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Abstract title: Supply Chain Value Contribution – Assessing the Economic Value of Supply Chain Initiatives

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Supply Chain Value Contribution –

Assessing the Economic Value of Supply Chain Initiatives

Abstract:

Logistics and operations management provide for competitive advantage and economic success of a company by ensuring reliable satisfaction of customer needs through focusing on operational excellence, which is also one lever to increase enterprise value. However, existing concepts are not able to clearly show how operational excellence contributes to enterprise value. Thus, managers fail to articulate the real value of their solutions to the primarily finance-driven boardroom. As a result, operational investment decisions are often based on assumptions about their financial impact, leading to high uncertainty about the true return on the investment. The article will fill this gap, by describing a clear and traceable approach for assessing the value created by operational performance improvements. The “Supply Chain Value Contribution (SCVC)” method creates a clear relationship of cause and effect of supply chain initiatives, on operational performance, to enterprise value, on the basis of the Supply Chain Operations Reference (SCOR)-model.

1 Introduction

The main goal of financial management is to ensure and increase long-term value for the stockholders through an effective use of capital.[1] From this overall objective, management tasks can be derived. On a daily basis, the working capital needs to be managed in order to improve its utilization. An improved utilization of the working capital can lead to higher profitability. On occasion, financial managers need to assess potential investments in fixed assets or cost reduction projects, in order to reduce operational risks and therefore improve the profitability of the assets.[2]

It is well accepted that logistics and operations play a crucial role in strengthening a company's competitiveness and economic success.[3] Logistics and operations management provide for competitive advantage and economic success of a company by ensuring reliable satisfaction of customer needs. They focus on improving operational excellence, which is also one lever to increase enterprise value, through increasing revenues, reducing cost, and reducing capital lockup.[4]

In recent decades, boosted by relatively low costs for transportation and various deregulations in international trade, multiple-tier supply chains were created, spanning significant distances and covering various time zones, resulting in increased lead times and decreased transparency. In this context, supply chain management (SCM), representing a comprehensive understanding of logistics management, has gained importance in recent years.[5] An indication that logistics and SCM are attracting more and more top management attention is a survey showing that 81% of the 405

[1] cf. Rappaport, 2006; Buffet, 1999

[2] cf. Garrison, Noreen, & Brewer, 2006

[3] cf. Weber, 2002, p. 29; D'Avanzo et al., 2003

[4] cf. Coenenberg & Salfeld, 2007, p. 145; Hofmann & Wessely, 2007, p. 43

[5] cf. Klaus & Kille, 2006, p. 18; Baumbach & Stampfl, 2002, p. 10; Haasis, 2008, p. 3

respondents expected that logistics would have a clear orientation towards enterprise value by the year 2010.[6] This value orientation is, on the one hand, demanded by the senior managers[7], but is also a pre-requisite for top management involvement in general, in order to be able to speak the same language.[8] This represents a shift in the focus from cost reduction to increasing enterprise value, leading to SCM becoming a truly integrated management concept by also including the management of financial processes and cash flows.[9]

This development has some important consequences, especially to established supply chain performance measurement concepts. Senior managers want a balance of financial and operational metrics in order to have a comprehensive and integrated view of true supply chain performance as the basis for creating enterprise value.[10]

However, logistics managers struggle to integrate value orientation in their daily management decisions, leading to a discrepancy between the demands of top management and the reality of their assigned management tasks.[11] One major reason for this discrepancy is that existing SCM concepts are not able to show how SCM contributes to increasing enterprise value.[12] They are often presented only from a costs perspective, without an illustration of the impact on the components of enterprise value, i.e., profitability, growth, and capital utilization.[13] Additionally, many SCM professionals do not speak the “language of finance”. Thus, they fail to articulate to the

[6] cf. Straube et al., 2005, p. 32.

[7] cf. also Melnyk et al., 2009, p. 4643

[8] cf. Straube et al., 2005, p. 10; Straube et al., 2005, p. 28

[9] cf. Stemmler, 2002, p. 166

[10] cf. Kaplan & Norton, 1992

[11] cf. Goepfert & Neher, 2001, p. 49; Sandberg, 2007, p. 288

[12] cf. Schnetzler et al., 2007

[13] cf. Timme & Williams-Timme, 2000

boardroom, most members having a primarily financial mindset, the contribution of their solutions to enterprise value.[14]

For these reasons, logistics and operations managers need to learn how to measure and sell the value created within the company as well as externally throughout the supply chain.[15] The challenge is to create a clear relationship of cause and effect between supply chain initiatives and enterprise value. Only then can uncertainty in making investment decisions on potential supply chain initiatives and evaluating their success be reduced. This facilitates true enterprise value-based supply chain management.[16]

1.1 Objective and Scope

In this context, the objective of this article is to develop a method to quantify the enterprise value generated by performance changes caused by supply chain improvement initiatives. This method will combine existing approaches and concepts from both financial management and supply chain management. An established process reference model will be used, providing the language and tools for a common understanding and comparability of supply chain performance.

The article focuses on the material, information, and financial flows which are directly connected to the production facilities of an enterprise through the relationships to direct customers, suppliers, and service partners. In the language of the Supply-Chain Operations Reference (SCOR)-model[17], these flows are represented by the “Plan”, “Source”, and “Deliver” process types. The technical make processes, as well as reverse logistics processes, or SCOR process type “Return”, are out of scope.

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[14] cf. Timme & Williams-Timme, 2000

[15] cf. Lambert D. M. & Burduroglu R., 2000

[16] cf. Karrer, 2006, p. 163

[17] Please see description in Chapter 3.1.

The target audience is key decision makers, academics, and consultants in the context of financial, operations, logistics, and supply chain management. The method to be described will support decision-making in the context of *ex ante* make-or-buy decisions or assessments of investments in supply chain improvement initiatives, and *ex post* controlling of the success of such initiatives.

1.2 Procedure and Structure

This article is organized as follows. After the introduction, the second chapter describes the relevant theoretical background and defines relevant basic terms. Chapter 3 describes the state-of-the-art in methods for assessing economic value, ending with the derivation of the research need. The fourth chapter describes the method developed to assess the economic value contribution of supply chain initiatives, by showing its use in an industrial application. Chapter 5 appraises the method and describes its benefits, limitations, and theoretical and practical implications. Chapter 6 concludes with a summary and outline of further research needs.

1.3 Research Method, Approach, and Origin of Research Results

The approach of the described research was based on the principles of Action Research (AR)[18], supplemented with aspects from the project management approach of Systems Engineering (SE)[19].

During the research, several specific AR projects were conducted in collaboration with companies, in which the generic theoretical framework and method were developed, tested, improved, and validated in a practical environment. The AR processes of the specific industry projects were modeled using the guideline of SE. The specific cases

[18] cf. e.g., Greenwood & Levin, 1998, p. 4; Coughlan & Coghlan, 2002; Susman & Evered, 1978

[19] cf. Haberfellner & Daenzer, 2002, p. XVIII

were used for triangulation and cross-checking of the generic theoretical framework and method.

2 Background and Definition of Relevant Basic Terms

This article touches and links several research domains. The introduction indicated that the lack of knowledge of financial terms and enterprise value oriented thinking is a recognized problem when dealing with people from operations and logistics management. Therefore, the task of this chapter is to define and describe relevant basic terms and concepts of financial management, in order to set a common basis of understanding. Thereafter, the terms operations, logistics, and supply chain management are discussed, concluding with a description of supply chain initiatives.

2.1 Financial Management and Enterprise Value

Financial managers have to base their decisions on the expectations of the investors of the company. For this reason they have to use performance metrics for expressing enterprise value other than the traditional accounting measures, which represent only the past performance of a company and therefore do not match the expectations of the investors.[20] The advantage of the value-based metrics lies in their consideration of the specific risk exposure of the company by assigning costs for investing capital in the company.[21] However, it is still necessary to have a good understanding about the basic accounting terms in order to understand the specific character of the capital costs which are related to a financial manager's decision-making.

[20] cf. StühRenberg et al., 2003, p. 63

[21] cf. Weber, 2002, pp. 146–147

2.1.1 Basic Accounting Terms

Every management decision involves a choice from at least two alternatives, for which the costs and benefits must be known. Only costs and benefits that differ between the alternatives are relevant for making the decision. Sunk costs are never relevant in decisions.[22]

A well-known metric for expressing costs related to the manufacture of products is the "Cost of Goods Sold (COGS)". It is considered useful as an accounting classification, for determining the amount of direct material, direct labor, and allocated overhead associated with the products sold during a given period of time.[23] According to the SCOR-model, COGS include direct costs for labor and materials and indirect costs (overhead) in the form of depreciation, material shipping and handling costs, plus inbound and in-process inventory storage and handling costs.[24] They do not include the costs for delivering the finished goods to the customer (distribution costs, or costs to deliver). This document will use this understanding of COGS.

The costs related to storing and handling inventories are usually classified as "Inventory Carrying Cost (ICC)". The ICC cover: cost of transferring to and releasing from stock, and moving material within the warehouse; rent and utilities for the portion of the warehouse used to store inventory stock; insurance and taxes on inventory; physical inventory and cycle counting; inventory shrinkage and obsolescence (write-offs); and opportunity cost of the money invested in inventory.[25] ICC usually is expressed as a percentage of the average inventory value, by dividing the sum of the expenses (along

[22] cf. Garrison et al., 2006, pp. 602–603.

[23] Cox III & Blackstone Jr., 2002

[24] cf. Supply Chain Council, 2008.

[25] cf. Schreibfeder, 2009

with the opportunity cost) by the average inventory value. It represents the amount of money it takes to maintain one dollar's worth of inventory for an entire year.

Up to this point, the costs described were relevant for the profit and loss statement (P&L). The costs represent expenses directly or indirectly (as overhead) related to the flow of materials and services in a company. But the definition of ICC also listed opportunity costs as cost of the money invested in inventory. In order to understand the relevance of this aspect, it is important to remember the structure of the balance sheet.

The assets side includes all values of the company that are needed to perform its business, represented by the current and fixed assets. The assets represent the capital lockup, which needs to be financed. How the assets are financed, either by debt or by equity, is represented on the liabilities and equity side of the balance sheet.

Both forms of financing, equity and debt, are linked to costs. Long-term liabilities, e.g., bank loans, are charged with interest rates. In a similar understanding, equity is also charged with "interest", which is the minimum return the investors expect from their investment. The interest rates and expected return on capital of investors are considered as "costs of capital".[26]

Because companies in most cases have a mixed financing structure, a company is required to calculate a weighted rate for describing the average cost of capital, in order to have a single metric for making investment decisions. For this reason, the metric "Weighted Average Cost of Capital (WACC)" was developed.[27] WACC is the minimum return that a company must earn on the existing asset base to satisfy its creditors (debt holders), owners (equity), and other providers of capital. It therefore

[26] cf. Cox III & Blackstone Jr., 2002

[27] cf. Weber, 2002, p. 146

represents the rate that a company is expected to pay to finance its assets. WACC is calculated as follows:[28]

$$WACC = Kd \times (1 - T) \times D\% + Ke \times E\%$$

Where Kd is the cost of debt before taxes, T is the tax rate, D% is the percentage of debt on total capital, Ke is the cost of equity, and E% is the percentage of equity on total capital. Especially the calculation of Ke is highly subjective.

The importance of capital costs for operations and logistics management was highlighted by Weber (2002), who cites a study showing that 21.5% of the total logistics costs are caused by capital lockup.[29] In this context, working capital represents the capital that is locked up in the "short-term" operating business, meaning that it is directly related to the flow of materials and services through the different stages in production.[30] A central element of working capital is inventory. Inventory appears as stored inventory and in-process inventory or work-in-process (WIP), meaning goods in various stages of completion throughout the plant.[31] In addition, inventory can also appear as "inventory in motion", or "inventory in transit", when the material is outside a plant or warehouse, but belongs to the company in focus.

Working capital transforms its representation in the balance sheet by going through the different production stages in a company. This flow of costs in a manufacturing company is described by Garrison et al. (2006):

"Raw materials purchases are recorded in the raw materials inventory account. When raw materials are used in production, their costs are transferred to the work in process

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[28] cf. e.g., Copeland et al., 2000; and Weber, 2002, p. 146

[29] Weber, 2002, p. 141, citing Davis, H.W.; Drumm, W. H.: "Logistics cost and service 2000", in: Council of Logistics Management (ed.): Annual Conference Proceedings, New Orleans, pp. 61–73

[30] cf. Garrison et al., 2006, p. 556

[31] cf. Schönsleben, 2007, p. 237

inventory account as direct materials. Notice that direct labour cost and manufacturing overhead cost are added directly to work in process. Work in process can be viewed most simply as products on an assembly line. The direct materials, direct labour, and manufacturing overhead costs added to work in process [...] are the costs needed to complete these products as they move along this assembly line. [...] As goods are completed, their costs are transferred from work in process to finished goods. Here the goods await sale to customers. As goods are sold, their costs are transferred from finished goods to cost of goods sold (COGS). At this point the various material, labour, and overhead costs required to make the product are finally recorded as expenses. Until that point, these costs are in inventory accounts on the balance sheet."[32]

With regard to the transfer of the cost from finished goods to COGS, which is also the transfer from the balance sheet to the P&L, Groth et al. (1996) refer to this point of time as the "Point of Value", meaning from then on the amount appearing on the balance sheet and the P&L is not based on the incurred costs anymore, but on the sales price invoiced to the customer, which contains the profit margin.[33] This amount appears in accounts receivable, until the payment of the invoice by the customer, at which time the amount disappears from the balance sheet and appears as revenue in P&L.[34]

2.1.2 Economic Value and Enterprise Value

Many companies used to think of their earnings generated during a financial year in terms of net operating income, or synonymously the accounting metric EBIT (earnings before interest and taxes)[35], when asked about the value creation of their company.

[32] Garrison et al., 2006, p. 45

[33] cf. Groth, Byers, & Bogert, 1996

[34] See also Scheer, 1994, pp. 443–444. The statement follows cash-based accounting principles for simplification reasons.

[35] cf. Garrison et al., 2006, p. 556

However, this understanding of value does not say anything about the profitability of a company, because it is 1) backward-looking, 2) short-term oriented, and 3) does not consider the risk of the business expressed in capital costs. For making management decisions it is therefore not appropriate enough, because managers have to decide on changes and projects that make the company more profitable *in the future*.[36]

Investors in the company are more interested in the future and long-term enterprise value.[37] This understanding of enterprise value is driven by the demand for an optimal utilization of their invested capital and resources, in order to provide a benefit to as many customers as possible in an efficient and profitable manner. Therefore, three key factors of performance in terms of enterprise value can be identified: 1) growth (delivering to as many customers as possible), 2) profitability (achieve this without burning money), and 3) capital utilization through efficient operations.[38]

Following the *resource-based view of the firm*, growth can be generated through a customer benefit which differentiates the company from its competitors. This differentiation can be based on a product which offers functionalities that are unique in the market or at a lower sales price. In order to be able to offer a lower sales price, companies have to have a better cost structure than competitors, which is determined by the asset structure.[39] Managers can only increase long-term enterprise value when they are able to provide their customers with a competitive product now and in the future and therefore generate and ensure profitable growth.[40]

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[36] cf. Lambert D. M. & Burduroglu R., 2000 and Ehrbar & Mühlfenzl, 1999, p. 66.

[37] cf. Buffet, 1999

[38] cf. e.g., Timme & Williams-Timme, 2000; Heggmaier, 2002, p. 567; and Krubasik, 2002, p. 56

[39] cf. Burr & Stephan, 2006, pp. 70-71

[40] cf. Rappaport, 2006

In this context, the concept of shareholder value, or stockholder value, has gained importance and is a commonly used approach to express enterprise value. One well-known shareholder value-oriented metric is “Return on Investment” (ROI). It measures the profitability of every utilized monetary unit. It is rather a metric *system*, breaking down the top level indicator ROI to lower level accounting metrics. ROI is calculated by multiplying the profit margin by the asset turnover which is determined by dividing the turnover by the total capital employed.

A metric that represents the bridge from a more operational perspective on value created is the Economic Value Added (EVA).[41] The EVA of a company is positive, i.e., value is generated, when an investment activity leads to higher net operating income after taxes and depreciation (NOPAT) than the weighted average costs of capital (WACC) invested in the assets (fixed and current) required for generating that income. The equation is therefore:

$$EVA = NOPAT - WACC \times Assets.$$

In other words, EVA is only generated when the investment is expected to provide more profit than the stockholders would get by alternative investments on the market. The structure of EVA is shown in Figure 1. Different to ROI, it includes the WACC.

There are three levers for improving EVA. The three levers are 1) sales, 2) cost (Total SCM Cost), and 3) assets, for which financing costs occur. EVA integrates all investment, financial, and operational management decisions in one single metric. Therefore, it provides a comprehensive basis for an integrated and value-based management.[42]

[41] cf. e.g., Stewart, 2006; Ehrbar & Mühlfenzl, 1999; Copeland et al., 2000; and Biddle et al., 1998

[42] cf. Hostettler, 1997, p. 32

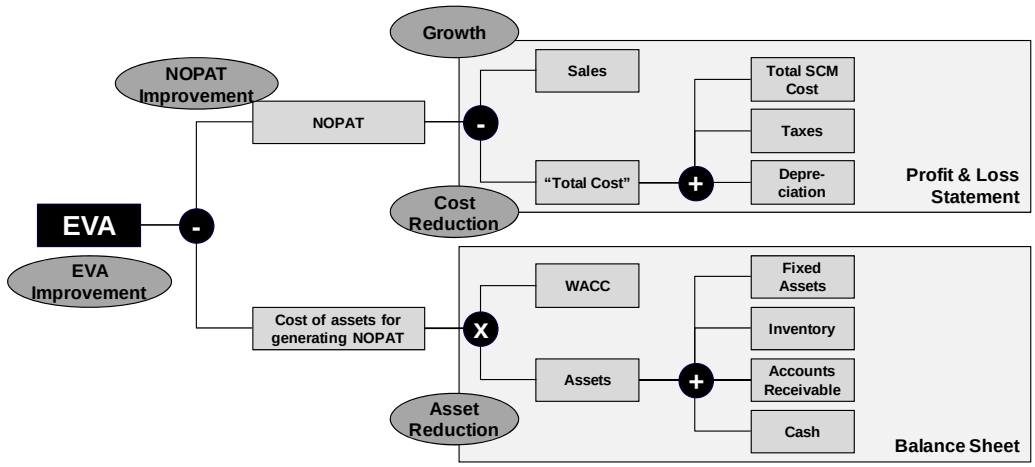


Figure 1 EVA and improvement strategies

EVA perceives expenses for research and development as investments rather than costs, which is not the case in other value-oriented metrics. Therefore, it is a more exact metric of value created within a reporting period, allowing it to be used as an operational goal setting metric in individual periods.[43]

2.1.3 Enterprise Value and Investment Decision Risks

When EVA is used as a key performance indicator, the objective is to maximize the total amount of EVA, not to maximize ROI. This is an important distinction. If the objective were only to maximize ROI, then every company should divest all of its products except the single product with the highest ROI.[44] Using EVA to evaluate a manager's performance facilitates the decision for every project generating residual income, therefore adding enterprise value.[45]

However, EVA as an absolute value provides no relation to the amount of capital needed for the investment. Moreover, EVA calculation also carries some uncertainty,

[43] cf. Ehrbar & Mühlfenzl, 1999, p. 87

[44] cf. Garrison et al., 2006, pp. 561–563. In practice, companies usually do not only use the ROI, but also absolute values, e.g., EBIT, for setting objectives.

[45] cf. Ehrbar & Mühlfenzl, 1999, p. 66

considering the discussion with regard to WACC and the determination of the costs of equity. So especially when the investment amount is rather high and the calculated EVA relatively low, investors might not want to take the risk of losing money, in case the EVA calculation made wrong assumptions about the WACC or other calculation elements.

In summary, value-based management according to EVA facilitates more comprehensive investment decisions when compared to an orientation only towards the ROI[46] and allows a periodic control of the operational performance within one single metric. It is a simple and transparent concept, which is based on general ledger accounting systems and is easy to combine with other management concepts aiming for increased enterprise value.[47] It is recommended to consider both EVA and ROI for a comprehensive management orientation towards increased enterprise value. However, managers need to be aware of the uncertainties arising from the calculation approaches and have to take the resulting risks into account.

2.2 Operations, Logistics, and Supply Chain Management

The term *operations* traditionally focuses on activities conducted inside a company. Shingo (2006) defines operations as "the interaction and flow of equipment and operators in time and space, i.e., the work performed to accomplish the transformation of material from raw material to a semi-processed component to a finished product."[48]

Logistics in contrast, is understood as "the organization, planning, and realization of the total flow of goods, data, and control along the entire product life cycle in and among

[46] cf. Garrison et al., 2006, pp. 563–564

[47] cf. Sennheiser & Schnetzler, 2008, pp. 31–32

[48] Shingo & Dillon, 2006, p. 4

companies."[49] Therefore, *logistics* includes the activities performed within *operations*. Klaus (2006) defines the task of logistics as the collection and use of knowledge and methods about optimal architectures of flows and processes and their control and mobilization, according to market and customer requirements.[50] However, this understanding of logistics includes management tasks and therefore rather describes the term *logistics management*. The objects of logistics management are *supply chains*, being "all the business activities associated with all phases of satisfying a customer's demand. A supply chain spans: all customer interactions (order entry through paid invoice), all physical material transactions (supplier's supplier to customer's customer, including equipment, supplies, spare parts, bulk product, software, etc.), and all market interactions (from the understanding of aggregate demand to the fulfillment of each order)."[51]

This comprehensive understanding represents the realization of a true *supply chain orientation*, which is defined as the recognition by an organization of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain.[52] Supply chain orientation is the basis of the integrated concept of *supply chain management* (SCM).

SCM represents a comprehensive understanding of logistics management. In order to stress this aspect, many authors provide a specific definition for SCM. Representatively, Mentzer et al. (2001) define SCM as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of

[49] Schönsleben, 2007, p. 7

[50] Translated from Klaus & Kille, 2006, p. 27

[51] Supply Chain Council, 2008, pp. 1.2.1

[52] cf. Mentzer et al., 2001

improving the long-term performance of the individual companies and the supply chain as a whole."[53]

In the context of this article, a new definition is provided, which uses the understanding of SCM as described above, but integrates the perspective of a financial manager into the performance aspect:

Supply chain management is the integrated design, planning, execution, control, and monitoring of goods, information, and financial processes within a supply chain and their improvement on a strategic, tactical, and operational level, with the aim of an optimal utilization of working capital and the creation of enterprise value for every individual company in the whole supply chain.

The key to SCM is the process orientation of all supply chain partners. Activities and projects aiming to improve supply chain performance are called *supply chain (improvement) initiatives* (SCI).

2.3 Supply Chain Initiatives

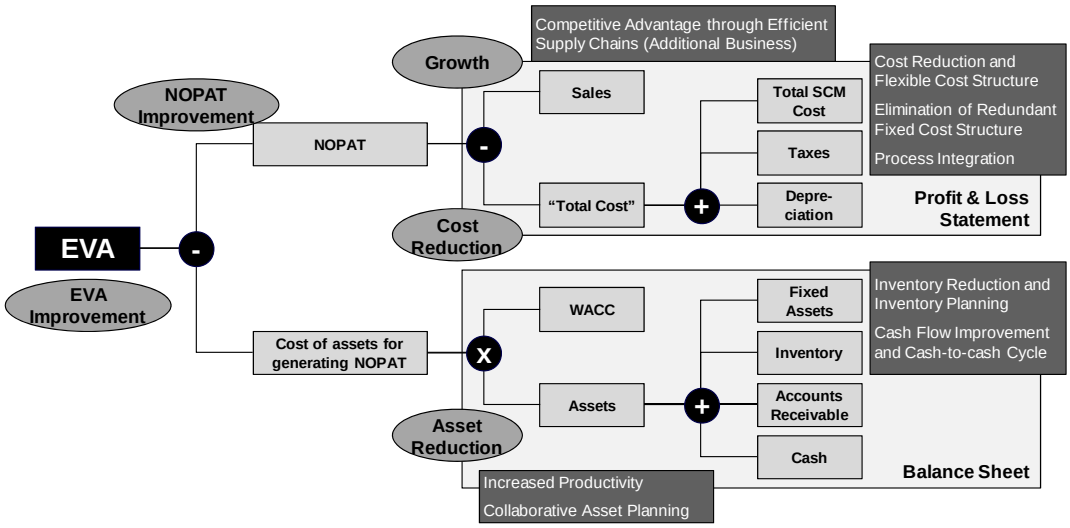
Any company needs to create and maintain a competitive advantage over rivals in order to be successful in the market. Porter (1998) defined a competitive advantage as "achieving a cost or differentiation position (industry-wide or in a niche) which can be defended against rivals"[54]. In order to maintain or even generate a higher competitive advantage financial resources can be used to invest in skills and assets. Such investments are investments in a company's supply chain, and therefore supply chain (improvement) initiatives (SCI). The aim is to maintain and increase the *operational excellence* of the supply chain, which is doing the right things (effectiveness) in the

[53] Mentzer et al., 2001

[54] Porter, 1998. Porter focuses on individual companies, but these aspects do also apply to a supply chain as a whole.

right way (efficiency).[55] Only by having operational excellence, the efforts in terms of employed personnel and assets can be minimized, in order to generate the customer value aimed for in economically profitable conditions.[56]

In this context, several authors have shown that an improvement of operational and logistical activities in a supply chain strongly contributes to the initially identified goal of generating value for a company.[57] The contribution of effective SCM to enterprise value in the form of EVA can be displayed on a qualitative level according to Figure 2.



EVA: Economic Value Added -- NOPAT: Net Operating Income after Taxes and Depreciation -- WACC: Weighted Average Cost of Capital

Figure 2 EVA and selected SCM improvement strategies[58]

SCIs can have an internal focus or focus on creating supply chain partnerships by outsourcing specific functions of a company's supply chain. In recent decades, many companies have invested in their processes through several waves of improvement programs, starting with Just-in-Time (JiT) and passing on to Total Quality Management

[55] cf. Haasis, 2008, p. 13

[56] cf. Coenenberg & Salfeld, 2007, p. 148

[57] cf. e.g., Schnetzler et al., 2007; Sennheiser & Schnetzler, 2008 and Lambert D. M. & Burduroglu R., 2000

[58] Own figure, based on Sennheiser & Schnetzler, 2008, p. 33; Wildemann, 2005; Lambert D. M. & Burduroglu R., 2000, and integrating discussions of Liker, 2004; Ohno & Bodek, 1988; Womack & Jones, 1990; and Womack & Jones, 2003

(TQM), Business Process Reengineering (BPR), Lean Production, Six Sigma, and various other management programs.[59] All these management concepts trigger improvements in the supply chain. However, these concepts all carry the risk of focusing the improvement efforts too much on cost-cutting, whereas experiences highlight the importance of a broader focus on the identification and delivery of enterprise value.[60]

When the potential for internal optimizations is considered being exhausted, SCIs should focus on a change of the collaboration setup, in order to improve the overall performance of the supply chain.[61] This would result in a contribution to value-generation on company level, i.e., for every individual supply chain partner.[62]

A change of the collaboration setup means that parts of the supply chain are turned over to other companies, which is called *outsourcing*.[63] The decision about whether to turn over activities to a supplier is called a "make-or-buy" (MoB) decision.[64] Where a company realizes that it lacks the know-how for an efficient utilization of resources, it tends to outsource activities related to operating and maintaining these resources.[65]

3 State-of-the-art and Research Need

The discussion hitherto indicated that an effective SCM contributes positively to enterprise value. However, this article argues that there is still a lack of practical methods for providing clear and transparent, traceable, and consistent links from supply

[59] cf. Garrison et al., 2006, p. 12

[60] cf. Murman, 2002, p. 281

[61] Weber, 2002, p. 20

[62] cf. Hofmann & Wessely, 2007, p. 45

[63] cf. Schönsleben, 2007, p. 70

[64] cf. Garrison et al., 2006, p. 613

[65] cf. Hildenbrand, 2006, p. 32

chain performance to enterprise value. In order to support this argument, this chapter describes the state-of-the-art of relevant theoretical and practical concepts in several domains and derives the research need.

3.1 Concepts for Providing Process Transparency

An important requirement for integrating, synchronizing, and optimizing a supply chain effectively is visibility on inter-enterprise processes with the establishment of shared metrics.[66] Increased visibility is also a requirement for documenting logistics innovations for top management and customers, who demand a traceable explanation of how logistics contributes to their wants and needs.[67] So a process-oriented business management calls for tools and concepts to map and design these processes.

One such tool is event-driven process chains (EPCs).[68] The concept of EPC focuses on providing syntax for documenting processes in a semi-formal manner rather than specifying processes formally.[69] They are not a normative model that already provides the content, which results in the need to start from scratch and develop the content (processes) by oneself.[70]

Due to the integration of EPCs in business software, they are widely used and accepted for modeling business processes. However, EPCs have a major disadvantage: they lack formal rigor, because neither the syntax nor the semantics are well defined.[71] This results in a situation where there is no comparability between different companies, or even different departments. Reference models tackle this disadvantage, by providing

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[66] cf. Lambert & Pohlen, 2001

[67] cf. Lambert D. M. & Burduroglu R., 2000

[68] cf. Keller, Nuettgens, & Scheer, 1992. A detailed description can be found in Scheer, 1994.

[69] cf. Mendling, Neumann, & Nuettgens, 2005

[70] cf. Scheer, 1994

[71] cf. Langner, Schneider, & Wehler, 1998

"blueprints" for business engineering, i.e., documenting process know-how that can be used for modeling.[72]

This is why a group of companies from the industry, together with associated academic institutions, founded the "Supply Chain Council" (SCC) in 1996 as a global non-profit consortium. The SCC developed a process reference model called the "Supply Chain Operations Reference (SCOR)-model" with the aim of providing a common language for supplier-customer relationships. The SCOR-model was recently published in its ninth revision.[73]

Applying SCOR itself does not directly result in more efficient and competitive supply chains. It has to be used in combination with other management concepts, for instance, change management, lean manufacturing, or BPR, in order to provide a valuable contribution in adding value and creating long-term success for the company.[74]

Within SCOR, the different business activities are structured according to five core tasks any manufacturing company has to fulfill, namely "Plan", "Source", "Make", "Deliver", and "Return". Figure 3 displays this structure.

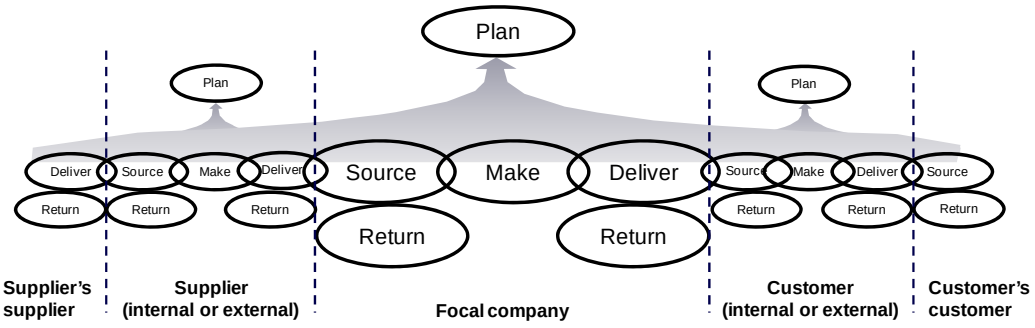


Figure 3 SCOR-model scope and structure[75]

[72] cf. Scheer & Nuettgens, 2000

[73] cf. Supply Chain Council, 2008; and Bolstorff et al., 2007, p. 343

[74] cf. Bolstorff et al., 2007, p. 343

[75] Adapted from Supply Chain Council, 2008

The major advantage of using SCOR lies especially in the possibility of describing complex management processes unambiguously, communicating them consistently, and redesigning them to achieve a competitive advantage. Moreover, SCOR provides the basis for consistent and comparable process measurement, management, and control.[76]

3.2 Supply Chain Performance Measurement

The previously described approaches for providing process transparency are a necessary basis for performance measurement. Studies show that companies with a defined process are also more likely to measure their effects in terms of cost, lead times, and service levels. The use of measures is in turn positively related to the effects experienced.[77]

A company's performance is comprised of the achievement of company objectives in the areas of quality, cost, delivery, and flexibility.[78] What is not measured or cannot be measured at all, cannot be improved.[79] Thus, a performance measurement is necessary to uncover deficiencies in the supply chain that can be addressed by SCIs.[80]

Since logistics is usually considered as a cost center, logistics performance measurement and reporting in most companies focuses on cost.[81] Apart from cost indicators, typical logistical performance measurement systems also cover measures for evaluating service levels and return on assets.[82] Schönsleben lists many traditional performance measures, clustered according to four key company objectives, namely

[76] cf. Stewart, 1997

[77] cf. Sandberg, 2007, p. 286

[78] cf. Schönsleben, 2007, p. 35

[79] cf. Coenenberg & Salfeld, 2007, p. 148

[80] cf. Lapide, 2000

[81] cf. Straube et al., 2005, p. 31

[82] cf. Brewer & Speh, 2000

quality, costs, delivery, and flexibility. He considers these as the four "target areas" of logistical performance.[83]

The SCOR-model also includes a comprehensive set of PIs. The performance measurement system is aligned to the underlying reference processes, providing a consistent and comparable basis for evaluating supply chain performance. Comparable to Schönsleben's performance target areas, the PIs within the SCOR-model are structured according to five "performance attributes", representing "characteristics of the supply chain that permit it to be analyzed and evaluated against other supply chains with competing strategies".[84]

Providing a list of PIs and their definitions would exceed the scope of this article. This document will use the performance indicators provided by SCOR. Thus, it is referred to the description of the SCOR-model for detailed definitions of the individual metrics.

3.3 Supply Chain Performance and Economic Value

In the last years many different authors described how supply chain performance affects enterprise value. However, many of these descriptions do not go beyond showing the qualitative relationship between operational performance and financial success.

A very good qualitative description of how SCM affects enterprise value is provided by Bauknight, who states: *"Effective and innovative SCM affects four levers of shareholder value: revenue, cost, working capital, and fixed capital. Revenue is affected by customer service and fill rates, which can increase market share and price premiums. Effective SCM yields cost savings by reducing cost of goods sold, transportation, warehousing, handling, and distribution. By reducing raw-material, in-process, and finished-goods inventory, SCM also can free up working capital. Finally, by designing supply chain*

[83] cf. Schönsleben, 2007, p. 35 et seq.

[84] Supply Chain Council, 2008

processes that optimize such physical assets as trucks, warehouses, materials-handling equipment, and manufacturing assets, companies stand to affect their fixed capital substantially."[85]

Another significant input is a concept described by Sennheiser and Schnetzler (2008). They elaborate on a more detailed relationship between SCOR best practices and EVA, which they call the "Supply Chain Value-Driver Decomposition (SCVD)".[86] This concept goes further than other concepts, because it explains which particular initiative causes which improvement, with a clear trace towards EVA. This approach has the advantage that it provides a graphical representation of the causal relationship between logistics and enterprise value, which is easy-to-grasp and provides the basis for a common understanding of logistics and financial managers. However, it still has the disadvantage that it only shows the relationship in a qualitative way, without providing a consistent and traceable calculation approach to connect specific performance improvements to enterprise value.

In their paper series "Creating Value" Groth et al. describe the "Point of Value (PoV)" concept, which represents an integrated view of supply chain events and related accounting elements on a high level.[87] They highlight the importance of the difference between the economic analysis of cash flow-related events that occur as a result of pursuing a particular course of action and the resulting accounting need. This integrated view is displayed in the "Operating Cycle", as shown in Figure 4.

[85] Bauknight, 2000, p. 29

[86] cf. Sennheiser & Schnetzler, 2008

[87] Please see Groth et al., 1996; Groth & Byers, 1996; Byers et al., 1997b; and Byers et al., 1997a. The following description is based on these sources.

The Operating Cycle shows the transformation of working capital in a supply chain, combining the values of the different elements of working capital with the "Operating Cycle Time (OCT)". The OCT is closely related to the Cash-to-Cash Cycle Time.

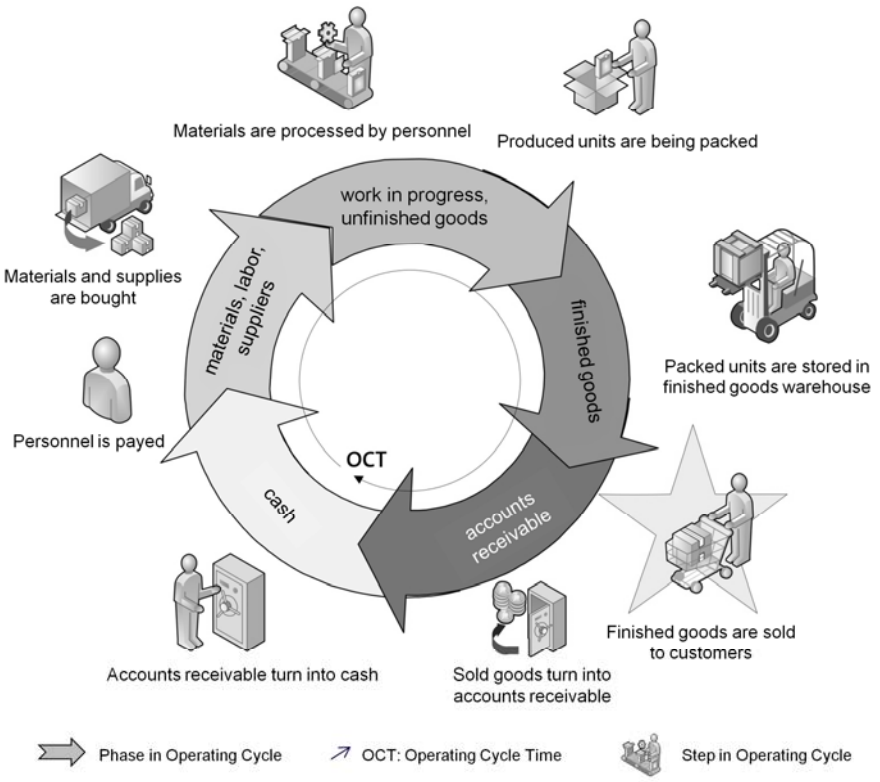


Figure 4 The Operating Cycle in the Point of Value concept[88]

The PoV concept is a first approach of linking the operational manager's perspective with the perspective of a financial manager. In the paper series, examples are also provided for calculating additional economic profit as a result of changes in the OCT. However, the concept remains at a very high level and lacks a detailed integration of the logistics manager's perspective, by providing a clear link to supply chain practices.

[88] Adapted from Groth et al., 1996

3.4 Summary and Derivation of the Research Need

In the last decades a significant amount of research has been complemented to improve supply chain performance measurement. However, the development in practice was considerably slower than in academia, probably also due to a lack of applicability of the concepts developed. Although there is high demand for transparency about logistics performance, there is a significant gap in terms of applicable performance measurement systems providing a comprehensive picture of supply chain performance and therefore meeting management needs.[89]

Most performance measurement systems focus too much on cost, without integrating success- and value-oriented metrics.[90] However, capital utilization is the area with the biggest potential impact of SCM on the financial performance of a company.[91] But a study shows that only 9% of the responding companies were measuring indicators which represent an orientation towards enterprise value.[92]

In summary, the analysis shows a clear gap in terms of comprehensiveness and practicability. The main gap is transparency of the influence of supply chain initiatives, via improved operational performance, on the utilization of working capital, which can then be further translated to financial success.

This fact results in practical issues from two perspectives:

- Companies have issues assessing the economic benefit they would gain from implementing the supply chain initiative. Hence, they do not know whether it is valuable to invest in the initiative or outsource parts of the supply chain, respectively.

[89] cf. Weber, 2002, p. 104

[90] cf. Weber, 2002, p. 93

[91] cf. Timme & Williams-Timme, 2000

[92] cf. Straube et al., 2005, p. 10

- Companies have issues controlling the effectiveness and efficiency of the supply chain initiative, if they decide to invest or outsource.

In order to close the described gap, the following aims are the two major objectives of the article:

- Identify the relevant operational performance measurement standards for assessing the impact of SCIs within manufacturing supply chains.
- Develop a theoretical framework and method of translating the change of these operational supply chain performance metrics into financial (success) metrics.

4 The Supply Chain Value Contribution Method

In this chapter the core research result is presented. First, a new method of presenting the relationship of supply chain performance and the elements of working capital is described. It provides the basic understanding and necessary insight into the approach to assess specific supply chain initiatives.

4.1 The Relationship Between Supply Chain Performance and Working Capital

The basic result of the research provides the basis for translating the performance of a supply chain into enterprise value. The underlying logic combines the use of the SCOR-model as an event-driven process reference model and the flow of costs in a manufacturing company from an accounting perspective, as described in Chapter 2.1.1 and integrated into the PoV concept. Only with this new combination are the elements of working capital clearly linked to the basic activities of a manufacturing company, providing the necessary transparency of supply chain performance from a financial perspective. Figure 5 displays an exemplary overview of this relationship for a make-to-stock production environment. An explanation follows.

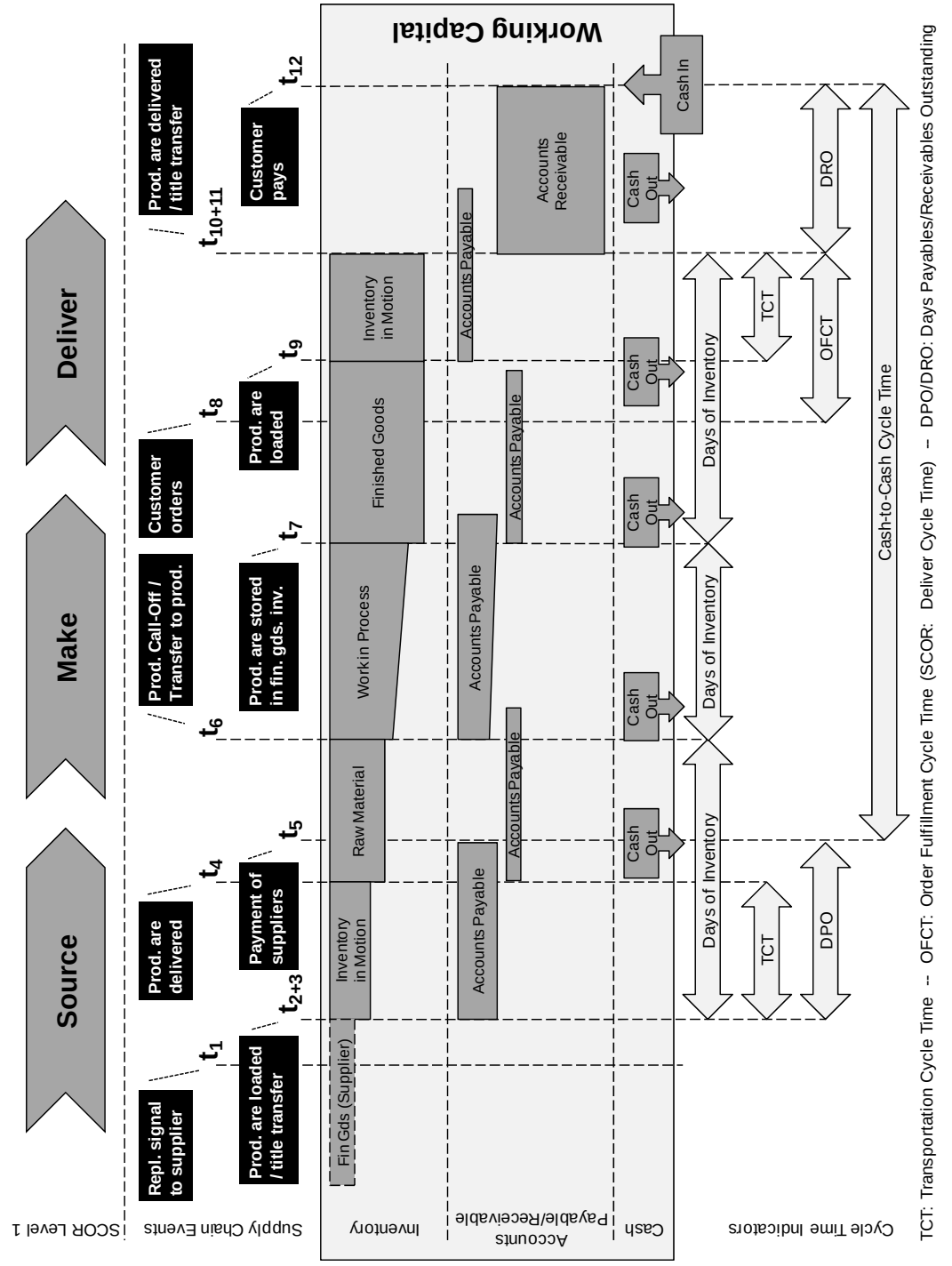


Figure 5 SCOR level 1, supply chain events, key cycle time indicators, and the relationship to elements of working capital[93]

[93] Own figure, assuming MTS environment and Incoterms: inbound FCA, outbound DDU/DDP

In order to be able to produce a product, a company needs raw material and components, which it sources from its suppliers. In a make-to-stock (MTS) environment, the company sends a replenishment signal to its supplier for this purpose (t_1). After receiving this signal, the supplier has to prepare the delivery of the material. Here, the material is sourced using "Collect Terms", i.e., the Incoterm code FCA (free carrier) is used. This means that at the moment the carrier picks up the delivery (t_2), the title of the material is transferred to the focal company (t_3). This also means that the pickup date is the same date as the invoice from the supplier. Thus, the open invoice is recorded as accounts payable in the balance sheet of the focal company.[94] Since title of the material has passed to the focal company, it appears as inventory (in motion / in transit), valued at sourcing costs, on the balance sheet of the focal company. The sourcing costs include the costs of managing and operating the transportation. At the time of delivery to and storage in the raw material inventory (t_4), it appears in the corresponding position on the balance sheet. The payment terms with the supplier determine t_5, representing the time when the focal company pays the supplier and has a cash outflow. The invoice is closed and does not appear on the balance sheet anymore.[95] T_6 represents the point in time when the material is called off for production and moved from raw material to work in process (WIP). In this thesis, the production process itself is out of scope and therefore considered as a "black box". However, there are value adding activities and corresponding events taking place until the assembly is finished and the products are stored as finished goods (t_7).

[94] In practice, supplier and customer often agree on fix intervals for sending invoices, which then aggregate several deliveries. This article does not take this into account for simplification reasons.

[95] Please note that for simplifying reasons, the costs related to the following flow of events are represented in additional "accounts payable" rectangles, but do not have a clear link to time stamps anymore. A more detailed representation would include their amount and payment terms in relation to the other supply chain events.

Once the customer order is received (t_8), the loads are prepared and carriers selected, so that the products can be loaded at t_9. On the balance sheet, they are then considered as inventory in motion, assuming the deliveries are conducted to "Delivered Terms", i.e. the Incoterm code DDU or DDP (delivery duty unpaid/paid). When the products are delivered and accepted by the customer (t_{10}), and therefore title has transferred (t_{11}), the invoice is active. At this moment the products no longer appear in the inventory position of the focal company's balance sheet. In contrast, the amount of the invoice appears in accounts receivable. When the customer pays (t_{12}), the amount disappears from the balance sheet and cash flows into the company's account, appearing later on the P&L (Point of Value).

Figure 5 displays that the time stamps of the material transformation (i.e., the supply chain events), which are measured by the above mentioned cycle time indicators, play an important role in the relationship of supply chain performance and working capital. The first key indicator is the cash-to-cash cycle time (C2C–CT), that is the time between the payment of suppliers and receiving the money from the customer. Part of this metric is the order fulfillment cycle time (OFCT), or in SCOR terminology the Deliver Cycle Time, which measures the time between receiving the customer order and the successful and accepted delivery to the customer. The order fulfillment cycle time plus the time until the customer pays then equals the order-to-cash cycle time (O2C–CT, not displayed in the figure). Additionally, the inbound and outbound delivery cycle times and the days of inventory play an important role. The shorter all the cycle times, the less capital is locked up in the form of inventory, as described in the following.

All material that is inventory, either in motion, raw material, in process, or finished goods, appears on the balance sheet valued at actual total costs. This has two important consequences. First, where costs are reduced, the valuation is decreased by the same

amount. Second, considering that the balance sheet is a snapshot of the company's asset and capital situation at a given point in time, there is material in the whole supply chain, which appears as inventory in the corresponding stage. The shorter the supply chain, the less material adds up in the inventory account. In Figure 5, the heights of the inventory rectangles represent the actual total costs of the material until the particular stage. The widths represent the duration of time (i.e. cycle time) the material remains within the particular stage of the supply chain at a given point in time. The area of the rectangles is the value of the particular element of inventory appearing on the balance sheet. By reducing costs, the height of the rectangles is decreased. By reducing cycle times, the width of the rectangles is reduced, resulting in a smaller area and therefore a lower valuation of the particular element of inventory. So both cost and cycle time reductions reduce the amount of capital lockup within a company.

A similar logic can be applied to the accounts payable and receivable, respectively. The widths of these boxes represent payment terms, or, as a performance measure, the days payables/receivables outstanding. The heights represent the amount appearing on the corresponding inbound or outbound invoices. Cash in- and outflows do not have a "cycle time", but do have a value and influence the amount of cash the company holds in the balance sheet. Figure 5 does not show the cash pool. Because production processes are here considered as a "black box", the figure displays this element not as a rectangle, but as a trapezoid. This represents the value-adding activities taking place in this phase, with costs incurred appearing in accounts payable. However, in a more detailed analysis and representation of a company's supply chain and working capital situation these aspects could be included.

4.2 The Approach of the Supply Chain Value Contribution Method

The relationships described previously provide the basis to show the influence of supply chain initiatives on the financial performance of the company. They are integrated in the newly developed "Supply Chain Value Contribution (SCVC)" method, which is represented in Table 1 and described in more detail in the following, in the form of a use case. A more detailed description of the SCVC method, including another and more comprehensive use case, can be found in Schneider (2010)[96].

Table 1 Approach of the Supply Chain Value Contribution Method

Step	Content	Sources, tools and methods
1	Select supply chain initiative (SCI) to be evaluated	SCOR, TQM, JiT, …
2	Select project team	n/a
3	Establish supply chain performance transparency	SCOR, EPC, …
4	Identify the influence of the SCI on supply chain performance and working capital	Expert interviews, benchmarking databases, papers and articles, simulation, …
5	Filter external effects	Statistical data bases for economic development and price indices, information from internal departments, …
6	Calculate the economic value contribution of the SCI	EVA, ROI, Excel…
7	Mitigate investment decision risks by integrating SCVC calculation	Powerpoint, Excel, Word, Make-or-buy decision, continuous improvement programs, …

When the value contribution of a certain SCI is to be evaluated for the first time, all steps have to be conducted as a project. So the generic hints and aspects about conducting collaborative projects, in terms of change management and project management, must be considered.[97]

The first two steps are part of selecting and preparing the SCVC project. Step 7 represents the bridge back to the initial management context which triggered the

[96] cf. Schneider, 2010

[97] cf. e.g., Schönsleben, 2007, pp. 952 et seq.

initiation of the SCVC project. The management context also determines the level of detail of all steps. In case of an *ex ante* make-or-buy (MoB) or investment decision, many assumptions about future performance have to be made, leading to a certain level of uncertainty about the calculation results. Because of this inherent uncertainty, there is probably no need for a significant level of detail in steps 3-7. In the case of an *ex post* controlling of the effectiveness of an SCI, the level of detail can be higher, because the information and data for the calculation is historic and therefore more reliable.

It is assumed that there is no need to describe steps 1 and 2 in further detail. The following sub-chapters will focus on steps 3-7. Please note that Table 1 indicates that there are many different tools and methods available that support the particular steps. However, because of the limited frame of this research, this article will not describe the use of all the listed tools and methods. The following description is based on one of the conducted use cases. There, it was decided to use the tools and methods provided by the SCOR-model and the logic of EVA to link process performance and economic value.

The selected use case describes how the approach can be used in order to assess the influence of a changed supply chain structure on the economic performance. It was conducted in collaboration with a manufacturer of piping systems, employing more than 3,000 people and headquartered in Central Europe. It produces fittings, pipes, valves, instruments, and other products for areas such as drinking water transport, sewers, semiconductor and chemical industries, and biotechnology.

The action research project was conducted with the central logistics department of the company, which is responsible for the distribution of the products. The aim of the project was twofold: the company wanted 1) to have an increased transparency on the utilization of its working capital related to the outbound activities in general, and 2) to analyze the influence of a probable change of the modal profile towards a regional

distribution center. Figure 6 displays the distribution scenario of the company within Europe, setting the scope of the analysis and representing step 1 of SCVC method.

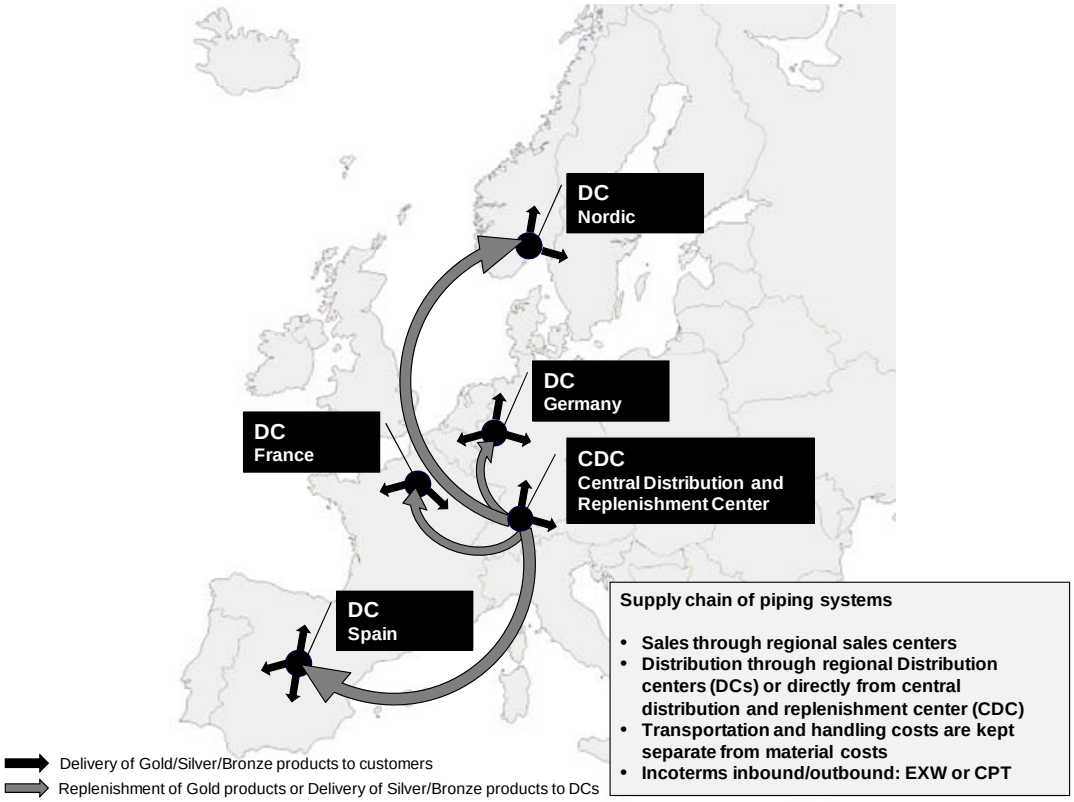


Figure 6 Distribution scenario of the use case

The logistics department is considered an internal service organization and managed as a cost center. The company's regional sales organizations (SO) are responsible for selling the products to the customers in their region and use the services of the logistics department to transport the products to the customers. In a similar way, the production plants of the company use the services of the logistics departments for storing the finished goods. The sales organizations receive bills from their responsible distribution center (DC). The production plants and the central SO receive bills from the central distribution and replenishment center (CDC).

The company introduced three service classes for its products, with different service levels towards the customers. The three classes are:

- *Gold* products: These products are stored in and delivered directly from every distribution center in a make-to-stock (MTS) environment. This ensures that any customer in Europe can be delivered to within a maximum of two working days. The regional DCs are responsible for the stock levels of the Gold products themselves, ordering and receiving a bill from the CDC. The CDC replenishes its stock levels of Gold products directly from the production plants. Customers of the central SO are directly delivered from the CDC.
- *Silver* products: Silver products are only stored in the CDC. When a regional SO receives a customer order for a silver product, it forwards it to the regional DC, which further forwards it to the CDC. The products are then first delivered to the regional DC and then to the customer. Customers of the central SO are directly delivered from the CDC. The promised order fulfillment cycle time to the customer is a maximum of six working days. This scenario also represents a MTS environment.
- *Bronze* products: This range of products is only made-to-order (MTO). Orders of customers are forwarded through the regional SOs, via the particular DC and the CDC, to the appropriate production plant. The deliveries go through all stages the other way round. The promised cycle time to the customer depends on the specific product and can be up to two months.

The value of the material is kept separate from the costs occurring from the storage, handling, and transportation. So only the total manufacturing cost is considered, which only contains all the direct costs and manufacturing overhead until the finished goods are stored in the finished goods warehouse (i.e. the CDC). All following costs are aggregated in the distribution cost. Within the project, the perspective of the CDC is taken, therefore representing the focal organization. The CDC receives bills from the

production plants only for the material, without any margin. The CDC distributes the material and sends bills to the regional DCs, containing the material valued at the price they have to pay to the production plants, plus the transportation and handling costs. When customers in the home country are delivered, the bill is sent to the central sales organization (CSO). The regional DCs send a similar bill to their regional SO, also without any margin. The SOs then bill the customers with a profit margin and only pay the preceding biller (DC or CDC) when they have received the money from the customer. The CDC pays the bill of the production plant when they have finally received the money from the DCs or the CSO.

Thus, inventories do not change their value because they are valuated according to COGS and no further overhead is attributed to them. However, the setup has implications for the overall profitability of the company because the inventories are distributed over Europe, resulting in capital lockup and corresponding financing cost, additional to the selling and distribution cost. This structure was introduced without considering this aspect in detail, so the analysis within the project aimed at providing transparency on the resulting capital utilization. Furthermore, because there are ongoing internal discussions about a change of transportation mode profiles between the CDC and the DCs, a detailed analysis of the different overall value contributions using the example of the DC Nordic was conducted. This analysis aimed to reduce the risk of making a wrong decision and, therefore, reducing the company's overall profitability.

With regard to step 2, the project team comprised the action researcher, the head of logistics, the head of supply chain planning and execution, and the logistics controller.

4.2.1 Establishment of Process Transparency

Step 3 of the SCVC method requires the establishment of process transparency in a comparable way. Within the project, it was decided to remain on SCOR level 2, because

this level of detail was considered deep enough for the management context. The basic distribution scenario, when displaying it using SCOR level 2 process categories, is the same for both Gold and Silver products. This is due to the fact that both product categories are produced and stored within a make-to-stock environment, and that the orders of the customers in the Silver scenario are always forwarded through the regional DCs, this only being different in the case of customers of the central SO.

Figure 7 depicts the relationship of the Gold product scenario and the associated process types with the elements of working capital and relevant cycle time indicators. The figure indicates that this range of products is stored at two locations, and that the DCs and the CDC have a customer–supplier relationship.

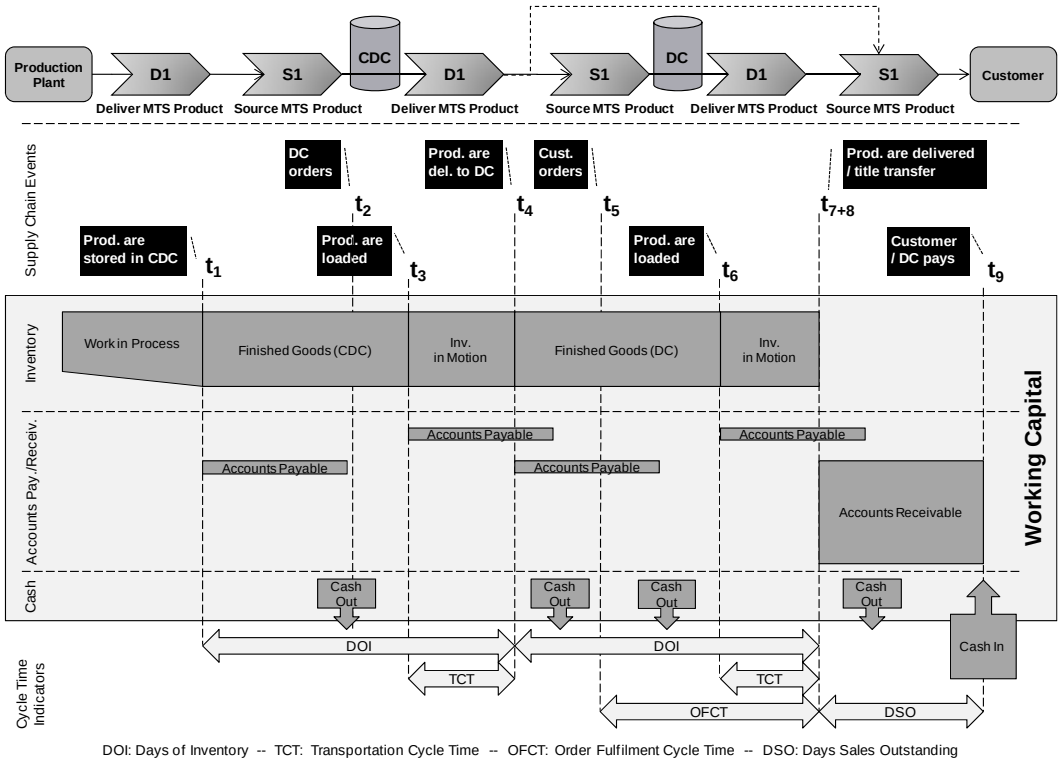


Figure 7 MTS Gold environment, cycle time indicators, and working capital[98]

[98] Assuming Incoterm code CPT and deliveries to customers of regional SOs

Now it is required to identify relevant performance indicators. Additional to the handling and distribution costs, relevant cycle time indicators in this scenario are the days of inventory in all storing locations, the transportation cycle times, the order fulfillment cycle time (to the customer) and the days of sales outstanding (DSO), which is a synonym for days receivables outstanding (DRO). Please note that t_9, representing the time of the payment of the customer, for simplification reasons also represents the point in time the regional SO also pays the DC, which then also pays the bill of the CDC. Therefore, the DSO for the SO is the same for the DC and the CDC. This simplification is allowed because the company-internal transactions are conducted automatically according to transfer prices as described previously.

The accounts payable in the figure represent the handling and distribution costs that the logistics department, which is located in the CDC, has to pay in the corresponding distribution phase.

Figure 8 depicts the situation for the Silver product scenario. In this figure the difference to the Gold scenario is represented by the difference in the relevant supply chain events. The customer order is automatically forwarded to the CDC, which loads the products and sends them to the DC, which then directly forwards the load to the appropriate customer.

Thus, although the relevant cycle time indicators are the same, the OFCT to customers of SOs outside the home country is expected to be much longer, but the DOI of the regional DCs is much shorter for Silver products.

With respect to the first objective of the project, the results of step 3 are already the basis for achieving the desired increased transparency on the capital utilization within the different distribution scenarios. The different elements of working capital and the performance indicators were filled with the actual values according to the information

stored in the company's ERP system, with the aim to observe the changes in future and identify improvement potentials. These results are not displayed in this thesis. In contrast, the further description will focus on the analysis aiming to achieve the second objective of the project. Therefore, the following steps will pick up the description of the Gold and Silver product scenario and describe the situation of the distribution of products in the Nordic region in more detail.

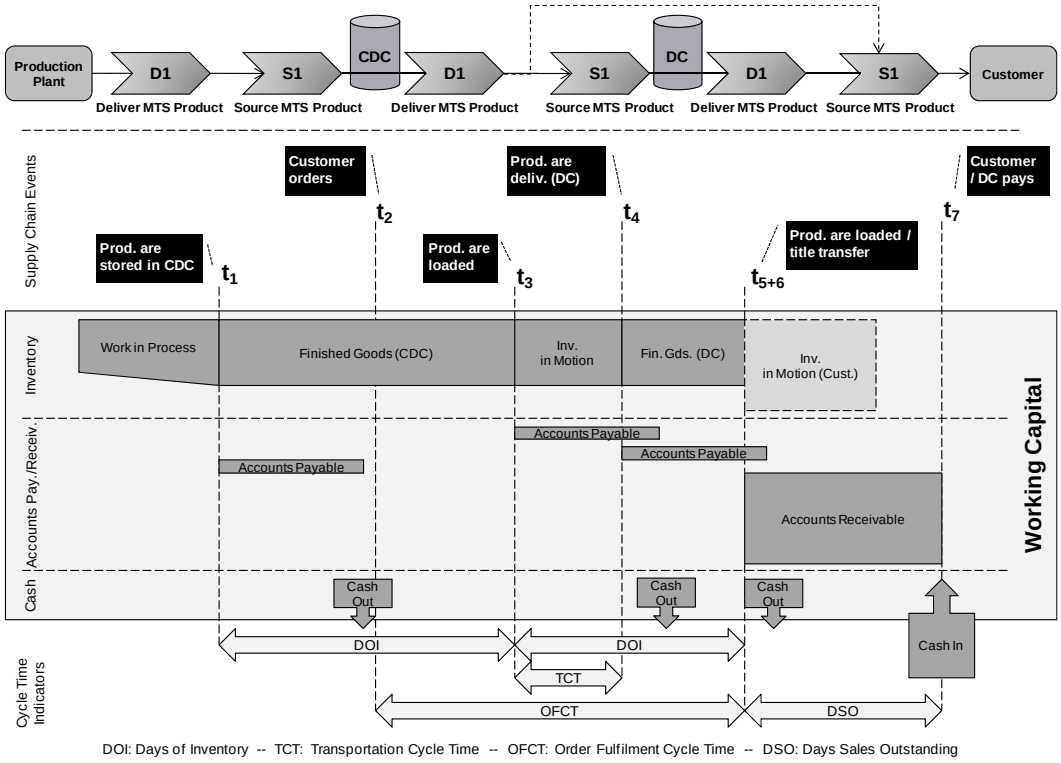


Figure 8 MTS Silver environment, cycle time indicators, and working capital[99]

4.2.2 Identification of the Influence of a Modal Change

There are ongoing discussions between the people of the central logistics department and the regional DCs with regard to the most appropriate distribution structure and associated transportation modes. The classification of products with different service levels are a result of the discussion about the distribution structure. However, the

[99] Assuming Incoterm code EXW and deliveries to customers of regional SOs

question about the most appropriate transportation modes remains. A reason for this discussion is the desired overall cost reduction of the central logistics department, which also wants to take the financing costs into account, and the concerns of the regional SOs, which want to keep the promise of short OFCTs to their customers. The transportation between the CDC and the DCs is currently performed by trucks in order to achieve short transportation cycle times. So it was decided to analyze a modal change of transportation to the DC Nordic with ships, as an exemplary case to illustrate the influence of a modal change and the resulting contribution to enterprise value.

The area of influence of a modal change is rather small. Figure 9 displays the influence area of this specific SCI in this context.

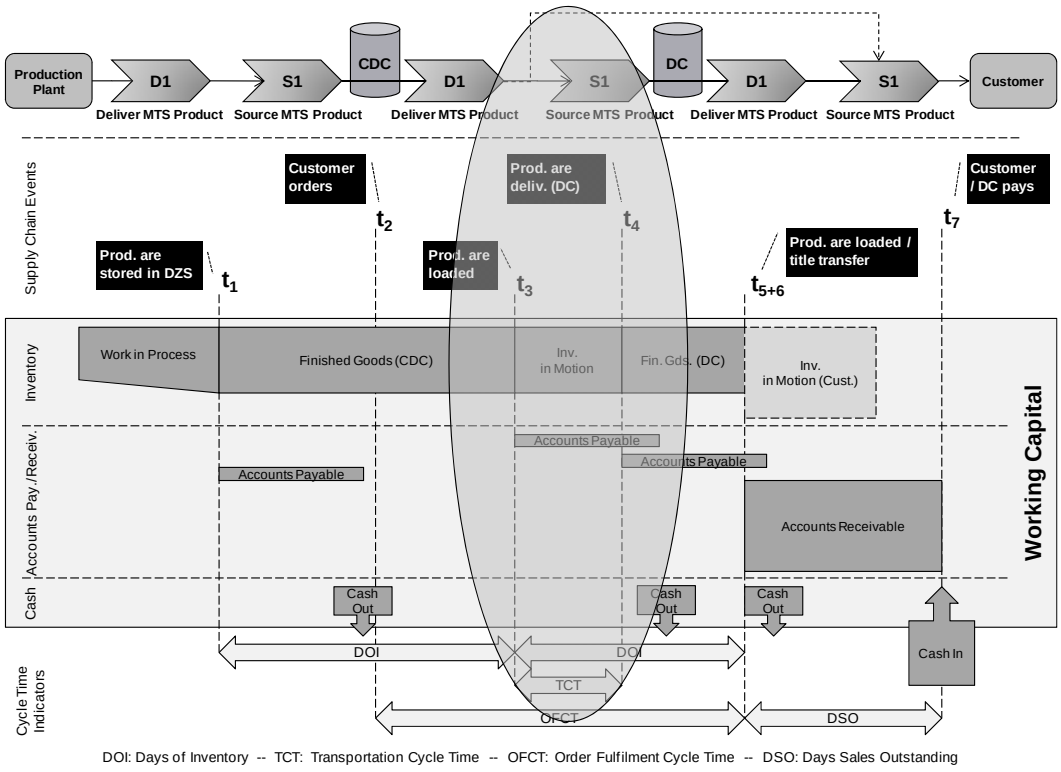


Figure 9 Influence of the SCI in the selected distribution scenario[100]

[100] Based on Silver product scenario and assuming Incoterm code EXW

The interrelations of performance effects are that the modal change will lengthen the TCT to the DC at lower costs, therefore also lengthening the DOI of the CDC, increasing the amount of inventory appearing on the balance sheet and increasing costs for financing the inventory. This increase needs to be compared to the overall cost reductions and the resulting decreased accounts payable, the latter also increasing the capital cost. In the case of Silver product deliveries, the lengthened TCT also lengthens the OFCT towards the customer, which might influence the customer satisfaction.

The KPI changes are related to working capital and EVA as follows:

- Total SCM Cost:
    - Reduction of total transportation cost, due to cheaper transportation mode (sea freight)
- Assets that need to be financed:
    - Increase of inventory in motion, due to longer TCT
    - Decrease of accounts payable, due to lower costs
- Sales/Revenue:
    - Probably negative effect on customer satisfaction due to longer OFCT, with the risk of resulting lower sales

4.2.3 Filtering External Effects

In achieving the objective of this analysis there were no relevant external effects identified. However, given that a decision is made in favor of a modal change, an *ex post* controlling of the effectiveness of the decision would need to consider and filter changes in assessorial fees, e.g., fuel, risk and security surcharges, and other inevitable price fluctuations as represented in transportation price indices.

4.2.4 Calculation of the Economic Value

The calculation of the contribution of the SCI to enterprise value starts with the definition of a baseline scenario. In this case, the baseline scenario is the current distribution setup with trucks as main transportation mode. Following the principle that only differential values are relevant for decision-making, Figure 10 displays the baseline for the Gold scenario with values attributed to the relevant elements of working capital and cycle time indicators. Please note that the following figures contain imaginary values and assume the use of Incoterm code EXW. However, the relationships between the imaginary values are based on the actual values of the use case company.

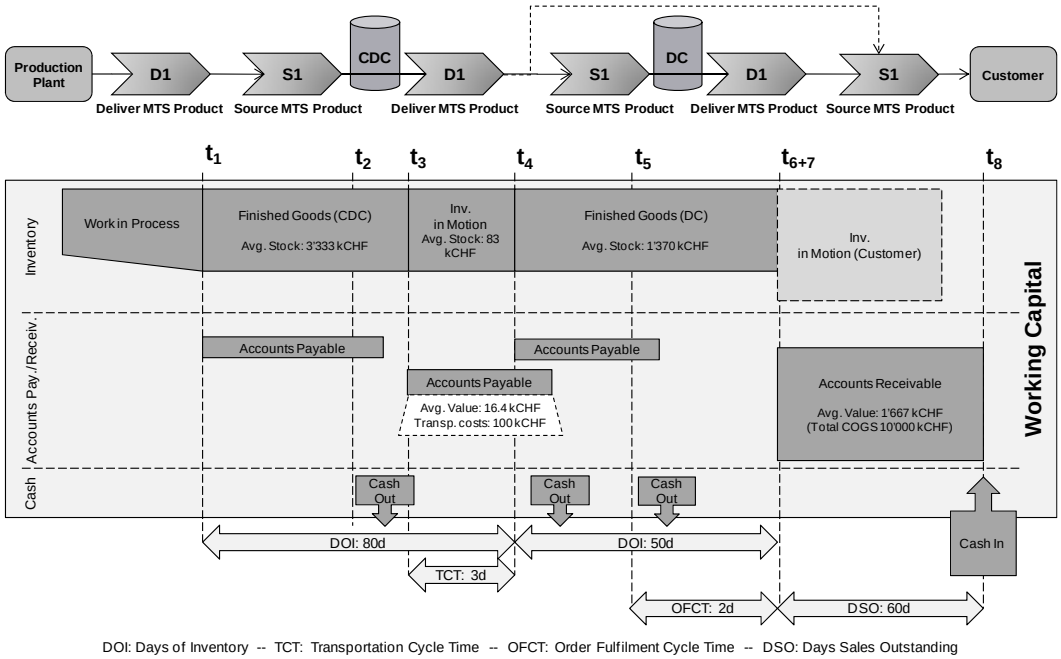


Figure 10 Gold baseline scenario with performance levels and values

The analysis for the Silver scenario was also conducted within the AR project. However, due to the limited frame of this article, the description focuses on the Gold scenario.

In order to now calculate the contribution of the SCI to the enterprise value, it is requires to make realistic assumptions on the expected performance changes. When the transportation mode is changed to sea freight, the costs are expected to be reduced by

25%. At the same time, the transportation cycle time is to be expected to be extended to 7 days instead of only 3 days. The resulting situation with regard to the working capital is displayed in Figure 11.

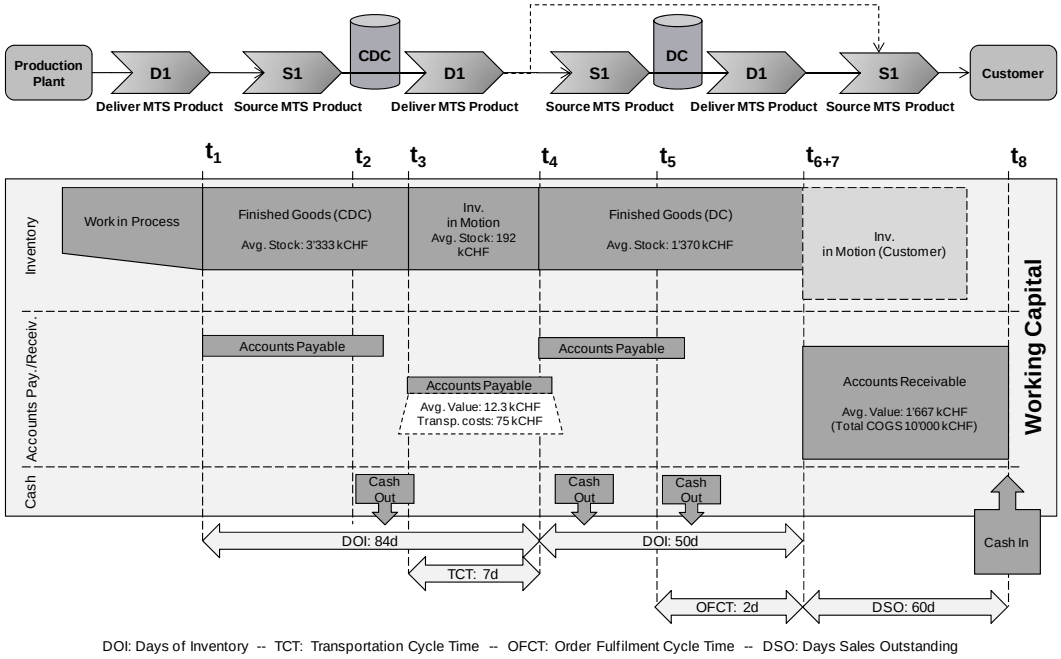


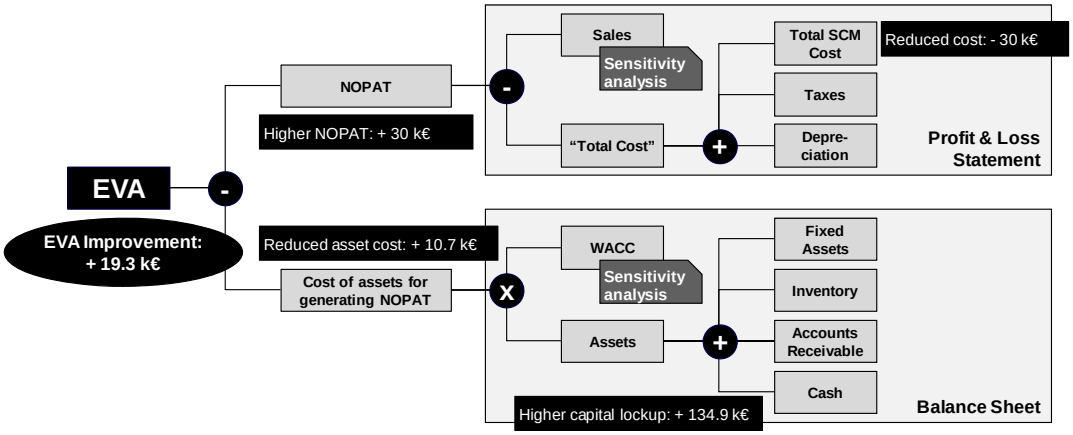
Figure 11 Gold To-Be scenario with expected performance levels and value changes

The relevant numbers in the two scenarios result in the following EVA contributions: The amount of inventory in motion is increased from 83 to 192 kCHF, due to the modal change. Furthermore, the accounts payable are reduced from 16.4 to 12.3 kCHF, therefore increasing the amount of current assets to be financed. The transportation costs are reduced from 100 to 75 kCHF. This results in an *EVA contribution of 16 kCHF* (25 kCHF – [109 kCHF + 4.1 kCHF] * 0.08), with WACC of 8% and payment terms towards suppliers and service partners of 60 days.

4.2.5 Mitigation of Investment Decision Risks by Integrating SCVC Calculation

Please note that there was no sales effect in the To-Be scenario calculation taken into account. Figure 12 represents the representation of the overall EVA contribution

resulting from the changes described above, including the numbers of the Silver scenario, which was not displayed above but provided very similar numbers.



EVA: Economic Value Added -- NOPAT: Net Operating Income after Taxes and Depreciation -- WACC: Weighted Average Cost of Capital

Figure 12 Representation of the EVA contribution of the modal change

The last step of the SCVC method requires conducting a sensitivity analysis when representing the economic value of an SCI. With regard to the effect on sales, the regional DCs argue that there will probably be a negative effect, caused by a higher OFCT and reduced customer satisfaction in the Silver scenario. Considering the EVA contribution of the modal change is rather low, it becomes transparent that a very small negative effect on the sales would already lead to a negative overall EVA contribution. This aspect is stressed by a sensitivity analysis with regard to the WACC. Considering the company's WACC of 8% are rather moderate, a probable higher WACC would easily lead to a negative EVA contribution.

Within the project, a very similar outcome was calculated with the actual numbers, leading to the decision not to realize the modal change, in order to avoid the risk of reducing the enterprise value contribution of the current distribution structure.

4.2.6 Summary

The analysis of the distribution structure at the manufacturer of piping systems, following the SCVC method, achieved two main objectives. First, the representation of the distribution setup increased the transparency of the supply chain's utilization of working capital. This provided the basis to analyze future performance changes in the supply chain, and the resulting contribution to enterprise value.

Following this logic, the second objective of the use case was achieved: a modal change in the transportation of products from the central distribution and replenishment center to a regional distribution center was analyzed in a comprehensive and enterprise value-oriented way. This represented an SCI that was permanently discussed internally. The analysis showed that the expected cost reductions would only marginally exceed the expected higher financing costs that result from the increase in working capital. Additionally, a qualitative sensitivity analysis of a probable negative sales effect showed that a very small decrease of sales would already burn the achieved cost reductions. Therefore, the decision was made in favor of not realizing the modal change. Thus, the risk of making a wrong decision for the implementation of the SCI was mitigated.

5 Appraisal of the SCVC Method

The implementation and use of the SCVC method for assessing the economic value contribution of supply chain initiatives carries several benefits. However, there are also some limitations of the method in the current stage of development to be identified.

5.1 Benefits of the SCVC Method

In 1996, LaLonde and Pohlen listed many benefits resulting from an implementation of their "supply chain costing" approach, which provides a comprehensive perspective on cost performance in different supply chain setups. Although their focus was on cost and

profit rather than added value, many of their findings also apply to the SCVC approach. A selection of the most relevant aspects, which were also identified in the collaborative action research projects conducted for the research described, is provided and supplemented with own experiences as follows:[101]

- *Financial assessment of Make-or-Buy decisions*: The manager of the focal company can base his decision upfront on whether to outsource the activities on the prospective changes in capital utilization and resulting value contribution on a more profound basis, and later control the effectiveness of the supply chain partner. This reduces the risk of making a bad investment decision. The outsourcing partner can use the information on prospective changes in the working capital of the potential customer as a sales argument, displaying the differentiation value.
- *Planning and control of the supply chain*: The analysis of the value contribution can be conducted according to different products, customers, or distribution channels. This information facilitates improved priority setting, by focusing on supply chains with the highest value contribution.
- *Design of supply chain processes and networks*: The SCVC method can reflect the results of potential decisions with regard to business process reengineering, the elimination of non-value-adding activities, alternation of supply chain structures, or changes of locations of functions performed within the supply chain. It enables the translation of non-financial performance measures such as delivery reliability, transportation lead times, and inventory levels into a financial impact affecting the value of the enterprise. This increased

[101] cf. Lalonde & Pohlen, 1996

transparency mitigates risks in making strategic decisions regarding the composition and structure of the supply chain.

- *Design of contracts with supply chain partners*: Linking operational performance to the resulting contribution to enterprise value can change the company's evaluation of service providers and vendors. Restructuring the supply chain to exploit efficiencies or seize a competitive advantage requires a mechanism capable of equitably allocating cost benefits and burdens between supply chain partners. The SCVC method allows the consideration of a supply chain partner's contribution to enterprise value, resulting from increased delivery reliability and reduced capital lockup, in such contracts.

5.2 Limitations of the SCVC Method

The concept described also carries some limitations. The following aspects were identified during the course of the research:

- *Organizational aspects:* The implementation of the concept requires some changes to the organization itself and the employed IT-infrastructure. Therefore aspects of Change Management must be considered, supplemented by a strong focus on information flows and the associated master data within the IT system.
- *Filtering external effects*: An important requirement for the SCVC method is a clear filtering of effects that are not caused by the supply chain initiative itself, for instance, changes in shipping volumes, product characteristics and channels, or regions in scope. Effects of inflation, exchange rate fluctuations, or changes of other price indices might also impact the cost situation significantly and need to be excluded from the evaluation of a specific supply chain initiative.

5.3 Fulfillment of Research Need

The SCVC method closes the research gap as described in Chapter 3.4. It can be stated that the approach allows both an *ex ante* and *ex post* assessment of the (expected) value contribution of an SCI. An *ex ante* assessment, based on expectations and assumptions, is naturally accompanied by more uncertainty than the *ex post* calculation using actual values. However, the experience gained from the validation activities indicates that the SCVC method puts the value contribution assessment on a more profound basis than traditional approaches, therefore strengthening decision-making based on enterprise value and mitigating investment decision risks.

6 Summary and Outlook

Effective supply chain management plays a crucial role in increasing enterprise value. This is a well-known fact, but until now there has been a lack of a clear and consistent method to show the contribution of SCM initiatives to enterprise value from a financial perspective. Hence, logistics managers have problems in communicating quantitative benefits of their management decisions, which go further than reporting service level improvements and cost reductions, to the boardroom. On the other hand, financial managers have problems assessing the real contribution to enterprise value of projects aiming to improve supply chain performance. Many assumptions have to be made when, for instance, calculating the net present value of such projects. As a result, investment decisions about supply chain improvement initiatives used to carry a certain level of risk.

This article described an approach to fill this gap. The “Supply Chain Value Contribution (SCVC)” method consists of seven steps. The key element and main innovation of the approach is the use of the SCOR-model and the identified relationships between related supply chain events and the different elements of working

capital. Any supply chain can be displayed accordingly, providing an integrated view of operational supply chain performance and the resulting utilization of working capital. Using the same approach to display a changed supply chain performance (*ex ante* and/or *ex post* and resulting changes in capital utilization), resulting from the implementation of a supply chain initiative, makes it possible to calculate the contribution of the initiative to enterprise value, based on EVA. With the application of the SCVC method, investment decisions can be made on a more profound basis, therefore mitigating investment decision risks.

The integrated view links logistics' and financial managers' perspectives on the supply chain and provides the required common language for assessing the contribution of supply chain improvement initiatives to enterprise value. The use of EVA facilitates a comprehensive and long-term understanding of enterprise value and allows the use of 1) a truly value-based target-setting methodology and 2) gain sharing elements in contracts with supply chain partners or internal incentive schemes.

The integrated perspective on supply chain performance and the utilization of working capital facilitates a true orientation of logistics management towards enterprise value. The use of EVA strengthens a comprehensive and long-term understanding of enterprise value and allows the use of a value-based target-setting with supply chain partners or internal departments, e.g., within incentive schemes or risk and gain sharing elements in service contracts. Researchers should monitor the consequences of the implementation of such elements, especially for customer-supplier relationships and the trust building process, because there is very little experience about the behavior of players in such environments. The importance of this aspect becomes clear when considering that the supply chain partners of the focal company also follow the goal of increasing enterprise value from their perspective, which might result in diametric goal systems.

During the research, there were also some areas identified that carry the potential for further improvement of the SCVC method:

- From a practical perspective, the underlying logic could be integrated into *ERP- or SCM software solutions*, as a controlling and reporting element. The application cases showed that currently available ERP data already provides the necessary input for the described approach. By integrating this logic in standard software, the analysis could be conducted in a more automated manner.
- From a theoretical perspective, there were several areas identified for further investigating in Action Research environments. The *risk* attached to the supply chain setup itself is a very important aspect. The probability of losses of production or suppliers, as well as the general risk of the industry and market, influence the financing costs for the capital employed in the supply chain. Improvements in the reliability of the supply chain can be displayed according to the approach described and then communicated to shareholders and external providers of capital, which puts the risk assessment on an even more profound basis and allows for a differentiation between different supply chains within one company. This can positively affect the financing costs of the company.
- The last identified area is a more detailed analysis of the *timing of cash flows* in relation to different supply chain setups and associated performances. This aspect has a strong influence on the liquidity of the company and also affects the financing costs.

In general, this article and the SCVC method are to be considered as only one step of the ongoing integration of financial aspects into the context of supply chain management.

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