Study , 52* (5).

Rinehart, L. M., Tzong-Ru, L., & Page Jr., T. J. (2008). A comparative assessment of domestic and international supplier-customer relationship perceptions. *International Journal of Physical Distribution & Logistics Management , 38* (8), 616-636.

Roberts, S. (2003). Supply Chain Specific? Understanding the Patchy Success of Ethical Sourcing Initiatives. *Journal of Business Ethics , 44*, 159-170.

Rogers, D. S., & Tibben-Lembke, R. (2001). An examination of reverse logistics practices. *Journal of Business Logistics , 22* (2), 129 - 148.

Santos-Reyes, D., & Lawlor-Wright, T. (2001). A design for the environment methodology to support an environmental management system. *Integrated Manufacturing Systems , 12* (5), 323 - 332.

Sanyal, P., & Cohen, L. R. (2009). Powering Progress: Restructuring, Competition, and R&D in the U.S. Electric Utility Industry. *Energy Journal , 30* (2), 41-79.

Schönsleben, P. (2000). With agility and adequate partnership strategies towards effective. *Computers in Industry , 42*, 33–42.

Schorr, J. E. (1998). *Purchasing in the 21st century – A guide to state-of-the-art techniques and strategies* (2 ed.). New York: John Wiley and Sons.

Selvaraj, P., Radhakrishnan, P., & Adithan, M. (2009). An integrated approach to design for manufacturing and assembly based on reduction of product development time and cost. *International Journal of Advanced Manufacturing Technology , 42* (1/2), 13-29.

Seshadri, D. V. (2006). Innovation through Intrapreneurship: The Road Less Travelled. *The Journal for Decision Makers , 31* (1), 17-29.

Shapiro, J. F. (1992). Integrated Logistics Management, Total Cost Analysis and Optimization Modelling. *International Journal of Physical Distribution & Logistics Management , 22* (3), 33 - 36.

Short, T. K. (1985). Industrial product life cycle analysis. *Strategy & Leadership , 13* (6), 18 - 23.

Smeltzer, L. R., & Siferd, S. P. (2006). Proactive Supply Management: The Management of Risk. *Journal of Supply Chain Management , 34* (1), 38 - 45.

Sohal, A., & Howard, K. (1987). Trends in Materials Management. *International Journal of Physical Distribution & Logistics Management , 17* (5), 3 - 41.

Song, D.-W. (2002). Regional container port compeition and co-operation: the case of Hong Kong and South China. *Journal of transport geography , 10*, 99-110.

Srivastava, S. K., & Srivastava, R. K. (2006). Managing product returns for reverse logistics. *International journal of Physical Distribution & Logistics Management , 36* (7), 524-546.

Stern, A. A. (1986). THE STRATEGIC VALUE OF PRICE STRUCTURE. *Journal of Business Strategy , 7* (2), 22-31.

Stevenson, M., & Spring, M. (2007). Flexibility from a supply chain perspective: definition and review. *International Journal of Operations & Production Management , 27* (7), 685-713.

Stinchcombe, A. L. (1984). Third Party Buying: The Trend and the Consequences. *Social Forces , 62* (4), 861-884.

Sun, P. Y., & Scott, J. (2005). Sustaining second-order change initiation: structured complexity and interface management. *The Journal of Management Development , 24* (10), 879-895.

Swamidass, P. M., & Kotabe, M. (1993). Component Sourcing Strategies of Multinationals: An Empirical Study of European and Japanese Multinationals. *Journal of International Business Studies , 24* (1), 81-99.

Swift, C. O. (1995). Preferences for single sourcing and supplier selection criteria. *Journal of Business Research , 32* (2), 105-111.

Szekely, J., & Trapaga, G. (1995). Industrial ecology - The need to rethink the materials cycle: Some problems, solutions, and opportunities in the materials field. *Journal of Materials Research , 10* (9), 2178-2196.

Tan, K. C. (2001). A framework of supply chain management literature. *European Journal of Purchasing & Supply Management , 7* (1), 39-48.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal , 18* (7), 509-533.

Thomas, D. J., & Griffin, P. M. (1999). Coordinated supply chain management. *European Journal of Operational Research , 94* (1), 1-15.

Tibben-Lembke, R. S. (2002). Life after death: reverse logistics and the product life cycle. *International Journal of Physical Distribution & Logistics Management , 32* (3), 223-244.

Treleven, M., & Bergman Schweikhart, S. (1988). A risk/benefit analysis of sourcing strategies: Single vs. multiple sourcing. *Journal of Operations Management , 7* (3-4), 93-114.

van de Water, H. (2000). A maintenance model for quality management. *International Journal of Quality & Reliability Management , 17* (7), 756 - 770.

Van Der Ryn, S., & Cowan, S. (1996). *Ecological Design.* Washington, D.C: Island Press.

Veugelers, R., & Cassiman, B. (1999). Make and buy in innovation strategies: evidence from Belgian manufacturing firms. *Research Policy , 28* (1), 63-80.

Vyas, N. M., Shelburn, W. L., & Rogers, D. C. (1995). An analysis of strategic alliances: forms, functions and framework. *Journal of Business & Industrial Marketing , 10* (3), 47 - 60.

Wagner, B. A., Fillis, I., & Johansson, U. (2005). An exploratory study of SME local sourcing and supplier development in the grocery retail sector. *Journal of Retail & Distribution Management , 33* (10), 716 - 733.

Walters, D. (2003). Supply chain financial performance measurement. In J. Gattorna, R. Ogulin, & M. W. Reynolds, *Gower handbook of supply chain management* (p. 218). Burlington: GowerPublisher.

Webely, S. (2007). *Use of Codes of Ethics in Business.* London: Institute of Business Ethics (ibe).

Weerawarana, J. A., & Houstis, S. (1997). On disconnected browsing of distributed information. *Research Issues in Data Engineering* , 101-107.

What is the Role of Purchasing and Materials Management? (1988). *International Journal of Physical Distribution & Logistics Management , 18* (2), 64-66.

Wight, O. W. (1995). *Manufacturing Resource Planning: MRP II: Unlocking America's Productivity Potential* (2 ed.). New Hampshire: John Wiley and Sons 1995.

Williamson, O. E. (1981). The Economics of Organization: The Transaction Cost Approach. *American Journal of Sociology , 87* (3), 548.

Wind, Y., & Douglas, S. (1981). International Portfolio Analysis and Strategy: The Challenge of the 80s. *Journal of International Business Studies , 12* (2), 69-82.

Wind, Y., Mahajan, V., & Swire, D. J. (1983). An Empirical Comparison of Standardized Portfolio Models. *The Journal of Marketing , 47* (2), 89-99.

Wisner, J. D., Leong, K. G., & Tan, K.-C. (2005). *Principles of supply chain management. A balanced approach.* Mason: South-Western.

Witcher, B. J., & Chau, V. S. (2007). Balanced scorecard and hoshin kanri: dynamic capabilities for managing strategic fit. *Management Decision , 45* (3), 518 - 538.

Wittfeld, K., Helferich, A., & Herzwurm, G. (2008). Vendor-Managed Inventory as a Knowledgeintensive Service in Procurement Logistics in the Automotive Industry. *VIMation Journal* (1), 1-9.

www.argeelogistics.com. (2008). Retrieved September 2009, from http://www.argeelogistics.com/Services/SUPPLY_1/body_supply_1.HTM.

Zadek, S., Lingayah, S., & Forstater, M. (1998). *Social Labels: Tools for Ethical Trade - Final report.* Brussels: New Economics Foundation for the European Comission.

Zipkin, P. H. (2000). *Foundations of inventory management.* california: Irwin/McGraw-Hill.