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Supply Chain Concepts for Steel Industry

Implementing new concepts for Improved Profitability and Competitive Advantage

Daniel Jung

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Supply Chain Concepts for Steel Industry

Implementing Consistent Supply Chain Concepts in the Steel Industry for Improved Profitability and Competitive Advantage

Daniel Jung

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Preface

IAFeS is supporting young researchers. This is the reason, that this masterthesis is published in IAFeS Edition.
It was written by the swisse student Daniel Jung in the program „Master of Business Administration in Management und Strategic Purchasing & Supply Chain Management“

Purchasing and Supply Chain Management are demanding, exciting and competitive discriminators Factors of each company become. Comprehensive skills and expertise on the highest level is required when the challenges
which are placed on the shopping today, Designed to take account. an extensive
Instrumentarium, the practice and sciencefor professional work along the value chain
have developed, is available, it requires only the correct application in the enterprise.
The present work was created here as part of a study at the BMÖ Academy. This Master program is offered by the Middlesex University in London and carried out by the KMU Academy in Austria.
The author works in the Swisse steelindustry and the results of this work are showing general trends of this industry worldwide.

Johann Günther
Secretary General IAFeS

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1. Management Summary

The European steel industry is the focal point of this paper. This industry is characterised by strong regulation as well as a large surplus capacity. The European Union practises a transparent policy that does not permit either a commodities market insulation or protectionism in the steel sector. The CO_2 emission-trading scheme is a role model on a global level when it comes to the strength of its integrity and form. Energy prices in Europe alone are constructed quite disparately, yet even at their peak are not competitive with nations such as China, USA or Russia. However, the mere consideration of all of these factors does not precipitate improved competitive conditions for the European steel industry, and stipulates that the drawbacks created are to be compensated through different means of compensation. It is at this juncture that the paper is introduced. Theories outlined therein will demonstrate that both competitive conditions and profitability can be improved by initiating consistent supply chain concepts. To this end, steel companies in Europe, USA and China were surveyed on the issue of initiating supply chain management and its accompanying potential for improvement. Response rates yielded a qualitative evaluation of the survey questions. It was clearly indicated that competitive ability and profitability could be improved by initiating supply chain concepts. Nevertheless, individual improvement values tended to appear on the lower ends of the value scale and only contingently

supported findings from other literary works. As a whole, evaluated data thoroughly determined a clear outcome that can greatly benefit the European steel industry. It is imperative to raise this potential, since current and future competition can only be successfully determined alongside the entire supply chain. The second portion of this paper will examine which transitions are imminent for the steel industry over the next 35 years. Key words such as mega-cities, infrastructure, mobility concepts and channels of commerce will become evident, to name only a few. These trends will leave their marks on the European steel industry. It was therefore considered necessary to take these trends into account in order to illustrate their influence on future and prospective markets in the European steel industry. In the next stage, potential services for both markets were determined in order to provide recommendations for action. These were established before and during the acquisition stage as well as during and after their use. As a result the steel industry leads the way as global suppliers of products and services as well as flexible solutions and service providers. The industry's stature is characterised by a sharp increase in digitisation, a full range of consulting services and return of waste products as well as by the motto, "think globally act locally". Europe's steel industry is already in the midst of sweeping changes and its advancements will be even more pronounced in the future. The opportunities for mastering them are already in place, yet the proper conclusions must be drawn beforehand and the course set accordingly.

2. Introduction

The steel industry exerted a very strong influence during the 19th and 20th centuries, yet developments of furnace prototypes were already in progress much earlier. In the 14th century, it was possible for the first time to heat iron in such a way that it remained in liquid form. At the onset of the 19th century, Friedrich Krupp founded a cast steel factory in Essen (Germany). His son Alfred Krupp took over the business in 1826, which back then had only seven employees. At the time of Alfred Krupp's death in 1887, the number of employees in the factory had increased to 20,000. Up until 1973, the steel industry was a very strong economic sector throughout the world, yet it marked a fateful year for the German steel industry. The world economic crisis strongly altered growth prospects in the steel industry, from which it still has not recovered even today.[1]

2.1. Problem Statement

The steel industry is regarded as traditional and conservative from a historical perspective, and as such the industry moves very slowly in terms of embracing changes. This perception is also reflected in a study in which one of the questions pertained to sufficient strategic orientation in the ASEAN regions (Brunei, Cambodia, Indonesia, Laos PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and

[1] Cf. http://www.planet-wissen.de/alltag_gesundheit/werkstoffe/stahl/ [surveyed on 29.03.2015]

Vietnam).[2] Individuals who were surveyed comprised the metal-producing and metal-processing industry, the engineering sector, the automotive as well as the electrical industry in Germany. 57% of those surveyed asserted there was no orientation in the ASEAN regions. Only 27% positively answered this question.[3]The attributes cited run contrary to trends in today's market, and the steel-producing industry is at a crossroads as a result. It is also characterised by massive capacity surpluses in Europe and Asia. To confound matters, there are additional obstacles in the form of state subsidies, which compensate for the surpluses. Additionally, the steel industry faces more challenges due to high energy costs in Europe as well as the CO_2 certificate issue. This paper seeks out new ideas that can make distinctive improvements to the profit situation for the European steel industry.

2.2. Objectives and Expectations

The objective of this paper is to illustrate possible means with which to resolve the steel industry's dilemma. Its scientific foundation is created on the basis of supply chain management. Supply chains from various industries will be subsequently analysed and special characteristics of the supply chain in the steel industry shall also be compiled. Supply chain scrap metal, alloys, electrodes and refractory material will be explicitly examined from the source up to the OEM (Original Equipment Manufacturer) stage, insofar as possible. The

[2]Cf. ASEAN, Association of Southeast Asian Nations, http://www.asean.org/asean/asean-member-states [surveyed on 07.04.2015]
[3]Cf. Langenscheidt und Venohr, 2014, p. 42

focus of this paper lies in the increase of competitiveness and profitability by means of supply chain management. Since this is a matter of urgency, Erwin Bronk (partner with PWC (PricewaterhouseCoopers)) also clearly expressed his concerns during his lecture at the "Stahlmarkt 2013" presentation. He acts on the assumption of imminent cutthroat competition on a global level if the steel industry does not downsize within the next few years. This paper shall point out that there is still earning potential that can be developed. However, this only stands to succeed if findings from this paper are combined with practical implementation by means of the change management process.

2.3. Research Questions

In this paper, answers to questions shall be established that facilitate improvement potential for the steel industry. The questions are as follows:

- What supply chains exist in the present-day steel industry?
- What supply chains are decisive competitive factors?
- To what extent are existing supply chain concepts used in the steel industry?
- Is it possible to generate a competitive advantage in the steel industry by implementing supply chain management?
- What can supply chain management offer in terms of competitive advantage for the steel industry?

- What is the current status of supply chain finance in the steel industry and how can it serve to close any contingent gap?
- What indicator systems exist in the steel industry?

2.4. Structure of the Paper

This paper is divided into 11 chapters. The first chapter includes the management summary. The second chapter outlines the problem statement, objectives and expectations, hypotheses, structure of the paper as well as the methodical procedure. In the third chapter the definition of supply chain is elaborated upon and reference is made to branch-specific characteristics and distinctive features within the steel industry. The fourth chapter concerns supply chain management and discusses developments and trends. Comprehension of the supply chain management concept will be explored in depth based on the motives for implementation, objectives and benefits, frame of reference, potentials, followed by a critical appraisal of supply chain management. In this chapter, great emphasis on the supply chain finance will be conceded and the topic of working capital management will be highlighted. Furthermore, supply chain performance management will be outlined, including its definition, target values, instruments and balanced scorecard. An additional range of subjects addressed in chapter 3 includes profitability, competitive advantage as well as change management. In the fifth chapter, the current steel industry situation will be described and encompass the competitive position, the global market positioning as well as the advantages and disadvantages of the

European steel industry in the context of global competition. Chapter 6 explains the methodology for the written expert survey and reports its results. Chapter 7 focuses on decisions regarding supply chain concept allocation, that is, which supply chain type best suits the respective supply chain. Improvements with respect to raising profitability and competitive advantage, acceleration of processes as well as risk minimisation serve as a foundation for the decisions made. Chapter 8 contemplates the forecast of the steel industry in Europe. With the aid of various literary sources, a potential scenario for the future will be projected and adapted to the steel industry, which will provide the basis for developing a prospective and potential supply chain concept. In chapters 9, 10, and 11 conclusions will be drawn, an ensuing discussion regarding the results will be generated, and a summary will be compiled correspondingly.

2.5. Methodical Approach

The methodology for the written survey supports transparency with regard to various perspectives. It subsequently is conducive to its implementation by which the theoretical approach is applied in order to extrapolate suitable trade recommendations. The survey is conducted in written form to counteract any risk of compromised results, since the author of this paper is employed in a steel-producing industry. The survey is divided into two categories. The first category involves companies that can be directly polled on the basis of relationships. This procedure ensures the suitability of the chosen questionnaire and allows for further enquires that could

raise the quality of the responses. In the second category, approximately 10-20 steel factories around the world are questioned via a survey tool, which ensures the anonymity of the question and answer protocol. The objective is to achieve a high response rate. Target subjects for the survey comprise managers from the purchasing, acquisition, logistics and supply chain management sectors. Survey questions are intended to provide conclusions regarding the current implementation status of supply chain concepts within the steel industry as well as cover concepts as defined in the work involving other sectors. The following sectors are included:

- Supply chain management
- Supply chain finance (working capital)
- Supply chain performance (operating numbers, balanced scorecard)
- Innovations
- Change management process

3. Supply Chain

Supply chain can be defined as a chain of supply. The term is relevant to all companies that develop, create or deliver a commodity – or are respectively involved in any of the processes. In this way, the meaning of supply chain encompasses all phases of the process from the raw material suppliers up to their receipt by the end user. This chain follows the flow of material, information and financial resources by means of the chain of supply to the companies involved in the service process. This chain of supply, or rather, network and its accompanying relationships are not rigid in any respect. Relationships and network partners alike are subject to the market development as well as the focal company strategy (a focal company is the stakeholder within a network who is looked after by the network management).[4] In this instance, the tempo at which an adjustment must be made is determined by the previously mentioned points.[5] The following illustration depicts the performance objects within the supply chain.

[4] Cf. Essig et. al., 2013, p. 10
[5] Cf. Beckmann, 2004, p. 1-2

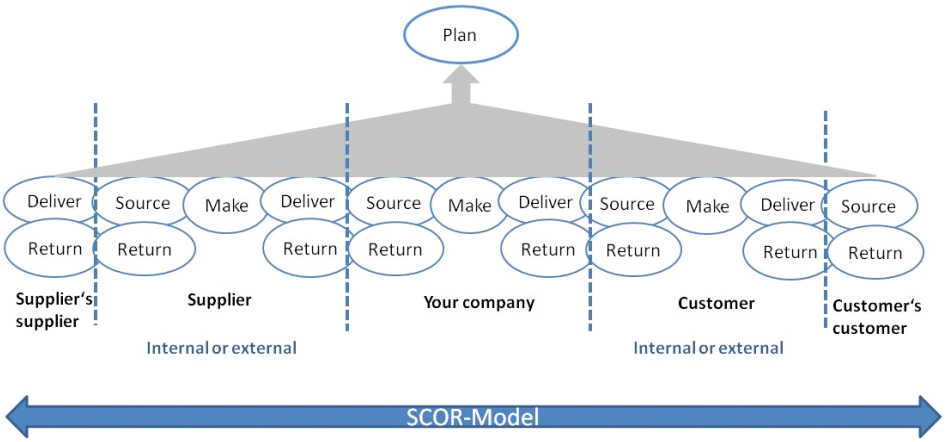

Figure1: Flow of material,finances andinformation within thesupplychainvia theSCOR Model[6]

The illustration shows the top level process of the SCOR Model, wherein there are five different processes. All planning processes are assigned within the process plan. The process source includes all acquisition activities that are necessary in order to generate a service. The subsequent process is known as „Make", in other words, the manufacturing stage of the product. This concerns the production processes as well as related activities i.e. capacity control. The delivery process includes distribution processes, which is found at the customer interface. The last link in the chain is the Return process and it is associated with any refund of goods, but also includes direct customer returns, repairs as well as all disposals.[7]

[6] Source: Bolstorff und Rosenbaum, 2012, p. 11
[7] Cf.Essig et. al., 2013, p. 288

3.1. Supply Chain Definition

Literature provides numerous explanations regarding the definition of supply chain. Yet in this case the multifaceted nature of its meaning is not as pronounced as in other definitions, but emerges only from the depth of its perspective. For instance, the supply chain is regarded as the central object of analysis for competition analysis.[8] This definition is very superficial. Beckmann supplies a vastly more precise meaning. He describes supply chain as the flow of service objects that extends from raw material suppliers to the end users and moves via a network of value-added partners. Distinct characteristics of the supply chain concept constitute:

- documentation of all processes along the supply chain
- encompasses all parties involved and logistic processes
- objectives are development, acquisition, production and distribution processes
- oversteps organisational boundaries
- coordination by means of a consistent information system
- fundamental objective is to create customer value while considering costs and profit.[9]

Another definition interprets supply chain as a network made up of flows of money, information and products, which identifies a market that generates utilisable products.[10] One developmental step in the vision of supply chain management is supply network management. This vision includes the seamless intertwining of complex supply processes. All persons involved with the respective aspects of the

[8] Cf. Bauer, 2011, p. 9
[9] Cf. Beckmann, 2004, p. 2-3
[10] Cf. Gleich und Daxböck, 2014, p. 23

process must be optimally informed and each individual must be able to draw a greater benefit than would have been feasible from the previous strategy. Networks of this nature are known as virtual companies.[11]

3.2. Branch-specific Characteristics of Supply Chains

Before the branch-specific characteristics of supply chains can be delineated in detail, reference will be made concerning the influence of the industry structure in which the supply chains are designed. This influence shall provide the initial insight into branch-specific characteristics. Kodama developed a very useful model that distinguishes between three different industry types. The termination rate of development projects serves as a basis for the differentiation, which can occur within the three industry types at various times. As a result, valuable information regarding the influence of product structure can be elicited. The industry types consist of the following:

- dominant design industry
- high tech industry
- science-based industry.[12]

The dominant design industry is characterised by mature markets and pre-existing key technology. Its success is due to low product costs. The following industry sectors can be appropriated to the dominant design category: the foodstuff industry, raw materials

[11] Cf. Voegele und Zeuch, 2002, foreword
[12]Cf. Corsten und Gabriel, 2004, p. 237-238

industry, steel industry and automotive industry as well as mechanical engineering.[13]

Rapidly growing markets and a high and strong momentum in technological developments are characteristic of the high-tech industry. In this case, the time to market is the greatest factor of success, in other words, the first with a new product on the market. [14] The electrical industry and electronic industry, the computer and software industry as well as the telecommunications industry comprise industry sectors that have been designated as a high tech industry.

The science-based industry has a very strong association with science. The most significant success factor is the meticulous planning of the product pipeline. The close connection to science involves high investments, which very sharply increase the risk for these projects. Industry sectors falling under this category include the chemical and pharmaceutical industries.[15]

A subsequent and much more detailed development began in 1996 with the founding of the independent and non-profit organisation, the Supply Chain Council (SCC). The goal of this organisation is to develop an ideal model of the supply chain. In the course of time, its members designed the Supply Chain Operations Reference Model (SCOR). This model facilitates the description, evaluation and analysis of supply chains for companies and industry cross-sectors

[13]Cf. Kodama, 1991, p. 129
[14]Cf. Kodama, 1991, p. 129
[15]Cf. Corsten und Gabriel, 2004, p. 240-241

alike. Version 11 of the SCOR Model is currently in use.[16] This yielded the four fundamental types of supply chain design, in which the most significant impacts are taken into account with respect to the customer, market, product and technology.[17]

Branch	Supply Chain Design
Automotive industry	Lean supply chain design
Chemical and Pharmaceutical industry	Associated supply chain design
Electronics industry	Agile supply chain design
Consumer goods industry	Fast supply chain design

Table1:The four basic types ofsupplychain design[18]

The four basic types of supply chain design shown in the table represent an abundance of features. These types are divided into requirements determined by the market: product and technology, resultant consequences for procurement, production, distribution and planning.[19]

[16]Cf. Werner, 2013, p. 64-65
[17]Cf. Corsten und Gabriel, 2004, p. 246
[18] Source: Corsten und Gabriel, 2004, p. 245
[19]Cf. Corsten und Gabriel, 2004, p. 247-248

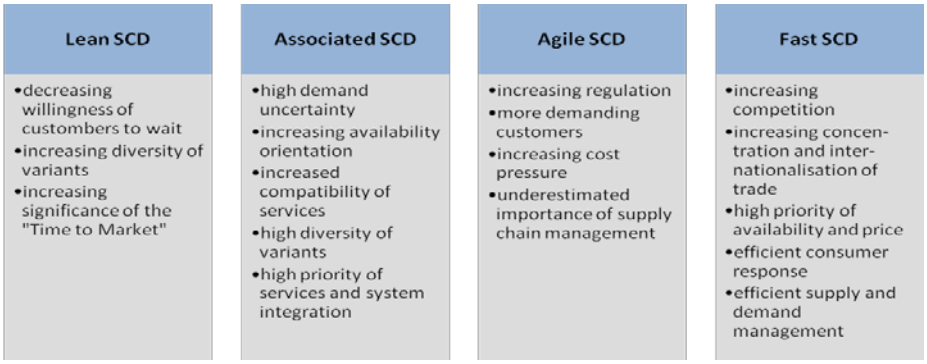

Figure 2: Brief description of the four supply chain designs inrelation to marketandcustomer requirements[20]

The figure depicts various demands on companies within the different branches relevant to the market and customer base. To be sure, designating categories is not always so straightforward in practise. It is more important for each individual company to specifically tailor the respective supply chain to their customer and market. However, such a defined supply chain design is not set in stone. It must be assessed at regular intervals and adjusted where necessary.

In a PWC study from 2013, the most important competitive factors as predefined by the survey clients from the various branches were requested. The variety of industries is certainly greater than those defined by the Supply Chain Council, yet can also be allocated accordingly.

[20] Source: Corsten und Gabriel, 2004, p. 247

Industry / Comp-etitive factors	Auto-motive	Chemicals & Process Industry	Industrial Products	Pharma-ceuticals & Life Sciences	Retail & Consumer Goods	Technology & Telecom
Minimised Costs	**90%**	**87%**	93%	94%	90%	83%
Max. Delivery Performance	87%	**87%**	**98%**	**100%**	**95%**	**94%**
Max. Volume Flexibility and Responsiveness	83%	77%	74%	78%	79%	90%
Complexity Management	67%	72%	61%	72%	70%	71%
Minimised Risks	67%	58%	60%	78%	60%	58%
Sustainability	53%	52%	38%	67%	45%	50%
Tax optimisation Efficiency	48%	42%	38%	53%	46%	50%

Table2:Importance of competitive factors in variousindustries[21]

The figure above shows defined competitive factors according to sector. The importance of these factors is measured in percentages. The data originates from a questionnaire issued by PricewaterhouseCoopers, in which 500 companies from Europe, America and Asia were surveyed in 2013.

[21]Source: PWC-Studie, Global Supply Chain Survey, Next generation supply chains, 2013, p. 20-31

Within the industrial products and pharmaceuticals and life sciences sectors, maximum delivery performance is given absolute top priority, whereas in other sectors it is less pronounced by up to 13%. These competitive factors consistently commanded first or second place with the exception of the technology and telecom sectors. Overall, this factor took first place. Minimised costs followed in second place. This category was rated as the most important for the automotive and chemicals and process industry sectors. It is remarkable that the pharmaceuticals and life sciences sector indicated the highest percentages for virtually all competitive factors. That is to say, the importance and associated intensity of the processing are somewhat higher than in comparable sectors.

3.3. Distinctive Features of Supply Chains in the Steel Industry

Steel manufacturers serve a varied and extensive customer base, ranging from rebar manufacturers which supply their products to the construction sector, to low-alloy sectors which supply materials to manufacturers of chains, cold headings, or to peeling operations as well as the automotive industry. The customer base also includes manufacturers of high-alloy and super-alloy steels, which produce tool steels, rustproof, acid-resistant and heat-resistant steels as well as high-grade and roller bearing steels. However, many steel manufacturers have one sector in common, the automotive industry. Yet in most cases it is not directly supplied by the manufacturers. Steel manufacturers are situated between supply chain levels tier 3

and tier 6, depending on how they have organised their own structures. It is then not surprising that in 1991 Kodama was already associated with the automotive industry and steel manufacturer in the same dominant design industry group. The dominant design industry prescribes a particular environment in which companies operate. Pre-existing key technologies and mature markets are examples within this scenario.[22] Consequently, cost reductions remain one of the most essential competitive factors in the steel industry. A powerful tool to this end is known as "fill the mill", which means that steel manufacturers try to make maximum use of their facilities in order to reduce costs.[23] Another important aspect is delivery performance. Since customer buying behaviour has drastically changed in the last few years and the market has become increasingly dynamic and complex, delivery performance must be even more proficient in confronting such changes.[24] Furthermore, it is essential to be responsive to product quality demands. Tolerances are more narrowly interpreted on a continuous and sustainable basis by steel manufacturing customers.[25] In conclusion, it can be maintained value drivers in the steel industry for many steel manufacturers are congruent with the automotive industry. This is attributed to the fact that they are at different levels in the same supply chain.

[22]Cf. Corsten und Gabriel, 2004, p. 237-238
[23]Cf. Studie Roland Berger, Challenging Conventional Wisdom in Steel, 2014, p. 2
[24] Cf. Warrian, 2012, p. 81
[25] Cf. Zipp, 2012, short summary

4. Supply Chain Management

During the course of this paper, several concepts and definitions are repeatedly presented. Nevertheless, repetition in this context is necessary in order ensure consistent and intelligible structure of the respective sections.

Since 1960, the image for the logistics sector has drastically changed. Whereas the emphasis was initially placed on storage and transport optimisation, this emphasis shifted in the direction of business logistics in the 70s and 80s. Thanks to new developments in the IT sector and its associated new opportunities, the sector was ready to consider the supply chain as a whole.[26] The origins of supply chain management stem from the USA. In the 80s, the consulting sector adopted the outsourcing trend in order to reduce vertical integration.[27] This new trend solidified at the end of the 80s in the USA with the creation of theoretical principles. By contrast, supply chain management in Germany was only established in the mid-90s.[28] It was driven by globalisation, which demands greater differentiation between increasingly reduced delivery times, stricter adherence to deadlines and flawless deliveries.[29] The widely used expression "Supply chains are in a mutual competition struggle" is especially apt within this context, since individual companies are no

[26]Cf. Corsten und Gabriel, 2004, p. 6
[27]Cf. Gleich und Daxböck, 2014, p. 23
[28] Cf. Werner, 2013, p. 3
[29] Cf. Pointek, 2013, p. 5

longer in a position to supply the services that customers and the market demand on their own accord. Such demands are only achievable through a consolidation of companies and services.

4.1. Definition of Supply Chain Management

In theory, there are various definitions for the term „supply chain management". The definition of supply chain management is essentially "management of chain of supply". In the sense of this version of a supply chain, flows of goods, financial resources and information are managed. The following are definitions based on this theory:

According to Beckmann, supply chain management relates to planning, control and monitoring flows of finances, information and materials along the supply chain.[30]

Packowski describes supply chain management in the process industry as the amalgamation of all activities pertaining to design, planning, implementation, and monitoring for materials procurement, production, and distribution along the end-to-end value chain, including the managed flow of information.[31]

Possibly the most comprehensive and most succinct definition from today's perspective is derived from Essig, Hofmann and Stölzle. They define supply chain management as a cooperative coordination of flow of finance, information and materials in company networks by generating integrative, cross-functional

[30] Cf. Beckmann, 2004, p. 1
[31] Cf. Packowski, 2014, p. 5

management and implementation processes with the objective of achieving a competitive edge with end clients and thereby raising absolute profitability for the entire network.[32]

4.2. Differentiation of Supply Chain Management Terms

The variety and associated complexity regarding the conceptual distinction between different approaches to supply chain management has grown significantly in recent years. For example, terms that have emerged within this framework include value added chain, logistic chain, supply network, supply pipeline, value chain, value stream and demand chain.[33] Some of these terms have no real added value and simply undermine a more precise implementation. However, the perspective changes when dealing with relevant supply chain management concepts. These concepts will be subsequently outlined.

Purchasing is traditionally divided into an operational area and strategic area. Both areas are closely linked and are mutually supportive. While operational purchasing is primarily concerned with raising purchasing efficiency (doing things right), strategic purchasing focuses on raising purchasing effectiveness (doing the right things). Purchasing is often equated with the term "Supply

[32]Cf. Essig et al., 2013, p. 41
[33]Cf. Bauer, 2011, p. 9

Management". [34] Nonetheless, purchasing activities are always restricted to the focal company.

The term materials management is more broadly defined than that of purchasing as a rule and includes the handling of goods in an economic sense. Materials management covers a wide scope of operation, including inventory management, in-house transports and material tracking, as well as supplying manufacturers. Compared to supply chain management, it comprises only a portion of the internal chain and has no activity outside the organisation.

The primary purpose of logistics is to guarantee product availability, that is, the physical flow of material within the company as well as between organisations and their environment. In this regard, it clearly differentiates itself from supply chain management and uses logistics for the purpose of physical transport processing.

The value added chain comprises value added and value destroying influence factors, which are reflected in the company's performance. These influence factors can also pertain to the company's image or design, which are not in agreement with supply chain management. In contrast to the value added chain, supply chain management encompasses product availability and the removal or utilisation of products. These activities are jointly conducted with the flow of money and information.

[34]Cf. Werner, 2013, p. 16

A logistic chain targets the internal and external horizontal connection of company operations. This is a chain in the literal sense as opposed to a network relevant to supply chain management.

Demand chain management focuses almost exclusively on customers. Supplier attributes are therefore only peripherally affected. Consequently, demand chain management can be viewed as a component of supply chain management.

In terms of collaborative customer relationship management, consolidating stakeholders' knowledge as well as adjusting marketing activities occupies the foreground. In contrast to supply chain management, upstream supplier activities are not taken into consideration.

The counterpart to customer relationship management is represented by supplier relationship management. [35] It monitors improvement of incoming supply flows and their interrelationship and can also be considered a segment of supply chain management.[36]

Supply chain relationship management is primarily concerned with establishing trust, promoting communication, increasing transparency as well as enhancing coordination. It concerns a special type of relationship management within supply chain management.[37]

[35] Cf. Werner, 2013, p. 15-21
[36]Cf. Essig et al., 2013, p. 110-111
[37]Cf. Werner, 2013, p. 22

Out of all of the various concepts mentioned, some exhibit common traits with supply chain management, although none are as comprehensive. Some concepts are an integral component, while others are ascribed to supply chain management, for example, in order to complement them from a social perspective.

4.3. Development and Trends in Supply Chain Management

The sphere of supply chain management is subject to ongoing adjustment. The catalyst is an increasingly rapid market shift, trigged by the continuous growth in globalisation. This raises ongoing demands on the supply chain and precipitates increasing complexity. Suffice it to say, it is obvious that this development engenders opportunities as well as dangers. This development also means that in the future only agile, flexible and forward-looking companies will become successful and be able to compete in the market for the long term.

Trends specified in the science of supply chain management have no claim to comprehensiveness, yet ought to indicate that the development in supply chain management is progressing rapidly and purposefully. It is therefore the endeavour of supply chain management to keep pace with the growing complexity and speed. There will be a closer examination of new trends that were developed for the various demands on a supply chain.

4.3.1. Sustainable Supply Chain Management (SSCM)

The following explanation can be applied in order to aptly define sustainable supply chain management: it is the integration of environmental and social aspects in traditional supply chain management.[38] The reasons to dispute sustainable supply chain management are manifold. The ever-increasing demand for flexibility in the supply chain prompts new forms of modern management, examples of which include Just in Time, Lean Production or ECR (Efficient Consumer Response). These innovative management styles helped companies raise their competitive edge in the global market. On the other hand, focus was increasingly placed on the company's production. Issues that took centre stage included: where can we produce most economically, how do we engineer our production to generate the best possible customer value. Although logistic costs played a certain role, it was not a decisive factor in light of present day freight prices. Conversely, growth in freight volumes has increased continuously. As a result, CO_2 emissions increased correspondingly. At this juncture, it was necessary to provide solutions in order not to jeopardise flexibility in the supply chain and sufficiently take sustainability into account. This is how sustainable supply chain management came into existence.[39] Integration of sustainability in a supply chain could be strategically designed in Figure 3 as follows.

[38]Cf. Harms und Klewitz in Bogaschewsky et al., 2013, p. 105
[39]Cf. Cetinkaya et al., 2011, p. 4-5

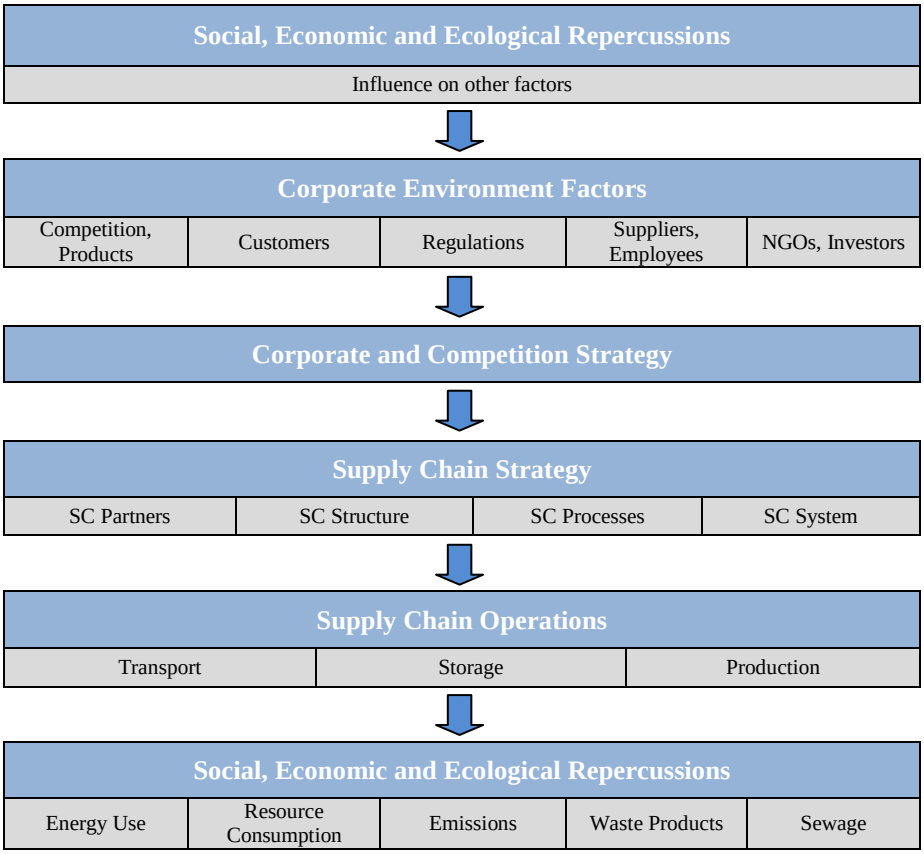

Figure3:Supplychainstrategyasabridgebetweencompetitive advantageandsustainability[40]

The process depicted begins and ends with social, economic and ecological repercussions. Ultimately, tangible measures that can be gauged and monitored remain at the forefront, which can subsequently be found in the feedback from Step 1.

[40] Source: Cetinkaya et al., 2011, p. 21

4.3.2. Supply Chain Event Management

Supply chain event management chiefly focuses on the ability of companies' vis-à-vis improving reaction time for short-term and unexpected developments (Advanced Planning and Scheduling Systems). This development also provides opportunities for logistics service providers who aim to expand their range of services. Some authors even entertain visions in which fourth party logistics providers (4PL) can be positioned in the range of the planning stage toward a channel master for the supply chain.[41] The basis for event recognition is the analysis and evaluation of status data. There are three types of status data to bring to the fore. Documented statuses include data from cargo manifests, delivery receipts, transportation damage reports, etc. The second group is formed by the observed statuses in the process operation, involving predominantly track and trace data. The last group assigns a name to the anticipated status in the process operation. In this instance, it does not concern the evaluation of received statuses, but rather the evaluation of statuses *not* received. For example, the data could indicate a potential late delivery. In this respect, it pertains to events that could prompt rash actions, to which one must react in order to proactively avert disaster. As a veritable decision support tool, an event management system can be understood when in the best-case scenario it reacts automatically to the occurrence of certain situations with proposals for action.[42]

[41] Cf. Beckmann, 2004, p. 146-147
[42] Cf. Beckmann, 2004, p. 150-152

4.3.3. Lean Supply Chain Planning

The springboard for developing lean supply chain planning involves current world market conditions and their characteristics. Packowski briefly describes this type of supply chain as VUCA World. VUCA stands for Volatility, Uncertainty, Complexity and Ambiguity.[43]

In present day planning concepts, volatility is intercepted solely by the security storage, which for the supply chain planner is regarded as inviolable. This procedure is strongly supported by ERP systems, although it leads to a deadlock, as far as the VUCA World is concerned. Last but not least, the procedure also has a negative repercussion on operational performance. In the lean supply planning approach, variability is controlled from two sides: production capacity on one side and inventory on the other. At this stage, the safety stock is actively incorporated into the planning process. Lean chain management includes the new planning paradigm for the end-to-end supply chain management in which the controls for variability, pre-parameterisation as well as synchronisation are grounded. Another component of LSCM is the transformation program, which comprises the organisational direction, performance measurement as well as add-on IT applications. Lean supply chain management improves customer service and raises supply chain agility by reducing the cycle time. Furthermore, LSCM collectively improves equipment performance with customised and clocked material flows, as synchronised by

[43]Cf. Packowski, 2014, p. xvii

customer demand. As a consequence, there is a noticeable reduction in working capital.[44]

4.3.4. Demand Sensing

Demand planning errors are staggeringly high for companies that manufacture consumer products. In fact, they amount to nearly 50%. This predicament is due to the manner of current planning methodology. Historical data is still used as the basis in attempting to plan for the future. In the bygone era when it concerned a demand variance of plus/minus 5%, this approach was certainly justified. However, in terms of the prevailing market conditions, this method is no longer equal to the task. New ideas are in demand, which could duly take this situation into account. This is the point at which demand sensing comes to fruition. In order to master this challenge and significantly reduce demand planning errors in the short term, access to current customer demand signals, orders, deliveries and other daily information within the supply chain is essential.

Typically, 80% of costs are associated with activities that take place within the next six months. This is where demand sensing comes into play. With a refined mathematical calculation over the six-week timeframe, the results are far more accurate. As a result, costs arising from demand planning errors can be greatly reduced.[45]

[44] Cf. Packowski, 2014, S. xxii-xxiii
[45] Cf. http://www.terratechnology.com/what-is-demand-sensing/ [surveyed on 29.03.2015]

4.4. Understanding the Supply Chain Management Concept

Supply chain management is, as previously outlined in Section 3, a relatively new approach. The term was first introduced in 1982 and is regarded as a segment of business administration even today. However, this designation is not without debate, since there is still no existing uniform nomenclature. There were certainly initial systematic attempts to develop supply chain management concepts which emerged in the 1990s. On the basis of existing supply chain management definitions at that time (a total of 50), Bechtel/Jayaram allocated these definitions into a so-called school of thought in 1997 and thus launched five supply chain schools of thought.[46] One such school is the Chain Awareness School and encompasses all supply chain management definitions, which designates supply chain as a chain that focuses on a continuous material flow of raw material up to the end customer. Another school of thought, the Integration School, is devoted to the redesign of companies to become virtual network structures, as well as the Future School of Supply Chain Demand, which signals a false concept comprehension.[47]

This enumeration partially reflects the definitions from the Supply Chain Schools of Thought. Be that as it may, the heterogeneous nature of the various explanations is evident. Therefore it is necessary to indicate the points that characterise the concept of the

[46]Cf. Tandler, 2013, p. 111
[47]Cf. Essig et al., 2013. p. 27-28

supply chain. Beckmann designates the following characteristics to this end:

- all processes along the entire supply chain are documented
- as an integrated system, it encompasses all parties concerned and logistic processes up to the end customer
- objectives of the supply chain include development, acquisition, production and distribution processes
- oversteps organisational boundaries
- coordination arises out of a continuous information system, accessible for all parties concerned
- the core objective is to establish customer value, arising from a positive relationship between costs and profit
- individual goals are achieved by means of the performance by the entire chain.[48]

The characteristics introduced concerning the concept of the supply chain do not correspond to any uniform structure. There are also designations from different levels of a corporate strategy, that is, different depths. Furthermore, some important points were obscured or only marginally considered. A greatly structured and comprehensive approach was developed by Essig, Hofmann and Stölzle. They created a catalogue of characteristics with seven characteristics that were derived from 41 various literary sources for the purposes of improved concept comprehension. This included flow, process, network, cooperation, objective, function and management orientation. These seven characteristics also form the

[48] Cf. Beckmann, 2004, p. 3

foundation for the preferred definitions of supply chain management in Section 4.1.[49]

4.4.1. Motives for implementing Supply Chain Management

Motives for implementing supply chain managements are attributed to many factors. One of the greatest triggers as of late is the rapid growth of globalisation and associated accompanying growth of "dynaxity", whereby dynaxity stands for dynamic and complexity. This impacts the need for increasingly shorter delivery times, tighter lead times as well as shorter model cycles. Moreover, products are becoming more complex, and product variety continues to grow.[50] Several business practises can be pointed out in detail that promote the development of supply chain management, such as companies that increasingly utilise the total cost of ownership approach to reduce costs (i.e. transaction costs) and to curtail maverick buying. Companies that are aggressively confronted with the impact of the bullwhip effect could avail from supply chain management. The competition environment within companies is vulnerable to increasingly rapid changes. Not to mention, customer demands are on the rise. Modern supply chain management is ideally equipped to handle this situation.[51]

[49] Cf. Essig et al., 2013, p. 30-40
[50] Cf. Beckmann, 2004, p. 5
[51] Cf. Werner, 2013, p. 36-50

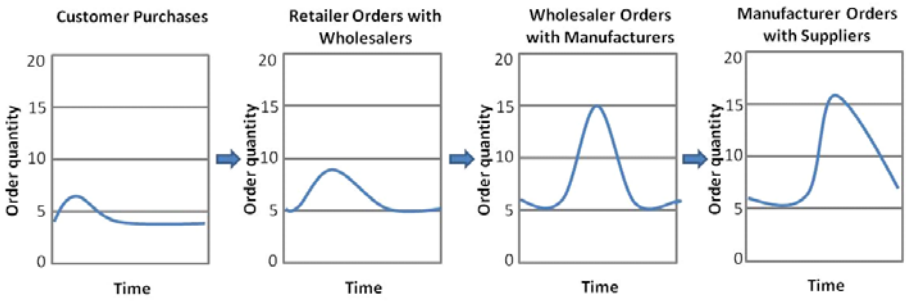

Figure4: Illustration of thebullwhip effect[52]

The figure impressively outlines the bullwhip effect. Slight consumer demand fluctuations could lead to increasingly greater fluctuations in demand at the various supply chain levels.

4.4.2. Objectives and Benefits

The primary objective is optimal supply chain alignment with customer demands. Customers ideally want the lowest possible costs, minimised risk and to simultaneously be able to focus on the core business.[53] Additional objectives include the ability to quickly adapt to market shifts, the guarantee of the security of supply and ultimately the avoidance of out of situations, the reduction of inventories and working capital, more efficient production control and capacity planning as well as shortened order lead times compared to competitors. [54] The benefits of supply chain management can be roughly divided into three categories: the

[52]Source: Essig et al., 2013, p. 7
[53] Cf. Blindzellner, 2011, p. 5
[54] Cf. Pointek, 2013, p. 7

market impact, internal impact as well as the supplier impact. Market impacts comprise the realisation of sustainable competitive advantages, heightened customer satisfaction, improved quality as well as accelerated innovation processes. Internal impacts provide transparency, increased warehouse operating efficiency and a reduced bullwhip effect, the opportunity for a made-to-order assembly and reduction in capital commitment. Lastly, supplier impacts facilitate the acquisition of new markets as well as save resources by means of streamlined procurement processes.[55]

4.4.3. SCM Frame of Reference

Essig, Hoffmann and Stölzle denote the frame of reference as a structured preconception of the supply chain management purview. It operates as a type of comprehensive overview that incorporates all functions and areas of operation. The seven criteria for the frame of reference are already explained in Section 4.4 and are arranged by frame of reference. These frames of reference are essentially arranged into five levels, the basis for which also comprises various approaches by different authors and have been developed sequentially for this model.[56]

[55]Cf. Beckmann, 2004, p. 12-15
[56]Cf. Essig et al., 2013, p. 41-45

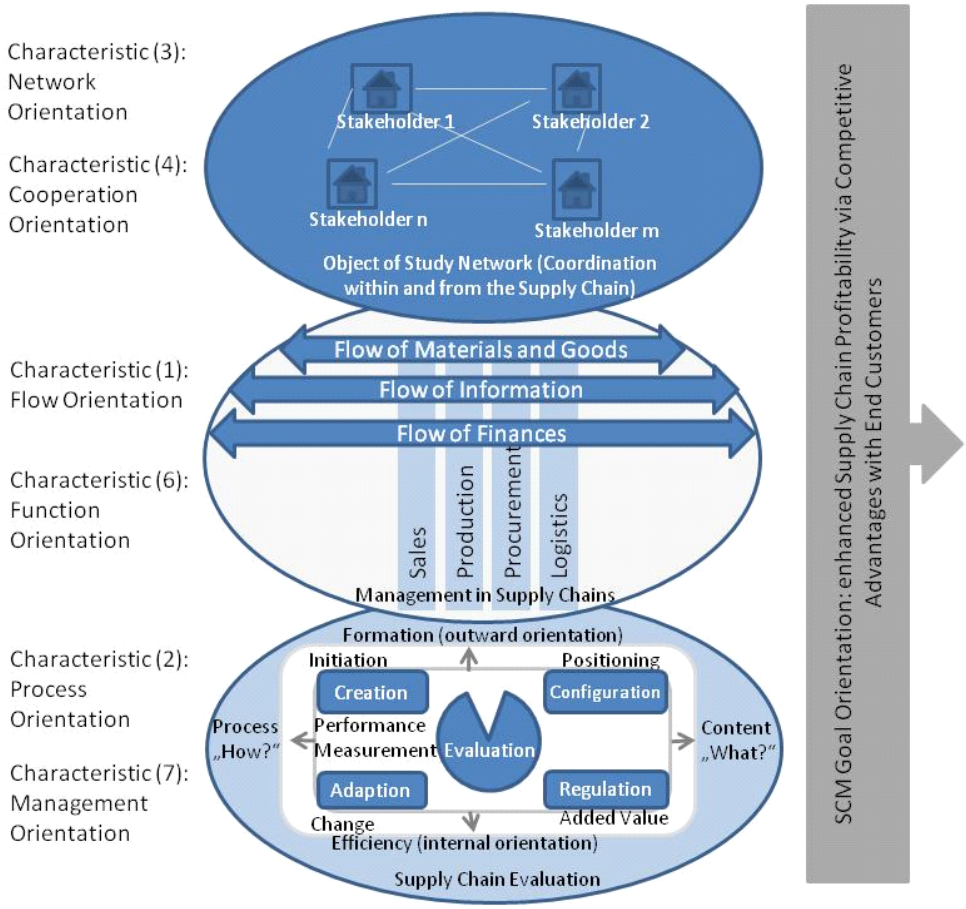

Figure 5: Supply chain management frame of reference[57]

The figure illustrates the fifth and final level of a development, which Essig, Hofmann and Stölzle compiled in their book, "Supply Chain Management". The development of the frame of reference grows more tangible with each level. This model is quite comprehensively designed and highlights the supply chain evaluation, starting from

[57]Source: Essig et al., 2013, p. 45

the bottom level. Level management for the supply change is featured at the centre. The internal configuration as well as the three corporate flows on this level consists of flow of materials and goods, flows of information and finances. The third and highest level is concerned with coordination in and from supply chains. At each stage, the corresponding criteria were also displayed. For example, the characteristic Process and Management Orientation is cited on the lowest level.

4.4.4. Potentials

Outcomes from the successful practical examples indicate an overall significant potential for supply chain management.

Author / Area of Improvement	Locker and Grosse-Ruyken[58]	Beckmann[59]
Inventory Reduction	50%	up to 60%
Increase in Delivery Reliability	40%	25 - 50%
Reduction in Overall Lead Time	27%	50%
Improvement in Inventory Turnover	Factor 2	
Out of Stock Reduction	9%	
Sales Increase	17%	up to 55%
Improvement in Prognosis Accuracy		25 - 80%

[58] Cf. Locker und Grosse-Ruyken, 2013, p. 1
[59] Cf. Beckmann, 2004, p. 15 and 17

Cost Reduction Potential Related to individual Supply Chain		3 - 25%
Profit Increase		up to 30%

Table 3: Comparison of supply chain management potentials[60]

According to the values shown in Table 3, potentials in supply chain managements vary greatly. If the area of improvement falls under the category Out of Stock Reduction, the value only indicates 9%. Conversely, if it appears in the Inventory Reduction category, the value is significantly higher at up to 60%. Depending on the type of Supply Chain used, even the potentials yield varying results.

4.4.5. Risks

In January 2012, the United States published its national strategy for global supply chain security. An important facet of this strategy constituted supply chain risk management. The report addresses the USA's competitive advantage, which is closely linked with managing risks associated with the physical structure of a supply chain.[61]

The topic of risks in supply chains is very important and is also taken into account by the different states. Grosse-Ruyken et. al. investigated 345 companies in 2012 for supply chain vulnerability. This investigation prompted the following ranking, which demonstrates the greatest triggers for vulnerability. Global sourcing

[60] Source: Own illustration
[61] Cf. National Strategy for global supply chain security, p. 1

(significance of 77%) took first place, followed by dependence on suppliers (72%), supplier concentration (68%), single sourcing (65%) and customer dependence (61%). [62] As a result, supply chain management can appreciate its great importance since considerable expectations concerning potential and competitive advantage are linked to it. The concept of supply chain management is certainly identified by a contingent dimension of a network and high level of complexity. These parameters pose the commensurate risk potential, which must be kept under control.[63] It is essential to distinguish whether the risk could emerge by implementing a supply chain management or within the scope of operation. Normative, strategic and operational aspects are differentiated for supply chain management implementation. Risk factors involved include a diverse corporate culture, diverging comprehension, lack of a common vision or lack of trust. Furthermore, a dissimilar purpose as well as emerging complications associated with the interface can also pose risks. In summary, it can be asserted that the key to implementing supply chain management can be manifested through the willingness and ability to cooperate.[64]

4.5. Critical Appraisal of Supply Chain Management

Supply chain management is one of the integral strategies that offer companies opportunities to increase yields and improve their competitive advantage. The competitive struggle is no longer

[62] Cf. Locker und Grosse-Ruyken, 2013, p. 182
[63] Cf. Beckmann, 2004, p. 17
[64] Cf. Beckmann, 2004, p. 17-18

restricted to rivalry among companies, but is also relevant to the entire existing supply network. Indeed there are also several points of criticism concerning supply chain management that provoke discussion. The complex nature of controlling supply chains is immense. Yet most companies operate in more than one supply chain. In most instances, it does not benefit the company to integrate all business partners within the supply chain since some partners are only sporadically present.[65] In many situations, it is not possible to incorporate network-wide planning and control through the focal company since this would otherwise threaten the breakdown of the market and competition. Nor is it feasible to even demand such a request if the proper authority is not in place. Moreover, there exists the need for basic precepts to which all parties concerned must adhere. Establishing precepts precludes opportunistic behaviour, thus manifesting absolute mutual trust. Information and communication technology also have great significance, which may be regarded as key factors. However, these technologies also strongly limit potential partners within a supply network, since they may not be in a position to establish an efficient IT infrastructure. Security risks, a common issue in the IT sector as a rule, must also be considered within this context. Types of associated risks include inadequate encryption technology or inadequate password management.[66] There are numerous obvious matters to resolve before opting to implement supply chain management.

[65] Cf. Stölzle Universität St. Gallen Präsentation, 2007, p. 16
[66]Cf. Brown, 2009, p. 41-43

4.6. Basic Types of Supply Chains

Supply chain design is a term often used in literature that predates types of supply chains. In this paper, the whole value network is specified and potential performance is determined. Supply chain design (strategic) forms the first level of implementation, followed by supply chain planning (tactical), by which the targeted application of performance potential is planned. The last level is represented by supply chain execution (operational). As the term already suggests, this involves the operational realisation of the performance program.[67] Since supply chain designs relevant to this paper were already outlined in detail in Section 3.2, the focus on the newest developments will be emphasised.

In previous years, there was a recognisable tendency for many mid-size companies to exhibit above-average growth. However, the associated difficulties could not be adequately resolved by the existing organisation. Consequently, an investigation was launched that elicited the formation of the supply chain. The investigation team defined a frame of reference tailored to a growth strategy for suitable supply chain design, taking the design fields of process, structure, collaboration and IT into consideration. Within this framework, the four various supply chain types could be defined. Lean supply chain corresponded to a market penetration strategy and international supply chain to a market development strategy, whereas the innovative supply chain found its application in the

[67]Cf. Brown, 2009, p. 44

context of a product development strategy as well as the hybrid supply chain for applications, for which a sharp distinction from the previously mentioned strategies is difficult.[68]

4.7. Exertion of Influence of SCM on Corporate Functions

It is difficult to create a clear influence on supply chain management based solely on the functions of the company, since the impact measures must be configured differently, depending on the choice of supply chain design (commensurate to customer demands). Examples cited for this purpose will include the various characteristics of a reactive and an efficient supply chain.

	Efficient Supply Chain	**Reactive Supply Chain**
Primary-Objective	Lowest possible costs	Fast reaction on demands
Product Design	Performance maximisation at a minimum of manufacturing costs	Creation of modularity for facilitating postponement
Price	Low margins	High margins
Manufacturing	Lower costs via high capacity	Creation of a flexible capacity
Inventory	Minimisation of stocks	Buffer stocks
Delivery Time	Reduction of delivery time without incurring costs	Reduction not contingent on rising costs

[68]Cf. Meiners und Buchholz in Bogaschewsky et al., 2014, p. 229-246

Suppliers	Selection according to costs and quality	Selection according to speed, flexibility, reliability and quality

Table 4: Comparison of reactive and efficient supply chains[69]

As is evident in Table 4, supply chain management has a continuous influence on the functions of purchasing, sales, marketing and production. It is indeed evident that its formation is very strongly controlled by the respectively predominant customer demands.

4.8. Supply Chain Finance

Supply chain finance is concerned with the interface of finances, purchasing and supply chain management. Its significance has sharply increased in recent years and this trend will continue to accelerate. Supply chain finance primarily affects the aspects of growing international trade, steadily increasing opportunities for electronic invoice processing, variances in national taxation as well as liquidity protection.[70]

4.8.1. Definition of Supply Chain Finance

Supply chain finance is concerned with reducing capital costs and optimising financing within the supply chain. The emphasis in supply chain finance is contingent on a more efficient organisation of

[69] Source: Chopra und Meindl, 2014, p. 58
[70] Cf. Locker und Grosse-Ruyken, 2013, p. 145-147

the cash conversion cycle as well as capital structure, financing fixed assets and working capital.[71]

4.8.2. Classification

Supply chain finance is an element of financial supply chain management. The interrelationship is visible in the illustration below.

Financial Supply Chain Management		
Supply Chain Finance	Financial Supply Management	Tax Supply Chain Management

Figure 6: Subdivisions of financial supply chain management[72]

The classification of financial supply chain management is a point of contention in technical literature. Additional terms such as supply finance, for example, are used. The figure above was developed as the basis for this paper.

4.8.3. Concept

Supply chain finance is concerned with options, particularly in the realm of working capital. In this regard, it has no great influence on EBIT, but is instead geared to shareholder value, that is, company value. It endeavours to optimise the relationship between customers,

[71] Cf. Metze, 2010, p. 32
[72] Source: Metze, 2010, S. 30-32 und Locker und Grosse-Ruyken, 2013, p. 148-149

suppliers and financial service providers through appropriate measures at all existing levels.[73]

The following concept matrix, designed by h&z Unternehmensberatung AG, effectively illustrates the variety of supply chain finance options.

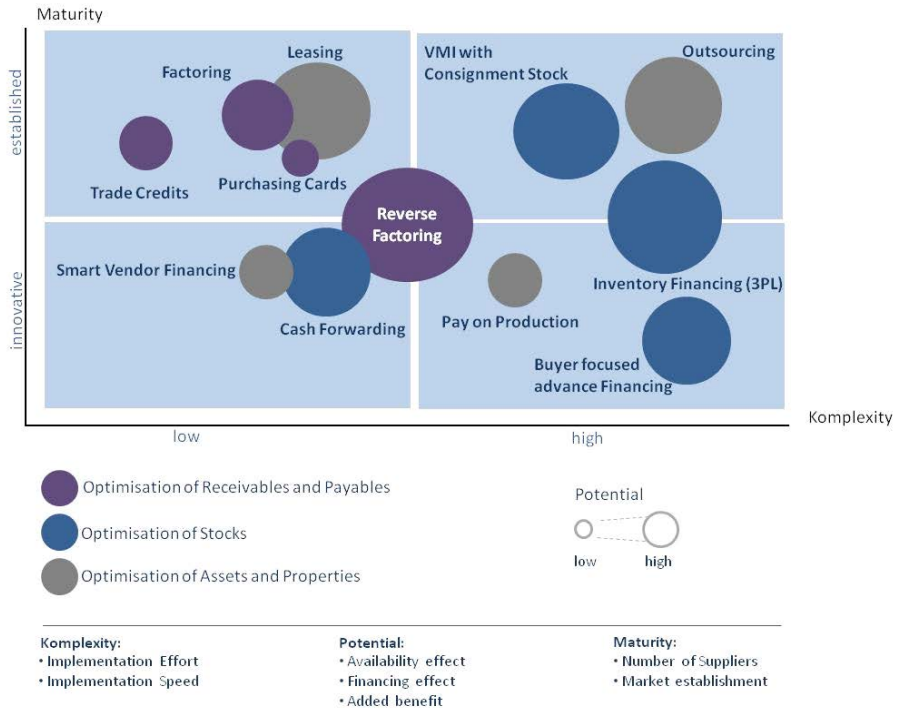

Figure 7: Supply chain finance concept matrix[74]

The supply chain finance concept matrix depicts an abundance of optimisation options, ranging from receivables and liabilities to inventories as well as assets and properties. The diameter of the

[73] Cf. Locker und Grosse-Ruyken, 2013, p. 153
[74] Source: h&z Studie, Supply Chain Finanzierung, p. 11

circle indicates the potential for the respective measures. Several of the terms used in Figure 7 will be subsequently outlined. Factoring means that a specialised company buys the receivables from another company (i.e. a production plant), which it has against third parties. In this manner, the production plant directly accrues liquid funds and the specialised factoring company receives an obolus, which it retains for bearing the contingency risk. Trade credits concern the relationship between the customer and supplier, in which there is a short-term financing for goods in stock. In this scenario, a financially sound customer could grant a financially weaker supplier a loan. Outsourcing in this context means that a service supplier assumes the complete financing and associated current service processes of a company. A production company does not actually buy the necessary equipment, but instead only pays for its usage. The manufacturer thus remains the equipment owner. This procedure is known as pay on production. Another option for reducing net working capital exists by applying what is known as buyer-focused advance financing. In this particular model, a bank obtains access to a manufacturer's information network, and thus the bank is capable of ensuring a dynamic financing that is adjusted to accommodate risk. To be sure, this method is strongly dependant on the solvency of the customer. Within the indirect commodities area there is the option of implementing purchasing cards. The specialised solution for the area of C-parts reduces operational costs. Credit card providers settle the payment and payment process for small invoice amounts by means of credit cards. In reverse factoring,

a bank assumes the interim financing from supplier receivables and thereby the supplier immediately receives its money at lower financing charges and the customer has the option to extend the term of payment. The last example is known as smart vendor financing, which represents a combination of various financing options. Its objective is to evenly distribute capital expenditure over the service life of the production plant.[75]

4.8.4. Working Capital Management

Working capital management has already long been a topic of discussion, not only in literature but also in practise. Yet in practise this topic still has not been lent the credence it deserves. However, funds are urgently required for investments in corporate added value, which are released through a proper and efficient working capital management. It is the only means by which sustainable growth can be guaranteed. According to a study by PricewaterhouseCooper, the companies investigated need approximately 309 billion Euros in the near future in order to be able to achieve a moderate degree of growth.[76] In peer-reviewed literature, working capital management is divided into three processes: the "order to cash "(income management), "forecast to fulfil" (supply management) and the "purchase to pay" (expense management) process.[77] The goal of working capital management is to raise capital turnover and thereby be in a position to reduce capital

[75] Cf. h&z Studie, Supply Chain Finanzierung, p. 14-15
[76]Cf. PWC, Cash for growth, 2014, p. 4
[77] Cf. Lies, 2011, p. 25

costs. Additionally, there is more financial flexibility in the company, which in turn has positive impacts on the profitability by the operating profit-enhancing application from the released funds.[78] From a fiscal point of view, working capital is also regarded as pure working capital. It also acts as liquid funds for the medium term and is the surplus of short-term circulating capital for short-term liabilities.[79]

4.8.4.1. Definition of DSI (Days Sales Inventory)

There is no consensus for the definition of inventory range in literature. It shall be referred to as days sales inventory in this paper yet is often also known as DIH, which stands for days inventory held. Less widely known terms include DIO, days inventory outstanding and ICP, inventory conversion period. Ultimately these different terms all have the same meaning. The timeframe used for measurement is the time between the supply of raw materials and the shipping of the end products.

DSI is calculated by dividing the stock on hand (average yearly stocks) by the material input (manufacturing or procurement costs) then multiplying the result by 365 (days).[80] Possible starting points for a company in reducing days sales inventory include the range design, for example, by reducing the spectrum. Improved planning, prognosis and control likewise facilitate the reduction of buffer

[78] Cf. Metze, 2010, p. 99
[79] Cf. Olfert, 2013, p. 491
[80] Cf. Metze, 2010, p. 105

supports. Production as well as warehouse management and distribution also offer leverage in reducing stock turnover.[81]

4.8.4.2. Definition of DPO (Days Payables Outstanding)

Days payables outstanding measures the time between the supply of raw materials and their payment. The higher this value, the more favourable it is for the focal company. The supplier acts as a financial institution and extends the loan term, in this case in the form of merchandise value. Days payable outstanding is calculated by liabilities from supplies and services (average over a time frame) divided by the cost of goods sold. This result is then multiplied by 365 (days).[82]There are still various simple options for optimising liabilities. One option in particular that is always negotiable is payment conditions. Conditions could define the time period for which payment should be received or, if time is a factor, the appropriate amount for a cash discount. Another option for discussion is collective invoices, since they serve to reduce operational costs and extend the term of payment.[83]

4.8.4.3. Definition of DSO (Days Sales Outstanding)

Days sales outstanding refers to the outstanding amount of the customer invoice and indicates the time frame between the recording of sales and money received according to customer payment. DSO is calculated by the average receivables (average

[81] Cf. Sure, 2014, p. 81-103
[82]Cf. Metze, 2010, p. 106
[83]Cf. Bleiber, 2015, p. 228-236

over a time frame) divided by the sales. The result is then multiplied by 365 (days).[84]A main component for receivables management can include a modern invoicing method as well as enhanced customer satisfaction via adequate process design. Additionally, implementing receivable management can simplify and expedite receivables liquidation (outstanding debts).[85]

4.8.4.4. Definition of CCC (Cash Conversion Cycle)

The cash conversion cycle is the average amount of time raw materials require in a bound monetary unit in order to generate monetary unit sales. In other words, it is the number of days required to pre-finance sales. This is also known as cash to cash cycle or cash flow cycle.[86]

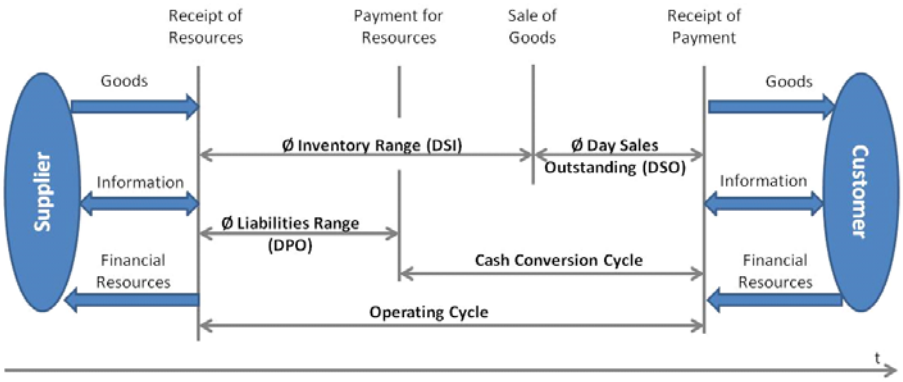

Figure 8: Depiction of the cash conversion cycle and operating cycle[87]

[84]Cf. Lies, 2011, p. 57-58
[85]Cf. Sure, 2014, p. 27-28
[86] Cf. Metze, 2010, p. 100-101
[87] Source: Metze, 2010, p. 102

The chart above visualises the cash conversion cycle calculation. The inventory range plus the days sales outstanding minus the liabilities range yield the cash conversion cycle in days.

4.8.4.5. Benchmark Outcomes

PricewaterhouseCoopers published a survey that evaluated the average working capital days (or cash conversion cycle). The following graphic impressively conveys the current status as well as the variation from the previous-year period.

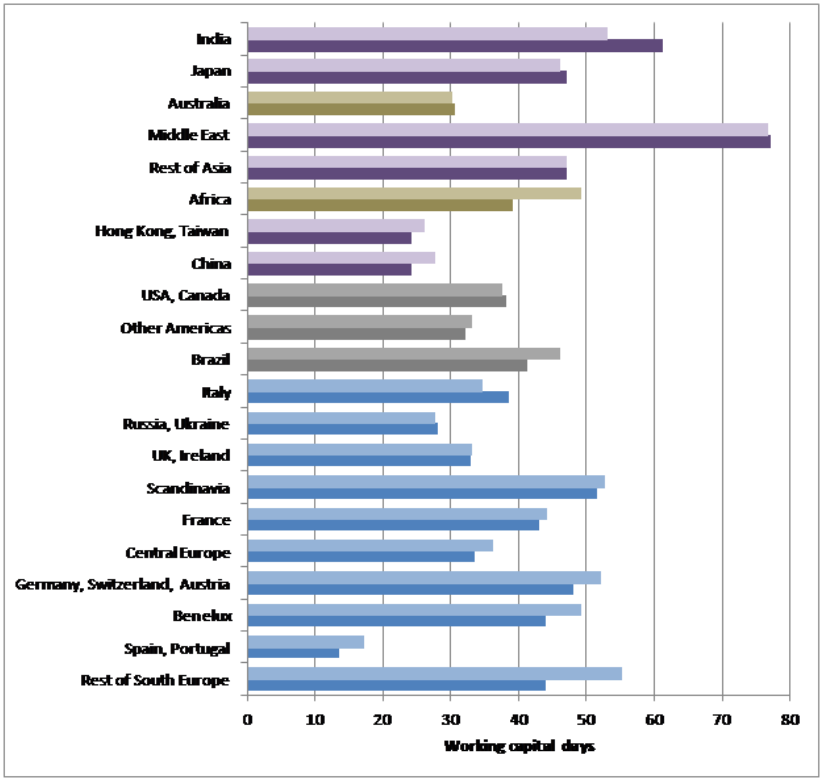

Figure 9: Average working capital days[88]

[88]Source: PWC, Cash for Growth, 2014, p. 9

In the average working capital days figure (calculated by inventory range plus average receivables term of payment minus the average supplier term of payment) [89] various countries and regions were compared with each other. Respective values in the slightly lighter colours are values for the year 2012 whereas the darker colours indicate values for 2013 in days. The cluster comprising Germany, Switzerland and Austria are comparable to USA, Canada and China in last place. An average of 50 days working capital days is the norm for the European cluster, while USA and Canada indicate 40 days and China only 30 days. However, only two clusters demonstrated an improvement of 8-10% from the previous year. USA and Canada's showed a decline of 1%.

4.8.5. Potentials for Supply Chain Finance

In order to raise the visibility of potentials of supply chain finance, a study by h&z Unternehmensberatung AG was reverted to. This study revealed the degree to which feasible savings potential (spectrum) can increase by implementing supply chain finance concepts.

[89] Cf. Bleiber, 2015, p. 64

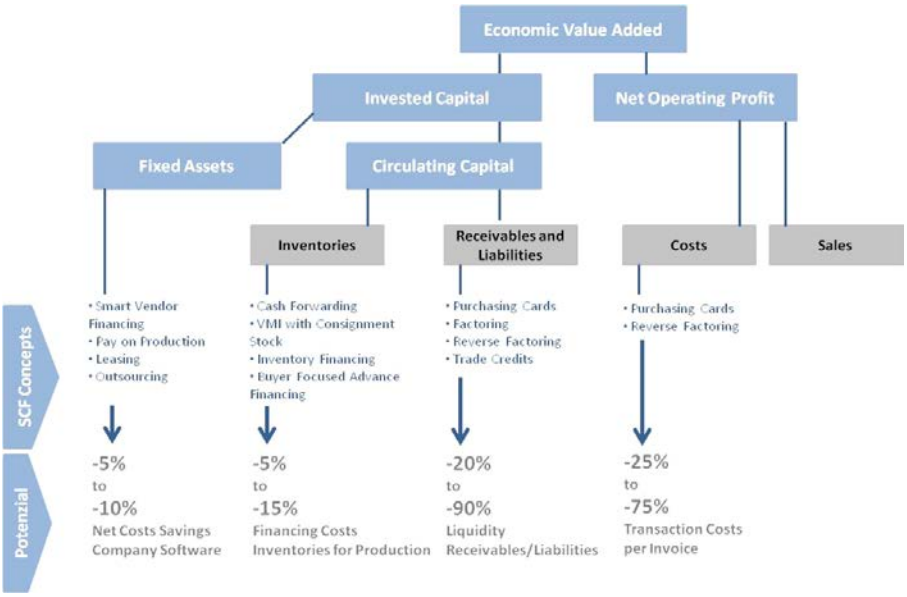

Figure 10: Potentials of supply chain financing[90]

By implementing purchasing cards or reverse factoring, it is possible to save up to 75% in operating costs, according to h&z Unternehmensberatung AG, and a potential of up to 90% for receivables and liabilities is ascertainable. That is, the liquidity associated with receivables and liabilities can be reduced by up to 90%. Even when taking only the respective smallest values into account, there is still considerable potential for supply chain financing.[91]

[90] Source: h&z Studie, Supply Chain Finanzierung, p. 7
[91] Cf. h&z Studie, Supply Chain Finanzierung, p. 7

4.9. Supply Chain Performance

Under present day competitive conditions, which are becoming more dynamic, rapid and complex, traditional indicator systems are not equal to the task of confronting these new demands. These timeworn systems lack a vision of the future as well as consideration of weak areas.[92] Furthermore, determining key figures and allocation ought not to be merely token gestures; rather, they should provide an accurate added value for the individual supply chain members as well the supply chain as a whole. This is the means by which supply chain performance measurement can encourage and improve the understanding and collaboration between supply chain partners, as well as raise the degree of integration for the supply chain.[93]

The most recent research results in this regard are concerned with the weak areas of supply chain performance. These weak areas were investigated (labour) in terms of to what extent the personal comportment of the decision-maker impacted the various supply contracts. Surprisingly, it could be ascertained that between the various test subjects various outcomes also ensued, which could subsequently prove that supply chain performance was 20% below its optimal performance.[94]

[92] Cf. Werner, 2013, p. 414
[93]Cf. Cetinkaya et al., 2011, p. 65
[94]Cf. Becker-Peth in Bogaschewsky et al., 2013, p. 131-145

4.9.1. Definition

Supply chain performance can be understood as the degree of profitability goals achieved within the existing supply chain management as specified at the network and stakeholder level. Supply chain performance appraises the efficiency, efficacy and performance of the entire supply chain.[95]

4.9.2. Target Values

Target values for supply chain performance were developed from the three dimensions of company achievement: efficacy, efficiency and agility. These dimensions are always the focal point for a supply chain. For these developed target values, a balanced relationship for the medium term should always prevail; otherwise they run the risk of undesired trade-off effects. For example, if the cost pressure is too strongly exerted, quality is compromised.[96] The following target values can be derived:

- increase efficiency
- improve quality
- improve speed
- increase adaptability
- enhance customer benefits
- embrace innovation
- reduce capital commitment
- collaboration.[97]

[95] Cf. Essig et al., 2013, p. 372
[96] Cf. Gleich und Daxböck, 2014, p. 46-47
[97] Cf. Gleich und Daxböck, 2014, S. 47 und Essig et al., 2013, p. 373

4.9.3. Instruments

In order to positively develop the target values laid out in the previous section, there is need for a set of methods and instruments to this end, some of which are outlined as follows.

In terms of making significant value added decisions, the total cost of ownership approach in a supply chain has the task of considering an overall perspective involving complete costs of a specific supplier, particularly in the purchasing of products. Total cost of ownership transparently and comparably designates the true costs.

Activity-based costing apportions the overhead costs according to the respective department to the individual cost-bearers. As a result, there is greater transparency and correspondingly the ability to clearly identify savings potentials.

Another instrument that is aimed at customer satisfaction is known as target costing. The objective of target costing is to ensure that a product complies with customer and market demands with respect to price, design, functionality and quality. The main issue at hand to ascertain is suitable product cost.

Open book accounting pertains to the disclosure of information and data concerning the internal accounting system between cooperation partners. However, this is only possible when there is a true relationship of trust between the parties and both strive for the

common goal of generating benefits. In open book accounting, discovering specific cost reduction potentials is the primary focus.[98]

4.9.4. Balanced Scorecard

Balanced scorecard is another instrument of supply chain performance. It was developed in 1997 by Kaplan and Norton and is the most prevalent performance measurement system today. In this system, a company's vision and strategy are converted to a performance system in a practical manner. Specifically, it involves breaking down a business strategy into uniform guidelines. Strategic objectives within a top-down approach are associated with these measures. The next step is to plan operational goals that are evaluated using the bottom-up approach. Levels of a supply chain scorecard can be variously designed according to the relevant company. However, as a rule they are restricted to the relationship or respectively potential level on the chain as well as the finance, customer, process and supplier levels.[99]

4.10. Profitability

It is not easy to discern the point at which the term „profitability" first appeared in economic literature. Yet it was a long time before it emerged in classic English and French literary works on the issue of

[98]Cf. Essig et al., 2013, p. 393-405
[99] Cf. Gleich und Daxböck, 2014, p. 50-55 und Essig et al., 2013, p. 409-411

national economy.[100] The concept of profitability is the ratio of profit from a fiscal period to the assigned capital (return on capital).[101]

This is also known as rate of return. For providers of equity and lenders, the rate of return - or more appropriately, profitability - is an important benchmark. On the one hand, equity providers expect reasonable gains and the associated profitability commensurate to their assigned capital. On the other hand, profitability is a significant value for lenders when assessing risks for their investments.[102] Investments are always demanded in order to be able to increase profitability in companies. This runs contrary to the goal of increasing in liquidity, since liquidity decreases with investment demand. Insofar as the necessary capital is available in the company, profitability is to be prioritised since it is better designed for the long term than liquidity and can greatly contribute in safeguarding a company's future.[103] Some of these performance indicators include return on equity, return on investment, return on sales, cash flow return as well as return on capital employment.

4.11. Competitive Advantage

According to Duden, competitive advantage is the ability to compete with other participants. Fundamentally, this definition can be considered particularly apt, since there is no consensus within economic literature for the term, „competitive advantage". It is also

[100]Cf. Arndt, 2014, p. 5
[101]Cf. Benesch und Schuch, 2013, p. 31
[102] Cf. Olfert, 2013, p. 58
[103] Cf. Pape, 2011, p. 20

deemed as the ability to sell, or to sustainably ensure or expand profitability for market shares.[104] Another interpretation goes beyond the previously cited definitions and describes competitive advantage as the potential of a company that can obtain, claim or expand upon a profitable position within an industry or market. This indicates that the company is able to recognise opportunities and risks in the competitive arena and use them for its own benefit. From a micro and macroeconomic standpoint, competitiveness is based on creating competitive advantages (the foundation for competitive strategy).[105]

4.12. Change Management

The importance of change management has grown substantially in the past two decades. What had initially only been considered a peripheral issue has since expanded into a vital and significant methodology for any company. Society and the economy alike are subjected to a permanent state of transformation reflected by profound and ongoing changes. Companies became more transparent through digitalisation and the mobile web, while networks and online communities comprised the focal point of innovations. Through the takeover of this leadership role for this social media, the transformation to the organisational model Enterprise 2.0 was levelled out. [106] For many sectors, this transformation prompts redefining successful positions while taking

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[104] http://www.wirtschaftslexikon24.com/d/wettbewerbsfaehigkeit/wettbewerbsfaehigkeit.htm [surveyed on 14.01.2015]

[105] Cf. Pirscher und Mothes, 1999, p. 2-3

[106] Cf. Capgemini, 2012, p. 3

an increasingly changing market and competition conditions into account. Consequently, rapid rationalisation effects are no longer sufficient in confronting today's market. Changes companies can adopt include strategic orientation, organisation, corporate culture as well as implemented systems and technologies. Bearing these factors in mind, change management has become a permanent challenge, which all members of an organisation must accommodate.[107]

4.12.1. Definition

Expressing change management in a single definition appears to be an impossible task due to its scope and high level of complexity. Experts in various studies attempted to briefly and succinctly describe this concept in a single sentence. The following sequence of answers could be determined, beginning with the ones most cited. Information must be both clear and credible, open communication must be fostered, the transformation must be understandable and comprehensive, individuals concerned must be included as participants and complex changes within an organisation must be actively controlled. This questionnaire included a catalogue of questions that all parties concerned were obligated to keep, since there would otherwise be varying answers that could no longer be logically allocated.[108] Despite the difficulties specified in arriving at a single meaning for the concept of change management, Vahs developed an appropriate and all-encompassing definition. He described change management as a targeted analysis, planning,

[107] Cf. Vahs, 2012, p. 283-284
[108] Cf. Classen, 2013, p. 50-51

realisation, evaluation and permanent advancement and integral measures for change in companies.[109]

4.12.2. Key Factors

In order to successfully initiate a change management project, various key factors must be considered. First of all, energy must be stimulated among the parties involved in adopting the change. This is achieved by including all parties as well as transparency in the task at hand, both of which serve to create the necessary trust. Of equal importance is reasoning in terms of processes as opposed to structures, a practise that must be permanently encouraged. Only through these measures can changes be clearly and understandably set out for all participants. The company must continually be attuned to its environment in order to establish that corporate measures yield their full effect and that no anomalies arise. Another key factor is interconnectedness via communication. Interconnectedness means that the necessary information within an organisation is on hand, yet does not reach the proper recipient. Last but not least, a company must advocate continuous learning.[110]

4.12.3. Strategy

In order to illustrate which strategy demonstrates a certain degree of potential for success in practice, a Capgemini study from 2012 will be highlighted. Within the study, 10 spheres of activity could be

[109] Cf. Vahs, 2012, p. 302
[110] Cf. Doppler und Lauterburg, 2014, p. 115-125

pinpointed that are necessary for a successful change movement design.

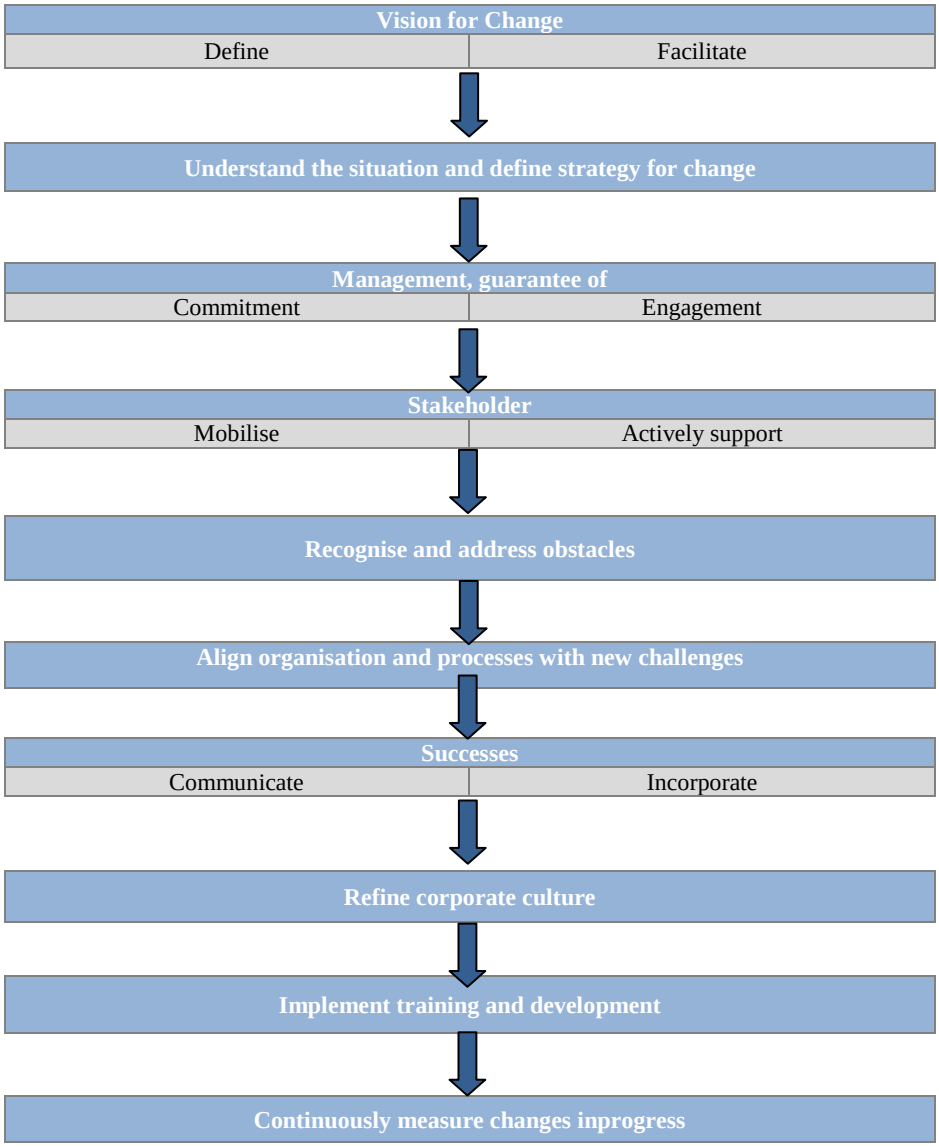

Figure11:Tenspheres of activityforsuccessfulchangemanagement design[111]

[111] Source: Capgemini, 2012, p. 26

Emphasis on the 10 spheres of action is very strongly influenced by the respective change objectives and can vary in their manifestations correspondingly. For example, when it concerns issues such as cost reduction or restructuring, the category of engagement and commitment by management is accorded a high priority. In terms of changes to the corporate or market strategy, definition and communication convey a clear vision.[112]

[112] Cf. Capgemini, 2012, p. 26-27

5. Present Day Steel Industry in Europe

Europe‘s steel industry is in the midst of one of the most strongly unprecedented restructuring processes. This process is driven by the massive overcapacity prevailing in the market, which could be offset as long as the Chinese economy was still able to achieve a growth rate of over 10%. Today this is no longer the case. China‘s economic growth is already well below the 10% mark. Therefore Chinese steel producers are increasingly attempting to deposit their product outside China with the support of the Chinese State with Europe as one of its targets.

A look back into the past indicates how the value of the steel industry in Europe has changed in comparison with the rest of the world. In 1978, the steel producing industry in China gained momentum. Up to then the nation had a production between 12 to 26 million tonnes of raw steel per year. The following graph illustrates the ratio between the development of raw steel production in China, Europe and the world.

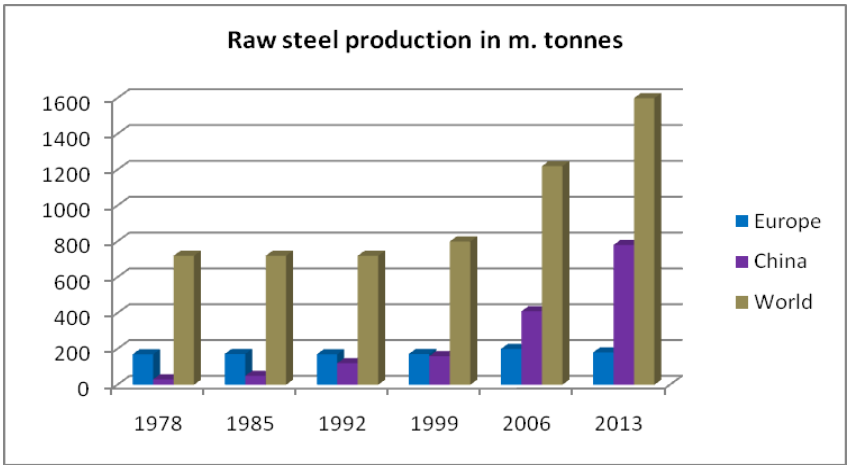

Figure12:Development in raw steel production from1978to2013[113]

As is evident in the graph, total raw steel production growth in the last 35 years was primarily driven by development in China. In Europe, by contrast, the increase in volumes remained static. In 2013 a total of 166 million tonnes was achieved. This value was already set in 2000. Europe survived the crisis year 2009 (raw steel production in Europe was at 139 million tonnes). However, steel companies only indicated the low values already cited. They were not sufficient for actual growth. On account of the prevailing market over capacities in steel, its selling price in the last two to three years has steadily dropped. Raw materials required for steelmaking did not similarly develop. Margins are affected by pressure. China's influence on the world and the European market is already great and will continue to grow - European raw steel production will continue to be consolidated. The Voestalpine Group will be cited here as an

[113]Source: Wirtschaftsvereinigung Stahl, Statistisches Jahrbuch der Stahlindustrie, 2013, p. 461

example, which has virtually already taken over nearly all independent steelmakers in Austria. These developments caught the attention of the European Union, and the European Commission mandated a plan of action in June 2013. This initiative is to assess current demands in the steel industry in order to increase its competitive advantage. One of the most important challenges for the steelmaking industry remains reducing necessary restructuring - as well as production capacity.[114] Another very distinctive feature in order to shed light on the current situation in the world steel market is the type of production method.

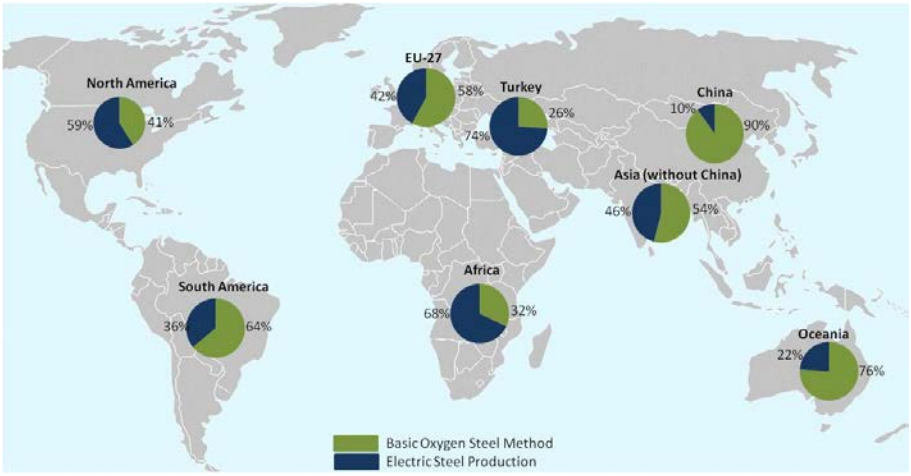

Figure 13: Proportion of production methods by region[115]

[114] Cf. Europäische Kommission, Aktionsplan für eine wettbewerbsfähige und nachhaltige Stahlindustrie in Europa, 2013, p. 3
[115] Source: Büchner, Präsentation Metall Recycling, Wege aus der Krise, 2014, p. 15

In the basic oxygen steel method, iron ore and hard coal coke are primarily used as raw materials, of which the proportion of iron scrap may comprise a maximum of 30%. By contrast, 100% is utilised for electric steel production, since it is 100% recyclable. However, this also means that electric steel producers are 100% dependent on internationally traded iron scrap prices, whereas these prices for the basic oxygen method vary within a particular range according to the market situation and proportion of iron scrap and can thereby gain an advantage. As is indicated by the graph, there are marked differences between the EU nations, Americans and Chinese. While Chinese steel producers use the basic oxygen steel method with up to a 90% frequency, this is somewhat more balanced in North America and Europe. In North America, there are nearly 10% more electric steel producers, whereas in Europe there are approximately 10% more basic oxygen steel producers. The high proportion of basic oxygen steel plants in China could be problematic in the future. China requires roughly half of the annual mined iron ore worldwide (about 1 million tonnes), of which around a third of the supply originates in the nation itself. From this statistic it is assumed that China will become an exporter of iron scrap in the next two to four years, which is attributed to increasing demolition activity in the real estate sector and the "relatively small" demand for scrap metal.

5.1. Competitive Position

While in previous years individual companies and corporations were the competitive contenders, steel has increasingly become a political

matter. However, it is more of an issue surrounding the respective supply within the domestic industry in terms of this particular commodity. For this reason, several countries more intensively immerse themselves in the market activity and attempt to influence it to their benefit. Some countries, China in particular, are exemplary in this regard. The Chinese state is aiming for complete self-sufficiency. By contrast, the Chinese state must adopt a different approach for comestibles since the area of cultivable land for foodstuffs is not sufficient to supply its entire population. However, China does not have a primary interest in importing products. Nevertheless, until it achieves a state of self-sufficiency China has no other choice. China now endeavours to expedite this process of attaining self-sufficiency through political measures, whether by means of trade barriers with respect to steel, or the opposite approach concerning raw materials. Furthermore, state subsidies are poured into the steel industry, which, for instance, support exports or make concessions for freight. In this way, Chinese steel plants are able to offer their products at very competitive prices. However, this situation is coming to a head, since steel sales in their own country are at a standstill. This has negative repercussions on the European steel industry, among others. As a consequence, an emerging phenomenon pertaining to the precarious situation in Turkey must be briefly addressed. Up until a year ago, it was the Turkish steel producers who virtually established the prices for scrap based on their acquisition behaviour. Since scrap metal and collecting activity in Turkey are not especially pronounced, there is a great need for foreign purchasing. According

to the degree of capacity utilisation, this amounts to about 1.5 million tonnes of steel scrap per month and roughly constitutes the entire quantity of scrap purchased in Germany[116] Due to the weakening economy in China, more steel is being exported overseas. On the one hand, China's steel industry supplies manufactured goods to customers from Turkish steel producers, and steel billets to Turkey on the other hand. This ultimately means that it is cheaper for Turkish steel producers to roll out the Chinese billets than to cast the billets themselves. This has a great influence on the European scrap price, and as a result forces pressure for a downward spiral in prices.

	Sales in M $	**EBIT in %**
Arcelor Mittal[117]	79,440	2.76
Posco[118]	60,093	4.84
Thyssen Krupp[119]	52,153	2.83
Nippon Steel[120]	43,321	0.458
JFE Holdings[121]	31,472	2.81
Tata Steel[122]	22,114	5.05
Nucor Corp.[123]	19,052	4.876

[116]Cf. Statistisches Jahrbuch der Stahlindustrie 2013/2014, Wirtschaftsvereinigung Stahl, 2013, p. 25
[117] Cf. ArcelorMittal, Business Report, 2013
[118] Cf. Posco, Business Report, 2013
[119] Cf. ThyssenKrupp AG, Business Report, 2012/2013
[120] Cf. Nippon Steel, Business Report, 2013
[121] Cf. JFE Holdings, Business Report, 2013
[122] Cf. Tata Steel, Business Report, 2013/2014
[123] Cf. Nucor Corp. Business Report, 2013

Gerdau[124]	17,816	6.908
Hebei Iron & Steel Co. Ltd[125]	17,760	0.1369
United States Steel C[126]	17,424	0.88
Voestalpine[127]	15,587	7.41
EVRAZ[128]	14,071	5.47
Severstal[129]	13,160	9.61
Salzgitter AG[130]	12,503	-4.229
Maanshan[131]	11,896	1.991
Novolipetskiy[132]	10,909	5.9
Steel Authority India[133]	7,303	7.48
JSW Steel[134]	6,314	11.19
SSAB AB[135]	5,119	-2.98
Shougang Fushan[136]	551	42.876

Table5:Profitabilityandcomparison in sales within the steel sectorsin 2013[137]

When evaluating the individual steel corporations, it is apparent that the largest corporations in the world ended the fiscal year of 2013

[124] Cf. Gerdau, Business Report, 2013
[125] Cf. Hebei Iron & Steel Co. Ltd., Business Report, 2013
[126] Cf. United States Steel Corp., Business Report, 2013
[127] Cf. Voestalpine, Business Report, 2013/2014
[128] Cf. EVRAZ, Business Report, 2013
[129] Cf. Severstal, Business Report, 2013
[130] Cf. Salzgitter AG, Business Report, 2013
[131] Cf. Maanshan, Business Report, 2013
[132] Cf. Novolipetskiy, Business Report, 2013
[133] Cf. Steel Authority India, Business Report, 2013/2014
[134] Cf. JSW Steel, Business Report, 2013/2014
[135] Cf. SSAB, Business Report, 2013
[136] Cf. Shougang Fushan, Business Report, 2013
[137] Source: Own illustration

with an EBIT margin between 0 up to 7%, among which Voestalpine was rated as one of the best within this sector. Nonetheless, the steel business still only constitutes roughly a third of the overall activities. Thyssen Krupp, with its headquarters in Germany and who sold its steel business to America in February 2014, also follows this trend. Consequently, the volatile and capital-intensive steel sector was brought down to below 30% of the overall sales. According to a business report for 2013/2014, ThyssenKrupp AG will continue to pursue this strategy. The Gerdau Brazil Company's own raw material reserves undoubtedly availed from the higher EBIT, and was likewise the case for the Russian Severstal and EVRAZ. The South Korean company Posco has another competitive advantage in the form of its own ships, which can be employed for the transport of raw materials. This may account for half of the price for raw materials in iron ore. Many other steel manufacturers who do not have such a competitive advantage at their disposal, attempt to raise their profiles through special steel grades. However, for many others, the positioning in the upmarket flat steel segment is common. In a nutshell, these are some of the strategies exercised to maintain a position amid the competition pressure as long as possible. Steel producers with relatively very small production volumes strategically orient themselves as niche players in order to achieve the necessary edge.[138]

[138]Cf. Michel, 2012, p. 40-43

5.2. Global Market Positioning

In order to more closely assess the global market, it is necessary to have a perspective of the size of steel-producing countries. As is evident in Figure 11, Germany is the largest producer of raw steel in Europe, yet only places seventh worldwide, slightly ahead of Turkey and Brazil. At eleventh place Italy is still lagging behind and according to the latest developments will continue to lose ground. Over the next ten years Austria could also potentially experience dramatic changes. Wolfgang Eder, CEO of Voestalpine, says he is considering a capacity shift to South America upon expiry of the operating time of the existing facility in Austria, which would result in a dramatic reduction for steel production in Austria.

Figure 14: Top 20 steel-producing countries in 2013 (in millions of tonnes)[139]

[139]Source: World Steel Association, World steel in Figures 2014

Since in the meantime other very large and notable steel corporations have announced they will only build up new capacities almost exclusively outside Europe, the status of the European steel industry will further weaken. Within existing steel corporations, Europeans fall even further behind in terms of sales in tonnes.

Rank	Company	Tonnage	Rank	Company	Tonnage
1	Arcelor Mittal	96.1	26	SAIL	13.5
2	Nippon Steel	50.1	27	Fangda Steel	13.2
3	Hebei Steel	45.8	28	Rizhao Steel	12.7
4	Baosteel Group	43.9	29	MMK	11.9
5	Wuhan Steel Group	39.3	30	JSW Steel	11.8
6	POSCO	38.4	31	Jiuquan Steel	11.2
7	Shagang Group	35.1	32	Baotou Steel	10.7
8	Ansteel Group	33.7	33	Anyang Steel	10.3
9	Shougang Group	31.5	34	Zongheng Steel	10.2
10	JFE	31.2	35	Taiyuan Steel	10.0
11	Tata Steel Group	25.3	36	Jingye Steel	9.7
12	Shandong Steel Group	22.8	37	Techint Group	9.0
13	U.S. Steel	20.4	38	Jinxi Steel	8.7
14	Nucor Corp.	20.2	39	Xinyu Steel	8.5
15	Tianjin Bohai Steel	19.3		Zenith Steel	8.5
16	Gerdau	19.0	40	Erdemir Group	8.3
17	Maanshan Steel	18.8	41	Sanming Steel	8.2
18	Hyundai Steel	17.2	42	Guofeng Steel	8.1

19	Benxi Steel	16.8	43	Shaanxi Steel	8.0
20	Evraz Group	16.1		Voestalpine	8.0
21	Thyssen Krupp	15.9	44	ISD Corporation	7.9
22	Severstal	15.7	45	Citic Pacific	7.7
23	NLMK	15.5	46	Riva Forni Elettricia SpA	7.6
24	Valin Group	15.0	47	Kobe Steel Ltd.	7.5
25	Metinvest	14.3	48	CELSA Group	7.0
	Jianlong Group	14.3	49	Usiminas	6.9
	IMIDRO	14.3	50	Essar Steel	6.1
	China Steel Corp.	14.3		Nanjing Steel	6.1

Table6:Top50steel-producing companiesworldwide in2013(inmillions oftonnes)[140]

Arcelor Mittal continues to be the largest steel company worldwide. The Indian corporation has held this position for several years. Its sales in tonnes is nearly twice as high as second-place Nippon Steel & Sumitomo Metal Corporation (Japan). Hebei Steel Group, which commands third place, is the first Chinese steel company to achieve an output of steel that is only 10% lower than the Japanese company placing second. Various Chinese corporations follow up to number 13, which is occupied by the first American company, U.S. Steel. The largest European company, Thyssen Krupp from Germany, only places at no. 21. The company boasted an output of nearly 16 million

[140]Source: World Steel Association, World Steel in Figures 2014

tonnes of steel in 2013, which corresponds to one sixth of that exhibited by Arcelor Mittal.

5.3. Advantages and Disadvantages of the European Steel Industry in Global Competition

The EU takes last place in terms of protectionism in the steel sector. It does not require import duties on steel products and strictly adheres to subsidy discipline. Nonetheless, it assumes an active role in terms of the reduction of global protectionism. It endeavours to toughen trade barriers and constantly strives to reduce existing restrictions. However, this present day imbalance means there are disadvantages on the international market for the European steel industry. 65% of global raw materials production is confronted by these trade restrictions.

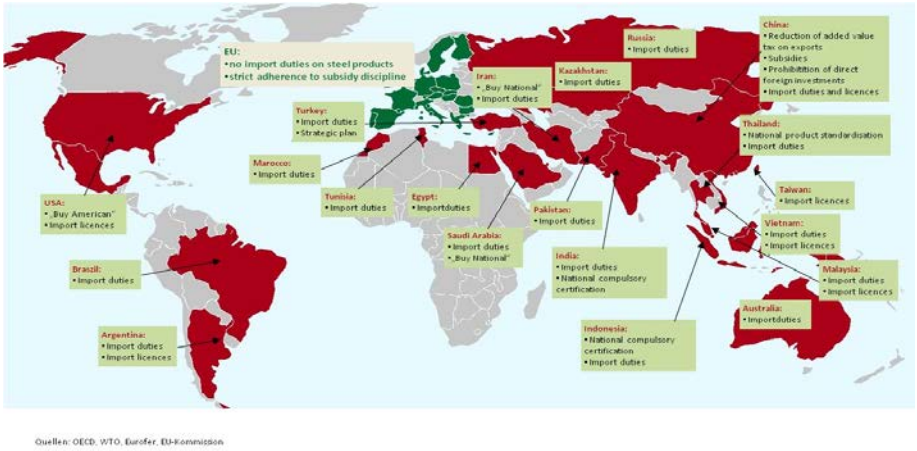

Figure 15: Global overview of protectionism in the steel sector[141]

[141] Source: Wirtschaftsvereinigung Stahl, Vortrag Denecke-Arnold Heike, Protektionismus bei Rohstoffen und Stahl, 2013, p. 3

China is clearly a frontrunner concerning protectionism. It is not a matter of restrictions pertaining to imports, but also regards the value added tax for exports. This occasionally leads to severe market distortions. The USA is on the list of nations that actively take part in this phenomenon. America attempts to encroach on the market by cleverly using the slogan, "Buy American". The USA has more advantages to which European steel companies must take a back seat. Reasonable energy prices and low wages in some states are worth mentioning in this regard. Even Turkey imposes import duties for steel products. However, this has no influence on European steel producers since the EU and Turkey have been bound by a tariff union since January 1996.

Figure 16: Compartmentalisation of raw materials markets, i.e. scrap, iron ore, coal and coke[142]

[142] Source: Wirtschaftsvereinigung Stahl, Vortrag Denecke-Arnold Heike, Protektionismus bei Rohstoffen und Stahl, 2013, p. 4

Another disadvantage for the European steel industry is the compartmentalisation of raw materials markets. This is another instance where there are no trade barriers in the European Union concerning raw materials (scrap, iron ore, coal and coke). Profiteers are the same nations that already imposed trade restrictions on the steel sector. China is also at the forefront in this regard. To illustrate, iron scrap has an export tax of 40%. For iron scrap dealers, this means that it is hardly worth exporting, and conversely the domestic steel industry avails from the raw material. This scenario is bound to change within the next few years. China will relinquish its role as an importer of scrap and will need to make the shift to a scrap exporter. Construction activity over the last decade has left its traces, which have a negative impact on the European steel industry. North and South America yielded to the free market. It was quite the opposite for Russia, who is attempting to guard the "treasures" harkening to the kolkhoz era. And thus the domestic steel industry is an influence in favouring steel scrap.

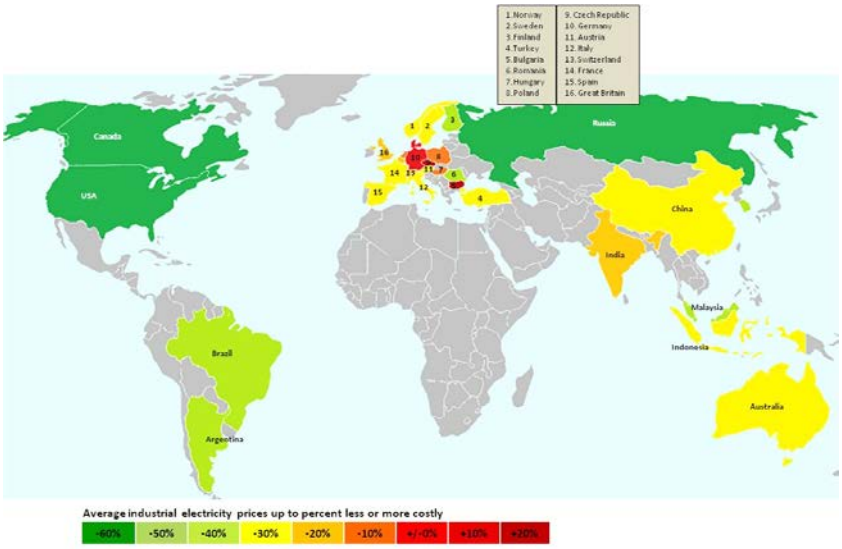

Figure 17: Global comparison of industrial electricity prices[143]

There is no uniform template for industrial electricity prices within Europe. Germany is the reference point in this graphic from which differences are measured. What is striking is that the Czech Republic and Bulgaria alone pay up to 20% more for electricity than Germany, while all other countries in Europe pay up to 50%. Southern European countries pay approximately 30% less. On a global scale, countries such as Canada, USA and Russia enjoy the best industrial electricity prices. These nations pay up to 60% less for energy than in Germany. A less marked difference is indicated by China at minus 30% and India with minus 20%. Bearing in mind that energy costs in the steel industry constitute roughly 8 to 12% of its revenue, significant competitive advantages for steel companies arise for those

[143] Source: Wirtschaftsvereinigung Stahl, Energiewende und industrielle Wettbewerbsfähigkeit im internationalen Kontext, 2013 p. 8

located in an "energy price-friendly" country. With this point of view in mind, energy prices in fact play a significant role for a new steel plant when it concerns choosing a location.

Another topic of discussion regarding competitive differences between Europe and the rest of the world is CO_2 emission regulation, which is handled quite differently.

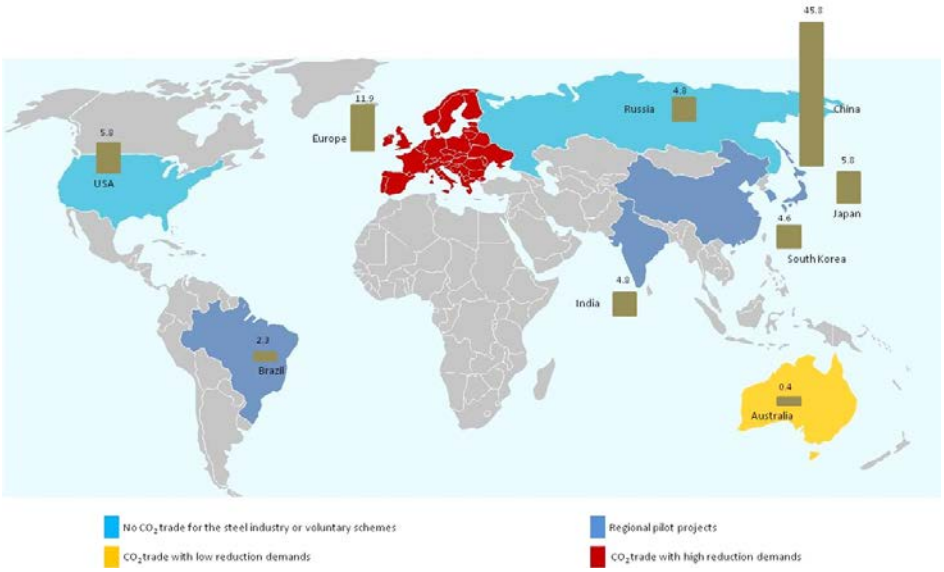

Figure 18: Competitive conditions via initiatives in emission trade schemes[144]

If one views the legislation pertaining to the CO_2 emission regulations from an individual country standpoint, clear differences can be ascertained that could prove detrimental for

[144] Source: Wirtschaftsvereinigung Stahl, Pressekonferenz Stahl 2013

Europe. In 2005, the European Union Emission Trading Scheme (EU ETS) was implemented in Europe. It now encompasses 27 EU member states as well as Norway, Iceland and Liechtenstein and is now in its third trading phase. Even today, it is the only worldwide, transnational emission trading scheme. The objective of the scheme is the systematic reduction in CO_2 emissions within the encompassing industry sectors. However, this can only be implemented by means of targeted investments, which are supported by the economy. Australia is the closest to the European solution: it possesses a nation-wide emission trading scheme of a binding nature. However, the defined reduction requirements are significantly lower than in the EU. South Korea is planning the implementation of a nation-wide emission trading scheme for 2015, one that is somewhat comparable to that of Australia. There is no compulsory trading scheme in any of the other countries. Moreover, implementation is not foreseeable in the near future. However it must be acknowledged that in some nations there are pilot projects, although they do not permit information regarding the inclusion of the steel industry for emissions trading. Thus in the forthcoming years there is still no indication of an international structure for CO_2 emissions trading.[145]

[145]Cf. Institut der deutschen Wirtschaft Köln Consult GmbH, Studie Emissionshandelssysteme in Ländern mit Stahlindustrie. 2013, p. 8-10 & 44

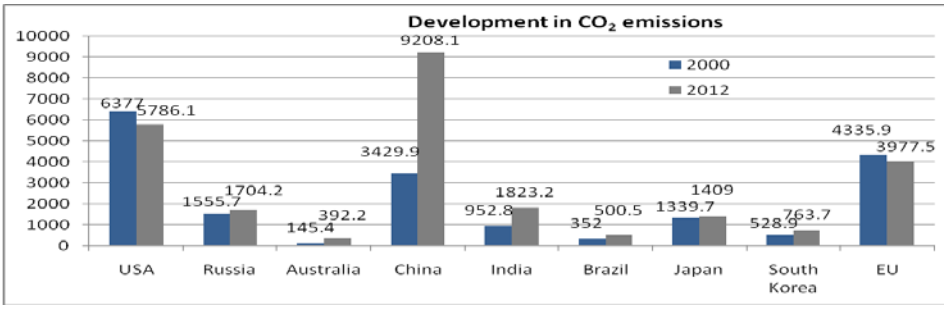

Figure19: Development in CO_2 emissionsin the years2000 and2012 inmilliont[146]

The illustration shows that China once again demonstrates impressive development compared to the rest of the world, since in most of the countries investigated an increase of CO_2 emissions was seen, with the exceptions of the USA and Europe. These regions reduced CO_2 emissions by about 10%. The USA has set a goal to reduce CO_2 emissions by 17% by 2020 compared to amounts recorded in 2005. However this cannot overshadow the overall situation, which has worsened. It is also crucial for other nations to consider adopting a similar scheme, which Europe has already successfully enacted. Thus the scope of international competition remains on equal footing and sustainability will be taken into account. The Chinese government is attempting to confront the issue of air pollution by innovative means, in which it shuts down offending facilities and operations and replaces them with new and more efficient alternatives. This is crucial when considering the air pollution levels in China's capital city. According to a report by the

[146] Source: Institut der deutschen Wirtschaft Köln Consult GmbH, Studie Emissionshandelssysteme in Ländern mit Stahlindustrie. 2013, p. 4

World Bank, which was compiled with the assistance of the Chinese government, roughly 750,000 people in China die every year from the consequences of environmental pollution, of which the largest proportion is air pollution, followed by contaminated water.[147]

There are not only disadvantages for the European steel industry, but there is also a sustainable advantage that must not disappear within the short term. The ability to innovate is a key factor. This is a characteristic exhibited by Europeans, although not by all member nations or in equal measure. If one compares patent applications for the year 2013 and calculates the number per million inhabitants, it is clearly indicative where Europe's potential lies.

Rank	Country	Applications per million inhabitant	Inhabitants	Applications
1	Switzerland	832	7,996,026	6,651
2	Sweden	402	9,119,423	3,668
3	Finland	360	5,266,114	1,895
4	Denmark	347	5,556,452	1,929
4	Netherlands	347	16,805,037	5,826
6	Germany	328	81,147,265	26,626
7	Austria	243	8,221,646	1,995
8	Belgium	180	10,444,268	1,885
9	Japan	177	127,253,075	22,555
10	France	148	65,951,611	9,754
15	USA	107	316,668,567	33,834
20	Canada	54	34,568,211	1,861
36	Turkey	5	80,694,485	375
41	China	3	1,349,585,838	4,056
44	Russia	2	142,500,482	232

Table7:Patent applications per million inhabitants by country[148]

[147]Cf. Lüthi, 2014, p. 62

[148] Source: Europäisches Patentamt, Europäische Patentanmeldungen 2013, http://www.epo.org/about-us/annual-reports-statistics/annual-report/2013/statistics-trends/patent-applications_de.html#tab=6 [surveyed on 07.04.2015]

Additionally supporting this fact is the share of hidden champions according to country per million inhabitants. Hidden champions refer to the generally lesser-known companies who command the top three positions in their sector on the world market or first place on their respective continent. Another criterion is that the sales figures do not exceed the limit of five billion Euros. What is extraordinary is that German-speaking countries command the top positions in this regard. Germany ranks at no. 1 with 16 hidden champions per 1 million inhabitants, followed by Luxembourg, Switzerland and Austria with close to 14. Sweden follows in fifth place with 5.4 per million inhabitants. The USA ranks relatively far behind with 1.2 hidden champions. China took last place in this evaluation with a very marginal proportion of 0.1 hidden champions per million in habitants.[149] In order to underscore this point, the sustainability of this competitive advantage must be analysed. One factor to consider is how quickly other nations are able to "duplicate" this trait. Innovation is not predictable, nor can it be prescribed. Various conditions are required to foster innovation. It necessitates a fundamental attitude toward the issue of leadership, which must be securely established within the respective companies. Contrastingly, this means that in China, for instance, several changes would be necessary to create sufficient room for innovation. One such change begins with the Chinese educational system. From the beginning, students are inculcated to adhere to the credo that whoever learns best by heart also achieves the best grades. This philosophy prevails

[149] Cf. Simon, 2012, p. 56

in all levels of the education system and is passed down through the generations. Therefore, many families – the ones who can afford it, that is – opt to send their children to foreign schools. The USA is the country of choice for education and the proportion of Chinese students studying there increases every year at a rate of roughly 30%. The Chinese government offers students willing to return from their overseas studies a very lucrative program, for example, what is known as the "thousand talents plan". This programme provides favourable pay, start-up capital for a company, a research project, etc. The government has set a goal to recover 2,000 graduates and entrepreneurs within the next decade who have earned a PhD abroad.[150]

[150] Cf. Lüthi, 2014, p. 140-155

6. Methodology for the Written Expert Survey

The study was carried out in the form of an expert survey using a questionnaire. The objective of the survey was to obtain answers to the research questions defined in this paper, namely issues that have a strong bearing on the key areas for organisations in connection with supply chain management. Since the steel industry exhibits rather conservative traits, it was not possible to easily categorise this project at its outset. The first step was to design a questionnaire consisting of 34 highly detailed questions. A trial run using three test subjects yielded the following outcome. To begin, both the time commitment and complexity of the survey were too great, and none of the companies approached were prepared to comply accordingly. In order not to forego the practical component of this paper, the survey was revised. This proved to be a challenge, since the research questions still required answering. The revised survey comprised an additional 17 questions, and some compromises were necessary relating to the degree of detail for the individual supply chain commodity groups. A new version using the same test subjects revealed that was feasible to derive answers.

Direct contact persons for this survey included managers, heads of logistics, heads of supply chain management as well as heads of purchasing and procurement. This approach was taken to ensure the effective responsible parties for supply chain management could be addressed and thus also guarantee a high quality of the answers. The

next step was to translate the questionnaire into English and Chinese in order to facilitate a comparison between China, USA and Europe. Various ways for conducting the survey were enacted, of which one involved an Internet-based survey tool. This tool was appropriate for companies in which there was no direct relationship with the interviewer. A second method for carrying out the survey was via e-mail. In this method, companies that were addressed had a connection to the interviewer by virtue of the interviewer's environment. Lastly, individual companies were directly interviewed. On average, the surveyed steel companies were allowed a six-week time frame in which to answer the survey questions. At the halfway point for the answer time frame, a friendly reminder e-mail was sent in order to encourage a higher response rate. In isolated justified cases, the deadline was extended. In total, 36 questionnaires were issued to 36 companies.

6.1. Results of the Expert Survey

Of the 36 questionnaires issued, 15 were returned by the deadline, which corresponds to a very good response rate of 41.67%. However, this value could only be attained by virtue of both the interviewer's existing network and environment. Of the 16 companies approached via the survey tool, there was a response rate of 0%. However, the total of all responses does not come close to a quantitative evaluation. Obtained results were input into Excel, in order to generate the analyses in an appropriate form. In the following

sections for Chapter 6, the relevant analysis results will be outlined by means of descriptive statistics and underscored with statements.

6.1.1. Survey Results for Steel Works in Europe/USA/China

The general component of the survey set out to assess whether the employee count had any bearing on the sales in tonnes and whether country-specific differences were evident.

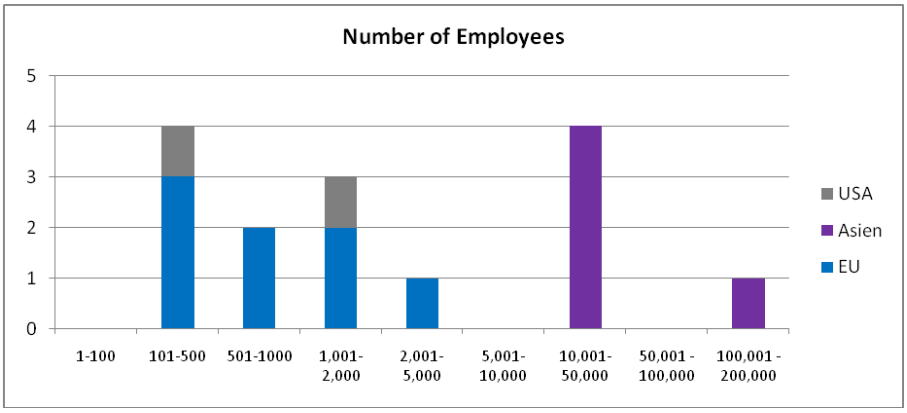

Figure20:Number of employees within the surveyed steel industry companies by country[151]

Steel companies with the most employees who participated in the survey were from China, which is not surprising, since many of the largest steel companies in the world have headquarters in China.

[151] Source: Own illustration

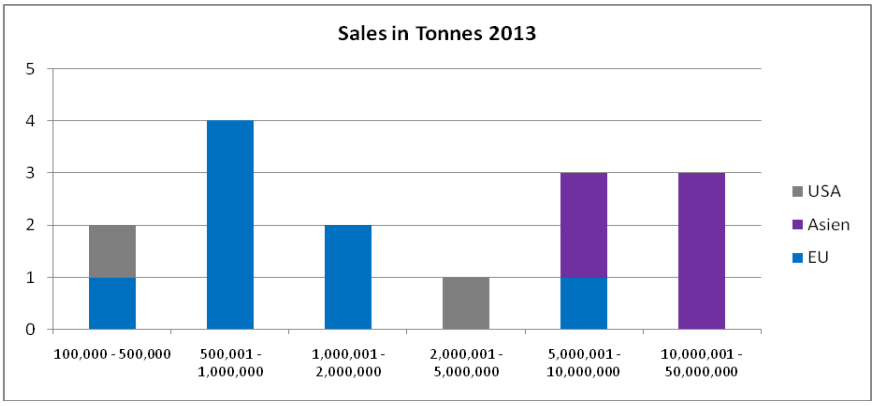

Figure21:Sales in tonnes for surveyedsteel companiesaccording to country[152]

Chinese steel companies are also ahead by leaps and bounds for sales figures in tonnes. However, it is worth noting that the span, in contrast to the number of employees, is smaller by far.

Who is already using supply chain management, where is it envisaged, for whom does it remain a non-issue? These questions form the basis for the following graphic.

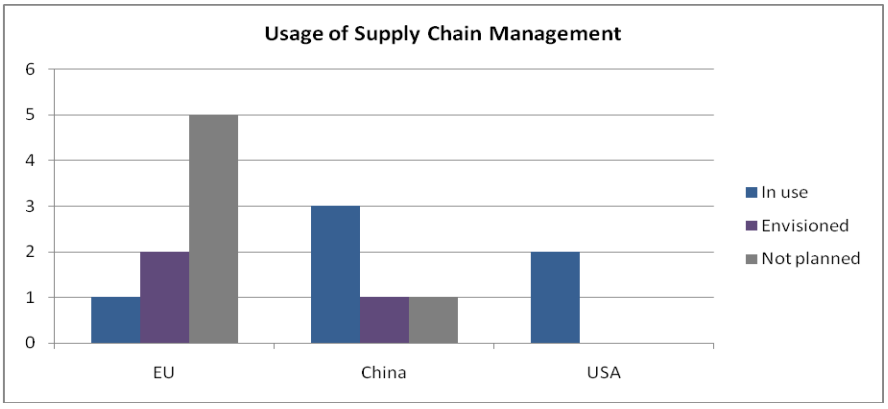

Figure22:Usage of supplychainmanagement by country[153]

[152] Source: Own illustration
[153] Source: Own illustration

Results concerning the question of supply chain management usage were astonishing. All survey participants from companies in the USA are already using supply chain management. This comes as no surprise, since the supply chain management approach was originally developed in the USA. Far more remarkable are the responses from Chinese steel producers. 60% are already using supply chain management and 20% are considering its implementation. Thus 80% are concerned with the issue of supply chain management. Contrastingly, Europe has a lot of slack to pick up. Only 12.5% are using supply chain management and 25% are considering its implementation. The remaining 62.5% are not concerned with the topic and do not anticipate doing so in the near future.

Companies that are already actively practising supply chain management were also surveyed regarding the type of their supply chain for respective commodity groups. In this instance country-specific differences could also be noted.

Which Supply Chain types are in use at your plant?				
EU/China/USA	Iron Scrap	Alloys	Electrodes	Refractory material
No answer				
Lean Supply Chain	1 / 1 / 0			
Flexible Supply Chain	0 / 1 / 0	1 / 0 / 0		
Consolidated Supply Chain	0 / 0 / 1	0 / 0 / 1	1 / 0 / 1	1 / 0 / 1
Fast Supply Chain	0 / 1 / 0	0 / 1 / 0	0 / 1 / 0	0 / 1 / 0
Derivations from the ReferenceModel				
Own types	0 / 0 / 1	0 / 0 / 1	0 / 0 / 1	0 / 0 / 1
Others				
None				
Don't know				

Table8:Usage ofsupplychaintypesaccording to commoditygroups by country[154]

While European steel companies are connected to every commodity group specifically associated with the apparently suitable supply chain type, for Chinese companies this is only the case in the iron scrap commodity group. The other commodity groups were allocated to only one and the same supply chain type. For the American steel works, there was no difference established between commodity groups. They are also the only companies who are using their own supply chain types.

Statements regarding profitability and competition can also be inferred on the basis of the cited supply chain types. The companies surveyed provided the following realised potentials.

[154] Source: Own illustration

What competitive and profitability advantages could you achieve?

EU / China / USA	1-10%	11-20%	21-30%	>30 %
Increase in RoA	0 / 0 / 1			
Increase in EBIT	0 / 1 / 1	1 / 0 / 0		
Reduction of transport costs	0 / 0 / 1			

EU / China / USA	1-10%	11-20%	21-30%	31-40%	>40 %
Reduction in overall lead time	1 / 0 / 0		0 / 0 / 1		
Reduction in customer complaints	1 / 0 / 0				

EU / China / USA	1-10%	11-20%	21-30%	31-40%	41-50%	51-60%	>60 %
Improved delivery capacity	1 / 0 / 0		0 / 0 / 1				
Reduction of storage costs	1 / 0 / 0	0 / 1 / 1					
Others	1 / 0 / 1						

EU / China / USA	1-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	>80 %
Reduction of quality costs	0 / 0 / 1								

EU / China / USA	1-6%	7-12%	13-18%	>18 %
Reduction of material costs	1 / 0 / 1			

Table9:Achievable competitive and profitability advantages by countries[155]

[155] Source: Own illustration

When taking all cited and improved potentials for success into account, it is evident that the American steel companies scored better in the key figures than their European counterparts. This came to light particularly in the area of process improvement. The response rate by the Chinese steel companies is too low to make a significant statement. Whenever an answer was provided, it is comparable to the European level.

Concerning the question of whether risks are also taken into consideration for implementing supply chain management, the response was unanimous: all participants answered this question in the affirmative. It will be interesting to see whether the same risks can be expected to carry the same weight among the various countries.

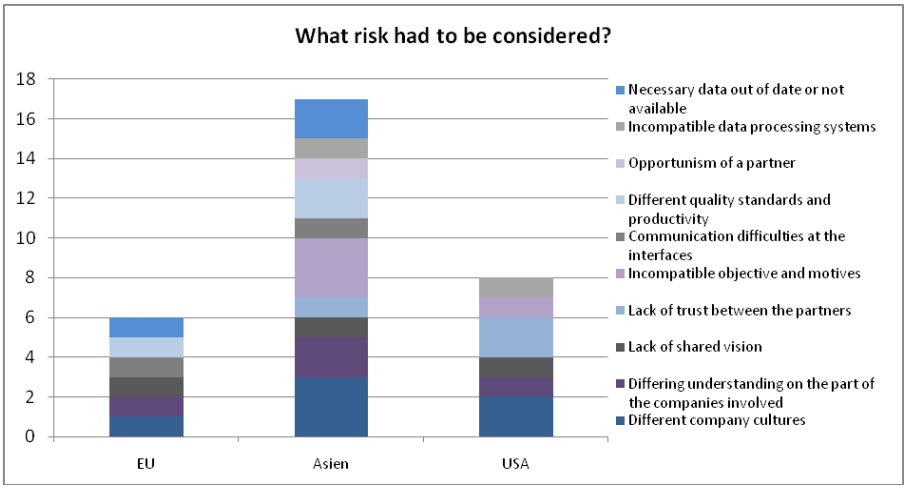

Figure23:Risks to be taken into consideration[156]

[156] Source: Own illustration

Chinese steel companies had by far more risks to conquer than the Europeans and Americans. There were also significant differences in the weighting of individual opportunities. Incompatible objectives and motives was one of the main risks for Chinese steel companies, whereas this risk did not come into play for European steel companies. The opportunism of a partner appeared exclusively within the Chinese companies, while the Americans had to contend predominantly with disparate corporate cultures as well as lack of trust between partners. Another important question concerned the competition criteria currently dominating the steel industry.

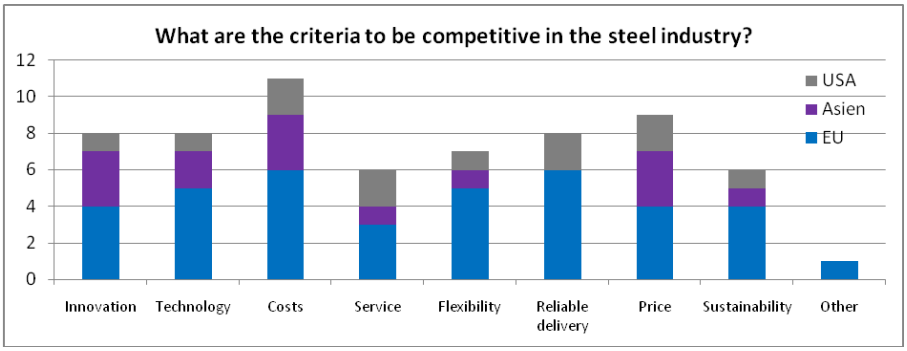

Figure 24:Current competition criteria in the steel industry accordingto country[157]

For the assessment of competition criteria, striking differences in their weighting are evident. While the Europeans rank costs and delivery reliability in first place, the latter criterion has no significance for Chinese steel producers. By contrast, innovation is very important for the Chinese, whereas for other nations it played a

[157] Source: Own illustration

rather minor role. All countries gave the criterion item of sustainability a very negligible weighting.

6.1.2. Survey Results for Steelworks Worldwide

Tallying the number of all the employees as well as tonnage yielded a total of 271,958 employees accompanied by a tonnage of 100,140,300. Measured against world production in 2013, this constitutes a share of 6.4%. However, if one regards the actively relevant markets for this paper (Europe, China, USA), the share increases to 9.5%.[158]

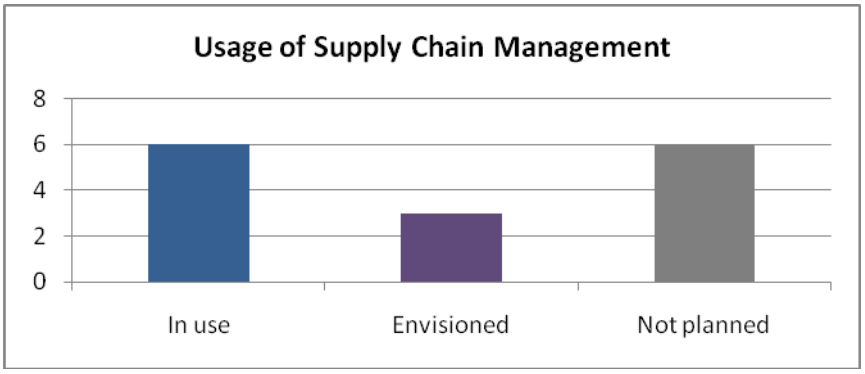

Figure25:Usage ofsupplychainmanagementworldwide[159]

40% of the companies who participated in the survey are already using supply chain management. Another 20% are considering its implementation in the foreseeable future. 40%, the same figure for companies who are already using supply chain management, do not intend to exercise this approach within the next few years. This is a

[158]Cf. Wirtschaftsvereinigung Stahl, 2014, p. 81
[159]Source: Own illustration

relatively high number, when one considers the associated opportunities for increasing profitability and competitive capacity. These options are specified in the following illustration.

What competitive and profitability advantages were you able to achieve?

	1-10%	11-20%	21-30%	>30 %
Increase in RoA	1			
Increase in EBIT	2	1		
Reduction of transport costs	1			

	1-10%	11-20%	21-30%	31-40%	>40 %
Reduction in overall lead time	1		1		
Reduction in customer complaints	1				

	1-10%	11-20%	21-30%	31-40%	41-50%	51-60%	>60 %
Improved delivery capacity	1		1				
Reduction of storage costs	1	2					
Other	2						

	1-6%	7-12%	13-18%	>18 %
Reduction of material costs	2			

Table10:Total of achieved competition and profitability advantages[160]

[160]Source: Own illustration

When considering the scores of answers obtained with respect to improvement potentials for the various key factors of competitive capacity, profitability, processes and risks, an improvement of only between 1-10% could be achieved. Several values, increasing EBIT, for instance, could only be raised by 11-20%. Implementation of supply chain types thus demonstrates a bold significance.

Which supply chain types are in use at your plant?				
	Iron Scrap	**Alloys**	**Electrodes**	**Refractory material**
No answer				
Lean Supply Chain	2			
Flexible Supply Chain	1	1		
Consolidated Supply Chain	1	1	2	2
Fast Supply Chain	1	1	1	1
Derivation from the Reference Model				
Own types	1	1	1	
Others				
None				
Don't know				

Table11:Total usage of supplychaintypesaccording to commodity groups[161]

The majority of companies most frequently cited the iron scrap supply chain. As a rule, this also comprises the most purchasing volume, followed by alloys, refractory material and electrodes. Another aspect is that supply chains for both refractory materials and electrodes end at the steel production stage, since they are consumed by the melting process.

[161] Source: Own illustration

Risks involved for implementing supply chain management revealed a tell-tale sequence of factors, which are cited in the following illustration.

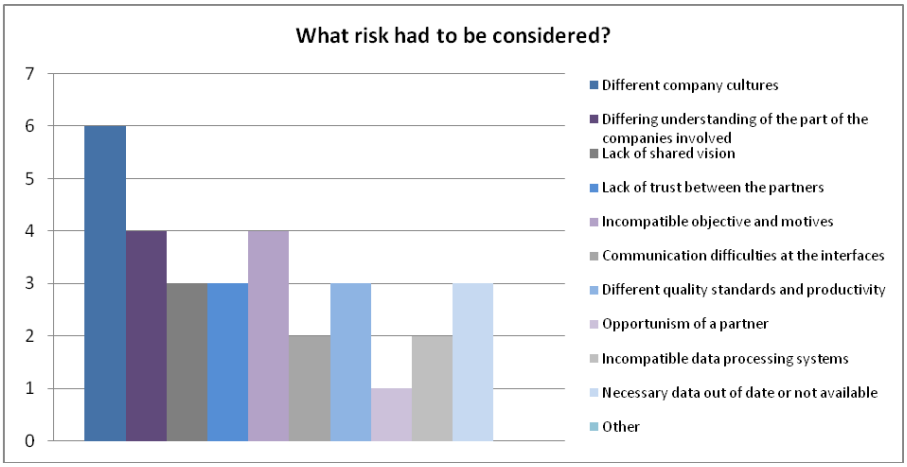

Figure26:Risks to consider[162]

A disparate corporate culture was by far the most cited item for risks to take into consideration. Differing comprehension of the participating companies took second place followed by incompatible objectives and motives of the participating companies. Incompatible data processing systems was noted near the bottom of the risk criteria. This is apparently a risk that can be ably managed.

The current assessment of competition criteria for the steel industry indicates a varied image, in which there are several top figures and a very strong middle ranking.

[162]Source: Own illustration

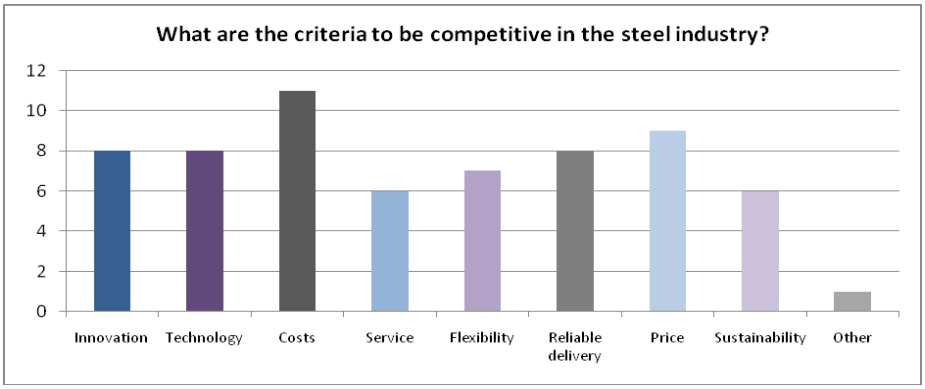

Figure27:Total current competition criteria in the steel industry[163]

Costs are top-rated among the competition criteria. Cost reduction is the highest priority for many of the companies, and far surpasses the well-known strategy of "fill the mill". This particular approach is no longer feasible in order to keep up with the increasingly stiff competition. What is quite surprising is that customer service has a rather minor significance, yet customer focus is the most important factor in supply chain management.

Concerning the question of whether an indicator system is in place, 11 companies surveyed answered in the affirmative. Only three of the companies answered with "No" (1 abstention). The types of indicator systems in place are presented in the following illustration.

[163]Source: Own illustration

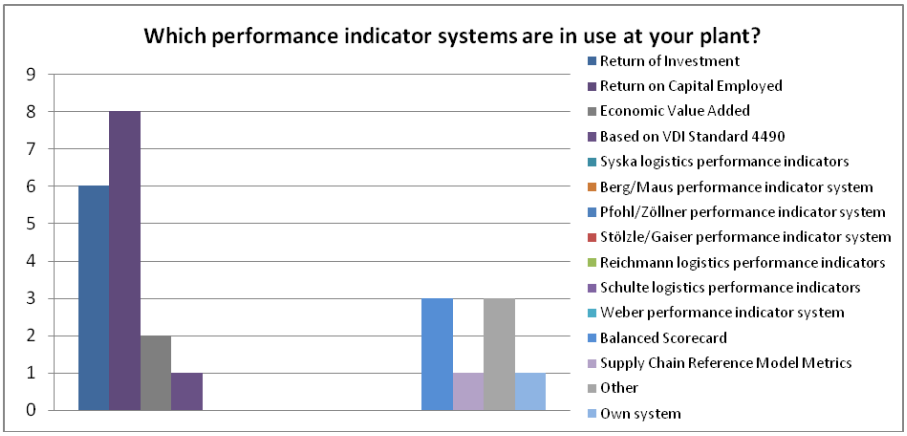

Figure28:Total performance indicator systems used[164]

Conventional indicator systems, such as return on capital employed (ROCE) and return on investment (ROI), are the most widely used. Modern approaches that are aligned with supply chain management, namely economic value added, balanced scorecard or supply chain reference model metrics, are only seldom used, but they still clearly exhibit potential.

For the final question addressed in this chapter, that of key indicators, networking capital takes centre stage. The question pertained to key indicators, which are continually measured.

[164]Source: Own illustration

Which performance indicators are continuously measured?

	1-10	11-20	21-30	31-40	41-50	>50
Days Inventory Held	3	3	2	1	1	2

	1-30	31-60	61-90	91-120	121-150	>150
Days Sales Outstanding	2	4	5	1		
Days Payable Outstanding	3	5	3	1		

	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80
Cash to Cash Cycle	1	1	2	2	1		1		1

Table12:Total of performance indicatorsfornetworkingcapital[165]

The answers could not have been more diverse. However, this was to be expected since a variety of payment conditions prevail only within Europe. In the southern countries, these tend to be longer than in their northern counterparts (see the corresponding table in the Appendix).[166]

6.2. Summary

In summary, it can be established that many differences exist among the markets investigated. Americans are the leaders in terms of implementing supply chain management. The Chinese follow closely thereafter, while Europeans lag somewhat behind. There are no significant differences in achieved objectives via the introduction of

[165]Source: Own illustration
[166] Cf. Table in Appendix, p. 156

supply chain management with respect to competitive capacity and profitability. The level of success among the individual key indicators can only be viewed as rather modest. Yet there is great potential when considering the total of all key indicators. Whereas Chinese steel companies perceived that implementing supply chain management would pose a high number of risks, the Americans and Europeans held this perception to a lesser extent. For the Europeans, it remains a minor issue. Within all three markets, costs are currently the most significant competitive factor. Yet it must not be assumed that liquidity alone is a guarantee for a company's continuous survival. To this end, investments that represent a company's mid- to long-term security ought to be handled very prudently. Last but not least, there was great potential demonstrated in the implementation of existing indicator systems. Supply chain management can only lead to success if all areas are targeted accordingly, which also includes a suitable performance measurement system.

7. Implementation for the Steel Industry

In order to aptly answer the question regarding the currently most effective supply chain per commodity group, results were compiled from the questionnaires. It is appropriate to give credence to the statements disclosed regarding competition criteria. Proper weighting regarding the frequency of competition criteria in addition to the actively achieved improvements should also be granted. In this way, a supply chain concept allocation can ensue, alongside the support from current market conditions. Additionally, supply chain management design according to commodity groups will be developed, with an emphasis on the focal company. These variances are expected, since there is no uniform supply chain definition point to encompass all commodity groups. Finally, this section will delve into the improvement potential in relation to profitability, competitive capacity, processes and risks. This forms the basis for additional development of future and potential opportunities for the steel industry addressed in Chapter 8.

7.1. Answer Matrix

The answer matrix was designed on the basis of an evaluation questionnaire. Therefore, using revamped graphs from Chapter 6 does not avail for this purpose, since they indicate a different degree of detail. Not all companies that actively employ supply chain management provided information concerning their realised potentials. It was foreseeable that not all companies would respond

to these questions, since they concerned their core area of activity. The first commodity group evaluated is iron scrap. In most of the steel companies that operate an electric arc furnace, this commodity group, along with alloys, yields the strongest purchasing volumes.

Iron Scrap:

Supply Chain Type / Improvement	Lean	Flexible	Consolidated	Fast	Own
SC Types Used (in number of mentions)	2	1	1	1	1
Profitability(RoA)					1-10%
EBIT	11-20%			1-10%	1-10%
Delivery Capacity	1-10%				21-30%
Overall Lead Time	1-10%				21-30%
Material Costs	1-6%				1-6%
Storage Costs	1-10%			11-20%	11-20%
Quality Costs					
Transport Costs					1-10%
Customer Complaints	1-10%				

Table13:Supplychainpotentialsfor the iron scrap commodity group[167]

For the iron scrap commodity group, there are various supply chains in operation and it is the group that ranks at the top of the lean supply chain with the most mentions. However, in the flexible and consolidated supply chain categories, there was no information submitted for improvement potential. In terms of the scales for

[167] Source: Own illustration

improvement, the achieved results ranked at the lower end of opportunities. The alloys commodity group fared similarly in this ranking.

Alloys:

Supply Chain Type / Improvement	Lean	Flexible	Consolidated	Fast	Own
SC Types Used (in number of mentions)		1	1	1	1
Profitability (RoA)					1-10%
EBIT		11-20%		1-10%	1-10%
Delivery Capacity		1-10%			21-30%
Overall Lead Time		1-10%			21-30%
Material Costs		1-6%			1-6%
Storage Costs		1-10%		11-20%	11-20%
Quality Costs					
Transport Costs					1-10%
Customer Complaints		1-10%			

Table14:Supplychainpotentialsfor the alloys commodity group[168]

For the alloys commodity group, the lean supply chain was immaterial. In fact, none of the companies use this type of supply chain. The number of mentions also does not indicate any preference, while the remaining supply chain types were mentioned with equal

[168] Source: Own illustration

frequency. Electrodes had a slightly different outcome in terms of types of supply chain, whereby the focal company is different than for iron scrap and alloys. It is the same for refractory material. Refractory material and electrodes are used for steel manufacturing and also consumed during this process, and thereby do not reach the final product stage.

Electrodes:

Supply Chain Type / Improvement	Lean	Flexible	Consolidated	Fast	Own
SC Types Used (in number of mentions)			2	1	1
Profitability (RoA)					1-10%
EBIT			11-20%	1-10%	1-10%
Delivery Capacity			1-10%		21-30%
Overall Lead Time			1-10%		21-30%
Material Costs			1-6%		1-6%
Storage Costs			1-10%	11-20%	11-20%
Quality Costs					
Transport Costs					1-10%
Customer Complaints			1-10%		

Table15:Supplychainpotentials for the electrodes commodity group[169]

By virtue of number of mentions, one supply chain type was brought to the forefront: the consolidated supply chain. In contrast to the alloys commodity group, neither the lean supply chain nor the

[169] Source: Own illustration

flexible supply chain merited any mention. Owing to the fact that they have the same focal company, it is to be expected that the valuation for the refractory material commodity group is identical to that of electrodes, since they fall under the same category.

Refractory material:

Supply Chain Type / Improvement	Lean	Flexible	Consolidated	Fast	Own
SC Types Used (in number of mentions)			2	1	
Profitability (RoA)					
EBIT			11-20%	1-10%	
Delivery Capacity			1-10%		
Overall Lead Time			1-10%		
Material Costs			1-6%		
Storage Costs			1-10%	11-20%	
Quality Costs					
Transport Costs					
Customer Complaints			1-10%		

Table16:Supplychainpotentials for the refractory material commodity group[170]

The above figure portrays a nearly identical image to that of the electrodes commodity group. However, there is no mention of use of

[170] Source: Own illustration

one's own supply chain, which means, in practice, a larger supply chain gap exists than for that of the electrodes commodity group.

7.2. SC Concept Classification

Supply chain concept classification is implemented on the basis of the results achieved from the questionnaire. Deciding factors for classification include the indicated potentials as well as the frequency of mentions for the individual supply chain types per commodity group. As demonstrated in the previous section, these vary greatly. Since customer demands form a core element of supply chain management, this element in the development of this paper regarding competition criteria within the steel industry will be included in this concept classification. The achieved improvements are classified into the mentioned competition criteria, in order to verify the greatest possible success. For this reason, the ideal variant of the supply chain type is developed for each commodity group.

7.3. Supply Chain Management Design

The SCOR model (Supply Chain Organisation Reference Model) from the Supply Chain Council will be consulted as the basis for this paper. It also served as the foundation for the questionnaire for the various supply chain types. On account of its complexity, only this portion of the value chain framework was deliberately selected. The purviews of Customer Chain Operations Reference (CCOR) and Design Chain Operations Reference (DCOR) were omitted. [171]

[171] Cf. Bolstorff und Rosenbaum, 2012, p. 12-13

However, several points are to be observed in the design of the supply chain. Fundamentally, the supply chain strategy must always be aligned with the company's prevailing competition strategy. The justification of its importance will be outlined in basic detail as follows. A retailer wants to offer a large selection of products. In order to do so in a cost-effective manner, he has decided to keep his inventory as low as possible. In addition, he opts for the cheapest transport company as well as the least expensive suppliers due to cost pressures. It is inevitable that his chosen strategy will not be a formula for success. From a selling perspective, the strategy of a wide assortment poses a danger and from the purchasing point of view, the cost optimisation is likewise at risk. As a result, the shelves are empty from time to time. This example demonstrates a large discrepancy in what is known as the strategic fit. The supply chain strategy is not congruent with the company's competition strategy. In order to achieve this strategic fit, several points must be taken to task. The competition strategy as well as all functional strategies must be aligned to promote a coordinated overall strategy. To successfully implement this strategy, three different functions within the various functions within the company must structure their processes and resources correspondingly. The performance objects and potentials can be made available in an ample capacity. Finally, the roles of each level as well as the design of the supply chain must be coordinated. The objective is to support the supply chain strategy.[172] Design of the supply chain for the four researched

[172] Cf. Chopra und Meindl, 2014, p. 44-47

commodity groups was based on competition criteria and their frequency. These factors determine the competition strategy to which the supply chain aligns itself.

7.3.1. Iron Scrap Supply Chain

The iron scrap supply chain had varying mentions in terms of supply chain type. Nonetheless, the number of mentions as well as the competition strategy of cost leadership speaks for themselves. The lean supply chain type should be prioritised for iron scrap, since this type yields the most mentions as well as the greatest potentials for cost improvement. Case studies in the automotive industry cite the lean supply chain as the ideal type.

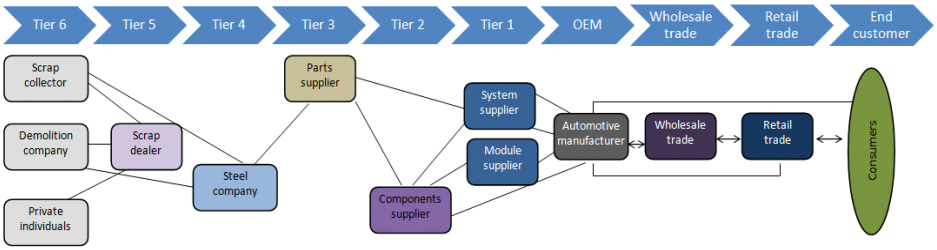

Figure 29: Supply chain illustration for iron scrap[173]

The figure illustrates a typical iron scrap supply chain, which designates the automotive industry as the OEM (Original Equipment Manufacturer). The favoured supply chain type, that is, the lean

[173] Source: Own illustration

supply chain, is characterised as integral and effective. By means of customers' decrease in willingness to wait, triggered by increasing variety, the demand has become more volatile. The concept of time to market has thus taken on a greater significance. These customer and market factors constitute the requirements for the lean supply chain type. Inevitably, this design also has repercussions for the individual functions of a company. For procurement, this means a concentration of suppliers and associated increase in the number of system/module suppliers from the OEM perspective. In addition, the segmentation of procurement logistics owing to high diversity of variants and the related large number of components, as well as close proximity to the OEMs by means of newly created industrial parks plays a role. For planning, selecting this supply chain type means construction of a chain encompassing the appropriate levels and continuous production planning. Shorter order processing time must be achieved through improved planning. To this end, approaches such as just-in-time or just-in-sequence can be enacted. Diversity of variants in designing individual vehicle models leads to complex replanning processes over which control must be gained through an appropriate dynamic change management. To successfully confront and resolve these demanding planning goals, complete integration of the entire supply chain is required.[174] This approach also applies to the steel industry.

[174]Cf. Corsten und Gabriel, 2004, p. 249-258

7.3.2. Alloys Supply Chain

The outcome of the survey regarding supply chain type for the alloys commodity group was surprising: no clear result could be determined in regard to the number of mentions for supply chain type. With the exception of the lean supply chain, which none of the individuals surveyed deemed as important, all the other types (flexible, consolidated, fast, and own) were classified the same. Consequently, no distinguishing characteristic could be derived. Be that as it may, the consolidated supply chain did not exhibit improvement potential, and thus this type is no longer available for further consideration. However, the flexible, fast and own supply chain types remain for a subsequent study. The fast supply chain is used in the consumer goods industry as a rule. The objective for this type is to design a fast and reactive supply chain encompassing basic products with short innovation cycles.[175]. For alloys, however, the supply chain involves complex products whose form, composition and availability can vary greatly. Innovation cycles are designed for the long term, since sustainable change is not possible without previous research. Comparatively, the flexible supply chain is ascribed to the high tech industry. It is conceptualised for dynamically fitted modular products with short innovation cycles. This also means that they are subject to high rates of change and must demonstrate a high diversity of variants.[176] In comparing these characteristics with those for alloys, it must be pointed out that they

[175]Cf. Corsten und Gabriel, 2004, p. 277-288
[176]Cf. Corsten und Gabriel, 2004, p. 259-268

are diametrically opposed. Even in this instance, the supply chain type allocation does not seem logical. Lastly, development of the company's own supply chain comes to the fore. This type is optimally suited to the previous knowledge level for the alloys commodity group. Since the lean supply chain type for the automotive industry is typically not relevant among the surveyed companies, it would be logical to modify this approach. Consequently, this paper will use the own supply chain type for the alloys commodity group.

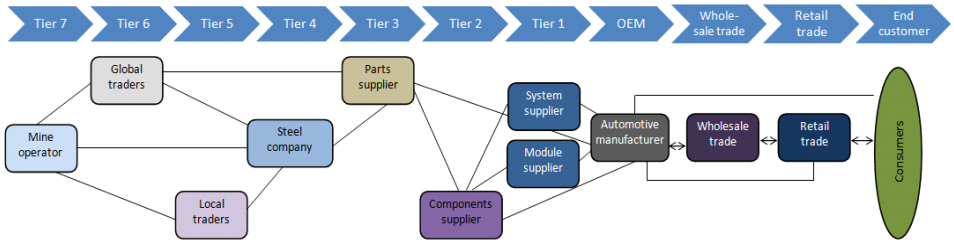

Figure 30: Supply chain illustration for alloys[177]

The supply chain for alloys is identical up to tier 4 from the iron scrap supply chain. However, from tier 5 it is specifically designed on the basis of the alloys commodity group, from which the gradation continues to tier 7. The steel industry is supplied by all suppliers along the chain. This means that local and global traders alike, as well as mine operators supply directly to the steel industry. Large steel companies such as Arcelor Mittal even have their own mine at their disposal.

[177] Source: Own illustration

7.3.3. Electrodes Supply Chain

None of the participants mentioned the lean or flexible supply chain type for the electrodes commodity group. However, own and fast supply chain types were actively used, which also exhibited savings potentials. The consolidated supply chain type received the most mentions. This type is suitable for rather basic products with longer innovations cycles. Increasing regulation prevails, customers are becoming more demanding, rising costs are emerging and the significance of supply chain management is underestimated.[178] This portrait aptly depicts the situation of the electrodes market. Superior quality is demanded at the lowest cost. Most producers are already unable to cover the costs for manufacturing their products. Additional services are only hesitantly introduced, which could offer customers additional value and thereby reduce cost pressure on the product. The company SGL Carbon GmbH will be cited as an example, which uses its service product SGL Pro for customers with a 4-level method with the support of Six Sigma (a management system for processing improvement, statistical quality and simultaneously a method of quality management) to examine all influencing variables concerning electrodes. These developed potential improvements are divided among the parties involved according to a negotiated key. This means a win-win situation for all concerned.

[178] Cf. Corsten und Gabriel, 2004, p. 269-276

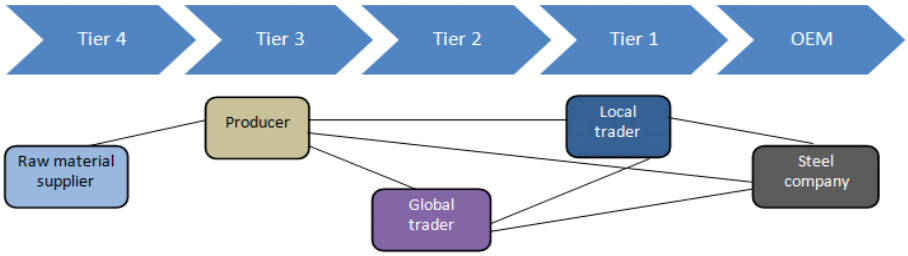

Figure 31: Electrodes supply chain illustration[179]

A striking change for the electrodes commodity group is evident in addition to the previously described commodity groups. This is not a component of the end product as is the case for iron scrap and alloys. The function of electrodes within the production process is to melt iron scrap. These are electrically heated with a temperature of up to a maximum of 3,600 °C in order to bring molten steel to 1,600 °C. Electrodes are used up in the process, and what is not usable goes through a recycling process. The steel industry can be supplied by all levels of the supply chain, except for tier 4, which supplies raw material for electrodes producers. However, this is dependent on the current sourcing strategy.

7.3.4. Refractory material Supply Chain

Refractory material received the least amount of mentions of all the surveyed commodity groups and thereby took last place in terms of importance. Only 50% of the companies who use supply chain management use it for the refractory material commodity group. As

[179] Source: Own illustration

a consequence, the diversity of the responses is greatly restricted and tends to focus on the fast and consolidated supply chain type. The consolidated supply chain type garnered the most mentions as well as the greatest potential. As previously described in section 6.3.3., the characteristics of this type also apply to refractory material. This type of material requires a very elaborate and energy-intensive production process. Innovation cycles are long by nature, since they usually also involve significant investments. The base material magnesite is mined in many countries around the world. Since it is a natural product, there tends to be great differences in quality

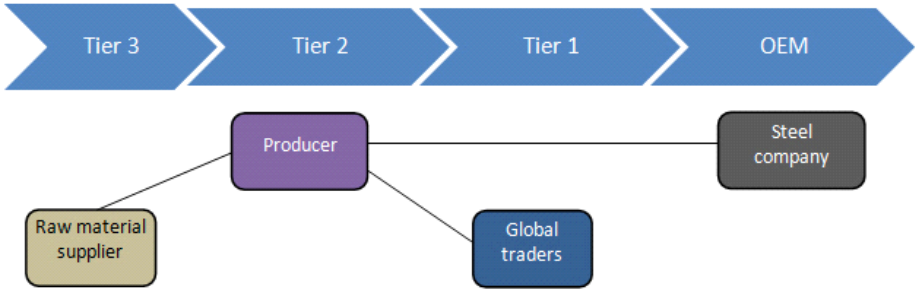

Figure 32: Refractory material supply chain illustration[180]

The supply chain is again one level shorter than for the electrodes commodity group. Since the number of producers is much lower than for other commodity groups, there are virtually no local traders in this supply chain. This also supports the fact that great product

[180] Source: Own illustration

knowledge is required in order to be in a trading position. From the perspective of most steel workers, refractory material is qualitatively the most sensitive product. Any errors made, whether at the procurement stage or even while delivering a furnace, can unleash massive repercussions. An error in the latter regard could lead to a break in the furnace, which means that the hot steel would eat through the entire furnace wall and subsequently leak. This is the reason to aim for long-term partnerships between suppliers and customers. It is the only means by which it can be guaranteed that, in terms of quality, a continuous level of service remains intact and existing risks can be reduced. Within this context, it is completely logical to implement the consolidated supply chain type. Therefore, this type will be used as the basis for the commodity group of refractory material for further evaluation within this paper.

7.4. Increase in Profitability

Return on asset and the EBIT were ascribed to profitability from the requested key indicators in the questionnaire. For EBIT (Earnings before Interest and Taxes), earnings before interest and taxes were identified. EBIT was not influenced by either financial or tax policy, which proves to be a great advantage and can be compared to companies with varying financing structures.[181] Return on assets demonstrates prior effectiveness of capital expenditure in terms of an investment object. RoA is an indicator of a company's evaluation, which reveals the profitability of the capital employed. Although RoA is comparable with return on investment, the former is better

[181] Cf. Pape, 2011, p. 258

suited for conveying the company's profitability by means of settling the interest on borrowed capital. In German, RoA is referred to as the return on total capital and is calculated as the outcome of profit margin and capital turnover.[182]

Profitability Key Indicators / Commodity Group	Improvement inRoA		Improvement inEBIT	
Iron Scrap	lean		lean	11-20%
	flexible		flexible	
	consolidated		consolidated	
	fast		fast	1-10%
	own	1-10%	own	1-10%
Alloys	lean		lean	
	flexible		flexible	11-20%
	consolidated		consolidated	
	fast		fast	1-10%
	own	1-10%	own	1-10%
Electrodes	lean		lean	
	flexible		flexible	
	consolidated		consolidated	11-20%
	fast		fast	1-10%
	own	1-10%	own	1-10%
Refractory material	lean		lean	
	flexible		flexible	
	consolidated		consolidated	11-20%
	fast		fast	1-10%
	own		own	

Table17:Key indicators for increasingprofitabilitypercommodity group andsupplychaintype[183]

[182] Cf. Chopra und Meindl, 2014, p. 71-72
[183] Source: Own illustration

The above table illustrates the achieved improvement potential from using supply chain management in the area of profitability. Improvement is demonstrated according to commodity group, key indicator and supply chain type. Supply chain types marked represent the favoured solutions according to commodity group. The most responses were generated for the EBIT key figure. This key indicator is widely distributed within most of the companies. By contrast, the RoA is used less often. EBIT was able to achieve improvements between 1-20% by using supply chain management, while RoA reported an outcome of 1-10%.

7.5. Increase in Competitive Capacity

Responses from the survey regarding competition criteria in the steel industry paint a vivid picture. The criterion of costs was the most cited. This indicates that companies that have their costs under control and also have ample measures on hand to improve costs can be successful in the long term. Key indicators for competitive capacity comprised material costs, storage costs, as well as transport costs. These indicators make sense insofar as the flow of material can be covered cost-effectively. Material is initially purchased, then transported, and then stored before it is eventually used.

Competitive Capacity / Commodity Groups	Material costs		Storage costs		Transport costs	
Iron Scrap	lean	1-6%	lean	1-10%	lean	
	flexible		flexible		flexible	
	consolidated		consolidated		consolidated	
	fast		fast	11-20%	fast	
	own	1-6%	own	11-20%	own	1-10%
Alloys	lean		lean		lean	
	flexible	1-6%	flexible	1-10%	flexible	
	consolidated		consolidated		consolidated	
	fast		fast	11-20%	fast	
	own	1-6%	own	11-20%	own	1-10%
Electrodes	lean		lean		lean	
	flexible		flexible		flexible	
	consolidated	1-6%	consolidated	1-10%	consolidated	
	fast		fast	11-20%	fast	
	own	1-6%	own	11-20%	own	1-10%
Refractory material	lean		lean		lean	
	flexible		flexible		flexible	
	consolidated	1-6%	consolidated	1-10%	consolidated	
	fast		fast	11-20%	fast	
	own		own		own	

Table18:Key indicators for increasingcompetitive capacity by commoditygroup andsupplychaintype[184]

Improvement in material costs was cited by all responding companies at a rate of 1-6%. This suggests that while objectives can be set for improvement, it is nonetheless not the primary focus. However, there is a higher priority for storage costs, wherein there was a spectrum of responses, of which the best rate of improvement

[184] Source: Own illustration

achieved was 11-20%. Supply chain management wields the most influence on storage costs as a factor in competitive capacity. For the criterion of transport costs, the response return was rather low: 1-10% could be saved, which indicated a more favourable result than for material costs. Ultimately, supply chain management is an interesting lever with respect to competitive capacity.

7.6. Acceleration of Processes

Delivery reliability and flexibility are additional competition criteria cited in the steel industry. They command third and fourth place behind costs and price. Delivery capacity has a high value in the steel industry. There are even companies whose profitability is controlled by delivery deadlines. This means that the material ordered can only be delivered once a profit margin previously determined by the company has been achieved. Under certain circumstances, this could lead to delays of several weeks or even months.

Process key indicators / Commodity Group	Delivery Capacity		Overall Lean Time		Quality Costs	
Iron Scrap	lean	1-10%	lean	1-10%	lean	
	flexible		flexible		flexible	
	consolidated		consolidated		consolidated	
	fast		fast		fast	
	own	21-30%	own	21-30%	own	
Alloys	lean		lean		lean	
	flexible	1-10%	flexible	1-10%	flexible	
	consolidated		consolidated		consolidated	
	fast		fast		fast	
	own	21-30%	own	21-30%	own	
Electrodes	lean		lean		lean	
	flexible		flexible		flexible	
	consolidated	1-10%	consolidated	1-10%	consolidated	
	fast		fast		fast	
	own	21-30%	own	21-30%	own	
Refractory material	lean		lean		lean	
	flexible		flexible		flexible	
	consolidated	1-10%	consolidated	1-10%	consolidated	
	fast		fast		fast	
	own		own		own	

Table19:Key indicators foracceleratingprocessesby commodity groupandsupplychaintype[185]

Interestingly, implementing supply chain management did not yield any reduction in quality costs. None of the companies surveyed could make a statement to this effect. Conversely, delivery capacity as well as overall cycle time demonstrated a certain potential. A

[185] Source: Own illustration

reduction of up to 30% is possible according to the selected supply chain type for both key indicators. This is a very sound value and sustainably supports the criteria of delivery reliability and flexibility. Indeed, the choice of supply chain type plays a crucial role. For some supply chain types, a value of "only" 1-10% improvement potential is demonstrated, and for others it is as high as 21-30%.

7.7. Risk Minimisation

The issue of risk minimisation is growing in importance, which can be attributed to an increasingly dynamic and complex economic environment. There are risks that are difficult to control due to their growing complexity. One such risk is product quality. Due to the security of supply, new methods must be devised. In order to maintain a competitive capacity, global raw materials are procured. As a result, material is available and costs are curbed. However this method can cause temporary quality problems, which are then reflected by customer complaints. If complaints become more frequent, a company runs the risk of sustainable damage to its corporate image under the circumstances. Ultimately, contracts are severed and customers look elsewhere for products and services.

Risk minimisation key indicator / Commodity groups	Customer Complaints	
Iron Scrap	lean	1-10%
	flexible	
	consolidated	
	fast	
	own	
Alloys	lean	
	flexible	1-10%
	consolidated	
	fast	
	own	
Electrodes	lean	
	flexible	
	consolidated	1-10%
	fast	
	own	
Refractory material	lean	
	flexible	
	consolidated	1-10%
	fast	
	own	

Table20:Key indicators forrisk minimisation bycommodity groupandsupplychaintype[186]

The response from the questionnaire regarding reduction in customer complaints was fairly week. This key indicator is certainly measured in the majority of steel companies. Nevertheless, implementing supply chain management only exercises a limited influence on this vital key indicator. An improvement of 1-10% for customer complaints also reflects the lowest value of the responses.

[186] Source: Own illustration

7.8. Summary of Results

The objective of this paper is to improve the competitive capacity and profitability by means of implementing targeted supply chain management in the steel industry. For this purpose, research questions were defined, which allowed conclusions to be drawn regarding the achievement of objectives on the basis of responses received. For a methodical approach, a written expert survey was selected, and then divided into two categories. Participants from the first category were directly surveyed by the author of this paper, which was possible due to a personal relationship and served as verification for the survey's feasibility. In the second category, 10-20 steel works worldwide were anonymously interviewed by means of an electronic survey tool. In total, 36 questionnaires were sent in German, English and Chinese. Fifteen completed questionnaires were returned within the response deadline. It is a response rate of 41.67%, which demonstrates an estimable figure. There was also a good response rate from companies in the various regions of the world: 8 questionnaires were submitted by European steel works, 5 from Chinese steel works and 2 from American steel works. These completed questionnaires facilitated a comparison of the regions. In so doing, they provided the basis for answering the research questions and these can be answered as follows.

There are many different supply chains in today's steel industry. Four commodity groups and their respective supply chains were outlined for this paper. These groups comprise the iron scrap, alloys, electrodes, and refractory material supply chain. Supply chain types

used today could be developed from the answers from the survey, namely, the lean, flexible, consolidated, and fast type, as well as a company's own supply chain designs.

It was also possible to determine the supply chain types for the competition arena. These were developed using the number of mentions per supply chain as well as the identified improvement potential. The slender supply chain type was allocated to the iron scrap supply chain. For alloys, the respective company's own creation was the most suitable, and for electrodes as well as refractory material the consolidated type was assigned.

On the basis of the survey results, existing supply chain concepts can be applied to 75% of the steel industry today. The concepts introduced in this paper (lean, flexible, consolidated and fast) were developed by the Supply Chain Council (SCOR model).

To the research question of whether it is possible to generate a competitive capacity in the steel industry by implementing supply chain management, the answer is a resounding „yes". However, this affirmation does not address the level of improvement potential.

The contribution supply chain management can proffer with respect to competitive advantages in the steel industry, when all potentials from survey responses are combined, is considerable. However, the respective improvement potential for the individual key indicators is found at the lower end of the predefined scale. Bearing these results in mind, surveys from other literary sources in which the potentials indicated are slightly higher are not verified.

The survey used in the paper on the current status of supply chain finance was restricted to the components of the cash conversion cycle. In this instance, no uniform picture could be developed. There were only compelling differences within Europe, since payment performance in other countries such as Italy and Germany can be as many as 60 days apart.

The question regarding which key indicator systems are available in the steel industry could be answered: return on capital employed as well as return on investment were predominantly utilised. Some companies were still implementing the balanced scorecard within the context of supply chain management to a lesser extent.

In summary, it can be maintained that on the basis of the rate of response from the surveys, answers for the research questions could be obtained, and could thereby fulfil the objective of this paper.

8. The Future of the Steel Industry in Europe

Describing the future of the steel industry in Europe requires the perspective of the global development trends. The author sought out trends that were frequently cited in books. The timeframe for which the prognoses were created, vary greatly. Thus, for the sake of simplicity and clear definition, the year 2050 was chosen as the upper limit for the period under review. Projecting further into the future from today's perspective is not logical, since the challenges that will confront the economy within the next 35 years are already great enough. And what exactly are the challenges for the next decade? According to Laurence C. Smith, they are the four global forces that the world must reckon with and by which it will also influenced. Demography is the first of these trends. Within this frame of reference, it pertains to the aging society in the old industrial nations. The average age of the population is increasingly rising and renders the influx of younger people, which the industry needs, more and more difficult. Another component of demography is migration and its currents. These factors have strongly gained significance, especially most recently, since they represent not only major challenges for Europe, but also the accompanying population growth. [187] According to demographers' estimates, the world population will increase to 9.2 billion by 2050. The second global force involves humanity's growing demand on natural resources.

[187] Cf. Smith, 2014, p. 31-37

These include finite resources (fossil fuels, minerals, etc.) as well as renewable resources such as water (rivers), arable land, plants, etc. There already exists a lack of natural resources today. The Chinese government has confronted this development and is preparing accordingly by purchasing arable land throughout the world and growing food for its own population. Globalisation comprises the third global force. As per Smith, globalisation is the increasing consolidation of nations in the areas of economic, social and technical processes. This consolidation will grow more interdependent over time. Climate change represents the fourth global force. This phenomenon has arisen from the negative repercussions on the climate triggered by mankind's industrial activity. One of its consequences is global warming, which is increasingly transforming the planet. In addition, a fifth force can be cited, which bears influence on all four global forces: technology.[188]

Another important and trustworthy source is a report from the Club of Rome. This report examines global developments respectively for the next 40 years. This report takes a somewhat different approach regarding the world population scenario. It maintains that the world population will reach its peak by 2040 with 8.1 billion people. This projection is based on the drastically falling birth rates corresponding to the rise of highly-populated megacities. An outcome of this phenomenon is the slower than anticipated GDP (gross domestic product) growth demonstrated by nations. Due to resource depletion, environmental pollution, climate change, loss of

[188]Cf. Smith, 2014, p. 37-49

biodiversity and social injustices, the growth rate for global consumption is to decrease as of 2045. Consequently, regions of the world were derived that will be among the winners in the future, namely, China or the BRISE countries (Brazil, Russia, India, South Africa, Indonesia, Mexico, Vietnam, Turkey, Iran, Thailand, Ukraine, Argentina, Venezuela and Saudi Arabia). The Club of Rome's report brands the USA as the absolute loser in this regard. Other countries that were not already mentioned will remain poor.[189]

Even Eberl speaks of a world population of approximately 9 billion in the year 2050, of which 6.5 billion will reside in megacities.[190] The trend towards megacities seems to be consistent with all previously researched sources, which gives credence to the probability of this scenario.

Last but not least, Lyons also addresses urbanisation, demographic trends as well as China's ascent and accompanying emergence of new trade corridors.[191] These factors prompt the question: what are the prognoses for the economy? With this valid question in mind, the focus will rest specifically on the automotive industry, which has been selected as the fundamental industry for this paper.

Simon outlines six economic trends for our future. As previously mentioned, he also supports the notion of accelerating globalisation and regards it as a key capability for companies and their employees to foster respect toward other cultures. This is the only means by

[189] Cf. Randers, 2013, p. 406-408
[190] Cf. Eberl, 2011, p. 4-5
[191] Cf. Lyons, 2014, p. 372-373

which globalisation can be sustained. Politics, in other words the government, will exercise even greater influence on companies. Therefore, management skills, which impact the political decision-making process, will become more significant (lobbyism). Furthermore, a narrower integration of management and capital will ensue. To this end, it is important to ensure that company management is a process that involves all aspects, from the manager to the entrepreneur. Simon also discusses tectonic shifts in the product landscape, by which he means the existence of a new segment at the lower end of the price scale. For the automotive industry, this would concern the ultra low cost car segment, which shows great promise, and customer behaviour will accordingly change increasingly. Rationality will become more prevalent and the cost-use advantages will rise to the fore. Expensive impulse purchases will be eschewed. Complete interlinking is advancing towards the distribution of digital products.[192]

By Hubbert's estimation, consumer behaviour will likewise change by moving away from the status symbol automobile in favour of a total cost of ownership approach, that is, the cost of a vehicle taking all factors into consideration. Emotion as the impetus for making purchases will be replaced by objective, fact-oriented decisions. In the upcoming decades, the automobile will transform into a sensitive vehicle. To elaborate, it will become aware of its environment by means of sensors and react accordingly. Complete interlinking also means that other vehicles in traffic can receive information at an

[192] Cf. Simon, 2011, p. 9-14

early stage and be able to act appropriately. In parallel to the innovations within the Smartphone and smart watch industry, automobile instrument panels will likewise change. They will be able to be individually customised, that is, user-oriented. Information will be displayed according to current importance and only displayed as long as necessary. Alongside the previously mentioned ultra low cost cars, another segment within megacities will be generated: the so-called city car segment. The importance of owning one's own vehicle will lose its significance within megacities. Combined traffic concepts are gaining importance. The appropriate drive concepts during the first phase are leaning towards a hybrid, that is, a combination of combustion engine and electric power system. It is highly probable that over time the electric power system will take precedence in mega cities. What do these developments mean for components and suppliers? Based on the efforts to continually reduce emissions and usage, these also impact vehicle weight, for example the drive assembly. These new developments require alternative materials, which have the same properties, yet are lighter. Possible variations might include aluminium-silicon alloys, magnesium alloys or what are known as TWIP steels, which is an alloy comprising iron, silicon, aluminium and manganese. TWIP steels were also an important subject at the 4th International Conference on Steels in Cars and Trucks in Braunschweig, Germany, and made their debut at SCT 2014.[193] These new, high demands will ultimately lead to a reduction of independent suppliers. All parts

[193] Cf. Wieland et. al., 2014, p. 582-612 and 677-696

and components associated with the fossil drive assembly must accept the reality of severe losses in the future. This development will primarily impact OEMs. Downsizing will be inevitable.[194] This conjecture is supported by a study from the Office of Technology Assessment at the German Parliament. Out of the three developed scenarios (conservative, technology gaps and mobility concepts), the mobility concepts scenario seems the most probable. This perspective envisions the added value transfer shift from conventional vehicle technologies to components suited for electro-mobility. Downsizing is an associated aspect of this shift, unless the German automotive industry orients itself towards mobility providers. In this report, seven central challenges for the German automotive industry within the next two decades were localised:

- development of efficient vehicles
- development of alternative engines
- consolidation of the position of the German automotive industry in the world market as a leader in technology and premium manufacturer
- adoption of small (or smallest) vehicles into the product portfolio
- exploitation of growth markets
- reduction of the number of vehicle platforms
- proactive implementation of new mobility concepts.[195]

Another factor not to be underestimated is the qualification level of employees. Without championing continuous employee training, the

[194]Cf. Hubbert, 2010, p. 37-45
[195]Cf. Schade et. al., 2014, p. 9-15

mandatory changes cited are not feasible. In this context, the Institute of German Economy in Cologne mentions the so-called MINT Qualification. MINT is the acronym for Mathematics, Informatics, Natural Sciences and Technology. The MINT qualification is essential for production on the technological frontier as well as for companies with a strong focus on exports in the high technology sector.[196]

What do these projections and scenarios mean for the steel industry of the future? As reported by PricewaterhouseCoopers in a study from 2014, four competencies are vital in order for European steel producers to use the changing market as an opportunity for optimisation. Material efficiency and plant efficiency make up the first competency. The assumption is that even for the medium-term, cost basis will be the focus of improvement measures for the European steel industry. Delivery service and flexibility constitute the next competency for the future. Efficient design of the customer value chain for customers via high delivery service, short cycle times and volume flexibility are prioritised. By means of geographic proximity, high flexibility as well as reliable delivery service can generate competitive advantages in comparison with overseas competitors.

Product quality and innovation form the third competency. The markets are changing at an increasingly rapid tempo. What is considered a niche product with favourable margins today can

[196]Cf. Institut der deutschen Wirtschaft Köln, 2013, p. 115-116

already be a large volume market by tomorrow, which is a highly competitive market for cost leaders.

Commodity management is the last of the four competencies, whose focal point is on the changes to the global raw materials and steel markets. These lead to price fluctuations and only offer few opportunities for differentiation in raw material procurement.[197]

A study by KPMG AG (accounting firm) from 2013 indicates a similar picture. Elaborating on the previously mentioned currents in the steel industry from the PWC study, KPMG AG sees growth potentials almost exclusively in the emerging countries (Brazil, Russia, India and China (BRIC) as well as Africa). Horizontal integration among steel producers is progressing at a fast pace. The causes are largely due to competitive capacity and improved purchase costs resulting from batching. KPMG AG also notes a significant decrease in loyalty in business relationships within the steel sector, which could precipitate an intense price war. Further, sustainability in the steel sector will determine the economy. Although this trend is already foreseeable today, laws are continually tightening. Even the precarious supply situation is forcing steel producers to implement a recycling scheme.[198] In order to meet these challenges, sufficient capitalisation is required. The steel corporations that are already experiencing losses today under the current situation and do not have sufficient capital resources at

[197]Cf. PWC, Stahlmarkt 2014, Stahl 2025: Quo vadis?, 2014, p. 8-9
[198]Cf. KPMG AG, Stahl 2020, 2013, p. 8-22

their disposal may have difficulty surviving in the future.[199] Prevailing worldwide overcapacities are viewed as the fundamental problem for the current as well as prospective situation, according to the OECD (Organisation for Economic, Cooperation and Development). The organisation also speculates that this will increase in the future.[200] Beddows developed a steel industry scorecard, in which the year 2013 acts as the starting point. Within this scorecard, he examines the situation in 1983 and 2028. The nine dimensions in the scorecard can achieve a maximum of 90 points (9 x 10).

Year / Dimension	1983	2013	2028
Service and Costumer	2	4	8
Managing Volatility	2	3	8
Managing Capacity	2	4	6
Efficiency in Use of Materials	3	7	8
Efficiency in Use of Energy	3	8	8
Efficiency in Use of Labour	2	6	8
Efficiency in Use of Capital	3	5	7
Degree of Appropriate Consolidation	2	4	6
Service to Shareholders	2	3	7
Total (out of 90)	**21**	**44**	**66**

Table21:Steel industryscorecard[201]

The acceleration of development regarding the overall points for the steel industry scorecard is significantly noticeable. While a time frame of 30 years was required for an increase of 23 points, it was

[199]Cf. EY (Ernst & Young), Global Steel 2014, p. 25
[200] Source: Beddows, 2014, p. 194
[201] Source: Beddows, 2014, p. 194

only 15 years for the subsequent 22 points. Dimensions gaining importance over the next 15 years include services and customer focus. No less important dimensions include managing volatility (extent of fluctuations) as well as service to shareholders.[202]

8.1. What can the Supply Chain Management Concept Tangibly Contribute to Improve its Competition Situation and to Safeguard the Future of the European Steel Industry?

Before this can be answered, several points and definitions must be clarified beforehand. The first of these to work out is the current state of readiness for the various supply chain types (by commodity groups). Determining the current readiness level will reveal a potential gap, which can be determined by evaluating the readiness criteria per supply chain type (by commodity group).

Supply Chain / Readiness level	**Iron ScrapSC**	**Alloys SC**	**Electrodes SC**	**Refractory material SC**
1				
2				
3	**x**			
4		**x**	**x**	**x**
5				

Table22:Readiness levelpersupplychain(by commodity group)[203]

[202] Cf. Beddows, 2014, p. 193-208
[203] Source: Own illustration

As is evident in the table, there is a gap in all supply chain types. Whereas alloys, electrodes and refractory supply chain types indicated a value of 4 out of a maximum of 5 points, iron scrap with 3 points is the type furthest removed from the target state. Conversely, this table indicates that the greatest catch-up potential exists for the iron scrap supply chain type. Determining the values for the table, "Readiness level per supply chain type" stems from individual readiness level tables, from which the criteria and preconditions for evaluation were established. A level from the individual criteria was respectively also allocated. The average weight of all readiness level criteria evaluation per supply chain type was the frame of reference for the table "Readiness level per supply chain type". This method is identical for all supply chain types. The same table also includes measures for improving the readiness level. These measures should only be viewed as possibilities as opposed to being regarded as conclusive, since it strongly depends on the respective market. The data provided was thus created with the European sphere and related markets in mind. It must also be noted that the process demonstrated in Chapter 8.1 presents a suitable opportunity to approach the chapter's subject, "What can Supply Chain Concepts Tangibly Contribute to Improve the Competition Situation and to Safeguard the Future of the European Steel Industry?" Nevertheless, every steel company must establish its own ideas of development while taking the readiness level and its evaluation into account. From this viewpoint, various gaps will emerge, which will need to be closed using the proper measures.

Therefore the solution introduced in this paper is only one way to show how the market environment can be represented.

Iron Scrap

Criteria	Requirements for Assessing Level of Readiness	Readiness Level					Measures for Improving Readiness Level
		1	2	3	4	5	
Supply Certainty	What percentage of the demand can be covered by the SC?					**x**	Steel plant sets max. value
Price Certainty	Is there coordination in price adjustment?				**x**		Improved collaboration and supervision
Quality Guarantee	Can the SC ensure a consistent quality guarantee?			**x**			Substantially upgrade goods receiving & goods issue control (improve)
Contract Certainty	Can contract fulfilment be guaranteed by all SC partners?			**x**			Focus on large scrap dealers
Time Certainty	Can delivery deadlines be guaranteed?		**x**				Focus on large scrap dealers
Capacity Guarantee	Can volume fluctuations of plus/minus x% be assured?			**x**			Negotiate long term contracts

Table23:Readiness level criteria for the iron scrapsupplychain[204]

As already cited in the preceding section, the table "Readiness level criteria for the iron scrap supply chain" serves as a basis for categorising the readiness level per supply chain type. However, this is only a proposed categorisation. In this illustration, criteria are defined from supply certainty up to capacity guarantee. Additionally, the preconditions for evaluating the readiness level of the individual criteria are provided. This is apparent for the criterion

[204] Source: Own illustration

of price certainty, namely, whether there is coordination of price adjustment among the participating companies. If the highest possible readiness level for the individual criterion was not achieved, measures for improving the readiness level are provided. For the time certainty criterion for iron scrap, performance for the readiness level is well below average. Improvement can be made by focussing on large scrap dealers. Supply certainty was the only criterion in the iron scrap table to achieve the highest readiness level, whereas improvement measures are essential for all other criteria.

Alloys

Criteria	Requirements for Assessing Level of Readiness	Readiness Level					Measures for Improving Readiness Level
		1			1		
Supply Certainty	What percentage of the demand can be covered by the SC?					**x**	Steel plant sets max. value
Price Certainty	Is there coordination in price adjustment?				**x**		Improved collaboration and supervision
Quality Guarantee	Can the SC ensure a consistent quality guarantee?			**x**			Substantially upgrade goods receiving & goods issuecontrol (improve)
Contract Certainty	Can contract fulfilment be guaranteed by all SC partners?				**x**		Closer cooperation, better contract design
Time Certainty	Can delivery deadlines be guaranteed?					**x**	
Capacity Guarantee	Can volume fluctuations of plus/minus x% be assured?					**x**	

Table24:Readiness level for the alloys supply chain[205]

[205] Source: Own illustration

There are far fewer individual gaps for alloys than for iron scrap. This is attributed to the much lower number of suppliers for this commodity group. Furthermore, the material is mined in order to make production volumes controllable. This was not the case for iron scrap, that is, the scrapper does not determine the quantity amount, rather this is done by the governing authorities (i.e. whoever approves a demolition) or the scrap collectors who determine when it is most favourable to collect the scrap and who ultimately receive it. Moreover, various companies in the steel-processing sector sell their production waste to the highest bidder. This does not only demonstrate that there is a large number of potential iron scrap suppliers, but also it substantially increases its complexity, rendering it difficult to adopt uniform standards. Since the price determines where the material is to be supplied, this virtually eliminates a strong supplier-customer relationship. Consequently, supply control is rife with several obstacles.

Electrodes

Criteria	Requirements for Assessing Level of Readiness	Readiness Level					Measures for Improving Readiness Level
		1	2	3	4	5	
Supply Certainty	What percentage of the demand can be covered by the SC?					**x**	Steel plant sets max. value
Price Certainty	Is there coordination in price adjustment?					**x**	
Quality Guarantee	Can the SC ensure a consistent quality guarantee?				**x**		Substantially upgrade goods receiving & goods issue control (improve)
Contract Certainty	Can contract fulfilment be guaranteed by all SC					**x**	

	partners?						
Time Certainty	Can delivery deadlines be guaranteed?				**x**		Build nearby storage facilities, consignment warehouses
Capacity Guarantee	Can volume fluctuations of plus/minus x% be assured?		**x**				Buffer warehousing, consignment warehouses

Table25:Readiness level for the electrodessupplychain[206]

Appraisal of the readiness level for electrodes on average demonstrates the same results as those for alloys. However with the exception of capacity guarantee, which only garnered two points, all criteria rated more favourably. Depending on the process parameters, the electrodes production process has a duration of between three and five months. This process is very costly and requires many stages of operation, as well as an abundance of energy for the individual baking stages. For these reasons, a short-term capacity adjustment for steel companies is very difficult to implement. Nonetheless, this challenge can be met with the outlined measures. The electrodes market differentiates itself from the other commodity groups vis-à-vis the number of producers. In Europe, there are no longer as many as there were previously. The reasons for the decrease in numbers have been previously cited in Chapter 5.

[206] Source: Own illustration

Refractory material

Criteria	Requirements for Assessing Level of Readiness	Readiness Level					Measures for Improving Readiness Level
		1	2	3	4	5	
Supply Certainty	What percentage of the demand can be covered by the SC?					**x**	Steel plant sets max. value
Price Certainty	Is there coordination in price adjustment?				**x**		More precise & rapid information pro-curement, Adjust contracts
Quality Guarantee	Can the SC ensure a consistent quality guarantee?					**x**	
Contract Certainty	Can contract fulfilment be guaranteed by all SC partners?					**x**	
Time Certainty	Can delivery deadlines be guaranteed?			**x**			Consignment warehouses / VMI
Capacity Guarantee	Can volume fluctuations of plus/minus x% be assured?		**x**				Additional contracts, new suppliers

Table26:Readiness level for the refractory material supply chain[207]

The market for refractory material very strongly differentiates itself in a different form than what was previously acknowledged. The number of suppliers who can deliver products is very negligible. However, this is not associated with the capability of the individual suppliers. Rather, it is a matter of whether the appropriate quality raw materials can be procured. China plays a very large role within this context as a mining country. For delivery time, its results proved identical to those for electrodes. Major manufacturers customarily sell annual production quantities. Consequently, there are very few contracts that have a duration of less than one year. For capacity

[207] Source: Own illustration

certainty, this yields a low grading. Remedial action can also be achieved here with the appropriate measures.

The next step is to define the efficacy profiles for the various supply chain types relevant to profitability, competitive capacity, process time, and risk. These profiles apply to current, future and potential markets. A time frame is to be established in order to demonstrate how the four competition factors are changing. This will provide an indication of which supply chain type gains or loses in importance. The focus is to be placed on it correspondingly.

Efficacy Profile

Today's Market	Impact on																				Ø
	Profitability					Competitive Capacity					Process Time					Risk					
	Relevance					Relevance					Relevance					Relevance					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Iron Scrap SC					x					x				x				x			4.25
Alloys SC				x					x						x			x			4
Electrodes SC			x					x						x				x			3.25
Refractory SC			x				x						x				x				2.5

Table27:Efficacy profile for today's market[208]

The efficacy profile for the present day market shows a clear ranking of the four supply chain types. Iron scrap commands first place with

[208] Source: Own illustration

an average of 4.25 points and has the greatest efficacy in terms of profitability and competitive capacity. The alloys supply chain type illustrates its greatest efficacy in process time. Otherwise, relevance for the other competition factors lies in the mid-range. The refractory material supply chain trails behind with 2.5 points out of a maximum of five points. It has the least efficacy in terms of the four defined competition factors. The average figures on the right hand side of the table are necessary for allocating the outcomes for all three markets.

Future Market	Impact on																				Ø
	Profitability					Competitive Capacity					Process Time					Risk					
	Relevance					Relevance					Relevance					Relevance					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Iron Scrap SC					x					x				x				x			**4.25**
Alloys SC				x					x					x				x			**3.75**
Electrodes SC			x					x						x				x			**3.25**
Refractory SC			x				x						x				x				**2.5**
Average	**3.75**					**3.5**					**3.75**					**2.75**					

Table28:Efficacy profile for the futuremarket[209]

Differences between the present day and future market in terms of supply chain types and competition factors are manifested in the international focus and associated organisational changes. Production locations are not affected in this comparison, thus the

[209] Source: Own illustration

sequence of relevance remains the same. The average value calculation per competition factor varies from the table "Efficacy Profile for the Future Market". In order to specify services in the course of this work, which can contribute to increasing competitive capacity and profitability prior to purchase, at the point of purchase, during usage and post-usage, these averages will provide the benchmark. Individual service will likewise be rated according to their relevance in order to establish comparisons.

Potential Market	Impact on																				Ø
	Profitability					Competitive Capacity					Process Time					Risk					
	Relevance					Relevance					Relevance					Relevance					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
Iron Scrap SC					**x**					**x**				**x**						**x**	**4.75**
Alloys SC					**x**					**x**				**x**				**x**			**4.25**
Electrodes SC				**x**					**x**					**x**					**x**		**3.75**
Refractory SC				**x**					**x**				**x**						**x**		**4**
Average	**4.5**					**4.5**					**3.75**					**4**					

Table29:Efficacy profile for the potentialmarket[210]

Much has changed in the efficacy profile for the potential market compared to the other markets. Steel companies now have a much wider activity range and operate according to the motto, "think globally, act locally". All associated activities are thoroughly detailed in the following table. The four various supply chains will rise in

[210] Source: Own illustration

importance within the potential market. Average values for nearly all competition factors have sharply increased, with the exception of the process time relevance. Moreover, average values for the supply chains have also notably increased. This also demonstrates that the supply chain management approach for the potential market has gained substantial importance.

Outcomes

	Markets for the European Steel Industry							
	Today	Future	Potential	Relevance				
				1	2	3	4	5
Iron Scrap	Steel supplier	Global supplier of products and services	Global, flexible solutions and service provider				**T F**	**P**
Alloys	Steel supplier	Global supplier of products and services	Global, flexible solutions and service provider				**T F P**	
Electrodes	Steel supplier	Global supplier of products and services	Global, flexible solutions and service provider			**T F**	**P**	
Refractory material	Steel supplier	Global supplier of products and services	Global, flexible solutions and service provider			**T F**	**P**	

Table30:Marketsfor the European steel industrytoday,future,potential[211]

The table above is a summary of all preceding efficacy profiles for the individual markets, wherein the market designation T stands for

[211] Source: Own illustration

today, F represents future, and the potential market is denoted by P. A new feature in this table is the description of the markets and their associated characteristics or operating principles unique to the steel companies. The starting position for today's market is defined as an individual steel company or as an operating company along with a smaller group, which predominantly distributes its products in the nearest country overseas. Additional services are only offered in direct relation to the finished product. Supply chain management is not a major issue, since even knowledge regarding the scope of this approach is not evident or is only partially evident. As a result, great value is placed on optimising internal processes as well as reducing the associated costs.

The future market is not merely different from today's market on a small scale. The steel company for the future market has an international focus on the sales side, and customers are served on a global basis. These consulting services differ insofar as the total cost of ownership calculations are also made in order to facilitate the optimal variant. A new service provides real-time quality monitoring for the customer. This method reduces costs for complaints and reinforces the relationship with the customer. Another issue gaining increasing attention is recycling. It is guaranteed that wastes produced by customers will become fully recyclable. The potential market constitutes the greatest change for the steel industry, and a steel company's strategic focus will be influenced to a considerable degree. It has reached a size that allows it to provide its local customer the desired product from any of its worldwide locations.

Supply chain management is enacted at all levels and encompasses the entire supply network. Consulting services can be offered around the world, customised to the local customers' needs. Information technology is fully operational at all stages of service. The customer is included in the steel company's information network and comprehensively informed at every site. The customer designs his products with a 3D designer according to his specifications. Product feasibility is already provided via parameterisation within the computer program.

The starting position for the various markets has thus far been outlined. From this vantage point, it is now possible to describe services prior to purchase, at the point of purchase, in usage and post-usage for future and potential markets. A description of today's market will be excluded, since at this juncture it is assumed to be generally known.

	Markets for the European Steel Industry and Corresponding Services		
	Today	**Future** Global supplier of products and services	**Potential** Global, flexible solution and service provider
1. Prior to purchase	Steel supplier	Comprehensive consulting concerning material properties Steel, application areas and costs along the entire SCM	Comprehensive consulting concerning material properties of various raw material (i.e. steel, carbon, synthetic materials, etc.), areas of application and costs along the entire SCM. Determing product features via a digital 3D steel product designer. Data transfer into a planning system for steel producers.
2. Point of purchase	Steel supplier	Global arrangement of terms, TCO calculations for customers, logistics consultation	Production of desired steel quality at customer's production location worldwide. Customer relationship via information technology to steel producers worldwide that encompasses technical, administrative and strategic areas of operation.
3. During usage	Steel supplier	Product quality monitoring for the direct customer in real time	Product quality monitoring along the entire supply chain in real time, including OEM.
4. Post usage	Steel supplier	Comprehensive recycling of returned steel products	Reduction of all customer generated recycling products (all materials) and their processing or compatible disposal.

Table31:Services corresponding to the various markets for the European steel industry[212]

The services offered will need to strongly develop over the upcoming years, so the existing and emerging customer demands can be met. One such example is monitoring product quality. Today's standard practice of only checking product quality before it leaves the steel company will no longer be sufficient in the near future. Quality in the future via information technology for customers in real-time will need to be checked along the entire supply chain. This is the only way to ensure a stable level of quality that stands the test of time. A pressing need is the return and disposal of recyclable materials

[212] Source: Own illustration

according to their usage. What is common in present day and future operations in terms of redemption of product wastes of respectively supplied products and their accompanying recycling will take on a greater dimension in the potential market. Meeting the correspondingly increasing demands requires an appropriate disposal system, which can be customised to customer specifications. This is not only a matter of recyclable material made out of steel, but all waste products that can pose a burden to customers. Services for the various markets will now be outlined to some extent. The next step is to determine which of the cited services are actually relevant for the two markets (future and potential). To this end, the projected services for both markets were individually specified and evaluated over a specific time period. These outcomes were then compared with the respective average value of the competition factors for the market concerned. If the matching rate was 50% or higher, it was categorised as relevant. The following services have been determined from the derived information.

Future Market Services prior to purchase	**Impact on**																			
	Type of Return					**Competitive Capacity**					**Process Time**					**Risk**				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Consulting for steel material properties				**x**					**x**				**x**						**x**	
2. Consulting for application areas			**x**					**x**				**x**						**x**		
3. Consulting costs along SCM					**x**				**x**			**x**						**x**		

Table32:Services for the future market prior to purchase[213]

[213] Source: Own illustration

For the future market, consulting in terms of material properties prior to purchase was significant, as was previously the case. Since the steel producer has the comprehensive know-how and there are no other sources, a consultation was requested. However, for the usage areas, it portrayed a different scenario. Because the customer is more experienced in this regard, he does not deem the service as desirable. Nevertheless, costs along the supply chain are sought out as a service offering. This requires a great deal of acquired knowledge on the part of the steel company, knowledge that is also important for profitability and competitive capacity.

Future Market Services at the Point of Purchase	**Impact on**																			
	Type of Return					**Competitive Capacity**					**Process Time**					**Risk**				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Globalarrangement of terms				**x**				**x**					**x**					**x**		
2. TCOcalculations for customers					**x**					**x**			**x**							**x**
3. Logistics consulting worldwide incl. costs				**x**					**x**					**x**					**x**	

Table33:Services for the future market at the point of purchase[214]

For services offered at the point of purchase, it is necessary to think outside the box, as per the following hypothetical situation. The customer would like a comprehensive consultation, demands that the product is in optimum condition and wants to obtain it at a random location somewhere in the world. For most steel companies,

[214] Source: Own illustration

this necessitates connecting with logistics companies in order to take this customer request into account.

Future Market Services During Usage	Impact on																			
	Type of Return					Competitive Capacity					Process Time					Risk				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Product quality monitoring for the direct Customer in real time				x					x					x						x

Table34:Services for the future market during usage[215]

At the usage stage, monitoring product quality is the crucial point. The relationship between the customer and the steel company is continually governed by a basis of trust, which the steel company enables by keeping the customer appraised of product data in real time. This level of service monitors quality for the customer and directly informs him of any postponements or deviations concerning the specified original product. Thus it is possible to immediately pinpoint higher consumption values and initiate remedial measures, as well as reduce accident risk and strengthen the relationship of trust.

Future Market Services Post-Usage	Impact on																			
	Type of Return					Competitive Capacity					Process Time					Risk				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Comprehensive recycling for customer returns of steel products					x				x				x					x		

Table35:Services for the future market post-usage[216]

[215] Source: Own illustration

As already mentioned in this paper, recycling and reprocessing usable materials is gaining in significance. In the future market, the issue of dealing with production wastes on the customer end will become more important. Recycling and reprocessing reusable materials means a win-win situation for all parties concerned. The customer receives a favourable price for the reusable material from the steel company while the latter can correctly sort the material for remelting thus transform the material into the same commercial product. Thus the recycling process has come full circle and can be continually repeated. At the same time, the steel company gains the advantage of forgoing the procurement process for new raw materials on the market such as alloys. As a result, a steel company can impel production without additional procurement in the free market by implementing a recycling scheme.

Potential Market Services prior to purchase	**Impact on**																			
	Type of Return					**Competitive Capacity**					**Process Time**					**Risk**				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Consulting for material properties			**x**						**x**				**x**						**x**	
2. Consulting approaches			**x**					**x**					**x**					**x**		
3. Consultation costs				**x**					**x**				**x**					**x**		
4. 3D Steel product designer			**x**							**x**				**x**					**x**	
5. Data transfer into a planning system			**x**						**x**						**x**				**x**	

Table36:Services for the potential market prior to purchase[217]

[216] Source: Own illustration
[217] Source: Own illustration

Services that continue to play a role prior to purchase for the future market are no longer relevant for the potential market. However, this does not imply a lack of customer demand for these services. But for the most part they are no longer required and are replaced by information technology. Via a 3D steel product designer, customers can customise as well as assemble the product themselves according to their specifications and necessary properties. Everything in this program that is possible the world over can also be produced by the steel plant. If the customer is pleased with the result, he can display the asking price as well the conditions directly. If the customer complies with the product design and corresponding price, he will pay the necessary amount, indicate the required delivery deadline and then receive the order confirmation online directly.

PotentialMarket Services at the Point of Purchase	**Impact on**																			
	Type of Return					**Competitive Capacity**					**Process Time**					**Risk**				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Steel production at customer location				**x**						**x**					**x**				**x**	
2. Customer IT connection to the network																				
2a. Technical			**x**						**x**					**x**						**x**
2b. Administrative				**x**					**x**						**x**				**x**	
2c. Strategic					**x**					**x**			**x**					**x**		

Table37:Services for the potentialmarketat the point of purchase[218]

[218] Source: Own illustration

As per the previously mentioned slogan "think globally, act locally", steel production at the customer production facility will become eminently significant. Further, customer connectivity to the steel company's network is in high demand at the technical (as already mentioned in the preceding section), administrative and strategic level. The connection in the strategic arena merits the most emphasis, since it demands a close relationship of trust among all companies concerned. However, the potential is of great interest. Strategies can be synchronised and the emerging synergy potentials fully exploited as a result. For example, pending tasks can be carried out by companies that have the necessary know-how to complete the work. It is also possible to improve the optimum use of total resources from all companies involved. The resulting potential will boost profitability and competitive capacity for all parties.

PotentialMarket Services During Use	**Impact on**																			
	Type of Return					**Competitive Capacity**					**Process Time**					**Risk**				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Product quality monitoring along the SC in real time					**x**					**x**				**x**						**x**

Table38:Services for the potential market during use[219]

Product quality monitoring in real time was already comprehensively outlined for the future market. For the potential market, the product quality of the customer is not only monitored,

[219] Source: Own illustration

but the entire supply chain is also monitored. This puts the steel company in a position to report the current quality level for the entire chain at any time. Deviations could then be detected at the earliest stage and remedial measures initiated and adapted to the supply chain. Supply certainly for qualitative products would be guaranteed as a result, and production would proceed without interruptions.

PotentialMarket Services Post-Usage	**Impact on**																			
	Type of Return					**Competitive Capacity**					**Process Time**					**Risk**				
	Relevance					Relevance					Relevance					Relevance				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1. Redemption of recycling products				**x**					**x**				**x**					**x**		
2. Processing of recycling products					**x**					**x**				**x**				**x**		
3. Compatible disposal of recycling products			**x**						**x**				**x**						**x**	

Table39:Services for the potential market post-usage[220]

For the potential market, it is not only important to reprocess reusable materials that accrue for the customer, but their preparation is also important. The steel company then becomes the reusable material processor and can then integrate a level into the supply chain accordingly, which demonstrates great cost-saving potential. This concept must be implemented in tandem with the customer production site, and in so doing, the steel company transfigures into a global processor of reusable goods.

[220] Source: Own illustration

8.2. Requirements for Implementing Supply Chain Management Concepts

The prerequisite for implementing supply chain concepts is the volition of top management. Since this involves a massive organisational change, this support is absolutely crucial. Another important component concerns the power structures for the already existing unmanaged supply chains. For a company that only generates a small share of revenue from suppliers and customers and that is not leaders in technology, implementation will be relatively difficult. A best-case scenario in this instance is to focus on the internal supply chain whereas the opposite would manifest itself in the total integration of the entire supply chain. However, in practise this is not a strong likelihood.[221] Further explanations in this section for both introduced options will not be pursued. In their place, a variant suitable for daily use will be developed by which an internal and external supply chain can be controlled. Nevertheless, this does not concern the last level of this chain. Additional parameters that are necessary to consider for implementing supply chain concepts include governance by means of a central authority. This authority is essential, as otherwise additional interfaces are created that could jeopardize its execution. Transparency of the necessary data is imperative, since it can ensure gaining trust the network partners. Realised savings potential as a consequence of implementing and executing supply chain management is to be distributed among the

[221] Cf. Essig et al., 2013, p. 146

companies involved according to a justifiable key. Last but not least, it is important to establish the time frame for collaboration.[222]

Since 1996, the Supply Chain Council has been a constant element in supply chain management research. Its SCOR model (Supply Chain Organisation Reference Model) is the basis for introducing supply chain management and illustrates the reference processes along the supply chain. Thus individual activities within these processes are continually outlined and substantiated on a continual basis. In this way, processes are subdivided into partial processes, sub processes and ultimately into activities. Subdividing enables the definition, operationalisation, measurement and evaluation of the respective process levels.[223] These subdivisions will be described in the following figure.

[222] Cf. Lehrstuhl Fördertechnik und Materialfluss, Supply Chain Management, p. 1
[223] Cf. Kurzmann und Langmann, 2015, p. 221

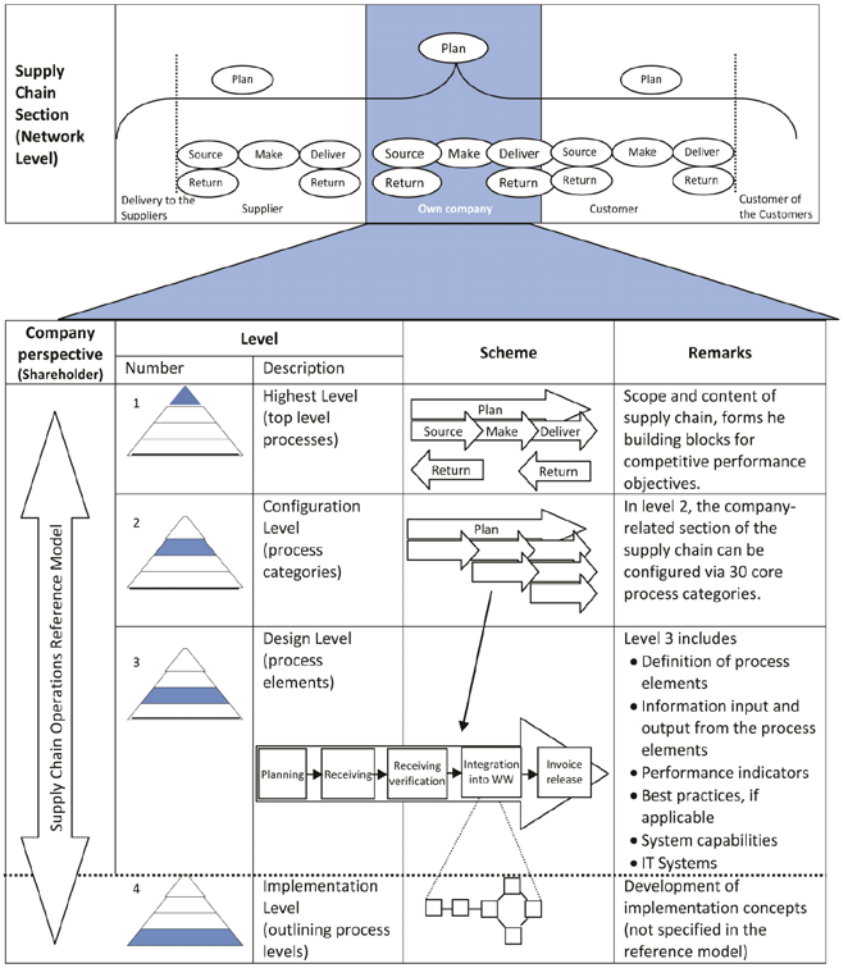

Figure 33: SCOR Model hierarchical levels[224]

Description of the supply chain section (network level) is omitted, since it was thoroughly outlined in Chapter 3 of this paper. The SCOR model extends over the entire supply chain, from the source of supply up to the point of consumption. It is made up of different

[224]Source: Essig et. al., 2013, p. 289

levels, by which the degree of establishment continually increases. Level 1 (top level) defines the content and scope of the supply chain, which is specified into five different process categories. The categories concern planning (Plan), procurement (Source), manufacturing (Make), delivery (Delivery) and return (Return).[225]

At Level 1, for example, divided locations are established. Individual locations and processes are linked with the companies involved.[226]

At the second level (Configuration Level), various standard modules are defined, which enable potential supply chain configuration. Thus, the supply chain is to be dissected into different sub-processes. For this reason, the five process categories that were already described for the first level are used and are displayed horizontally. Three process types are added to these categories, namely, planning, execution and infrastructure. These are displayed vertically. This categorisation yields a matrix, which is labelled as a configuration toolbox by the Supply Chain Council.

On Level 3 (Process Element Level), process categories are dissected into individual process elements, the objective of which is to define each process element and convey the input/output relations.[227]

It also serves to illustrate and form the sub-processes from Level 2 in detail. At this point, service attributes (i.e. flexibility, costs) and best

[225]Cf. Werner, 2013, p. 65
[226]Cf. Brown, 2009, p. 61
[227] Cf. Werner, 2013, p. 66-70

practice (i.e. combining several products into a single delivery) can be defined.[228]

Level 4 is concerned with implementation, which forms the transfer from standardised, cross-industry process elements to sectors and company-specific process steps. On account of individual design possibilities, this level will not be further outlined in the SCOR model.[229]

The Supply Chain Differentiation Guide is another new approach for implementing targeted supply chain management. The Department of Logistics Management at the St. Gallen University has long pursued this approach. Renowned companies took part in the study and offered their knowledge to this end. The difference between existing approaches forms the unconditional focus on the customer and his or her requests. This approach acknowledges that the various world market places have completely different needs. To elaborate, a company purchases product X in Europe and in Asia. It stands to reason that the European customer has different requests relating to the product than his Asian counterpart. Therefore it would be expedient to operate the differing markets with the same supply chain. This is why segmentation is mandatory. Segmentation bolsters the success of supply chain management since customer needs are better satisfied.

[228] Cf. Hertel et al., 2011, p. 108
[229] Cf. Brown, 2009, p. 62

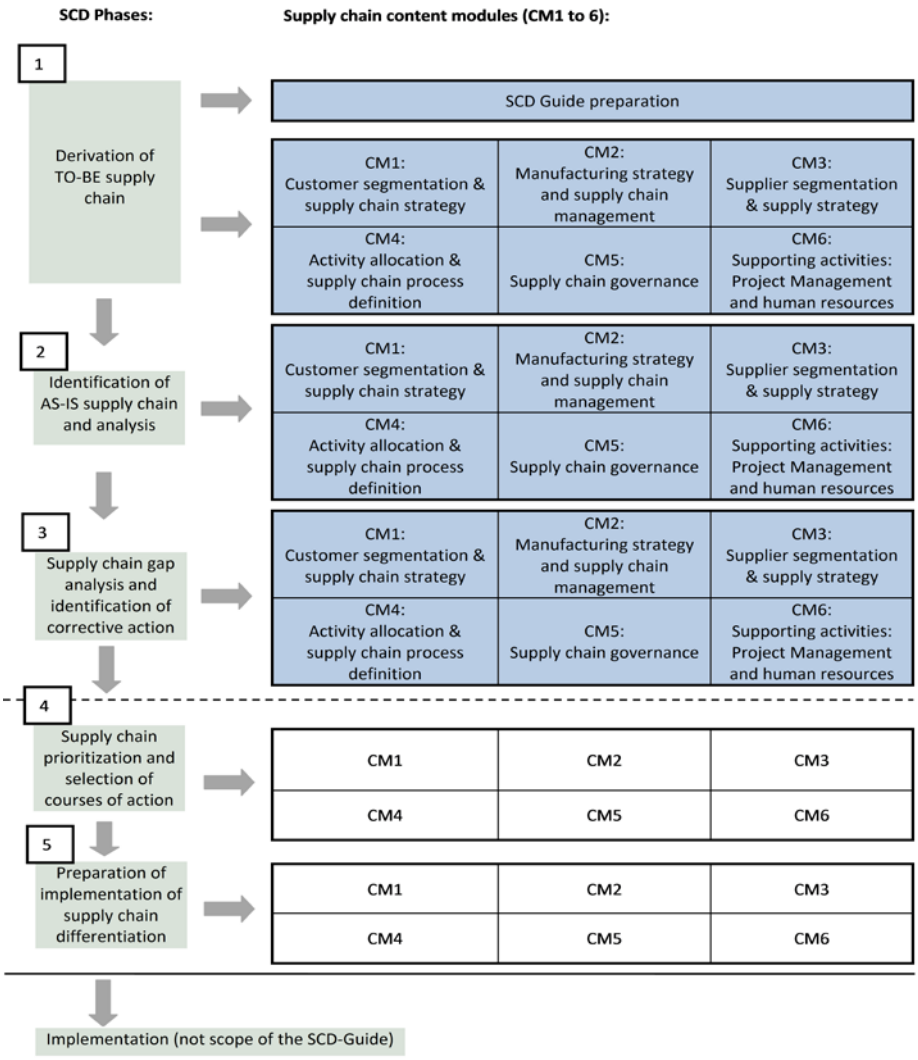

Figure 34: Structure of the supply chain differentiation guide[230]

[230] Source: Hofmann et al., 2012, p. 17

The Supply Chain Differentiation Guide consists of five steps. Implementation analogous to the SCOR model was not included for observation. The first step is to design a prospective supply chain that focuses on customer requests, while the second step is concerned with the appearance of the existing supply chain.

In the third step, the existing and prospective supply chains are compared in order to be able to recognise gaps. If there are identifiable gaps, measures are to be determined and implemented so that the desired form of the future supply chain can be achieved. The fourth step prioritises the supply chain and chooses the sequence of measures. Preparing for implementation constitutes the fifth and final step of the Supply Chain Differentiation Guide.[231]

8.3. Potentials Across Supply Chain Management in the Steel Industry

Supply chain management offers the steel industry true added value in positioning itself for the future. As a result, the industry can regard approaching changes as an opportunity rather than a threat. However, potentials derived from the survey were not as high by far from those cited in several literary sources, which in no way questions the validity of these sources. Rather, it should be regarded as the multifaceted and varied nature of supply chain design and its achieved potentials accordingly. In the questionnaire, on which this paper is based, specified commodity groups were surveyed vis-à-vis application of supply chain concepts. There was only a fixed set of

[231] Cf. Hofmann et al., 2012, p. 17-27

supply chain types. This restriction was necessary in order to make a statement with emphasis. Be that as it may, the spectrum of options could not be covered in its entirety. The segmentation approach, which was brought to bear in the supply chain differentiation approach, was also omitted since it would have substantially increased the complexity of the survey. A guarantee of a statement for the research questions would not have been possible on account of the modest response rate. In order to make the potential more tangible, the hypothetical company XX will be created. The following basic information pertains to company XX:

Revenue 600 million, material costs 400 million, EBIT 40 million, transport costs 20 million, customer cost complaints 5 million and a net working capital of 120 Million (corresponds to two months or 60 days). These statistics could easily reflect figures for an actual steel company. However, a 100% agreement with an existing company would be purely coincidental. In the next step, potentials from the questionnaire will be extrapolated to company XX in order to calculate an overall potential. Other achieved improvements in the areas of delivery capacity, overall cycle time, etc. will not be included in the following table.

	Company XX Data in Millions	Improvements as per Survey Responses (Ø)	Potential for Company XX via SCM Usage
Revenue	600 mil.		
Material Costs	400 mil.	3%	12 mil.
Transport Costs	20 mil.	5%	1 mil.
Customer Complaint Costs	5 mil.	5%	0.25 mil.
Net Working Capital	120 mil.	35 Days	50 mil.
EBIT	40 mil.	10%	4 mil.

Table40:Projection of possible improvement potential forcompanyXX[232]

As is depicted in Table 41, a considerable improvement is feasible, even with a rather low potential. For a greater potential as described by Locker and Grosse- Ruyken or Beckmann as illustrated in Table 3 of this paper, the outcome is significantly higher. For example, Beckmann indicates a profit increase of up to 30%, achieved by an identified Net Working Capital reduction of 50 million, which is an actual reduction. It prompts the question of company XX's capital base in terms of interest savings. For the purpose of this fictitious scenario, we will set the rate of interest at 5% for incorporated borrowed capital. This results in a reduction of interest charges to the effect of 50 million. Multiplied by 5%, that is 2.5 million. This figure was not evident in either the EBITDA or in EBIT, yet quite visible in the shareholder value. Even so, all supply chain finance options are far from being exhausted. There also remains additional potential that can be raised. Further improvements, which were visible in the evaluation of the survey, included raising supply capacity between 1-30%. Conversely, the overall cycle time could be reduced by 1-30%.

[232] Source: Own illustration

Comparing these figures with the information provided by Locker and Grosse-Ruyken as well as Beckmann, which specifies changes from 25-50% for improving delivery reliability and overall cycle time reduction, statistics derived from the questionnaire are too low. Moreover, adopting supply chain management concepts lowered storage costs between 1-20%. For several years, there has been discussion around the subject of supply chain management or supply (chain) network management. Virtually no company has only one supply chain, since this would indicate that for every respective level of the supply chain there would only be one company. This does not reflect a true scenario. Indeed, every company is a part of a comprehensive network of customers and suppliers. This approach offers additional options, which can contribute to improving competitive capacity as well as to increasing returns.

9. Conclusions

The steel industry will be subject to major changes in the next 35 years. The markets and associated trade currents will shift. Megacities will spring up like mushrooms from the ground. These megacities will provide great impetus for the construction and infrastructure sectors. For the automotive industry, on which this paper is based, this likewise means sweeping changes. Mass production of automobiles will be transferred to countries that have the greatest sales. Mobility concepts will rise in development and the combustion engine will be increasingly replaced. What can supply chain management contribute in order for the European steel industry to weather these turbulent times? On the basis of the appraisal formed in Section 7.1 regarding potential developments for the future and potential markets, courses of action can be set out. Supply chain gaps were determined as a result. Subsequently, a set of measures were specified to help close the existing gaps. Efficacy profiles were created for the three markets (today, future, potential). From these profiles, potential services for the business conditions prior to purchase, at the point of purchase, during usage as well as post-usage were outlined, whereupon developments could be brought to the fore alongside appropriate and effective services for the future and potential markets. This paper tangibly illustrates how current and future developments for the markets for a company can be transparently and intelligibly created. Suffice it

to say, initiating these development requires the unequivocal support of upper management. Thus on the strength of well-established change management, the process of change can come to fruition.

10. Discussion

Recommendations arising from this paper are targeted to all steel-producing companies. Yet it would neither be valid nor appropriate to maintain that all the potentials represented are applicable to all companies across the board. Applicability is contingent on a range of influences, which can be ultimately and effectively implemented. For various companies, it is simply a lack of power that prevents supply chain management from being comprehensively introduced. This was vividly demonstrated in terms of present and future use of supply chain management by the survey results. For 40% of companies surveyed, implementing supply chain management was not at all envisioned. Another tell-tale indication is illustrated by the degree of consolidation within the steel industry. According to Grebe, the degree of concentration (top five companies from the respective sectors were observed) for coal producers was 65%, as well as for producers of iron ore. In 2013, the degree of concentration in the automotive industry was

indicated as 63% and only 17.2% in the steel industry.[233] This is a testimony to the fact that many steel companies have not achieved the necessary size to be able to thoroughly implement supply chain management. It also indicates that implementing supply chain management would entail a major effort for every organisation. It is essential to abolish existing and timeworn interfaces that do not avail a company's progress. The mindset must be fundamentally altered. It is no longer a matter of departments and interfaces, but rather actively controlling the flow of the entire value chain. For this reason, it is necessary to garner additional know-how, so that such a step can be put into practice. In a normal situation, such a fundamental change does not occur without changes in personnel. Whether this is intentional or unintentional has no bearing in this analysis. Moreover, a company must also be cognizant that such a major change cannot take place without the appropriate pre-investments. In other words, sufficient liquid funds must be available. From the steel industry's present day situation, this is not an easy matter. Further, outside the actual company there are often conflicting corporate cultures, which make it very difficult to achieve the desired result. It cannot be denied that there is a risk for the focal company to fall into a type of dependence. Ultimately, this can precipitate a loss of decision autonomy for the actual company within the network. Finally, the additional and impeding increase in complexity must also be acknowledged. Managing a network that spans the globe is undoubtedly more complicated

[233] Cf. Grebe, 2015, p. 17

than that of one's own company. Despite the disadvantages mentioned that would arise from implementing supply chain management, it is still profitable to follow this path. The instruments as well as methods are varied to an extent and reveal great potential in bolstering a company's competitive capacity. Therefore it is not urgent whether all levels of a supply chain can be managed. It is already beneficial for suppliers and customers alike to enjoy reaping the benefits associated with supply chain management.

11.Summary

Acceleration of the market dynamic, increased complexity, the continually rising flow of information, these are all developments attributed to globalisation. There are new economic powers, which on account of their social structure, operate differently than in the previous markets. Markets are changing and trade currents are shifting. Customer needs are aligned to these conditions at a rapidly increasing tempo. New global trends are already at the implementation stage. There is a sharp inclination towards megacities. Essential factors associated with this inclination are already being embedded in the area of strategic planning among many companies. These factors include, for example, the necessary

infrastructure, or a transport system that can ably bring externally-produced goods into these cities. The European steel industry is in the midst these turbulent developments, which has its sights set on profiting from these new global opportunities. This paper endeavours to establish foundations in order to recognise the environment in which the European steel industry is situated today.

At the initial phase, a theoretical basis was developed. From this basis, sector-specific characteristics of supply chains as well as special features for the steel industry were examined. Four basic types could be pinpointed, which serve as the foundation for this paper. These types comprise the lean, consolidated, flexible and fast supply chains. Further, the automotive industry was established as a primary customer for the steel industry and used as the basis for further evaluation.

The next step was to explain and delineate supply chain management. Current developments to this end were then explored, for instance, sustainable supply chain management or demand sensing. Supply chain finance has become an important approach, which is concerned with the interfaces between a company's finance department, purchasing, and supply chain management. Consequently, capital costs are reduced in order to optimise financing. A component of this approach is known as net working capital management, which are the "order to cash", "forecast to fulfill" and "purchase to pay" approaches. In order to enable the implementation of supply chain management, an intact

and integrated change management process is mandatory. For this purpose, 10 action fields were incorporated as mentioned by Capgemini in a report regarding successful initiation of change management. The goal of the practical portion was to create a valid basis for illustrating the present day situation of the steel industry in Europe within a global context.

From this exercise, it was soon evident that worldwide competition in no way operates on a level playing field, whether for energy prices or environment taxes. In addition, no sanctions are imposed in Europe. However, this claim is only true for the most part, since effective March 26, 2015, the European Union imposed anti-dumping taxes on cold rolled stainless steel sheets from China with a maximum of 25.2% and up to 12% from Taiwan.[234] Despite this announcement, it indicates that the European market is freely accessible, which is not the case in other nations outside Europe. In some countries, the government very specifically controls exports and imports by assigning punitive duties on products. For the European steel industry this presents another challenge: global excess capacities. These excess capacities amounted to about 25% based on the nominal existing steelwork capacity in the year 2012. Europeans must continually draw on their own strength to enhance their competitive capacity in order to be able to stand up to global competition.

[234] Cf. Stahl Online.de, 2015, http://www.stahl-online.de/index.php/eu-beschliesst-anti-dumping-zoelle-gegen-china-und-taiwan/ [surveyed on 10.04.2015]

The survey involving steel companies proved to be difficult. However, this eventuality was already recognised in choosing the subject matter for this paper. Since supply chain management deals with the core areas of the respective companies, certain restraint was exercised. Despite the challenges, several questionnaires were subsequently collected that allowed for evaluation. Results obtained regarding the improvements achieved by implementing supply chain concepts were much lower than expected. However, this can be ascribed to the restricted choice of answer options, which enabled managing the complexity of the issue at hand. When regarding the improvements achieved in an overall context, the potential for supply chain management is evident, since improvements not only visibly impact the EBIT but also the net working capital, which is ultimately recovered in the shareholder value. For the domain of supply chain finance, there was only a small selection of pertinent questions. Supply chain finance is solely concerned with the cash conversion cycle. Other potentials offered by supply chain finance were outlined in this paper. The survey rate of return enabled a qualitative evaluation, wherein it could be ascertained that the implementation of supply chain management in the USA has long been a reality. China is significantly gaining momentum in this regard, whereas in Europe over 60% steel companies do not envision implementing supply chain management. Yet this statistic is very surprising when one casts a glance at the current market situation. There was one aspect where all individuals surveyed had a consensus. The absolute primary

competition criterion for the steel industry is costs. Price pressure on the European steel industry as a result of globalisation has substantially increased. For this reason, it is no surprise that prices followed in second place. Successes achieved from implementing supply chain management appear on the lower scale of the pre-defined values. To be sure, it is not solely the level of improvements achieved that are to be considered, but also the spectrum. This indicates how many parameters can be altered. This improvement potential then became the deciding factor for its allocation to the supply chain type for the respective supply chain, taking the amount of mentions per supply chain type into account. As a result, the iron scrap supply chain was allocated to the lean supply chain type, the alloys SC to the own, the electrodes SC as well as refractory were each assigned to the consolidated supply chain type. In order to shed light on the future of the steel industry in Europe, global development up to the year 2050 was also investigated in this paper, taking a variety of literary sources into account. Thus a portrait could be created in terms of where and in which products the European steel industry can deliver their finished goods. Future as well as potential challenges for the steel industry were also examined and outlined. Within this context, it was also specified what supply chain management concepts can contribute in order to render the steel industry more competitive as well as how the return can be increased.

It is clear that competitive capacity does improve and returns do increase by implementing supply chain management concepts.

Therefore, it is necessary to provide these concepts as soon as possible to companies in the steel industry. Initiating as well as exercising these concepts requires a high degree of commitment and willingness to change for all parties concerned. However, those who want to set the pace for competitive conditions in the steel industry cannot avoid supply chain management. The automotive industry is exemplary, adhering to the slogan "think globally, act locally" in terms of its suppliers. For steel companies, this means making optimum use of globe-spanning production opportunities. This approach demands a high amount of capital resources in order to stem such a major undertaking. Furthermore, expansion of information technology requires massive investments in order to satisfy customer requests in the future. An appropriate level of personnel is also essential for this endeavour. In addition to their competence, they must contribute the willingness and ability to help make the change. This is a tall order since the demographic shift is in full swing. There are existing opportunities for the European steel industry for the future. Nevertheless, the course must be set for the near future in order to realise these opportunities. This is applicable to politics as well as the economy.

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13.Table of figures

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15.Appendix

Questionnaire on Supply Chain concepts in the steel industry

General

Location of the plant (country):……

Number of employees: ……

Sales in tons 2013:……

Supply Chain Management

Supply Chain Management is the integrated process-oriented planning and control of the flow of goods, information and cash along the entire supply chain from the customer to the raw material suppliers.

1. **Do you already use Supply Chain Management?**

   ☐ Yes — *Please go to Question 2*

   ☐ No — *Please go to Question 3*

2. **For which product groups do you use Supply Chain Management?**

   ☐ Iron scrap — *Please go to Question 5*

   ☐ Alloys — *Please go to Question 6*

   ☐ Electrodes — *Please go to Question 7*

   ☐ Refractory material — *Please go to Question 8*

3. **Are you considering introducing it?**

☐ Yes *Please go to Question 4*

☐ No *Please go to Question 15*

4. For which product groups do you plan to introduce Supply Chain Management?

☐ Iron scrap *Please go to Question 12*
☐ Alloys *Please go to Question 12*
☐ Electrodes *Please go to Question 12*
☐ Refractory material *Please go to Question 12*

5. Which supply chain types in the iron scrap division are in use at your plant?

☐ No answer

☐ Lean Supply Chain (lean, efficient SC for complex, assembled and usually integral products with longer innovation cycles; homogenous and few products)

☐ Flexible Supply Chain (flexible, agile SC for dynamically assembled and usually modular products with shorter innovation cycles; high number of variations (e.g. IT))

☐ Consolidated Supply Chain (consolidated, focused SC for simple chemical and pharmacological products, usually with long innovation cycles = raw materials)

☐ Fast Supply Chain (fast, reactive SC for simple products, usually with short innovation cycles; e.g. food industry)

☐ Derivations from the Supply Chain Organisation Reference Model

☐ Own types Which? ……

☐ Others Which? ……

☐ None

☐ Don't know

6. Which supply chain types in the alloys division are in use at your plant?

- ☐ No answer
- ☐ Lean Supply Chain (lean, efficient SC for complex, assembled and usually integral products with longer innovation cycles; homogenous and few products)
- ☐ Flexible Supply Chain (flexible, agile SC for dynamically assembled and usually modular products with shorter innovation cycles; high number of variations (e.g. IT))
- ☐ Consolidated Supply Chain (consolidated, focused SC for simple chemical and pharmacological products, usually with long innovation cycles = raw materials)
- ☐ Fast Supply Chain (fast, reactive SC for simple products, usually with short innovation cycles; e.g. food industry)
- ☐ Derivations from the Supply Chain Organisation Reference Model
- ☐ Own types Which? ……
- ☐ Others Which? ……
- ☐ None
- ☐ Don't know

7. Which supply chain types in the electrodes division are in use at your plant?

- ☐ No answer
- ☐ Lean Supply Chain (lean, efficient SC for complex, assembled and usually integral products with longer innovation cycles; homogenous and few products)
- ☐ Flexible Supply Chain (flexible, agile SC for dynamically assembled and usually modular products with shorter innovation cycles; high number of variations (e.g. IT))
- ☐ Consolidated Supply Chain (consolidated, focused SC for simple chemical and pharmacological products, usually with long innovation cycles = raw materials)
- ☐ Fast Supply Chain (fast, reactive SC for simple products, usually with short innovation cycles; e.g. food industry)

- ☐ Derivations from the Supply Chain Organisation Reference Model
- ☐ Own types Which? ……
- ☐ Others Which? ……....
- ☐ None
- ☐ Don't know

8. Which supply chain types in the refractory materials division are in use at your plant?

- ☐ No answer
- ☐ Lean Supply Chain (lean, efficient SC for complex, assembled and usually integral products with longer innovation cycles; homogenous and few products)
- ☐ Flexible Supply Chain (flexible, agile SC for dynamically assembled and usually modular products with shorter innovation cycles; high number of variations (e.g. IT))
- ☐ Consolidated Supply Chain (consolidated, focused SC for simple chemical and pharmacological products, usually with long innovation cycles = raw materials)
- ☐ Fast Supply Chain (fast, reactive SC for simple products, usually with short innovation cycles; e.g. food industry)
- ☐ Derivations from the Supply Chain Organisation Reference Model
- ☐ Own types Which? ……
- ☐ Others Which? ……
- ☐ None
- ☐ Don't know

9. Was it easy to implement Supply Chain Management? Evaluate it on a scale from 1-10 where 1 means difficult and 10 means easy.

□ 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ 8 □ 9 □ 10

10. What were the biggest challenges?

……
……
……
……
……
……
……
……

11. What are the criteria to be competitive in the steel industry?

□ Innovation □ Technology □ Costs □ Service □ Flexibil

□ Reliable delivery □ Sustainability □ Other

12. What competitive and profitability advantages were you able to achieve? (Multiple answers possible)
What advantages do you expect following the introduction of Supply Chain Management?

□ Increase in profitability of the assets invested (return on assets)

□ 1-10% □ 11-20% □ 21-30% □ >30%

□ Increase in EBIT (Earnings before Interest and Taxes)

□ 1-10% □ 11-20% □ 21-30% □ >30%

□ Improved delivery capacity

□ 1-10% □ 11-20% □ 21-30% □ 31-40% □ 41-50% □ 51-60%

□ Reduction in overall lead time

□ 1-10% □ 11-20% □ 21-30% □ 31-40% □ >40%

□ Reduction of material costs

□ 1-6% □ 7-12% □ 13-18% □ >18%

□ Reduction of storage costs

□ 1-10% □ 11-20% □ 21-30% □ 31-40% □ 41-50% □ 51-60%

□ Reduction of quality costs

□ 1-10% □ 11-20% □ 21-30% □ 31-40% □ 41-50% □ 51-60%
□ 71-80% □ >80%

□ Reduction of transport costs

□ 1-10% □ 11-20% □ 21-30% □ >30%

□ Reduction in customer complaints

□ 1-10% □ 11-20% □ 21-30% □ 31-40% □ >40%

□ Other:……

□ 1-10% □ 11-20% □ 21-30% □ 31-40% □ 41-50% □ 51-60%

13. In the decision to introduce Supply Chain Management, were there also risks to consider?

□ Yes *Please go to Question 14*
□ No *Please go to Question 15*

14. What risks had to be considered?

□ Different company cultures

- ☐ Differing understanding on the part of the companies involved
- ☐ Lack of shared vision
- ☐ Lack of trust between the partners
- ☐ Incompatible objective and motives
- ☐ Communication difficulties at the interfaces
- ☐ Different quality standards and productivity
- ☐ Opportunism of a partner
- ☐ Incompatible data processing systems
- ☐ Necessary data out of date or not available
- ☐ Other: …….....

Questions on Supply Chain Finance

Supply Chain Finance is the cross-functional optimisation of the free cash flow of a company, as well as the integration of financing processes with customers, suppliers and service providers, in order to increase the value of the companies involved.

15. Which performance indicators associated with the networking capital are continuously measured at your plant? Please indicate the current value in days

☐ Days Inventory Held (DIH)

☐ 1-10 ☐ 11-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐

☐ Days Sales Outstanding (DSO)

☐ 1-30 ☐ 31-60 ☐ 61-90 ☐ 91-120 ☐ 121-150 ☐

☐ Days Payable Outstanding (DPO)

☐ 1-30 ☐ 31-60 ☐ 61-90 ☐ 91-120 ☐ 121-150 ☐

☐ Cash to Cash Cycle (CCC)

□ 1-10 □ 11-20 □ 21-30 □ 31-40 □ 41-50 □ 51-60 □ 61-70 □ 71-80

Questions on Performance Indicator Systems

16. Do you use performance indicator systems?

- □ No
- □ Yes

17. Which?

General performance indicator system:

- □ Return of Investment (ROI)
- □ Return on Capital Employed (ROCE)
- □ Economic Value Added (EVA)
- □ Based on VDI Standard 4490
- □ Syska logistics performance indicators
- □ Berg/Maus performance indicator system
- □ Pfohl/Zöllner performance indicator system
- □ tölzle/Gaiser performance indicator system
- □ Reichmann logistics performance indicators
- □ Schulte logistics performance indicators

SCM performance indicator system:

- □ Weber performance indicator system
- □ Balanced Scorecard
- □ Supply Chain Reference Model Metrics
- □ Other: …….
- □ Own system: ……..

Annex 1:

Definition of the performance indicators

Return on Assets

Ratio of earnings plus interest to total assets. The **Return on Assets** therefore reveals how efficient the capital expenditure was regarding an investment. It is a ratio used for company evaluation which describes the profitability of the capital employed. Although the ROA is comparable with the Return on Investment, it is better suited to examining the earning power of a company, due to the adjustment of interest on borrowed capital. It expresses how high a company's rate of return would have been if the capital employed had consistently been entirely of equity capital.

EBIT

This is the sum before interest and taxes. This performance indicator shows the operating income independent of regional taxations and various methods of financing. Thus, this performance indicator can be consulted in the international comparison of companies.
EBIT = Annual net profit +/- extraordinary income + tax expenditure - tax revenue +/- financial result

Total Supply Chain Management Cost

Total Supply Chain Management Cost is the total cost to manage order processing, materials acquisition, inventory, supply chain finance, planning, and IT costs, as represented as a percent of revenue.

Supply Chain Finance Cost

Costs associated with paying invoices, auditing physical counts, performing inventory accounting, and collecting accounts receivable.

Capital Turnover (Asset Turns)

Performance indicator for the ratio of revenue to equity or total capital. The Capital Turnover shows how many revenue monetary units were generated with one equity or total capital monetary unit.

ROCE (Return on Capital Employed)

The **Return on Capital Employed** (**ROCE**) is a business performance indicator which measures how efficiently and profitably a company utilises its capital employed, and could be said to represent a derivation of the Return on Investment. The Return on Capital Employed is a quotient calculated from the Net Operating Profit After Taxes (NOPAT) and the total capital minus short-term, non-interest bearing liabilities and liquid assets, in short: from fixed assets and floating assets.

Flexibility

Flexibility is the ability to adjust the staff capacity to a fluctuating volume of orders.

Delivery Capacity (Service Level)

The Delivery Capacity measures the correspondence between the customer's desired delivery date and the agreed delivery date.

Quality Costs

According to DIN 55350, the Quality Costs are all costs which arise from error prevention and systematic quality assessment activities, and from the identified internal or external errors. Basically, it is the sum of prevention costs, appraisal costs and failure costs.

Working Capital

Working Capital (WC) is defined as the floating capital of a company minus the short-term liabilities. The Working Capital is the capital to be raised by the company, which is necessary for the processing of the operating activities. WC = Floating capital – short-term borrowed capital.

Capital Costs

Capital Costs are defined as the return which the investor expects on the capital invested in the company (borrowed & equity capital). This return represents costs for the company (as opposed to the investor).

Annex 2:

Definition of the performance indicator systems

Return on Investment (ROI)

Return on Investment (ROI) is derived from the return on sales multiplied by the stock turn rate of the total capital. The result gives an indication of the financial success relative to the total fixed capital of the company.

Return on Capital Employed (ROCE)

See explanation in Annex 1

Economic Value Added (EVA)

This concept determines the difference between the business profit generated by the capital employed and the costs associated with the employment of capital by a company, calculated for a certain period. The profit value determined in this way is also referred to as residual value. Another term for this concept is the "excess profit concept". The EVA is, however, more than just a performance indicator. It combines requirements of the management as well as those of the shareholders and debt holders. The EVA, then, measures not only the financial capacity, but also the market value of the company. Accordingly, a positive EVA means that the company value has been increased further. EVA = NOPAT (Net Operating Profit after Taxes) – c * Capital

VDI Standard 4490

The logistics processes selected in this standard correspond to the material flow in a typical company. Broadly speaking, the standard takes into account all those processes of the different activities which take place in the company between receiving the goods on the ramp to dispatching the goods on the ramp. "Ramp to Ramp" encompasses the following activities:

- Goods receiving
- Returns
- Warehouse input
- Storage / replenishment
- Order-picking / warehouse output
- Packaging
- Dispatch
- Quality assurance and controlling
- Empties and environmental management

The focus of the standard is clearly on the operational level. Neither the materials planning level, on which the ERP functions are typically established, nor the strategic level, with its focus on Operations Research, are taken into account.

Syska logistics performance indicators

Syska works on the development of a performance indicator system for logistics to serve the management as a planning, control and monitoring tool. The basis of the observation is a hierarchical target system in the logistics functional area, which is divided into a logistics performance target system and a logistics costs target system. This corresponds to the separation into a monetary and a non-monetary area. The top priorities of the target system are the two objectives "Increase in delivery readiness" and "Reduction of logistics costs", which are both further refined hierarchically. Syska develops performance indicators for this target system. This is done on the basis of empirical surveys, with which the significance of individual performance indicators as a tool for the measurement of the extent of objective achievement is determined, through a correlation analysis and other statistical methods. The target and performance indicator systems which are developed in this way are suitable as a tool for cause and effect analysis, through a functional connection and a differentiation of the objectives (for products, customers etc.).

Berg/Maus performance indicator system

The performance indicator system created by Berg and Maus to control distribution is based on calculation systematics. Using two key performance indicators; Service Level 1, which represents the relationship between actual sales and target sales in a planned service period, and Service Level 2, determined by the relationship between the quantities actually delivered in the intended service period and the target quantities, distribution performance indicators are derived using computations.

Pfohl and Zöllner performance indicator system

The focus is the measurement of efficiency logistics. The basis for the Pfohl/Zöllner logistics performance indicator system establishes the idea that the lack of relationships in the large number of existing logistical individual performance indicators contradicts an integrated view of logistics processes. As a result, a hierarchical concept of logistics performance indicator systems is considered the goal. It is divided into performance indicator systems for logistics as a whole, as well as for individual logistics systems, logistics management and the interfaces with other operational activities. By partitioning the global performance indicators, businesses receive the benefit of each of their influence quantities. These can be divided on one hand according to the logistical activities in the logistical total system, transport, warehouse, storage and order fulfilment, and on the other hand according to the phases of the flow of goods in corporate, procurement, production and outbound logistics.

Stölzle and Gaiser performance indicator system

The logistics performance indicator system created by Stölzle and Gaiser allows a performance comparison of distribution warehouses. General logistics objectives serve as the basis of the performance indicator system. They span three analysis levels: Overall warehouse, Warehouse areas and Performance areas within the warehouse areas. The extent of objective achievement is measured based on the objective achievement in the performance areas of the distribution warehouse. The performance indicators are defined as a gauge for objective achievement. Stölzle and Gaiser differentiate between efficiency, time, quality and complexity performance indicators, amongst others.

Reichmann logistics performance indicators

The logistics performance indicator system developed by Reichmann is part of the "Enhanced RL (profitability-liquidity) ratio system". It serves the development of logistical target values, the support of profitability monitoring, the adaptation to modified labour market situations and the reconciliation of opposing tendencies in logistics, production and sales requirements. The key performance indicators of this system examine the stock turn rate of all assets, the total logistics costs per sales unit and the degree of delivery readiness. Reichmann also identifies the subdivisions of materials management, production logistics and outbound logistics as sections of logistics according to the phases of the flow of goods.

Schulte logistics performance indicators

Within a logistics performance indicator system, Schulte arranges the individual logistics performance indicators according to the logistical sections of procurement, material flow, transport, storage and order-picking, production planning and control, and distribution. He structures the performance indicators according to the structure types, structure and framework performance indicators, productivity performance indicators, profitability performance indicators and quality performance indicators. As a result, it is organised as a matrix.

Weber performance indicator system

Supply Chain Controlling.

The focus is clearly on the cross-company relationship between suppliers and buyers. In general, controlling is defined as the support of the management, which includes the guidance, monitoring and regulation of processes in addition to control. The primary functions of controlling are the information and coordination functions. Logistics controlling can thus be seen as the execution of controlling functions in the logistics division of a company, which serve to support the logistics management.

Table: Days in receivables in Europe (page 71)

	until 30 days (in %)	**until 60 days (in %)**	**>60 days (in %)**
Germany	78,4	16,3	5,3
Austria / Switzerland	72,3	25,6	2,2
Scandinavia	65,1	31,6	3,3
Benelux	57,9	39,2	2,9
Russia / Ukraine	47,9	28,6	23,5
Poland	42,2	43,0	14,8
Baltic States	41,7	42,9	15,5
Czech Republic, Hungary, Slovakia, Slovenia	39,3	48,3	12,6
Turkey	37,3	42,7	20,2
Great Britain, Ireland	32,4	52,0	15,5
Romania, Bulgary, croatia, Bosnia	29,9	43,0	27,1
France	25,6	48,8	25,6
Italy	20,1	33,8	46,3
Spain / Portugal	20,0	50,7	29,3

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