The Definition of a Supply Chain Project 15

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Supply Chain Management aims at improving competitiveness of the supply chain as a whole, by integrating organizational units along the supply chain and by coordinating material, information and financial flows in order to fulfill (ultimate) customer demands (Sect. 1.1). Supply Chain Management projects range from functional improvements on the IT level to large-scale change programmes. Functional improvements might be the introduction of a new forecasting method or the adjustment of the master planning optimization profile. Examples for larger SCM projects are the optimization of the supply chain network, the redesign of the planning processes or the adjustment of the business strategy based on SCM concepts. In either case, the goal of SCM projects is to improve competitiveness of the supply chain.

In recent years since the peak of the e-business hype Supply Chain Management and especially Advanced Planning Systems were viewed more and more critically by industry firms, as many SCM projects failed or did not realize the promised business value. There are three reasons for that.

The first reason for the failure of SCM projects is the perception "that the more you spend on IT (e.g. APS) the more value you will get from it" (Willcocks et al. 2001). This attitude leads to technical capabilities searching for business problems to be solved. The role of IT (and APS) was clearly over-estimated in the past as the single source of business value. In order to get "value" out of an APS implementation the SCM concept must be formulated prior to the APS implementation. The SCM concept defines the needs and priorities for the APS implementation; the APS supplies advanced planning functionality to be utilized by the SCM concept. For example, the SCM concept describes the network

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H. Stadtler, C. Kilger and H. Meyr (eds.), *Supply Chain Management and Advanced Planning*, Springer Texts in Business and Economics,
DOI 10.1007/978-3-642-55309-7_15,

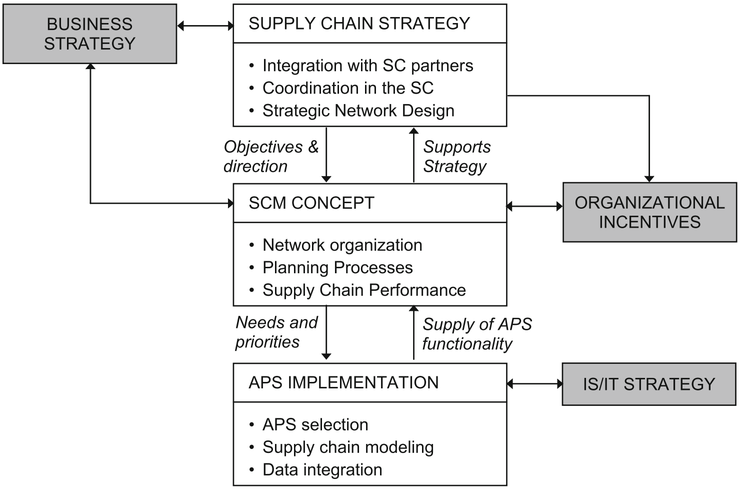

Fig. 15.1 Strategic SCM framework (adapted from Ward and Peppard 2002)

organization, the planning processes and the supply chain performance targets and indicators.

A second reason for the failure of SCM projects in the past is an inadequate alignment of the SCM concept with the supply chain strategy. Many decisions that have to be taken as part of SCM projects have a direct impact on the supply chain strategy (i.e. support the strategy or not) and must therefore be aligned with the supply chain strategy. Examples are the integration with supply chain partners, coordination and leadership in the supply chain and the results from strategic network design. The supply chain strategy sets the objectives and the direction for the SCM concept; the SCM concept must support the supply chain strategy. The supply chain strategy itself must be derived from the overall business strategy and may influence the business strategy. Further, decisions about organizational incentives (e.g. profit sharing, management bonus) for the supply chain participants must be aligned with the supply chain strategy and concept. Note that the APS implementation layer must be aligned with the information systems and information technology strategy (IS/IT strategy). In particular, the selection of an APS vendor is governed by the IS/IT strategy (see also Chap. 16). The relationship between business/supply chain strategy, SCM concept, organizational incentives, APS implementation and IS/IT strategy is depicted in Fig. 15.1.

A third reason for the success or failure of SCM projects is found in the organizational and managerial culture of industry firms. Based on our experience from many SCM projects six management practices are important prerequisites to make SCM projects successful. These practices were also described in a study by Collins (2001) of 11 large companies that consistently and massively outperformed their competitors over a decade or more:

- A mature and strong leadership
- A focus on people and their strengths and skills
- An ability to confront the brutal facts without losing faith in the end goal
- A clear and well-formulated business strategy, backed by a viable financial model, passion and ability to be world class in delivering the idea
- A culture of discipline
- Seeing technology as an accelerator of business performance rather than a single cause of momentum and breakthrough.

The initial phase of a SCM project must deliver a thorough understanding of the current situation, potential improvement areas and associated risks. Section 15.1 describes the phases of a supply chain evaluation process. Further, it describes the functional areas of a supply chain that have to be examined in order to make an initial assessment of the current structure and performance of the supply chain. The supply chain evaluation answers the question *Where are we today?*

Based on the business strategy and the results from the supply chain evaluation the improvement areas in the supply chain are identified. These are mapped to SCM concepts capable of improving the supply chain performance. To-be APS models are designed supporting the SCM to-be concept, and the related benefits are described and quantified—with the help of logistical and financial *key performance indicators* (KPIs). In particular, the impact of *external factors* influencing the performance of the supply chain can be attenuated by SCM concepts, as closer integration and coordination enables quicker and optimized reactions to external changes. This phase—Supply Chain Potential Analysis—is described in Sect. 15.2, and answers the question *Where do we want to go?*

In the last step of the definition of a SCM project the total scope of the project is broken down into smaller sub-projects, each of those having a specific business objective. The sub-projects are time-phased according to a high-level implementation plan. Benefits and implementation costs are time-phased based on the implementation plan, resulting in a business case and a return on investment calculation for the SCM project. Section 15.3 describes the procedure to create a project roadmap, answering the question *How do we get there?* All three phases together—supply chain evaluation, potential analysis, and roadmap—constitute a systematic approach to defining a supply chain project (see Fig. 15.2).

15.1 Supply Chain Evaluation

The supply chain evaluation is structured according to the functional areas of the supply chain organization, including executive management, the IT function, suppliers, customers and competitors. The following paragraphs discuss topics that have to be clarified with the various functional entities in an organization before entering an APS implementation project. Figure 15.3 shows the structure of a supply chain evaluation.

To get an initial overview of the supply chain, the SCOR methodology can be applied as part of the supply chain evaluation. With SCOR, the logistical structure of

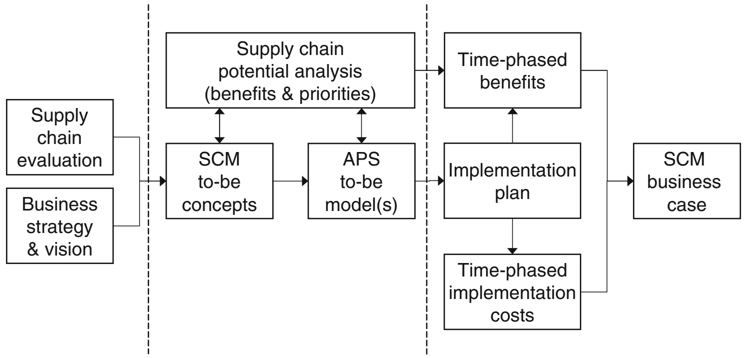

Fig. 15.2 Structuring the phases of a SCM project definition

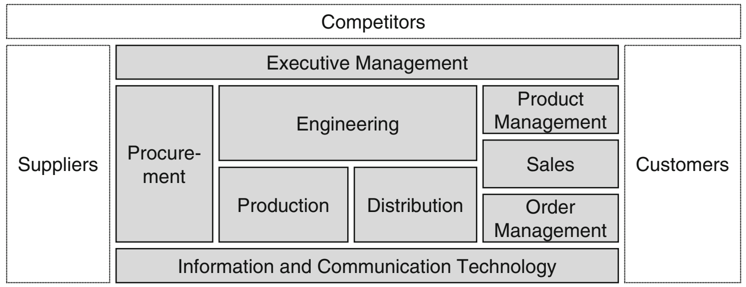

Fig. 15.3 Participants of a supply chain evaluation

the supply chain can be visualized using Supply Chain Threads, and the processes of the supply chain can be documented by mapping them to SCOR process categories on level 2. For details on the SCOR methodology and further techniques for analyzing supply chains refer to Chap. 2.

Another tool that has proven to be helpful in the early stage of SCM projects is the lead time analysis of supply chain decisions shown in Fig. 15.4. On the right hand side of the figure the typical distribution of customer orders on hand—based on their due date and the number of orders or the order quantities—is shown over time. On the left hand side the lead time of decisions that have to be taken prior to order fulfillment is depicted. For example, if the procurement lead time of some material is 4 weeks, assembly lead time is 1 week and distribution and transportation lead time is also 1 week, the procurement decision must be taken 6 weeks in advance before customer orders using that material can be fulfilled. This analysis helps to understand the position of the decoupling point in the supply chain which is an important indicator for many decisions related to Supply Chain Management, in particular the need for planning processes. The lead time analysis is conducted with the help of interviews with order management, distribution, production and procurement—its purpose is to give a rough overview of the demand and supply lead times in the particular supply chain.

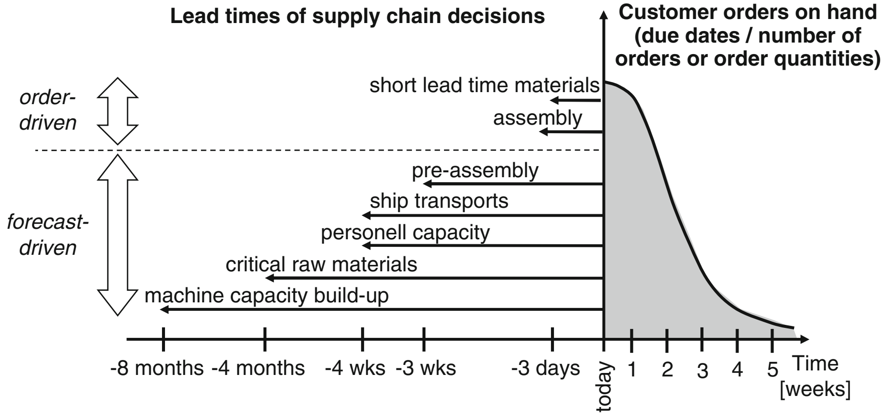

Fig. 15.4 Lead time analysis of supply chain decisions

Figure 15.4 shows an example of a lead time analysis. In this example procurement of materials with a short lead time and assembly operations can be executed order-driven, whereas the remaining supply decisions have longer lead times and—therefore—need to be executed driven by the forecast.

15.1.1 Executive Management

Executive management is an important information source related to strategic issues, cross-functional change programmes and the right target levels of the supply chain.

An example for a strategic decision related to Supply Chain Management is the creation of a new e-business sales channel in parallel to the existing sales channels (Kilger 2000). This decision will clearly influence the existing sales channels—direct sales via sales representatives as well as indirect sales via channel partners—and hence, has to be managed from the top. Another example is the question whether to enter an electronic marketplace on either side of the supply chain—suppliers or customers. In particular, if some marketplace is open to other companies, it is possible that competitors will participate as well in the marketplace. Thus, this decision must be aligned with the strategic differentiation from competitors and the targeted collaboration level with suppliers and customers, respectively.

Strategic decisions are long lasting decisions and have a big impact on all aspects of the business. They should be taken before entering a change program, as they influence the general direction and the initial scope of the SCM project. Furthermore, strategic decisions in a supply chain should be centered around a common vision of the supply chain participants (see Chap. 1 and Poirier 1999).

The second role of executive management is to enable the change of procedures across multiple functional areas and departments. Most planning processes stretch across multiple functional areas. It must be investigated how these planning processes are done currently and how management is enforcing the collaboration between the departments. Examples for cross-functional planning processes are demand planning and master planning. Executive management must break barriers between the departments, bridge gaps in understanding and enforce collaboration between the functional areas.

The third role of executive management is to set the target levels and organizational inventives for the functional areas and the departments. In many cases, the target definitions of the departments are not consistent or even contradictory. For example, procurement is responsible for keeping inventory levels low, order management has to guarantee a high due date performance and production must ensure a high utilization rate of the production equipment. All three have to collaborate in the master planning process and thus have to agree on uniform goals and targets for the master planning process. Executive management must approve the common master planning targets and make sure that all three departments work towards these targets. Conflicting targets are even more likely to occur if the APS project includes multiple partners in the supply chain, e.g. suppliers and customers.

15.1.2 Sales

The sales force is closest to the customers and thus can give input about the behavior of the customers, the market segments, the demand patterns per segment etc. Sales should be the owner of the demand planning process, resulting in an unconstrained demand plan representing future market demand. Important aspects to investigate are the planning frequency, the planning cycle time, the planning accuracy, the structure of the forecast (along the three forecasting dimensions product, geography and time) and issues like seasonal demand patterns, product cannibalism etc. (for details on the demand planning process see Chap. 7). Also the basic questions *What is being forecasted?* and *Who is giving input to the forecast* must be clarified. Often there is no common understanding of the definition of the forecast—which is a prerequisite for measuring the accuracy of the forecast against actuals and to setup a collaborative forecasting process, with input from sales, product management, production, procurement, management and customers. It must also be clarified who is committing to the approved forecast.

One common trap when talking to sales must be observed. In most companies, there is a central sales organization in the headquarter, and there are multiple sales organizations, e.g. regional sales offices. The sales representatives create the demand plan for their sales region. The regional plans are merged to one uniform demand plan by headquarter sales. When talking to sales it is important to distinguish between these two sales functions. As SCM projects are started by the headquarter, it is obvious that project activities focus on headquarter sales. However, it is very important also to involve the sales regions in the project from the beginning on, as the sales regions are closer to customers, and by that, have better knowledge about the customers' behavior and expectations. Further, changes in the forecasting procedures directly affect central sales operations and the sales regions.

15.1.3 Product Management and Engineering

Product management is responsible for the definition and the positioning of the product lines on the markets. Engineering is in charge of designing new products defined by product management. One important aspect of product management and engineering is the product life cycle management. Especially in industries where the product life cycles are short as in the high tech industry, product life cycle management directly impacts the performance of the supply chain. At the beginning and at the end of a product life cycle, supply and demand are difficult to predict, often leading to excess inventory and/or unmet demand. As an example consider the assembly of computers. Disk drives being one of the major components of a computer have an average product life cycle of 4 months—there are three product generations per year. Product management/engineering must align the product life cycles of their own products with those of the disk drives and make sure that all planning processes that are dependent on the supply of disk drives—e.g. demand planning, master planning, order promising and production scheduling—observe the product life cycles.

Secondly, product management and engineering gives input to postponement strategies (see also Chap. 1). Postponement helps to reduce marketing risk. Every differentiation which makes a product more suitable for a specified segment of the market makes it less suitable for other segments (Alderson 1957). Thus, differentiation has to be applied as late as possible in order to be able to react to demand from a large variety of market segments.

A third aspect of product management are marketing activities, e.g. marketing events, the definition of special product bundles or special product offers etc. Marketing activities may influence the demand plan by creating additional demand. All planning processes related to procurement, production and order fulfilment must be aligned with the marketing activities.

15.1.4 Procurement

All in-bound supply processes are executed by procurement. In many industries the supply lead-time (from procurement to shipment) is greater than the order lead-time. As a consequence raw materials must be ordered based on the forecast. In order to give the suppliers a forecast of what will be procured in the future, procurement forecasts the future purchasing decisions as part of master planning. In practice the following issues related to the supplier forecast are often apparent:

- *Gap between sales forecast and supplier forecast*: Theoretically, the sales forecast is the direct input to the supplier forecast. However, in many companies there are gaps between demand planning and master planning, the latter creating the supplier forecast. These gaps may be due to disconnected information systems or due to communication barriers within the company's organization (i.e. sales department and procurement department).

- *No feedback to sales about feasibility of the forecast*: In material constrained industries it is very important to get an early feedback from the suppliers whether they can fulfill the forecasted quantities. Especially in an allocation situation, where material is short in the market, the master plan will be constrained by the supply. In this case, sales should receive information about the supply they can expect (see also Chap. 14 about collaborative planning).
- *No clear representation of supplier flexibility*: In order to represent the supply capabilities of a supplier, a "flexibility funnel" can be defined, specifying—per time bucket—the lower bound of the quantities that have to be purchased and the upper bound of the quantities to which the supplier is bound by the terms and conditions of the supplier contract.
- *Accuracy of supplier forecast not being measured*: The supplier forecast accuracy measures the forecasted quantities against the actually procured quantities. The supplier forecast accuracy is a KPI for the procurement processes, as it steers the production of the procured materials at the suppliers' sites.

Besides the supplier forecast, the number of inventory turns (or average days of supply), the distribution of the inventory age and the on time delivery of suppliers are important KPIs indicating the performance level of the procurement processes.

15.1.5 Order Management

The management of customer orders gets more important as markets get more competitive. The responsibility of order management is to manage and control customer orders throughout the order life cycle, i.e. from the first customer inquiry to the delivery of an order. Order management is responsible for the creation of an initial order promise. Together with sales, order management defines specific allocation policies, allocating the feasible production supply to customer segments (allocated ATP—see Chap. 9).

If the supply, the capacity or the demand situation changes, orders have to be rescheduled in order to get a new feasible promise. In many organizations, orders are not rescheduled even if the situation has changed—leading to unrealistic order promises.

As products on global markets get more and more interchangeable due to comparable quality and features, the reliability as a supplier becomes more important—being measured by the customer service level. The customer service level is measured by three KPIs, the on time delivery, the order fill rate and the order lead-time (see Chap. 2). Besides the customer service level, the order volume, the average number of orders per day and the peak order entry rate are important measures of the order management processes.

15.1.6 Production

In industries with a complex production process and significant production lead-time, one of the most important performance criteria is the work-in-process (WIP) inventory level. Low WIP inventory levels have a positive impact on many related processes and performance indicators (Goldratt and Fox 1986):

- *Low WIP reduces production lead-time and increases on time delivery:* The production lead-time directly depends on the WIP level. The more material sits in the queue in front of a workstation the longer is the average queuing time, leading to a longer production lead-time. The variability of the production lead-time is increased if the queue in front of a workstation grows. This directly reduces the on time delivery, as it is more difficult to predict the exact production time and to confirm orders accordingly.
- *Low WIP improves quality of products:* In most industries production failures leading to quality problems occur in the early production steps, but are detected at later production stages (usually the testing operations). In order to improve the quality of the products, the quality of the whole process must be improved. If the WIP level is high the average lead-time is also high (see previous item). A long lead-time (induced by a high WIP level) may result in a long time lag between the actual producing operation and the final test operations. Thus, the test operation is reached a long time after the operation being responsible for the failure has terminated. Potentially the whole production process changed in the meantime, and the root cause of the quality problems cannot be determined—preventing an improvement of the process. Thus, the lower the WIP, the easier is the detection of quality problems in a complex production environment.
- *Low WIP speeds up time-to-market of new products:* As product life cycles get shorter, the importance of the time-to-market of new products grows. If the WIP level is high the production lead-time is also high—leading to a longer time to market. Furthermore, the old products that are still in production can often be sold only for a lower price. Thus, lower WIP enables a business to bring new products more quickly to market and to get a higher margin for their products.
- *Low WIP improves forecast accuracy:* The accuracy of the sales forecast depends on the input sales get from customers. In many industries a specific time window exists, and customers give their suppliers visibility of their demand within that window. This "window of visibility" is often derived from the average production lead-time of this industry—and thus depends on the WIP level. If actual production lead-time is below the average forecast accuracy will be high. If production lead-time is above the average forecast accuracy will be low as sales does not get an accurate demand signal outside the window of visibility. This increases the risk that purchasing will procure the wrong materials, production will start the wrong production orders, WIP levels increase even further.

Besides the WIP level, manufacturing lead-times, excess capacity, bottlenecks in production and sourcing decisions are further potential improvement areas.

15.1.7 Distribution

Distribution can give information about the distribution strategy, distribution and transportation planning processes, merge in transit operations, physical material flows and inventory levels at distribution centers (see also Chap. 12). It is important that these processes are synchronized with the demand (i.e. the customer orders) and with the production supply. One of the main issues found in distribution is the synchronization of the supply feeding multiple order line items that have to be shipped together. If the supply is not synchronized unnecessary inventory is build up, and the delivery of the complete order in time is jeopardized.

15.1.8 Coordination and Integration Technology

One root cause for disconnected planning processes is the extensive use of spreadsheets to support the planning processes:

- Spreadsheets maintain data locally; they do not enforce data consistency and data integrity. Thus, it is highly probable that planners use different data sets, leading to inconsistent planning results.
- Spreadsheets are highly flexible; they can easily be adapted to the needs of the individual planners. However, this flexibility leads to a continuous change of the spreadsheets, making it difficult for others to understand the planning process and the planning results.
- Spreadsheets are stored as individual files, limiting the integration with transaction systems (for loading historic sales, orders on-hand, etc.) and restricting the capabilities to exploit historic data as input to planning.
- Disconnected, spreadsheet based planning processes normally do not consider constraints, leading to planning results without checking feasibility.

Due to the sequential execution of the planning processes based on spreadsheets and the insufficient decision support functionality of spreadsheets planning cycles tend to be long, decreasing the quality of the planning results.

The second important aspect of integration technology is the availability of data (Kilger and Müller 2002). APS require highly accurate data, including data elements that are normally not maintained within spreadsheets. Even ERP systems like SAP R/3 and Peoplesoft do not maintain data at a level of detail as required for an APS. For example, the detailed product structure and geographic structure as needed by an APS to support forecasting is normally not maintained in spreadsheets or ERP systems. But also "standard" data like routings and BOMs are often not maintained in a quality requested by an APS—especially if no planning functionality has been employed that would need this data. The precise review of the available data and the data maintenance processes in place are important input to the supply chain evaluation.

15.1.9 Graphical Visualization of the Supply Chain

In order to make the communication with the supply chain experts in the organization more effective, graphical visualization techniques should be employed. Especially the visualization of the material and the information flows of the supply chain helps in the discussions with the various departments and is a good starting point for identifying constraints and/or improvement areas in the supply chain. Additional information to the operation and the material buffer representations of a supply chain flow model can be attached representing specific characteristics like vendor managed inventory, multi-plant sourcing, security stock levels, batch sizes, lead-times etc. If already possible in this step, all constraints in the supply chain should be identified in the model, as well as locations of inventory.

The next step in a supply chain evaluation would be to get an overview of the planning processes, e.g. *sales forecasting*, *master planning*, *production planning*, *distribution planning*, *detailed scheduling*. A simple process flow notation can be employed, showing sequential relationships between the individual planning processes, the IT systems (decision support systems, transactional systems, ERP systems) supporting the planning processes and the data flows between the IT systems. Chapter 4 gives an introduction to the various planning processes. The most important item to be checked is the integration of the planning processes. In many organizations, planning processes are performed sequentially and disconnected. Planning results of a former process step are not or only partially used as input to the subsequent steps. This leads to non-synchronized process chains and suboptimal planning decisions.

15.2 Supply Chain Potential Analysis

Based on the results from the supply chain evaluation and the analysis of the business strategy potential improvement areas are identified and the initial scope of the project is defined. To achieve the improvements and related benefits specific SCM concepts are applied and to-be models for an APS implementation are designed. To-be SCM concepts include

- *Processes:* planning, execution, performance measurement
- *Organizational models:* intra-organizational and inter-organizational models (e.g. collaboration mode with supply chain partners)
- *Structure of the supply chain:* physical structure of the production and distribution network
- *IT support:* support from APS and other IT systems to support the intended to-be models.

The design of the to-be SCM concepts and the required APS-functionality to support these concepts must—even in this early phase—be mapped against the capability of the organizations participating in the supply chain and the project. As Willcocks et al. (2001) observe in the context of e-business initiatives, “people are at the heart of strategic transformation. [. . .] An essential part of the planning process is a detailed analysis of the current capabilities of the available resources. An assessment of the skills and competencies necessary to deliver and implement in a world where change is continuous and where the contribution of the IT department is measured as much by its intellectual capital as by the reliability of its systems." The capability of people must be assessed on two levels: On the project level and the operational level. On the project level, the question must be answered: *Do we have the right people and skills to improve business by applying SCM concepts?* On the operational level, the question is *Are our employees capable of operating the new system and work according to the new processes in their daily work?* Both questions must be answered positively before advancing with the project.

The SCM concepts that can be applied to improve business performance are described in detail in Part I; the APS modules to support these concepts are described in Part II of this book. In this chapter we focus on the *benefits* that can be created from SCM in an industrial organization.

15.2.1 Financial Performance Indicators

Following Goldratt and Fox (1986), the goal of an industrial organization (or supply chain) is to be profitable and to improve earnings (defined as revenue minus cost of sales, operating expenses and taxes). Financial benefits can be measured in three ways. *Net profit* is an absolute measurement of making money. However, if we know that a company earns $ 20 million a year, we cannot tell whether this is a good or a bad performance—as the performance of a company depends on the money that has been invested in the business.

In the business environment at the beginning of the third millennium the performance of a business relative to the invested capital is in the focus of managers and shareholders. The term *shareholder value* is ubiquitous. The *return on capital employed (ROCE)* is "a measure of the returns that a company is realizing from its capital. ROCE is calculated as profit before interest and tax divided by the difference between total assets and current liabilities. The resulting ratio represents the efficiency with which capital is being utilized to generate revenue" (InvestorWords 2014). The invested capital consists of multiple components, e.g. cash, receivables, inventories, property, buildings, equipment and liabilities. SCM concepts mainly affect the assets, not the financial components of the invested capital like debts and equity. That is why from a Supply Chain Management perspective the *return on assets (ROA)* is often used as relative business performance measure instead of the ROCE.

The third measurement of the financial performance of a business is the *cash flow*. "Cash flow equals cash receipts minus cash payments over a given period of time; or equivalently, net profit plus amounts charged off for depreciation, depletion and amortization" (InvestorWords 2014). Cash Flow is rather a short-term measure of a company's financial health than a long term performance indicator.

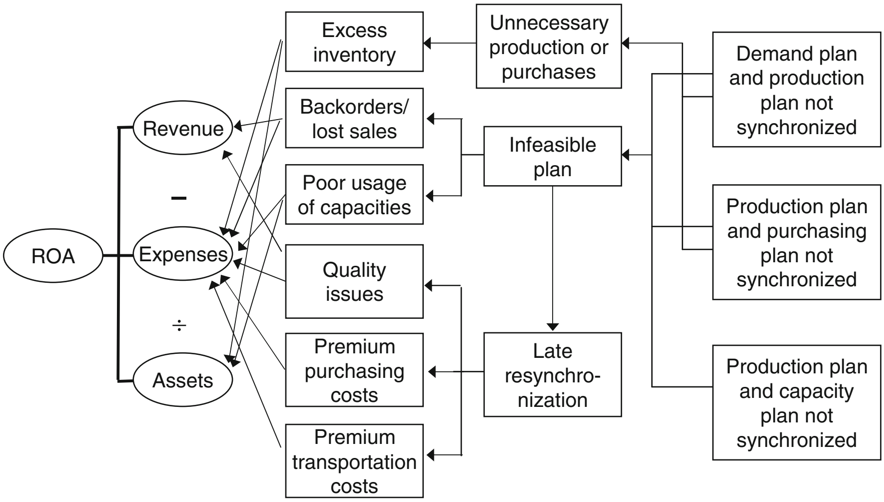

Fig. 15.5 Impact of SCM planning on the ROA

15.2.2 Return on Assets

In the following, we focus on the return on assets as the bottom line performance measure. A common definition for the ROA is as follows (InvestorWords 2014):

$$\text{ROA} = \frac{\text{Earnings}}{\text{Assets}} \tag{15.1}$$

$$= \frac{\text{Revenue} - \text{Cost of Sales} - \text{Operating Expenses} - \text{Taxes}}{\text{Assets}}$$

Revenue is all the money the customers pay for the offered products and services. Cost of Sales—also called Cost of Goods Sold (COGS)—equals the cost of purchasing raw materials and manufacturing finished products. Operating Expenses are expenses arising in the normal course of running a business. Assets include all equipment and material that is involved in turning inventory into sales. On a balance sheet, assets are equal to the sum of liabilities, common stock, preferred stock and retained earnings.

In order to evaluate the benefits from SCM, we have to analyze how revenue, costs/expenses and assets can be improved by SCM concepts. Figure 15.5 gives examples of how SCM planning capabilities impact the ROA.

15.2.3 External Variability

Let us illustrate the impact of poor planning capabilities on the ROA by means of an example (adapted from Kilger 1998). Figure 15.6 shows a supply chain with

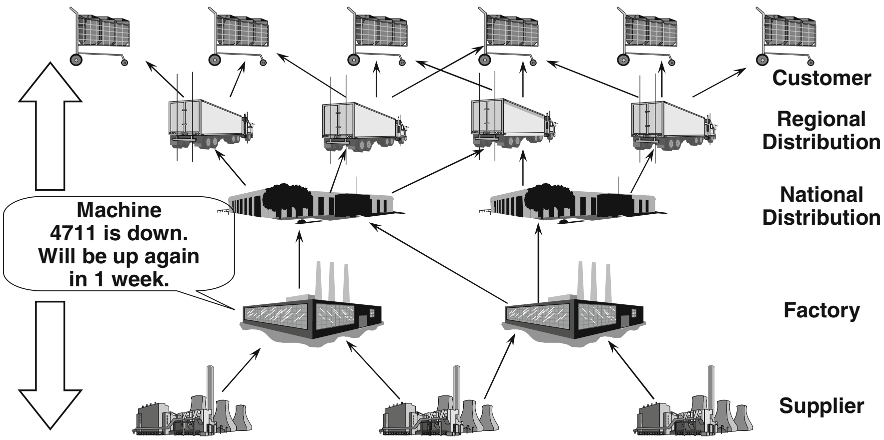

Fig. 15.6 Propagation of changes in a supply chain

suppliers, factories, national and regional distribution centers and customers. For example, let us assume that in one factory a machine goes down and due to the service required the machine will be up again in 1 week. An ERP system would adapt the schedule of that machine accordingly and move out all manufacturing orders that are impacted by the change. But what is the impact of the downtime of that machine on the ROA of the complete supply chain? In order to answer that question the new situation has to be propagated upstream and downstream:

- *Upstream:* Due to the machine downtime of 1 week manufacturing orders have been moved out and the required raw material will be consumed later. The supplier can peg this material potentially to other customers (factories) and thus make revenue elsewhere.
- *Downstream:* The national distribution center receiving the finished goods 1 week later may run into a stockout situation, if the supply that is now delayed is required to fulfill all customer orders on time. This would reduce revenue and increase inventory (assets) and expenses.
- *Planning scenario:* In order to assess whether the plan at the national distribution center can be re-optimized a planning scenario is created to check whether the national distribution center may receive the short material from an alternate factory. This potentially can help to ship the orders in time, by that securing revenue.

This example indicates that the performance of a supply chain is to a large extent influenced by external disturbances and external variability. Thus, in order to assess the potential benefits of SCM concepts and an APS implementation, focus should be laid on the impact of external factors on the ROA components—revenue, expenses and assets. It is interesting to note that transaction systems like Enterprise Resource Planning (ERP) systems (SAP R/3, Peoplesoft, etc.) focus rather on the internal processes than on the external factors influencing the ROA. For example,

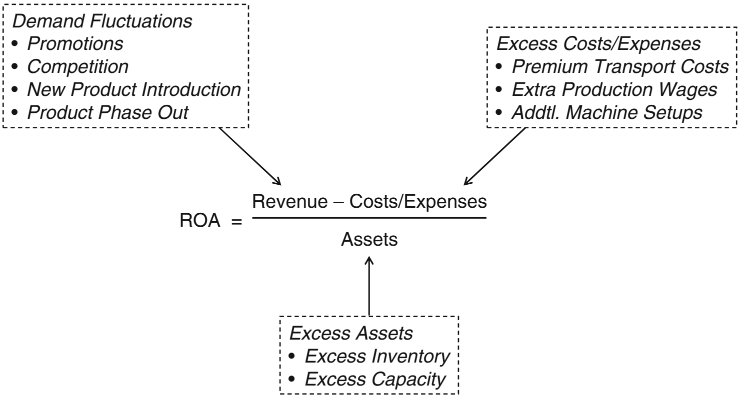

Fig. 15.7 Impact of external variability on the ROA

the MRP and production planning modules of an ERP system help to create an initial production schedule (that is often not feasible) and support the tracking of the material flow on the shop floor—but they do not provide simulation capabilities and problem resolution functions to quickly react to external changes.
In the following, we discuss examples illustrating the impact of external factors on demand, expenses/costs and assets (see also Fig. 15.7).[1]

15.2.4 Demand Fluctuations

The impact of external factors on the revenue is obvious as sales are generated by external customers. However, there are some specific situations in which it is particularly difficult to predict sales quantities:

- Promotional actions (reduced promotional prices, special product offerings, etc.) may create higher additional demand than planned for.
- Competition may attack in certain markets or in specific product areas, leading to an unexpected drop in demand.
- The introduction of new products may be more successful than expected and/or may cannibalize the demand for other products.
- The phase out of products may result in a demand drop of other products, as customers were used to buying both products together.

Fluctuations of demand directly impact revenue. In addition, they may have side effects on expenses and assets. For example, introducing a product in a new regional market costs money due to marketing activities. If the resulting demand is not properly planned or if it is not properly supplied (as other product/market combinations are more profitable or are prioritized for other reasons), the additional demand will

[1] The examples are partially based on discussions with Sidhu (1999).

not be transformed into additional revenue—but the additional expenses have been spent.

15.2.5 Excess Expenses/Costs

Expenses are partially controlled internally and partially externally. In every industry there is a cost segment that is determined by the type of production. For example, computers are assembled in a similar way all over the world: get all components you need and assemble them into the housing, test the device, pack it and ship it. The costs implied by this process are comparable across the computer industry and—more important—there is only a marginal impact of Supply Chain Management techniques on the internal production costs. However, there is a big impact of Supply Chain Management on the expenses determined by external factors and corresponding actions, being for example:

- Payment of premium air freight fare to get material because of late or short supply by the standard suppliers.
- Payment of extra production wages for subcontractor manufacturing in order to account for peak load situations due to additional demand or delayed production.
- Rescheduling of the production plan (including the need to pay overtime rates for the workers) because of short term additional demand or delayed supplies of material.
- Buying critical components on the spot market (e.g. processors, memory) for a higher price compared to the preferred supplier.

15.2.6 Excess Assets

The total value of assets in a supply chain can be split into "base assets" that are required for the production operations and "excess assets" that are being used to shield the supply chain from external variability. For example, excess inventories may exist for raw material, work in progress and finished goods. Excess inventories are used to buffer production from the demand variability of the market, and may lead to increased material costs due to

- Price reductions (e.g. the price of electronic components reduces by 2 % per week in the average)
- Obsolescences (i.e. components that cannot be sold on the market any longer because a better successor has been introduced to the market for the same price)
- Stock keeping costs
- Internal capital costs
- Material handling.

By better controlling the volatility in the supply chain, excess inventory may be reduced and business performance will increase. However, please note that some safety stocks will in most cases be required due to uncertainties that are "inherent" to the supply chain and may not be controlled (Chap. 7 gives an overview of safety stock policies). Further, the reduction of excess inventories may lead to an increased risk of capacity shortages and—as a consequence—to excess expenses as described in the previous section.

Excess capacity is built up in order to have sufficient capacity to cover peak load situations. Due to the interdependencies in a production system—a resource can start a production operation only if all preceding operations have been completed and all required raw material is available—the load variability of a resource increases with the number of preceding operations. Thus, load variability is higher the more downstream the resource is located, and—because of that—excess resources are often built up at the end—downstream—of the supply chain (this is typically the test area or the distribution network).

15.3 Project Roadmap

In the preceding section we have shown that external factors and external variability influence the financial performance of a supply chain. Especially demand fluctuations, excess expenses and excess assets have a negative impact on the ROA. SCM concepts supported by APS functionality enable a supply chain to quickly react to external changes and by that help to improve the ROA.

However, having identified improvement potentials related to revenue, expenses or assets does not necessarily tell how to realize these potentials. Which levers exist to create additional demand and transform this into additional revenue? What is the root cause of excess expenses or assets? Which SCM concepts can help? What module of an APS do I need? In case there are multiple things I can do to improve the ROA, how shall I prioritize?

15.3.1 Enabler-KPI-Value Network

In order to answer these questions and to create a project roadmap, the targeted financial improvements have to be related to concrete project activities. The bridge between these financial criteria and the project activities is formed by logistical KPIs. The following steps describe the way to define a SCM project roadmap by a value driven approach:

1. identify improvement potentials based on financial performance indicators (i.e. conduct a supply chain potential analysis as described in Sect. 15.2),
2. transform the targeted improvements of the financial indicators into targeted improvements of logistical KPIs, and
3. map the targeted improvements of the KPIs to SCM concepts and/or APS modules enabling the improvement.

As there are many SCM concepts and a broad range of APS functionalities—as described in detail in Parts I and II of this book—it is very important to start the definition of an APS implementation project from the value perspective, as indicated by steps 1–3 listed above. Starting the definition of an SCM project from the functional perspective bears the risk that the system gets overengineered, i.e. the system would contain many functions that do not necessarily help to improve the business performance.

For example, in the computer industry, order promising and production planning is normally constrained by the material supply and not by capacity. Thus, exploiting the finite capacity planning abilities of APS in order to improve the production scheduling process would not lead to a big business improvement. Following the three steps listed above, one could define the project scope as follows:

1. The main target of the project is to generate additional sales and to increase revenue.
2. Additional sales can be generated by improving the on time delivery. (This value proposition can be backed by industry benchmarks and interviews with the customers; refer to Chap. 2 for additional details.)
3. On time delivery can be improved by an APS by
   - Synchronization of purchasing decisions and order promising based on forecast/ATP
   - Creation of feasible master plans considering all constraints
   - Simulation of receipts according to different scenarios/rescheduling of orders in order to improve the short term production plan.

Thus, the focus of the project should be laid on forecasting, master planning and order promising, instead of production scheduling.

In general, the relationships between financial performance indicators, logistical key performance indicators and APS enablers form a complex network. The structure of the network strongly depends on the particular situation of the supply chain, its improvement potentials and the initial scope of the SCM project. Figure 15.8 shows an Enabler-KPI-Value network based on the example given above, connecting APS enablers with logistical KPIs and their relation to financial performance criteria. The arrows in the boxes indicate whether the value of the KPI or financial performance indicator will be increased (arrow upwards) or decreased (arrow downwards). A detailed description of logistical KPIs can be found in Chap. 2. Setting up one or—in complex situations—multiple Enabler-KPI-Value networks defines the framework for improvements, linking SCM and APS enablers with financial performance indicators by logistical KPIs. Each path through that network represents a logical relationship of an enabler, a KPI and a financial performance indicator. Usually, the enabler has a *positive* impact on the logistical KPI (e.g. reduction of order lead time or increase of inventory turns). In some cases an enabler may also have a *negative* impact on a KPI. For example, the creation of an optimized master plan may result in higher inventory (reducing the KPI inventory turns) if additional inventory is needed to buffer the supply chain against large demand peaks and to achieve a high service level. Negative implication of an enabler to a KPI is indicated by a dashed line (Fig. 15.8). Note that a negative implication of an enbabler should be compensated by a greater positive implication on some value component via other paths in the network—in order to assess this enabler as beneficial.

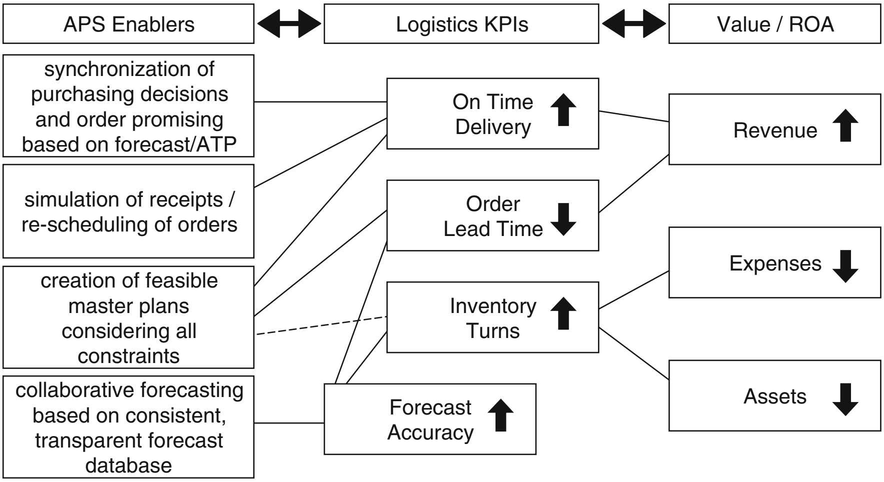

Fig. 15.8 Enabler-KPI-value network

15.3.2 KPI-Driven Improvement Processes

Having identified a collection of logistical KPIs that shall be improved the next step is to further detail the improvement. This is done by setting up a *KPI profile* for each of the KPIs. A KPI profile consists of the following constituents (Kilger and Brockmann 2002):

1. The first step is to determine the current as-is value of the KPI. This fixes the starting point of the targeted improvement activities and is the base for measuring the success of the project.
2. Then, the targeted to-be value of the KPI has to be set. This gives us the goal we want to reach by the project.
3. In the next step, the time horizon to reach the to-be KPI value is estimated. This can only be a rough estimate as a detailed project plan has not yet been created.
4. From the targeted improvements the enablers of APS that can help to reach the targets have to be determined, as well as additional influencing factors like process restructuring, reshaping the organizational structures, analyzing high-level data requirements etc. Especially process changes are required in most cases to realize the full benefit as expressed by the to-be KPI value.
5. Based on the as-is value, the to-be value, the estimated time horizon and the considered APS enablers, actual project activities are setup and implemented. It is important to note that each of these sub-projects have to generate business value in a given time period, by applying predefined APS enablers.
6. In order to enter a continuous improvement process, one can go back to step 1 and start the cycle again from a higher performance level.

Note that at this point in time, we are still in the definition phase of the project. The KPI profiles help breaking down the complete project scope into a sequence of sub-projects, each having a clear objective and a well-defined scope. By that we make sure that the definition of the sub-projects is value driven and not driven by the "nice functional features" of an APS—helping to prevent the system to get overengineered. The result of the project roadmap definition phase is a high level project plan, consisting of the identified sub-projects, including preliminary milestones and a first estimate of project schedule, resources and implementation costs. The targeted financial benefits and the implementation costs can be structured along the milestones and the project schedule, resulting into a cash flow series and an initial ROI calculation and business case for the project.

From the APS enablers that are used in the KPI profiles a requirements list for the selection of an APS can be derived. In the next chapter we focus on the selection process of Advanced Planning Systems—with the requirements list being one major input to the APS selection. However, despite the fact that APS are providing advanced planning capabilities that may help to improve business, it is important to realize that additional measures have to be taken to achieve the full business objectives as documented by the KPI profiles. Especially process changes and the provision of additional data for the APS are required in most cases and should be roughly planned already at this stage.

References

Alderson, W. (1957). *Marketing behavior and executive action*. Homewood, IL: R. D. Irwin.

Collins, J. (2001). *Good to great* (1st ed.). New York: HarperBusiness.

Goldratt, E., & Fox, R. (1986). *The race*. Croton-on-Hudson: North River Press.

InvestorWords (2014). http://www.investorwords.com. Visited on Feb. 28, 2014.

Kilger, C. (1998). Optimierung der Supply Chain durch Advanced Planning Systems. *Information Management & Consulting*, *13*(3), 49–55.

Kilger, C. (2000). Supply-based eBusiness: Integration von eBusiness und Supply Chain Management. In W. Dangelmaier, W. Felser (Eds.), *Das reagible Unternehmen* (pp. 74–86). Paderborn: Heinz-Nixdorf-Institut.

Kilger, C., & Brockmann, K. (2002). Supply chain detectives in der high tech industrie. In W. Dangelmaier, A. Emmrich, & D. Kaschula (Eds.), *Modelle im E-Business* (pp. 139–154). Paderborn: Fraunhofer-Anwendungszentrum für Logistikorientierte Betriebswirtschaft und Heinz-Nixdorf-Institut.

Kilger, C., & Müller, A. (2002). *Integration von Advanced Planning Systemen in die innerbetriebliche DV-Landschaft*. In A. Busch, & W. Dangelmaier (Eds.), *Integriertes Supply Chain Management* (pp. 213–234). Wiesbaden: Gabler.

Poirier, C. (1999). *Advanced supply chain management: How to build a sustained competitive advantage*. San Francisco: Berrett-Kochler Publishers.

Sidhu, S. (1999). Private conversation.

Ward, J., & Peppard, J. (2002). *Strategic planning for information systems* (3rd ed.). Chichester: John Wiley.

Willcocks, L., Petherbridge, P., & Olson, N. (2001). *Making IT count*. Oxford: Butterworth-Heinemann.