ZVEI:
Die Elektroindustrie

Guideline

Supply Chain Management

in Electronics Manufacturing

German Electrical and Electronic Manufacturers' Association

Impressum
Guideline
Supply Chain Management in Electronics Manufacturing

Published by:
ZVEI - German Electrical and Electronic
Manufacturers' Association
Electronic Components and Systems Division
PCB and Electronic Systems Division
Lyoner Straße 9
60528 Frankfurt am Main, Germany

Phone: +49 69 6302-267
Fax: +49 69 6302-407
E-mail: zvei-be@zvei.org
www.zvei.org

Responsible: Bernd Künstler, ZVEI

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November 2014

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Foreword

Globalisation creates opportunities for faster development and production. Thanks to modern communication devices, these opportunities can now be exploited. The flexible use of global manufacturing capacities, combined with a focus on core competencies, is key to maintaining a sustained competitive advantage in today's business environment. However, this capability requires increasingly complex supplier networks, which must be controlled and optimized to provide reliable, fast and flexible services.

ZVEI members also increasingly recognise the importance of an optimal organisation of supplier networks. Although this topic is equally important for all segments of the electronics industry, the initiative to set up a Supply Chain Management (SCM) working group and to draft this white paper was originally launched by the ZVEI Electronic Components and Systems Division and PCB and Electronics Systems Division. These companies are located upstream in the electronics value chain and thus face higher variability and disruption risk. As it is difficult to forecast the sales volumes of end products, the upstream companies are required to maintain high flexibility and fast reaction times (responsiveness). Additionally, supplier structures are becoming increasingly global and increasingly subject to natural disasters, political upheavals and transport risks, as well as a wide variety of individual trade and customs regulations.

Since these challenges must be addressed by people, organisations, processes and IT systems, the availability of experienced and skilled staff is one of the key success factors of an optimised supply chain.

With this in mind, the ZVEI working group 'Supply Chain Management in Electronics Manufacturing' was constituted in April 2013 to collaborate in providing recommendations for companies that help them to better understand value networks, determine their ideal design and prepare them for future challenges. This paper focuses on the availability of electronics components in the supply chain for high value products such as vehicles, airplanes, machines, industrial goods, process systems, power plants, hospitals, medical products, etc. In addition to the primacy of availability, it also discusses aspects of supply chain efficiency.

The findings have been summarised in this industry recommendation, which in addition to sharing expert knowledge, also suggests courses of action and provides checklists and best practices.

The paper examines the following topics:

- Supply chain management – definition, fundamentals, standards
- Robust supply chains with high responsiveness and flexibility
- External framework conditions
- Supply chain management training programmes

This white paper does not claim to be exhaustive, but offers useful reference and guidance. Every company has its own size, focus and position and thus different levels of maturity in supply chain management. This white paper is based on the knowledge and expertise of more than 80 supply chain experts from different companies and thus provides a sound knowledge base for all industries with a special focus on the electronics industry.

Since supply chains are also subject to constant change and adaptation processes, this document reflects the current status of the aggregated view of the participating companies. More information on updates, new documents and upcoming events can be found on the ZVEI website. Moreover, discussion groups and working group meetings encourage the exchange of knowledge and experience.

We wish our readers much success in designing and optimising their supply chain processes and hope this paper provides useful support.

Editorial team

Frankfurt am Main, November 2014

1 Supply Chain Management – Definition, Fundamentals, Standards

This chapter first clarifies the definition of supply chain management and discusses the fundamentals of the SCOR® model, as well the requirements for skilled staff. Finally an overview of supply chain management standards is provided.

Figure 1: Supply chains extend from the supplier's supplier to the customer's customer (SCOR® model) (Copyright Osram OS)

1.1 Defining supply chain management

The term 'supply chain' refers to a network of organisations involved in generating value for the end customer in the form of products and services via upstream or downstream links in different processes and activities.[1] In an industrial enterprise, the delivery of input materials marks the starting point of a supply chain, while the supply of finished material to the customer marks the ending point.

Business processes are becoming increasingly complex as a result of growing market globalisation. Additionally, to save costs and increase responsiveness, companies are under constant pressure to optimise their production and supply chains.

With competition becoming increasingly fierce, price, quality and functionality are no longer the sole key deciding factors for a purchase decision. Flexibility, speed and customer satisfaction have also become top priorities. This can be achieved by improving the service and customising products to meet specific requirements. The success factor time (meaning to be fast) describes the necessary adaptation of companies to changing competition and market conditions.

In short, the demands placed on companies and supply chain management have multiplied, necessitating greater flexibility within the supply chain,[2] and companies that fail to adapt in time to the changing conditions face substantial disadvantages in terms of profitability and long-term competitiveness.[3]

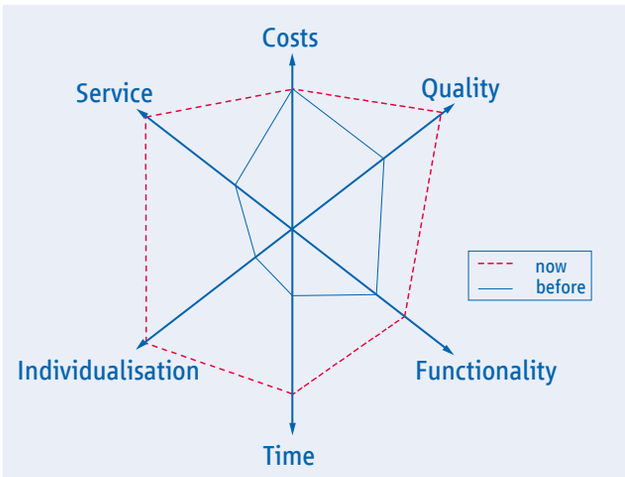


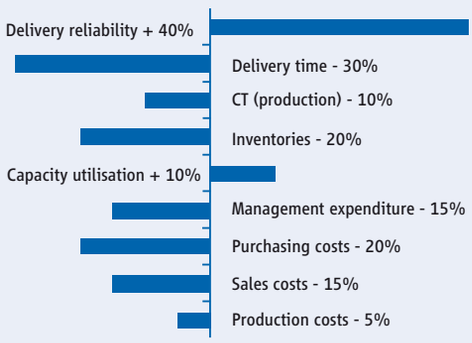
Figure 2: Development and importance of strategic success factors (based on Blecker and Kaluza, 2000) (Copyright ZVEI)

1 Christopher, 1998

2 Blecker and Kaluza, 2000

3 Beckmann, 2004

The impact of supply chain management stems from the creation of transparency along the entire value chain and the consequent avoidance of information asymmetries.



Companies that use their supply chains strategically realize better business results than their competitors

These companies also achieve better supply chain performance

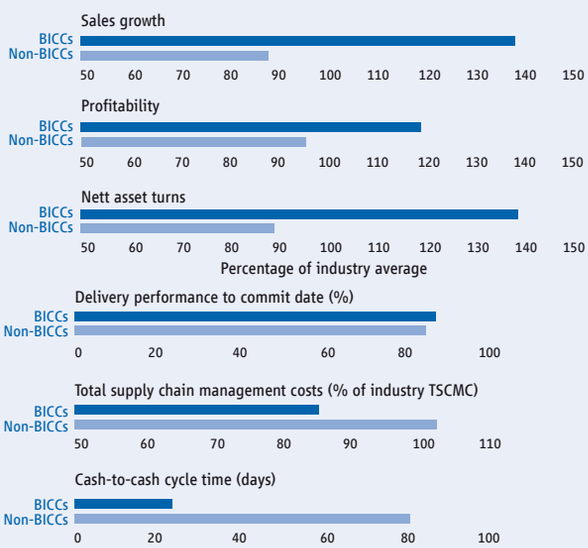


Figure 3 and Figure 4: Supply chain impact
(Copyright Figure 3 Wildemann, Copyright Figure 4 Cohen and Roussel, 2013)

„The supply chains of best practice companies are nearly twice as fast as the average!" (Prof. Dr. Wildemann)

1.2 SCOR® model

This recommendation (*Supply Chain Management in Electronics Manufacturing*) is based on the current 2012 version 11.0 of the SCOR® model that was first developed and published by the APICS Supply Chain Council (APICS SCC), a global non-profit organisation, in 1996, and has been continuously revised since. The Supply Chain Operations Reference model (SCOR®) is a management tool to assess and analyse supply chain performance.

SCOR® represents a global standard in supply chain management by providing a unique framework that determines and links performance metrics, processes, best practices and *people's skills* into a unified structure.[4] The SCOR® model can be used to describe the value chains from the supplier's supplier to the customer's customer and is organised around the six primary management processes – *Plan, Source, Make, Deliver, Return* and *Enable*.

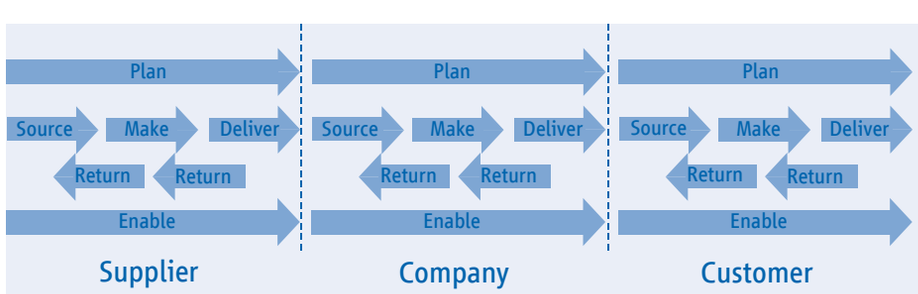


Figure 5: Processes within the SCOR® model (Copyright ZVEI)

4 APICS Supply Chain Council (SCC), 2014

The **Plan** process links demand and supply activities and coordinates all other processes within one value-added level or across companies. For example, the Plan instance coordinates scheduling activities of procurement (*Source*), manufacturing (*Make*) or sales order fulfillment (*Deliver*) and thus ensures smooth collaboration within a company or along the entire supply chain.

In addition to the material flow from the supplier to the customer, the SCOR® model includes an order and the value flow running in the opposite direction, as well as non-directional information flows.

Enable processes are not directly assigned to an instance, but provide the basis (i. e. enable) the processes *Source*, *Make*, *Deliver*, *Plan*

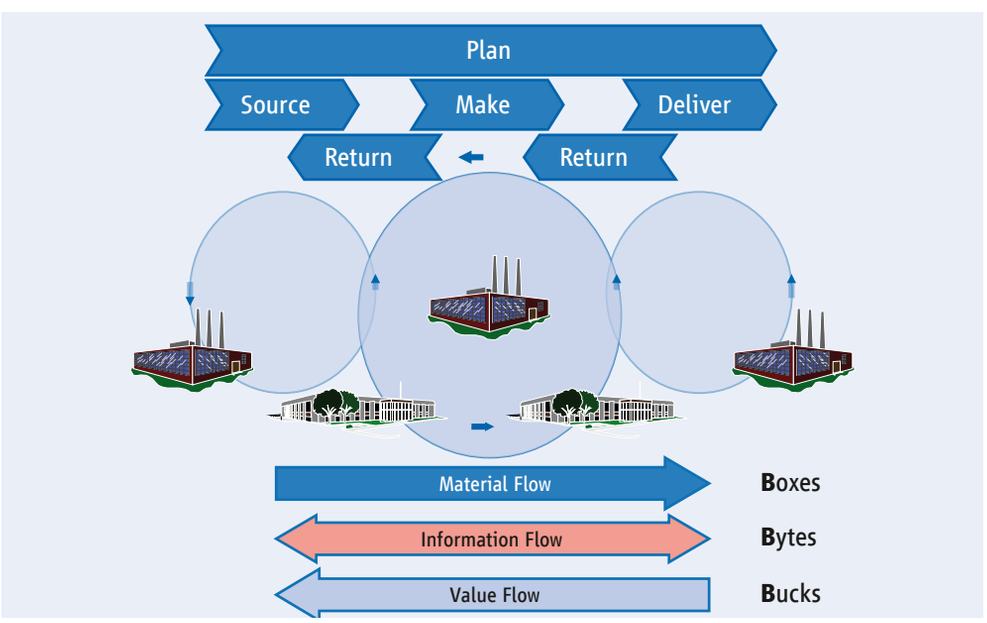


Figure 6: The supply chain is about processes (according to SCOR®) relating to material, information and value flows. (Copyright Infineon Technologies)

The **Source** process combines all activities related to the procurement of materials required to meet planned or actual demand. It also includes operational activities regarding suppliers and material inspection.

Make refers to the actual manufacturing process, i. e. all processes required to manufacture a finished end product from the materials provided by *Source*. This also includes repairs or services.

Transport management and storage of the finished products are assigned to the **Deliver** process, which also covers the receipt of orders and receivables management.

Teh **Return** process is the interface to the supplier and refers to the returning of goods or information.

and *Return*. This includes the necessary regulatory body, guidelines and conditions such as performance measurement, risk management, master data management, human resource decisions or network planning.

1.3 Skilled workforce along the supply chain

Supply chain experts and managers should be capable of understanding and managing system and methods knowledge, actual production processes as well as material and information flows.

This capability requires emotional and social moderating as well as communication skills, in addition to problem solving skills, such as analytic abilities. In other words, supply chain experts and supply chain managers must be generalists in their field of knowledge.

Supply Chain generalists need to be familiar with the actual situation and processes along the supply chain and understand the methods, organisational forms and tools to be used. A basic understanding of controlling, business economics and IT systems, e. g. in ERP (*Enterprise Resource Planning*), APS (*Advanced Planning System*), EDI (*Electronic Data Interchange*) and MES (*Manufacturing Execution System*) is required.

To ensure the supply of logistics specialists, it is recommended that external networks be set up and expanded, collaboration with universities and associations fostered, and discussions with educational facilities started concerning training and study contents. The following list provides an overview of frequently used methods to contact potential job applicants:

- awarding project assignments and internships to potential applicants,
- offering Bachelor's and Master's dissertations as well as doctoral theses to students
- employing working students,
- recruiting graduates of logistics and supply chain studies,
- offering dual track studies to retain students in the long term,
- providing on-the-job in-house training and qualification measures.

Large companies often design their own qualification programmes to introduce staff to supply chain management and to further provide training in specific areas. Some companies even choose to run their own supply chain academies in order to foster and develop supply chain talent.

More information on the subject of training and qualification is provided in chapter 4.

1.4 Overview of supply chain management standards

This section lists sample approaches intended to provide an initial overview of the different strategies, levels of supply chain design, key performance indicators (KPIs), interfaces, cost factors and future requirements for communication processes in supply chain management. The words written in **blue and bold** refer to topics that will be explained and detailed in the following chapters of this white paper.

1.4.1 Selection of different strategies

The following examples represent a small selection of the many different SCM strategies and approaches in place:

- *Efficient Consumer Response (ECR) with logistics components:* from **vendor**/supplier **managed inventory** (*VMI/SMI*) and **cross-docking** (demand-driven goods distribution) to synchronised production and urban production,

- *Customer Relationship Management* (*CRM*) and relationship marketing: continuously improving customer satisfaction, customer loyalty and customer acquisition,

- **postponement strategies**: reducing semi-finished and finished goods inventories through delayed differentiation,

- *sourcing strategies*: **single sourcing** and **multiple sourcing** procuring modules/systems from system suppliers (*modular/system sourcing*) and developing the market by systematically expanding the procurement policy to international sources (*global sourcing*),

- *production and procurement strategies*: **Kanban** with **just-in-time** production systems (*JIT*) / **just-in-sequence** (*JIS*) production systems, **consignment**, indicators of progress to provide transparency by closely linking the supplier and customer and managing the collaboration via call-off orders and JIT delivery schedules, etc.,

- *supplier management*: qualification, purchasing, logistics, quality,

- *electronic marketplaces*: as platforms for the commercial exchange of goods and services and the option of selling products at a certain time and place,

- *inter-organisational collaboration*: including the creation of between legally independent partners within the network of a supply chain via the Internet,

- *virtual freight exchanges*: to improve shipping capacity utilisation and reduce shipping costs, **tracking and tracing** (external/internal) to monitor shipments, e-auctions, etc.,

- *disposal and recycling strategies*: which should also be mentioned for the sake of completeness.

1.4.2 Levels of supply chain design

In order to assess the different levels of supply chain design, it is necessary to first explain possible approaches or methods to supply chain management before going into more detail on the various tools.

Methods

Many companies design their supply chains by first introducing and applying general approaches to SCM and subsequently resolving the process issues.

The first SMC approaches to be implemented in-house often include *lean* processes and *continuous improvement processes* (*CIP*), t*ime management methods* ('*Arbeitsablauf-Zeitanalyse*', *AAZ*) such as *methods-time measurement* (*MTM*) or REFA (methods of the German REFA Association for Work Design/Work Structure, Industrial Operation and Corporate Development) and value stream optimisation and design and improving process flows.

The following approaches are used in-house and across companies focusing on the customer and/or supplier: *design for manufacturing* (product, process and logistics-related) and *design for testability*, *design to cost*, etc. In addition, digital or cross-linked factories and simulations are introduced as well as inter-company comprehensive value stream design from the customer (or customer's customer) and the company's own production to the supplier/distributor/manufacturer.

The methodology introduced with the SCOR® model in the mid-90s has proved to be reliable for the practical analysis and design of supply chains and can also be used for the strategic coordination of the aforementioned methods thanks to its *top-down approach*. This methodology has only recently been expanded to include the '*Management for Supply Chain*' (*M4SC*) concept.

The idea of supply chain segmentation plays a major role in supply chain design and optimisation. In this context, a supply chain can be understood as a well-defined value stream that combines products/services and customers/markets. Supply chain segmentation thus connects product and market segmentation. The aim of supply chain segmentation is to align separate supply chains to the strategic business requirements in order to avoid a one-size-fits-all approach to performance management and control. Consequently, supply chain segmentation is essential in establishing supply chain management as a control tool aligned to the relevant market requirements.

SCM tools

This section lists the most common SCM tools according to their relevant application area and does not claim to be exhaustive.

Two commonly used tools to reduce inventory are inventory decomposition using ABC/XYZ analyses and stock coverage and inventory turnover analyses. By analysing the inventory range, items can be classified in fast movers (<3 months), moderate movers (3-12 months) and slow movers (>12 months).

Cycle time and set-up time analyses are also extensively performed to understand time losses. Electronic tools are frequently used to improve inventory control and reduction: eKanban, min-max control, C item management, etc. Additionally, strategic partnerships are often established between supplier and customers to improve inventory management, including consignment and **VMI**.

The following SCM tools are used, among others, to reduce shipping costs: system-supported shipping requests, automatic shipping cost calculation, self-billing processes, summary invoices, standard and returnable packaging, milk runs and round trips, hubs (internal/external), **cross-docking** (demand-driven goods distribution), freight pooling, shipping guidelines, etc.

For IT support the following tools are widespread in today's industry: **EDI and WebEDI**, barcodes (2D, data matrix, etc.), RFID, BI (databases; data warehouses), **ERP** and MES systems, CAx systems, electronic work flows, alternative stocktaking procedures, **internal tracking and tracing**, **comprehensive traceability**, **etc**.

Accurate, timely and useful information is essential to effective and optimized supply chain management, and therefore many companies use internet portals or supply chain 'cockpits' to disseminate critical supply chain information (order statuses, inventories, inventory ranges, etc.). Additionally, sharing supply chain information can be disseminated effectively through the internet, using e-Learning modules, computer-aided training, and internal Wikis.

1.4.3 Supply chain controlling KPIs

Supply Chain *key performance indicators* (*KPI*) are used to measure the performance and quality of a supply chain. Although KPIs need to be viewed from within their own context, their importance increases when compared to a company's own or external business data.

Examples of KPIs and other aids (results-oriented and time-limited):

- *Sourcing KPIs*:
  delivery times, price trends according to commodity groups, etc.,

- *Planning KPIs*:
  forecast accuracy and flexibility,

- *Warehousing KPIs*:
  warehouse inventory, inventory turnover factor, inventory range, etc.,

- *Production KPIs*:
  utilisation rates of business divisions (production facilities), **cycle times**, set-up times, etc.,

- *Distribution KPIs*:
  orders in hand including forecasts, order backlog, invoice backlog, total sales/sales by business division, etc.,

- *Financial process KPIs*:
  productivity and profitability KPIs, etc.,

Non-quantifiable data, e. g. employee know-how, is difficult to express in figures. Since KPIs are determined at a certain point of time and are therefore static, they should be specified promptly with the process flows.

Additionally, KPIs provide information on the 'what' and 'where', but not on the 'how'. They neither indicate how they have been compiled nor how to proceed.

The SCOR® model provides guidance in this matter with standardised KPIs in a clear structure: the KPIs (*metrics*) are organised in a hierarchical structure according to performance attributes, and they are assigned to the relevant processes.

Performance Attribute	*Definition*	*Strategic SCOR®-Metric (Examples)*
Reliability	Ability to perform tasks as expected	*Perfect order fulfillment*
Responsiveness	Speed at which tasks are performed	*Order fulfillment cycle time*
Agility	Ability to respond to marketplace changes in the supply chain	*Upside supply chain flexibility*
Cost	Costs associated with operating the supply chain	*Total cost to serve*
Assets	Effectiveness in managing assets (fixed and working capital) in the supply chain	*Cash-to-cash cycle time*

Table 1: Examples of strategic SCOR® model metrics (Copyright ZVEI)

The strategic metrics form the top level of the hierarchical structure. They help companies translate their strategies to supply chain strategies. Below the strategic metrics, there are the diagnostic metrics and, at the lowest level, the root-cause metrics. The SCOR® model defines more than 500 metrics.

1.4.4 Supply chain interfaces

Supply chain interfaces are becoming more important/critical with increased outsourcing and globalization. Information on this subject is detailed in the guideline issued by the ZVEI working group 'Traceability'.

Various identification labels serve as interfaces between the supply chain stages. Standardised labels such as **MAT labels**, **GTL** (*Global Transport Label* for outer packaging) VDA labels and delivery information in paper form (e. g. shipping documents) or electronic form (dispatch notification or EDI messages).

The electronic data interface supports the sharing of information, ranging from planning and forecast data, inventory/requirements overviews, contracts and orders, order confirmations and invoices to delivery notes and delivery status information.

1.4.5 Identification and packaging

As a result of increasing cross-company standardisation, the various identification labels can again be named as examples here, especially MAT labels for inner packaging and GTL for outer packaging, the latter serving also as a master label.

These labels almost always include barcodes to enable automatic recording of data content. RFID labels are also increasingly used and contain a passive antenna for touch-free data reading and processing in addition to the barcode and plain text.

Packaging is also increasingly subject to standardisation – from standardised box formats to reusable packaging and containers.

1.4.6 Supply chain management cost factors

Various costs may incur in supply chain management. Examples of some of the most frequently occurring aspects are given below:

- costs incurring from insufficient speed, especially when it concerns semiconductor products or semiconductor-enabled products. According to *Moore's Law*[5] und *More than Moore*[6] some semiconductor products

Figure 7: Barcodes facilitate quick and easy reading of the corresponding data. (Copyright Escha)

5 Moore, 1998
6 Zhang and Roosmalen, 2009

can be produced at increasingly lower cost, thus losing value,

- logistics costs (shipping, handling, supply channels, calculations, etc.),
- employment costs,
- costs incurring from the scrapping of goods, especially in the event of short product life cycles and inaccurate forecasts,
- costs incurring from a company's own inventories (in-house, **consignment**),
- packaging costs,
- infrastructure costs (storage facilities, IT equipment such as manual devices, PDAs, WLAN coverage, software), external service providers, etc.),
- insurance costs, **taxes**, **customs**, **misdeclaration** (e. g. wrong class of goods), **export controls**, etc.,
- **certification** costs (e. g. through the German Federal Aviation Office (**LBA**) for airfreight security, authorized economic operator (**AEO**), etc.),
- costs for capacity and flexibility provision (storage, production, shipping capacity, late diversification, scrapping, sales planning, etc.),
- costs resulting from special activities such as special deliveries, interim inventories, etc.,
- costs resulting from a lack of standards,
- costs incurring from complaints and returned shipments,
- costs incurring from sample management,
- costs caused by missing process synchronisation,
- incidental costs (planning provisions, contingencies, sub-optimisation).

1.4.7 Future requirements for standardised and ad-hoc communication processes

Rolling sales forecasts transmitted from the customer in defined formats and intervals are prime examples of requirements for standardised communications process. The forecasts should be internally discussed in **S&OP** (*Sales & Operations Planning*) meetings and incorporated into the production and order planning derived from this data. It is recommended that this process be standardised, systematised and conducted on a regular basis (see VDA Recommendation 5009 for the automotive industry). Forecast accuracy is of the essence. The better a forecast, the more downstream processes can be run automatically.

In addition to preventive measures such as increased inventories, production flexibility (short cycle times) and flexible assembly lines in terms of the products to be produced[7], scenario planning will be increasingly requested in the future. Scenario planing yields, different results depending on the business and production conditions. With information from scenario planing, companies would be able to respond quickly and specific to different situations.

Against the backdrop of increasing volatility, staff and IT-supported ad hoc communication will play an increasingly important role. Communication is essential, especially in the event of a crisis. However, it is equally important to define control limits with thresholds triggering an alarm for action.

7 VDA-Projektgruppe 'Programm- und Produktionsplanung', (2008)

2 Robust Supply Chains with High Responsiveness and Flexibility

As explained in chapter 1, supply chains are becoming more and more complex due to the increasing number of company and country networks as globalization increases.

The ability of companies to adapt to changing competitive and market conditions is a key success factor. Supply chains need to be highly flexible.[8] Another critical factor is the responsiveness of the supply chain, since this greatly influences the flexibility and customer satisfaction. Supply chain processes can be optimised in this context with high forecast accuracy and by reducing the bullwhip effect (see chapter 2.3.1 for definition).

The robustness of a supply chain is another core element of successful supply chain management. The supply chain design must ensure that they are able to withstand disruptions and risks. Consequently, comprehensive risk management plays a major role in safeguarding the supply chain.

The following chapter provides an overview of the design and control of a supply chain's central success factors: flexibility, responsiveness, forecast accuracy and robustness.

The information provided below is based on the SCOR® modell (chapter 1.2).

2.1 Measuring and increasing flexibility

Prior to presenting a guideline for measuring and increasing flexibility, it is necessary to first define flexibility and to identify the triggers requiring greater flexibility.

2.1.1 Definition of flexibility

"The more human beings proceed according to plan, the more effectively they may be hit by coincidence." (Friedrich Dürrenmatt)

Although the concept of flexibility is gaining importance, there is no clear definition of the term. The speed at which companies adapt to a new external situation is one part of flexibility, as are the resources employed. Costs incur both from unused flexibility or the lack of flexibility.[9]

We define flexibility as follows:
Flexibility is the ability of supply chains or supply chain companies to adapt to changes within an appropriate time frame and at a corresponding cost.[10]

According to the SCOR® modell, the concept of flexibility can be subdivided as follows:

- *Plan flexibility* includes processes and methods.
- *Source flexibility* groups production goods and production procedures.
- *Make flexibility* maps factory and plant capacities.
- *Deliver flexibility* deals with demand and shipping.

Flexibility is broken down into internal and external flexibility. Internal flexibility describes internal company processes and external flexibility describes the adaptability of a cross-company supply chain. It is also possible to classify the concept in terms of the planning horizon, i. e. in operational and strategic flexibility.

The following observations focus on internal and operational possibilities to measure and increase flexibility.

8 Blecker and Kaluza, 2000

9 Günthner, 2007

10 Simchi-Levi, Kaminsky, Simchi-Levi and Bishop, 2007

2.1.2 Triggers demanding greater flexibility

A survey has been conducted among ZVEI members to identify the most common reasons for demanding flexibility.[11]

TOP 10 – Triggers for Demanding Greater Flexibility	
01 PLAN	Short-term supply volumes demanded by customer
02 MAKE	Cycle time
03 SOURCE	Short-term supply volumes required from supplier
04 MAKE	Production capacity
05 PLAN	Inventory
06 DELIVER	Delivery date
07 SOURCE	Procurement date
08 PLAN	Long-term sales forecasts
09 ENABLE	Performance capability of the identification technology
10 ENABLE	IT architecture

Figure 8: Triggers demanding greater flexibility in the electronics industry (Copyright ZVEI)

The list above shows the top 10 triggers for demanding greater flexibility in descending order and assigned to the relevant SCOR® process. Short-term changes in supply quantities requested by customers (*Plan*) are the main reasons for flexibility, followed by the request for shorter cycle times (*Make*).

11 Questionnaire sent to 50 members of the ZVEI SCM working group, response rate 13

2.1.3 Guideline for measuring and increasing flexibility

Although it is difficult to measure flexibility using hard indicators, there are approaches available that help make company processes more flexible.

The following recommendations for action have been devised:

- buffer capacities at plants or defined storage spaces before diversification,
- low and flexible quantities in the order and production stages,
- late diversification,
- product and inventory segmentation.

Short-term supply increases present a major challenge for companies in terms of flexibility. The challenge in this case is to determine the appropriate amount of free capacities. Whereas extremely high capacities lead to high idle time costs, extremely low free capacities may result in orders that cannot be fulfilled and lead to customer dissatisfaction.

Companies often specify minimum order quantities to lower their fixed production and administration costs. These measures, introduced on the grounds of cost efficiency, adversely affect flexibility. Flexible order and production quantities and specifying shipping costs per unit instead of fixed lump-sum freights, both help companies to support more flexible supply chains.

Another obstacle to supply chain flexibility is the increasing customer demand for customisation combined with ever shorter product life cycles. Postponement strategies are one approach to resolving this situation. These can relate to production (assembly postponement) or logistics (geographic postponement). Assembly postponement focuses on keeping products and processes generic for all products as long as possible. As a result, nearly finished products are then finished to meet the customer's individual requirements, allowing the base, generic product to remain as long

as possible in the production, and thus maintaining a high level of flexibility until close to the delivery, when the customer demand is known. In logistics, the postponement strategy refers to the storage of already differentiated products in central distribution hubs.[12]

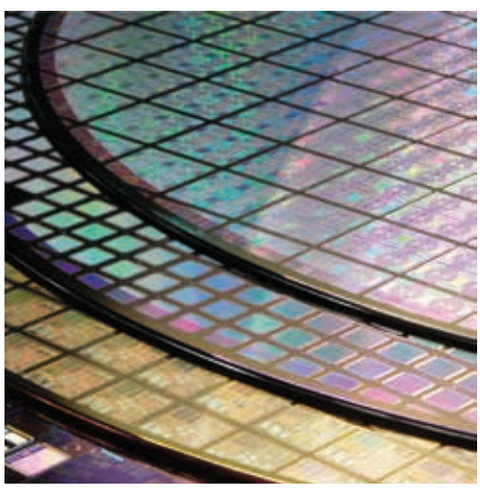


Figure 9: IC wafer: Semiconductor innovations enable new product launches and product upgrades in ever shorter time frames. (Copyright X-Fab)

It is recommended that products be categorised according to the order processing strategy, in *make-to-stock* (*MtS*) or *make-to-order* (*MtO*) segments. Products that require no specific customer order to start production should be manufactured according to the MtS strategy. It should be possible to forecast demand for these products as accurately as possible to ensure they can be sold later. In the event of low capacity utilisation, the maximum stock quantity of these products can be manufactured until the capacities are required for other purposes, e. g. for an MtO product. Thus it is possible to achieve high production utilisation rates while maintaining high flexibility. The MtO strategy is applied for product ramp-up or in the case when it is difficult or not possible to establish reliable volume forecasts. The capacity is then utilized only once an order is received, reducing the risk of future product scrap. For some industries it might be advantageous to employ a combination of MtO and MtS strategies. For example, it is often customary in the semiconductor industry, to make to stock until the 'Die Bank', i. e. as long as all chips are still on one wafer, and use the MtO strategy from the 'Die Bank' onwards.

Decentralised production networks are another option to increase flexibility. The aim of these networks is to localise production on a regional level, which is particularly useful in the case of customised products. Decentralized production networks can be achieved with sustainable manufacturing systems and application of the relevant logistics, consisting of lean and flexible plants through the use of base products and components, which are not specific to a particular customer.

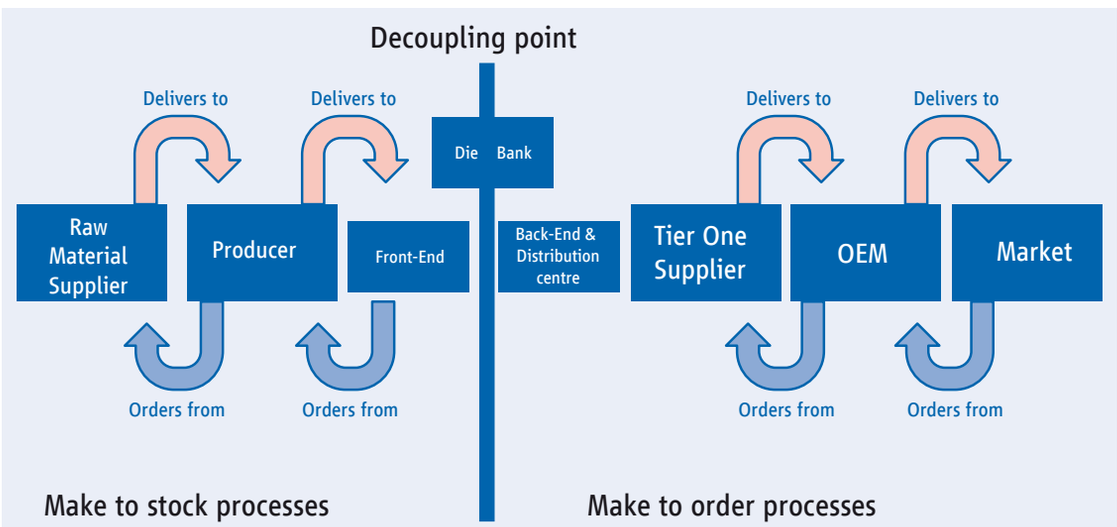


Figure 10: Manufacturing strategies in the semiconductor industry (Copyright Infineon Technologies)

12 Pfohl, 2004

2.2 Measuring and increasing responsiveness

Prior to introducing a guideline for measuring and increasing responsiveness, it is necessary to define the concept of responsiveness and detail the measurement methods.

2.2.1 Definition of responsiveness

In the context of supply chain management, responsiveness refers to the time required by a company to adapt to changing requirements, which can result from a variety of sources, including product innovation, technological process or new legal requirements.

2.2.2 Measuring responsiveness

Responsiveness can refer to:

1. *Responding to a customer request*: The time measured from receiving the request to sending the first information relating to the fulfillment of the request to the customer.
2. *Meeting the contractually agreed responsiveness*: The ratio between the orders completed according to the agreement and total number of orders served. Although this KPI does not measure the responsiveness itself, but the delivery reliability, it provides an initial indicator of responsiveness.
3. *Fulfilling the customer request*: Here, responsiveness reflects the speed and ability of a company to respond to a customer request. The complete fulfillment of the order, at least delivery time and quantity, is usually considered. To measure the result, the KPI *On-Time In-Full* (*OTIF*) can be used. This KPI gives the percent of deliveries which arrive at the customer according to the customer's request date and request quantity.

To compare with a benchmark or the theoretically shortest possible reaction the *Flow Factor* (*FF*) can be used. This is defined, in this context and for this purpose, as the ratio between the actual responsiveness and the theoretically shortest possible reaction.

2.2.3 Guideline for measuring and increasing responsiveness

The *Flow Factor* concept comes from the semiconductor industry and is calculated as the ratio of the *Cycle Time* (*CT*) to the *Raw Process Time* (*RPT*). In turn, the *Cycle Time* is derived from the ratio between *Work in Progress* (*WIP*) and throughput, here referred to as *Going Rate* (*GR*). *Inventory* refers to the number of manufacturing units currently in a production system and *Going Rate* to the number of units manufactured per day, for example. The *Raw Process Time* is the average time it takes a job to be processed under ideal conditions, i. e. excluding queuing times and inefficient processes (provided all four partners involved are fully available: man material, machine and method). The theoretical optimum Flow Factor is thus '1.0'. Assuming a given variability (α) combined with a high availability of the four partners and their synchronisation, a low value of α enables high process speed and results in high utilisation rates. Reasonable flow factors that can be achieved in the semiconductor production, range between 2.5 and 3.0 based on 24/7/365 operation.[13]

$$\text{Flow Factor} = \frac{\text{Cycle Time}}{\text{Raw Process Time}}$$

$$\text{Cycle Time} = \frac{\text{Work in Progress}}{\text{Going Rate (throughput)}}$$

The flow factor is often used in connection with the operating curve, which uses variability (α) to show the variation in the operating curve for a standard manufacturing process or for processes in general. Low variability α indicates few disruptions and high utilization is possible (Flow Factor approaches 1.0).

13 Hopp and Spearman, 2011

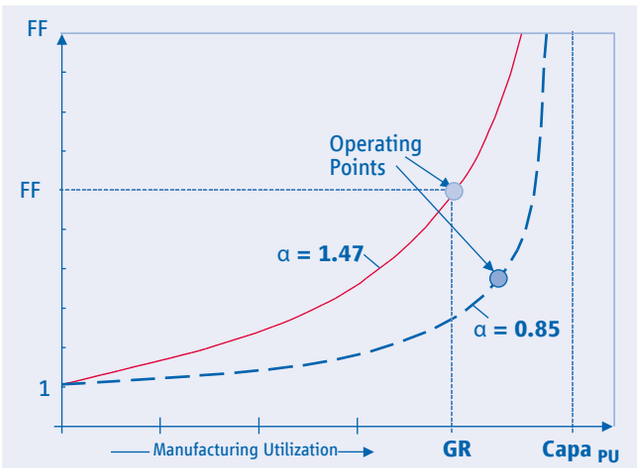


Figure 11: Operating points on two different operating curves (Copyright Infineon Technologies)

Assuming a given going rate (in this example 80 percent of the maximum capacity of the production unit), Figure 11 illustrates that the blue operating curve has a significantly smaller flow factor and thus shorter cycle time compared to the red curve, consequently indicating a considerable advantage of the blue production network in terms of responsiveness. This method, tried and tested in semiconductor manufacturing, can also be transferred to administrative processes in general.

A key element of a company's responsiveness is production cycle time, as responsiveness necessarily decreases with increasing product cycle time. Therefore, as a short-term solution, it is recommended that a limited number (e. g. 10 percent of the manufacturing capacity) be reserved for emergency batches to be able to respond to customer requests received at short notice or with high priority. Prioritising production orders can be another solution for such exceptional situations. However, for long term cycle time improvement, one approach can be illustrated with the operating curve. Low variability α, in other words small deviation from standard manufacturing processes, enables the lowest cycle time to be achieved, i. e. a cycle time approaching the *Raw Process Time*.

Another approach to increasing responsiveness is the employment of different order processing strategies.

As discussed in the section 2.1.3, products which can be reliably forecasted can be produced as MtS, with a high capacity utilization. The buffer stock then can fulfill demand when an MtO product is produced.

Being able to respond quickly to customer requests is particularly challenging for companies whose products have extensive bills of materials. The many different component parts present a higher risk of supply shortages and of sources of error, both reducing responsiveness. Standardising the products and taking a foresighted approach in contract negotiations with customers and suppliers are two options to handling this situation. Improvements can be achieved, for instance, with *dual/multiple sourcing* strategies such as warehousing strategies coordinated along the entire value chain and defined acceptance periods (*frozen windows*). The provision of information at the point of sale within all levels of the value chain can also contribute to substantially increasing responsiveness.

Cross-company coordination of the entire value chain is a major challenge. This is often due to conflicting goals and incentives along the supply chain. For example, a marketing unit may inflate its demand forecast to ensure future supply for potential customers. If the market does not materialize, these fig-

ures are reduced, resulting in misalignment, miscommunication and mistrust towards the upstream supply chain stages and contributing to the bullwhip effect (see section 2.3). Simulation programmes can be used to gain an overview of the complete process chain. Bottlenecks can thus be identified early on, countermeasures initiated and emergency plans developed.

the BOM to meet customer demands without affecting the inventory structure of the organisational unit (see figure). The dependency is reflected in the fact that inventories must be increased or decreased if/when DFF ≠ 1.0.

The data required for the calculation is determined on the basis of database evaluations.

$$\text{Delivery Flow Factor} = \frac{\text{Sum of all production jobs confirmed completed}}{\text{Sum of consumption quantities plus delay regarding the desired delivery date}}$$

Delivery Flow Factor

The *Delivery Flow Factor* (DFF) has been developed based on the flow factor. The DFF is the ratio of the sum of all production jobs confirmed completed to the consumption quantities plus the delay regarding the desired delivery date per organisational unit.

The sum of *confirmed and completed production jobs completed* includes fully or partially completed production jobs (quantity and/or process).

The delay *regarding the desired date of customer orders* must also be considered since it measures the production service not yet supplied.

Supply backlogs of externally procured materials, e. g. commodities, must not be included.

This calculation approach shows that the Delivery Flow Factor is an indicator of the ability of the supply chain management and production together to respond to changing market requirements. This suggests that the Delivery Flow Factor is more focused on production (control).

In addition to the Delivery Flow Factor, it is recommended that the replenishment lead time and inventory coverage for in-house produced items be considered, in order to highlight possible interdependencies between these two indicators. The ideal situation is reached when DFF = 1.0. In this case, the output of the production areas equals the required consumption data for all levels of

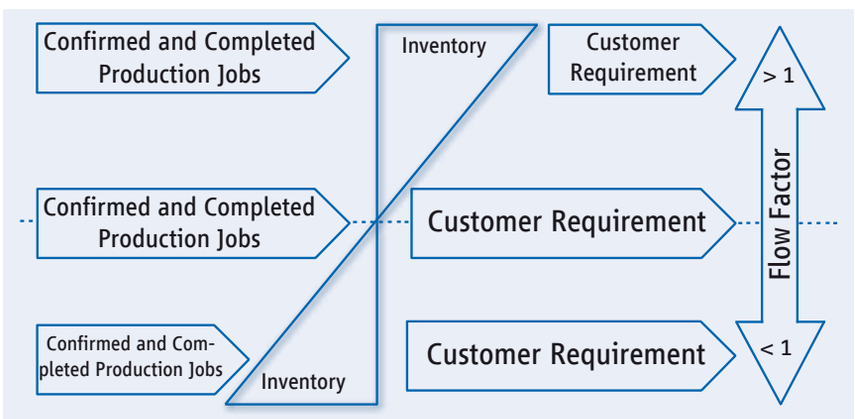


Figure 12: Delivery Flow Factor (Copyright ZVEI)

2.3 Measuring and increasing forecast accuracy and measuring and reducing the bullwhip effect

Prior to introducing guidelines for measuring and increasing forecast accuracy and for measuring and reducing the bullwhip effect, the concept of bullwhip effect and forecast accuracy must first be defined and forecast accuracy measuring methods must be explained in detail.

2.3.1 Definition of the bullwhip effect

The bullwhip effect refers to 'the phenomenon where orders to the supplier tend to have larger variance than sales to the buyer'.[14] The information exchanged with regard to orders is increasingly distorted as it travels upstream in the supply chain. The reasons for the development of the bullwhip effect in supply chains can be divided into operational and behavioural causes.

14 Lee, Padmanabhan and Whang, 1997

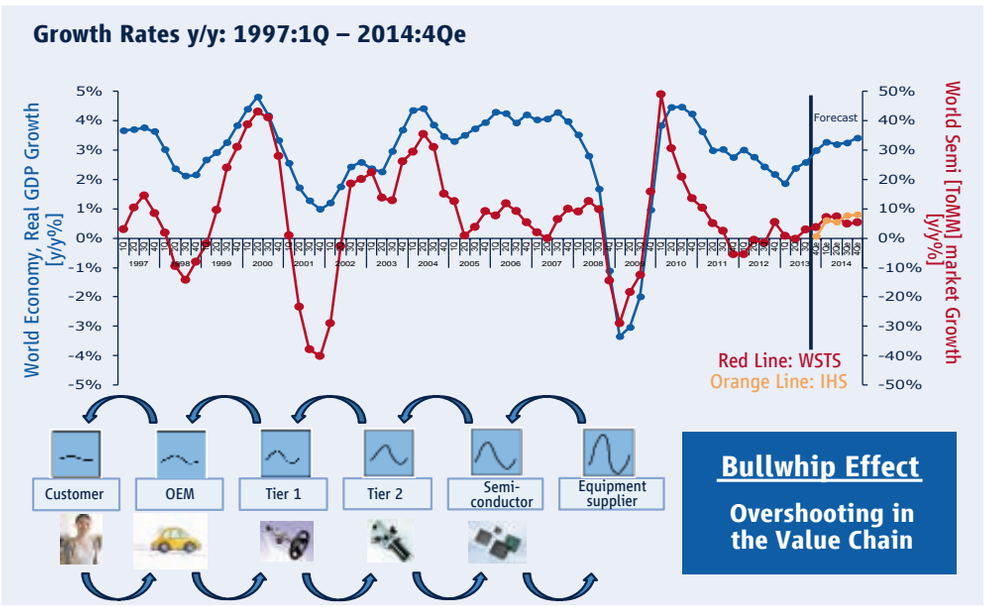


Figure 13: Risks spring from unlinked supply chains – the bullwhip effect (Copyright Infineon Technologies)

According to Lee[15], there are four different operational causes:

- demand signal processing,
- rationing and shortage gaming,
- order batching,
- price fluctuations.

Demand signal processing describes the situation that the original customer demand is distorted and delayed due to long lead times between the individual company orders along the supply chain and incorrect order volume interpretation by downstream participants.

When demand exceeds supply, *rationing and shortage gaming* occurs. Companies pass on orders to their upstream suppliers that are greater than the actual orders they have received. The aim is to receive a larger portion of the limited supply.

Order batching results from the various warehousing and storage strategies of companies resorting to *material requirements planning* (*MRP*), *enterprise resource planning* (*ERP*) or *advance planning systems* (*APS*). These systems are usually based on monthly or weekly planning cycles and issue orders at similar times. Consequently, the majority of orders are issued weekly/monthly, i. e. within a short time window. Fixed order and shipment costs or minimum order quantities – although often necessary and reasonable – are another reason for combining orders and thus further distorting the original demand signal.

The fourth cause of *price fluctuations* refers to demand distortion by granting discounts to drive up sales figures, for example. Due to the periodic discounts, customers buy more than they need and stock the excess quantity. As a result of these additional orders, demand is further distorted since less is ordered in the subsequent periods than the actual demand.

15 Lee, Padmanabhan and Whang, 1997

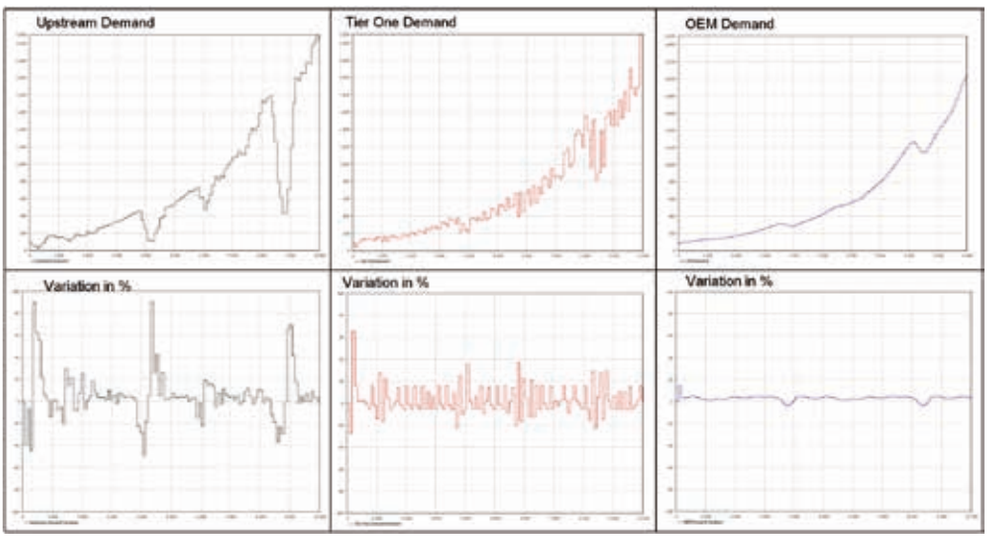


Figure 14: Typical demand distortion along a supply chain (Screenshot – Copyright Infineon Technologies)

Nienhaus[16] observed the behavioural causes when analysing the behaviour of the players participating in the beer *distribution game*.

The first behaviour, also referred to as safe *harbour strategy*, describes the participants' aim to create safety stock in order to prevent bottlenecks and shortages. Thus, participants place larger orders than they need and thus artificially inflate demand.

The second pattern observed is the panic strategy: participants manage their stock sloppily until it falls below a defined safety level. In this case, they panic when receiving more orders, which is reflected in the significantly higher number of orders they issue. Consequently, the demand signal is not correctly passed on at any time.

The bullwhip effect is well documented and is a wide-spread phenomenon in supply chains.

2.3.2 Definition of forecast accuracy

Forecast accuracy is the ability to forecast as accurately as possible demand and demand development of a customer or market segment for a product or product group High forecast accuracy is essential for creating efficient supply chains and preventing the bullwhip effect.

2.3.3 Measuring forecast accuracy

To continuously improve forecasts, metrics are required that help analyse the planning data. There is a wide variety of complex and less complex metrics available for companies to employ. This paper explores the two most popular metrics and their interpretation.

The first metric is the *Mean Absolute Percentage Error* (*MAPE*), which is the arithmetic mean of the absolute deviation of the forecast from the actual customer orders received in relation to the actual demand. MAPE is thus easy to calculate and can be intuitively interpreted.

For other analyses, the *Symmetric Mean Absolute Percentage Error* (*SMAPE*) can be used. Although it is more complex to determine and its interpretation is less intuitive, SMAPE is more stable in terms of demand distortion caused by individually occurring major deviation periods.

16 Nienhaus, Ziegenbein and Schönsleben, 2006

The following section details activity approaches to improve forecast accuracy. It is recommended that the two metrics mentioned above be used to measure the success of the activities.

$$MAPE = \frac{1}{n} \sum_{t=1}^{n} \left| \frac{A_t - F_t}{A_t} \right|$$

$$SMAPE = \frac{\sum_{t=1}^{n} \left| A_t - F_t \right|}{\sum_{t=1}^{n} \left(A_t - F_t \right)}$$

t period 1 to n
n number of periods for which MAPE or SMAPE is calculated
F_t forecast for period t
A_t actual demand in period t

2.3.4 Guideline for measuring and increasing forecast accuracy

Insufficient reconciliation of synchronously running planning systems within a company and its departments can result in coordination problems. Sharing information, enforcing decisions and generally improving collaboration is therefore essential in this context. It is recommended that a standard framework be created, e. g. by using the same metrics in all planning processes and exchanging demand data via standardised electronics formats.

Introducing a global *Sales & Operations Planning* process (*S&OP*) can help counteract the lack of focus and system reconciliation. This process ensures that the operational plans are coordinated between all functions of an organisation and thus support the business plan in the long term.

A clear differentiation between original and adjusted forecast data must be provided to ensure that the analysis of deviations is not neglected but continues to be pursued. Coherent and, above all, current data is required for a good forecast. It is recommended that the data at the point of sale be used to capture demand changes more quickly and more accurately. This data updated on a daily or weekly basis reflects the actual and direct customer demand. Standardised formats, preferably the *Electronic Data Exchange* (*EDI*), should be used for sharing this information along the entire supply chain.

The systematic evaluation of the forecast and analysis of its origins is one of the basic requirements for a company's planning process. Systematic reporting using MAPE or SMAPE for metrics supports the identification of sources of error and misinterpretations.

2.3.5 Guideline for measuring and reducing the bullwhip effect

The following discusses recommendations for actions to counteract the operational causes (*demand signal processing, rationing and shortage gaming, order batching and price fluctuations*) of the bullwhip effect.

Insufficient or delayed information flow along the supply chain amplifies the bullwhip effect. Improving *demand signal processing* involves raising awareness of this effect, providing good forecasts and creating transparency. By training the parties involved in the supply chains, the presence and causes of the bullwhip effect can be communicated. Accurate forecasts can also help reduce distortion of the original demand along the supply chain. Measures to improve the forecast accuracy are detailed in chapter 2.3.4 *G*uideline for measuring and increasing forecast accuracy. However, it is not sufficient that each company improves its in-house forecasts for its own use. For a reliable forecast (not limited by production capacities), it is necessary to have access to demand forecasts of supply chain participants. In order to be able to make reliable statements (capacity or order unitrelated) in terms of the forecast and delivery

time, companies need information on inventories, production capacities, cycle times and expected coverage rate of the inventory currently processed in addition to the forecasts. Exchanging this data provides transparency, thus ensuring long-term improvement of the information flow along the supply chain and counteracting one cause of the bullwhip effect.

Rationing and shortage gaming is another cause of the bullwhip effect. In this context it can be helpful to segment the customers. Instead of allocating the limited supply of goods according to the actual order volume on hand, customer prioritisation should follow other criteria such as customer-specific planning quality and the general availability of forecast data for a defined time frame beyond the mere replenishment time.

Order batching also contributes to demand distortion. Customers can break bulk orders by ordering minimum quantities only instead of their actual demand, for instance. While higher costs may arise from the adjustment of the customer's production to the lower order quantities, *truckloads containing different products* from the same manufacturer may help reduce fixed transportation cost for the individual orders. The external logistics service provider may group different orders, also from other companies, and thus lower freight charges considerably. This approach can be implemented company-wide provided that the order volume is sufficiently high.

Frequently changing prices result in a similar phenomenon to *order batching*. Lower sales prices induce customers to buy more products than they actually need. However, this may annoy customers who purchased the same products earlier at regular sales prices. A *low-price policy* can help counteract these two effects of *price fluctuations* by guaranteeing customers permanently low sales prices.

These recommendations clearly show that it is only possible to limit the bullwhip effect by a mutual exchange of information, i. e. mutual trust and transparency within the supply chain.

2.4 Meaning of a robust supply chain

Companies face major challenges resulting from growing market globalisation and hence continuously increasing complexity, which requires companies to permanently optimise their internal value chain and supply. Not only must companies respond to higher prices and changing market competition, they also must manage a greater number of variants and reduce delivery times and inventories.[17]

Companies that fail to adapt in time to the changing conditions will face substantial disadvantages in terms of profitability and long-term competitiveness.[18]

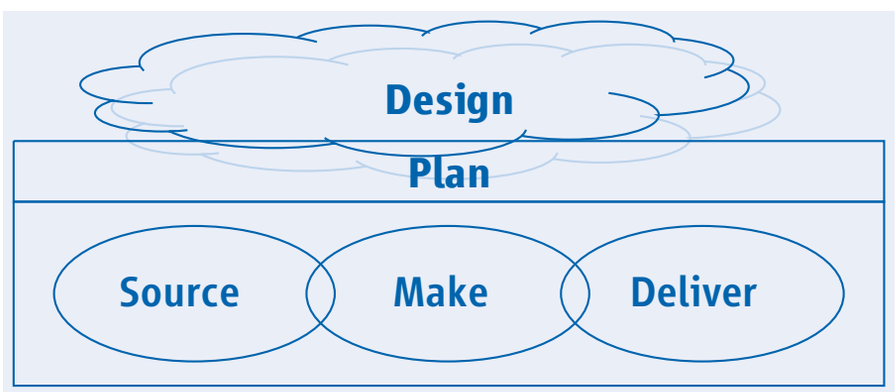


Figure 15: It is essential that supply chains are robust. (Copyright ZVEI)

17 Becker, 2007
18 Beckmann, 2004

However, it is not enough just to meet and further optimise the new requirements caused by market changes. In closely linked global supply chains, minor network interruptions may result in breakdowns along the entire supply chain.[19] Therefor the focus of supply chain management should also be on end-to-end planning, controlling and monitoring processes along entire value adding networks (supply chains)[20], with the aim is to identify weaknesses and risks in supply chains early on and implement robust processes to prevent breakdown.

2.5 Definition of a robust supply chain

No clear term definition of *robust* supply chain can be found in the literature. Robust processes are described as insusceptible to external errors. Another definition of robust processes refers to their ability to eliminate minor process deviations autonomously.[21]

This means that a robust supply chain must be as reliable and immune as possible to external influences and risks, possibly intercepting errors when they occur to minimise their impact on downstream processes.

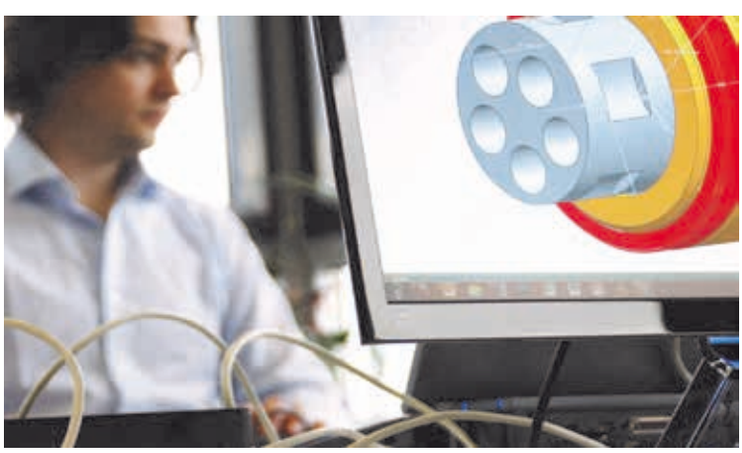


Figure 16: Research and development areas significantly influence the complexity of the future supply chain. (Copyright Escha)

2.6 Development of a robust supply chain

To design a supply chain as robustly as possible and hence protect it from potential risks, it is necessary to identify the weaknesses of the individual areas of a supply chain (e. g. purchasing, materials management and inbound logistics, production planning and production, requirements and sales planning, development and design, outbound logistics and warehousing). This paper first discusses the risks that may occur in the individual areas. Then, the protection measures identified for these areas in order to improve the robustness of the supply chain ar detailed.

2.6.1 Risks to the individual areas

A supply chain risk is the damage – assessed by its probability of occurrence – that affects more than one company in the supply chain and that is caused by an event within a company, within a supply chain or its environment.[22] A number of international and recognised standards (e. g. ISO 31000 – *Risk Management*, IEC 31010 – *Risk Management – Risk Assessment Techniques*).

Comprehensive risk management requires knowledge of the risks that may occur in the different areas of the supply chain.[23]

A classification of supply chain risks according to the SCOR® areas is provided in the following subsections. The *Design* area has been added since, in our opinion, it also poses substantial risks for supply chains. The *Return* process is not considered since we feel it plays a minor role in this context.

19 Dumke, 2013
20 Beckmann, 2004
21 Becker, 2005
22 Kersten, Hohrath and Winter, 2008
23 Lasch and Janker, 2007

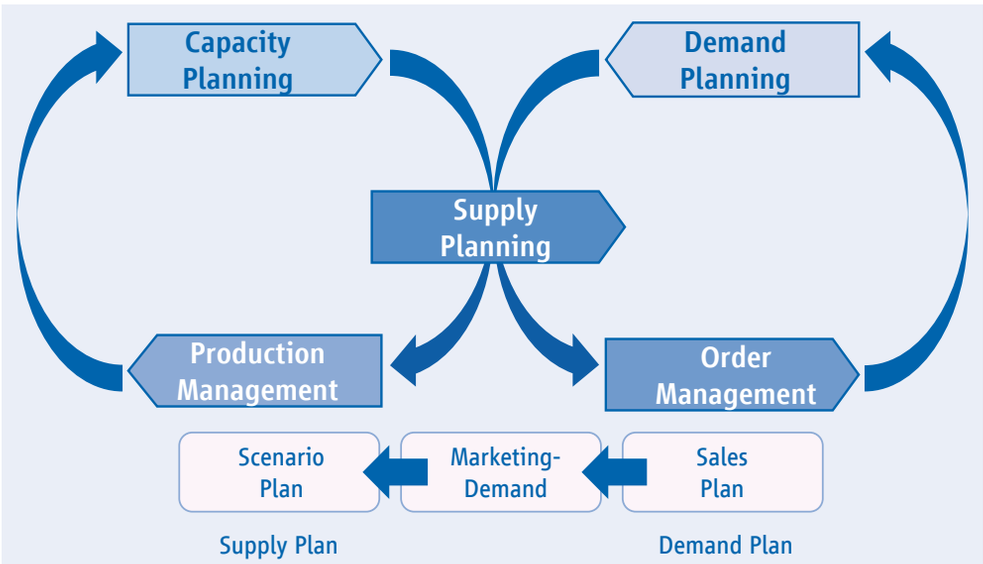


Figure 17: During the planning process it is essential to consider foreseeable and unforeseeable events to be able to respond directly. (Copyright Infineon Technologies)

2.6.1.1 Design

The future complexity of the supply chain and its structures is already being determined in the field of research and development (*Design*). In addition to procurement costs, production and distribution, the product architecture greatly influences the variant diversity.[24]

Greater variant diversity means higher complexity and risks in the downstream supply chain processes. The use of extremely specific purchased parts and technological dependencies on individual suppliers can lead to supply chains that are difficult to control and which face higher risk of disruption. In this way, the design process directly influences the purchasing strategy and supply chain of a company and dictates process flows.

Possible supply chain risks in the area of *Design* are:

- increased complexity caused by variant diversity,
- technological dependencies, specific purchased parts,
- single sourcing,
- unforeseeable procurement costs,
- geographical risks caused by the necessity to procure goods from volatile markets,
- long-term availability of purchased parts,
- absent/insufficient collaboration with downstream supply chain areas (comparing/sharing specialist knowledge).

2.6.1.2 Plan

Possible risks for the *Plan* process may arise from the flow of information and material flow control and planning. The uncertainties and risks occurring here may impact all processes.

Inaccurate planning is often the result of inaccurate information (see chapter 2.3). If information about changing requirements or forecasts, capacity shortages, process disruptions or imminent or existing supply bottlenecks is not passed on or passed on too late within company, the Plan process provides no basis for decision-making. Risk indicators are thus either incorrect or incomplete or not identified at all.

24 Corsten and Gabriel, 2004

Possible supply chain risks in the area of *Plan* are:

- information about requirements or forecast changes is passed on too late,
- information about requirements or forecast changes is passed on incorrectly or not in full,
- insufficient forecast accuracy in terms of upstream supply chain areas,
- information about internal/external disturbance factors (e. g. capacity, process, quality) is passed on insufficiently or not at all.

2.6.1.3 Source

The impact of supply chain risks occurring in the *Source* area extends from the supplier to production. Identifying early on the full scope of all major procurement risks that may arise in the procurement market or on the supplier side is essential in managing a supplier-customer relationship in a way that is commensurate with the risks involved.[25]

In addition to the geographical location of the respective procurement source/supplier, the stability of the supplier in terms of quality, reliability, flexibility and financial standing plays a key role. Delays in delivery on the part of suppliers or their sub-suppliers significantly affect downstream supply chains.

Possible supply chain risks during the *Source* process include:

- procurement markets with geographical risks (e. g. floods, earthquakes or other forces of nature),
- political uncertainties,
- tariff restrictions (see chapter 3.2),
- missing/insufficient supplier expertise and flexibility to be able to respond to increasing requirements regarding dynamics and quality,
- allocation vulnerability,
- long or inaccurate restocking and delivery times,
- missing/insufficient system-supported processes /information flows,
- missing certifications.

25 Vahrenkamp and Siepermann, 2007

2.6.1.4 Make

The *Make* process considers the supply chain risks of the company's in-house production. In this context it is necessary to first clarify the question as to which factors may disrupt production systems to be able to evaluate possible risks. Disruptions can be caused by external and internal factors.

External factors influence the production system from the outside and cause disruptions within the system. Examples are quality or quantity-related problems with purchased parts (see *Source* process).

Internal factors refer to inherent uncertainties occurring in the event that the production programme is not fulfilled or the production system disrupted.[26]

Internal factors/risks can be divided into:

- information risks,
- input risks,
- process risks,
- output risks.[27]

If changes in demand structures and hence changing capacity utilisation rates in the affected production area are not or are insufficiently passed on due to absent *information flows* within a company, there is a high risk that occurring bottlenecks are not detected in time or not at all.

The following bottlenecks may occur in the *Make* area:

- insufficient system capacities,
- insufficient tool capacities,
- insufficient workforce capacities.

Moreover, the latent danger exists that companies cannot respond to technical or variant changes in time and are thus unable to manufacture products for which there is market demand.

26 Zschorn and Käschel, 2007
27 Rogler, 2002

Internal input risks refer to:

- damage of goods fed into production,
- unplanned increased consumption of goods (e. g. wastage),
- shortage of materials supplied from upstream areas.

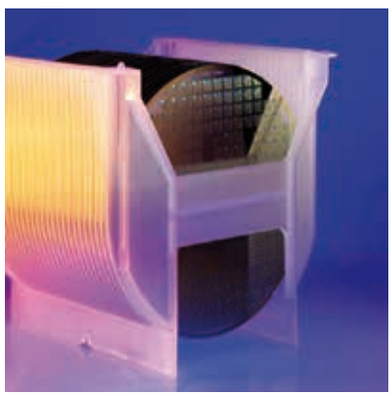
Unplanned production waste results in unplanned higher upstream supply chain demand. Companies often lack the necessary response time to be able to compensate higher material consumption, which increases the risk of material shortage.

Process risks are disruptions that result in quantitative or qualitative losses during the production process. They represent another risk factor since capacities that have been theoretically determined are not fully exploited (see above).

Output risks include, among others, products that fail to meet the specifications, products that fail to meet demand and products that cannot be produced due to plant emergencies.[28]

Possible supply chain risks during the *Make* process include:

- insufficient/delayed (system-supported) information flows within companies,
- delayed (system-supported) transfer of information, e. g. demand changes to the affected supply chain areas,
- missing/incorrect master data,
- process disruptions,
- missing capacity evaluations,
- higher wastage,
- missing quality control loops.



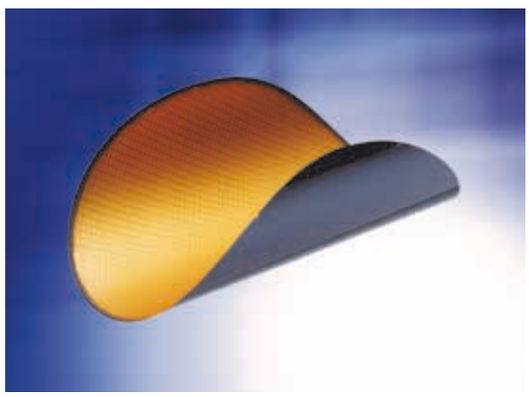


Figure 18 and Figure 19: Transport carrier for wafers and flexible 300 mm discs: It is no longer possible to use traditional carriers in cleanrooms for handling ultrathin wafers for energy-saving power semiconductors.
(Copyright Figure 18 X-Fab / Copyright Figure 19 Infineon Technologies)

2.6.1.5 Deliver

The Deliver area considers the supply chain from a company's production to the customer. The following errors/risks primarily occur during the *Deliver* process:

- wrong point of delivery,
- schedule deviations,
- quality deviations,
- quantity deviations,
- damaged or lost goods.

Examples of a wrong point of *delivery* and *schedule deviations* can be incorrect/faulty order picking or packaging (e. g. caused by untrained staff). External factors such as waiting times or goods clearing problems (e. g. if customs formalities have not been considered early on) also contribute *to schedule deviations*.

Figure 20: Deliver process risks quickly lead to quantity and schedule problems that may incur substantial extra costs.(Copyright Infineon Technologies)

28 Rogler, 2002

Quality deviation in the context of Deliver refers to damage to the goods by non-productive areas. Incorrectly picked/packed/shipped goods (over-/underdeliveries (*quantity deviations*), wrong/mixed goods, incorrect shipping documents) can also lead to quality-related issues.

Damage or *loss of goods* refers to the partial or full destruction of goods. This can be the result of plant emergencies, shipping accidents or force majeure (fire, floods, etc.).[29]

In the event of errors occurring during the *Deliver* process, supply is sometimes only possible at substantial extra cost.

2.6.1.6 Tabular risk summary

The main risks that may occur in a supply chain are summarised below and assigned to the areas *Design*, *Plan*, *Source*, *Make* and *Deliver*.

Risk	*Design*	*Plan*	*Source*	*Make*	*Deliver*
Increased complexity	x	x	x	x	x
Variant diversity	x	x	x	x	x
Technology dependence	x		x		
Long-term availability (end-of-life)	x		x		
Transfer of expert knowledge	x		x	x	
Delayed or insufficient information flows	x	x	x	x	x
Insufficient forecast accuracy/planning safety		x	x	x	
Demand fluctuations		x	x	x	
Insufficient system-supported processes/IT processes	x	x	x	x	x
Geographical location risks			x	x	
Political risks in procurement markets			x		
Currency			x		
Tariff restrictions			x		x
Missing certifications/missing expert knowledge			x		
Single sourcing			x		
Procurement costs	x		x		
Flexibility		x	x		
Capacities			x	x	
Qualification			x	x	
Long replenishment lead times/delivery times		x	x		
Allocation			x		
Master data		x	x	x	
Process disruptions				x	
Quality	x		x	x	
Wastage			x	x	
Packaging			x	x	x
Transport damage/plant emergencies			x	x	x

Table 2: Typical supply chain risks (Copyright ZVEI)

29 Ziegenbein, 2007

2.6.2 Safeguarding areas against risks

Companies need to have a systematic, cross-company risk management system in place to be able to safeguard the supply chain against the risks identified in chapter 2.6.1 to the best possible extent.[30]

The aim of risk management is to identify early on potential risks along the supply chain, evaluate their potential impact, identify preventive measures, and evaluate their impact through a cost-benefit analysis. Preventive measures based on this analysis should be implemented to ensure the highest possible level of supply safety for the companies involved in the value-adding process.[31]

In the next sections, measures to safeguard the supply chain are grouped according to the SCOR® model.

2.6.2.1 Design

It is necessary to involve all areas participating in the supply chain process so as to be able to already identify and consider risks during the product development process. Establishing inter-disciplinary project teams in the organisational structure can help provide a comprehensive view of the risks and opportunities that may arise in a project. In addition to staff members from development, the core functions such as purchasing, logistics, production and quality management, should also be represented on the teams.

For example, the following can already be considered and analysed during the product development stage:

- standard parts/preferred parts,
- preferred suppliers,
- long-term availability (*end-of-life*),
- supplier performance,
- technology dependence,
- single sourcing risks,
- geographical uncertainties (unstable procurement markets),
- technological and qualitative feedback from the series organisation, e. g. from preprojects (transfer of expert knowledge, lessons learned),
- complexity can be reduced by deliberately using standard components and platform strategies.

In addition to inter-disciplinary project teams, system-supported information such as a central component database, problem reports, 8D reports, FMEA, FAMP and supplier evaluations create transparency.

Figure 21: Interdisciplinary project teams enable a comprehensive view of the risks and opportunities along a supply chain.
(Copyright Siemens)

30 Kajüter, 2007
31 Vahrenkamp and Siepermann, 2007

2.6.2.2 Plan

Today, the flow of goods and information is controlled by different systems depending on the company size and industry. ERP systems provide the basic architecture to integrate business processes across functional organisational structures and optimise the process flow.[32]

However, traditional ERP systems are limited in the face of continuing market globalisation and increasingly complex supply chains. Consequently, supply chain management systems (SCM systems) are used more and more to master and safeguard increasing supply chain complexity. A major difference between SCM and ERP systems is their approach. SCM systems consider concurrent and cross-company planning steps beyond company boundaries, whereas ERP systems are limited to the internal company planning an processes. Using SCM systems, it is also possible to simulate changes using predefined conditions/limitations or to include them in optimisation scenarios.

The purpose of SCM systems is to:

- communicate information promptly, in full and without error,
- generate requirements forecasts,
- coordinate and control physical process flows,
- control intra-logistic and external supply chains,
- ensure maximum supply chain transparency,
- simulate supply chain scenarios,
- enable stress tests by simulating extreme but possible demand scenarios[33],
- optimise supply chains.

Adaptive SCM systems using the database of existing ERP systems and extending it as necessary, are also referred to as *Advanced Planning and Scheduling Systems* (*APS*).[34]

The following figure illustrates the systemic boundaries between the different systems.

<table>
<tr><th></th><th>Source</th><th>Make</th><th>Deliver</th><th>Sell</th><th></th></tr>
<tr><td>Supply Chain Configuration</td><td colspan="4">Strategic Supply Chain Modelling
Strategic Supply Chain Optimisation</td><td rowspan="2">Strategic Planning Systems</td></tr>
<tr><td rowspan="3">Supply Chain Planning (incl. APS)</td><td>Supplier Management</td><td>Overarching Planning</td><td>Inventory and Warehouse Management</td><td>Customer Order Management</td><td rowspan="3">Optimisation Tools</td></tr>
<tr><td>Procurement Programme Planning</td><td>Master Planning</td><td>Distribution Planning</td><td>Sales/ Requirements Planning</td></tr>
<tr><td></td><td>Detailed Production Planning</td><td></td><td>Customer Order Simulation (ATO, CTO)</td><td rowspan="2">Advanced ERP-1 Systems</td></tr>
<tr><td>Supply Chain Execution (ERP)</td><td>Procurement Handling</td><td>Production Handling</td><td>Warehouse and Shipment Handling</td><td>Sales Handling</td></tr>
</table>

Figure 22: Symmetric differentiation between the different supply chain management systems.[35] (Copyright ZVEI)

32 Kilger and Müller, 2002

33 Gruber, (2012)

34 Wannenwetsch, 2005

35 Schulte, 2013

The holistic modelling and planning approach of APS systems across company boundaries and the classification of the different systems mentioned above is mapped in Figure 23 below.

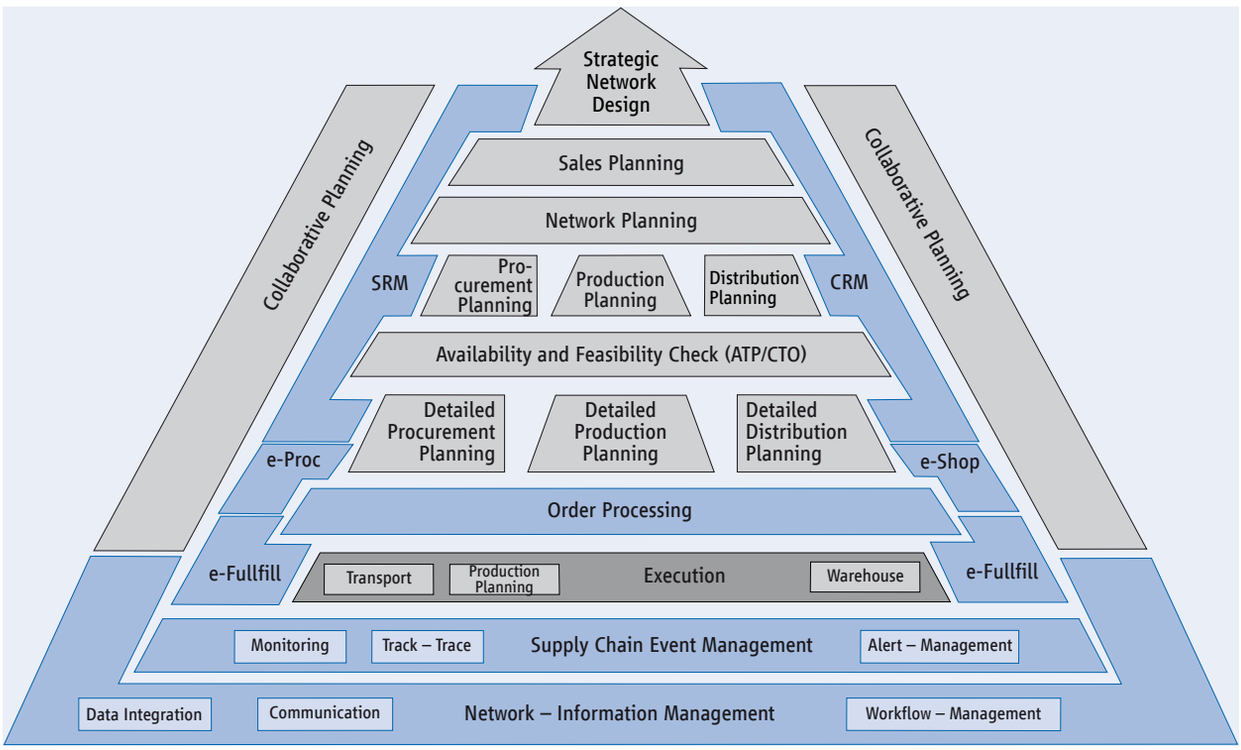


Figure 23: The holistic modelling and planning approach of APS systems is required for a view beyond company boundaries.[36] (Copyright ZVEI)

2.6.2.3 Source

The continuously growing globalisation of procurement markets, combined with the increasing delegation of responsibilities to upstream supply chain partners, places great expectations on suppliers. Selecting suitable and powerful partners/suppliers is thus of utmost importance for supply chain managers.[37]

Supplier Relationship Management (*SRM*) has increasingly gained importance in companies over the years as part of the comprehensive view of supplier structures and the pro-active management approach of all supplier relationships. The main focus of SRM is on collaborating with suppliers with the aim of speeding up the joint development of products that are more reliable at less cost. Thanks to its collaborative approach, SRM offers the opportunity to reduce friction losses and deploy resources optimally.[38]

As part of the process of identifying and selecting new suppliers/business partners, the scope of procurement markets to be analysed is reduced. Geographical, political and currency risks of the individual markets are estimated and evaluated.

A supplier analysis is usually conducted to enable a comparison of the potential suppliers. Individual supplier portfolios are created for this purpose based on existing and researched information (e. g. company reports) and certification records.

36 Hribernik, Ghrairi and Carl, 2011
37 Lasch, Bogaschewsky and Essig, 2011
38 Corsten and Gabriel, 2004

Possible content of supplier portfolios:

- technological and logistic expert knowledge,
- performance,
- price structures,
- organisational structure,
- scope of IT-supported information flows,
- flexibility,
- liquidity, capital structures, economic stability,
- certificates.

The system-supported supplier evaluation contains the major performance data of a supplier. Consequently, poor performance or the loss of efficiency can be identified early on and countermeasures to prevent imminent supply chain risks initiated.[39]

The following figure illustrates the supplier management process.

If the performance of existing suppliers decreases, countermeasures must be introduced. This can range from discussing the problem with the supplier, and devising remedial actions to conducting process audits or specific supply chain audits, e. g. according to Global GMMOG/LE standard, at the respective supplier's end. In the extreme case, the supplier can be dropped and replaced.

To systematically record, track and remedy logistic or qualitative performance errors of third-party goods, it is recommended that supplier management be incorporated into established quality control loops. System-based test reports are recommended to record and assign performance errors on a causal basis and forward them to the responsible party.

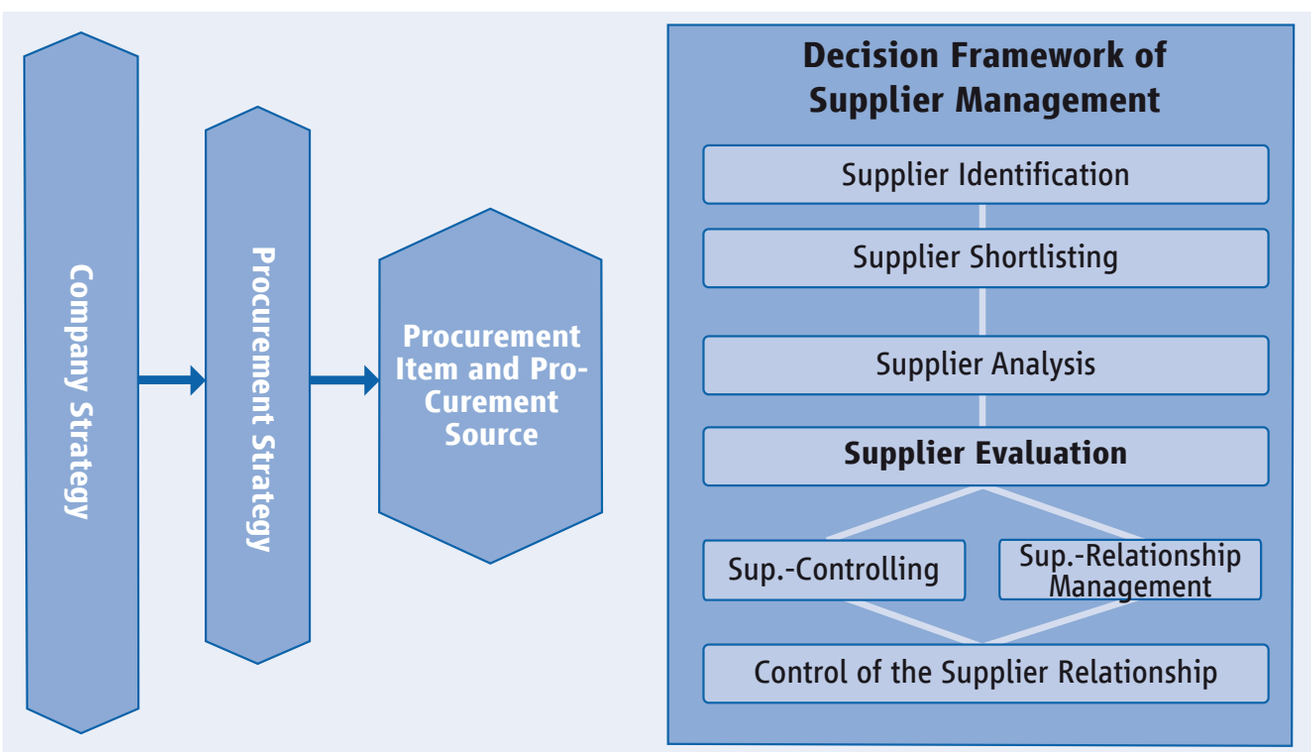


Figure 24: Supplier management process[40] (Copyright ZVEI)

39 Lasch and Janker, 2007
40 Lasch and Janker, 2007

Test reports may provide information on:

- defective product, defective process (including ident information),
- error description,
- date and place of error occurrence,
- supporting visual documentation (if available),
- timeline for corrective measures to be initiated.

Subsequently, the party causing the performance error creates an 8D report based on the error notification, describing and scheduling immediate, medium and long-term measures as well as actions to protect the customer. After the countermeasures have been implemented, their effectiveness and long-term impact is checked.

2.6.2.4 Make

The integration of a comprehensive business process-oriented risk management requires transparency in terms of structure and performance of the processes to be analysed. For this purpose, a risk analysis and evaluation must be conducted to identify the scope of internal and external risks as well as their impact on performance. This can be done by means of a risk classification matrix (see 25).

The purpose of a risk classification matrix is to classify risks according to impact and localise areas where the risks may arise in order to define and implement suitable measures based on these findings.[41]

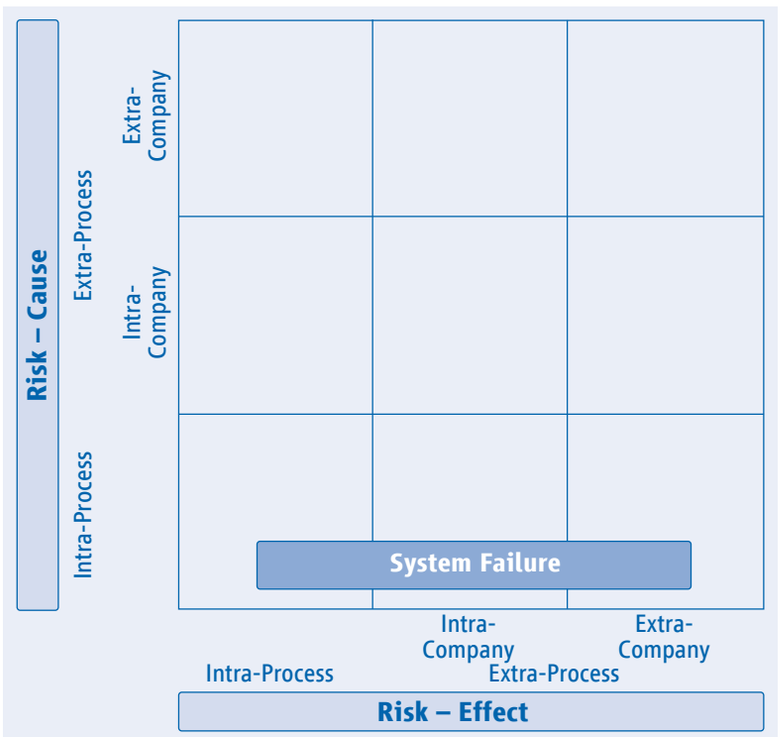


Figure 25: The purpose of a risk classification matrix is to classify risks according to cause and effect.[42] (Copyright ZVEI)

Risks can be grouped as in chapter 2.6.1.4 into 'information flows', 'input', 'process' and 'output'. The following focuses primarily on internal factors since the external factors have already been dealt with above.

Information flows

To safeguard *information flows*, it is necessary to ensure end-to-end supported transmission of information relevant for all process parties along the supply chain. It must also be ensured that the information is transmitted promptly, in full and without any error. This can be achieved through the use of supporting systems to manage and control the process and provide adequate transparency.

41 Himpel, Kaluza and Wittmann, 2008

42 Himpel, Kaluza and Wittmann, 2008

The following provides an overview of supporting system landscapes.

Traditional *Production Planning and Controls systems* (*PPC systems*), which are nowadays usually based on *Manufacturing Resources Planning* (*MRP II*), monitor, control and plan the individual process steps along the supply chain.[43]

These systems are generally embedded in *Enterprise Resource Planning Systems* (*ERP systems*) that cover the standard functional areas of a company in terms of processing functionalities and operate on a process-integrated basis.

The following figure illustrates the complete process flow of PPC system in an ERP landscape.

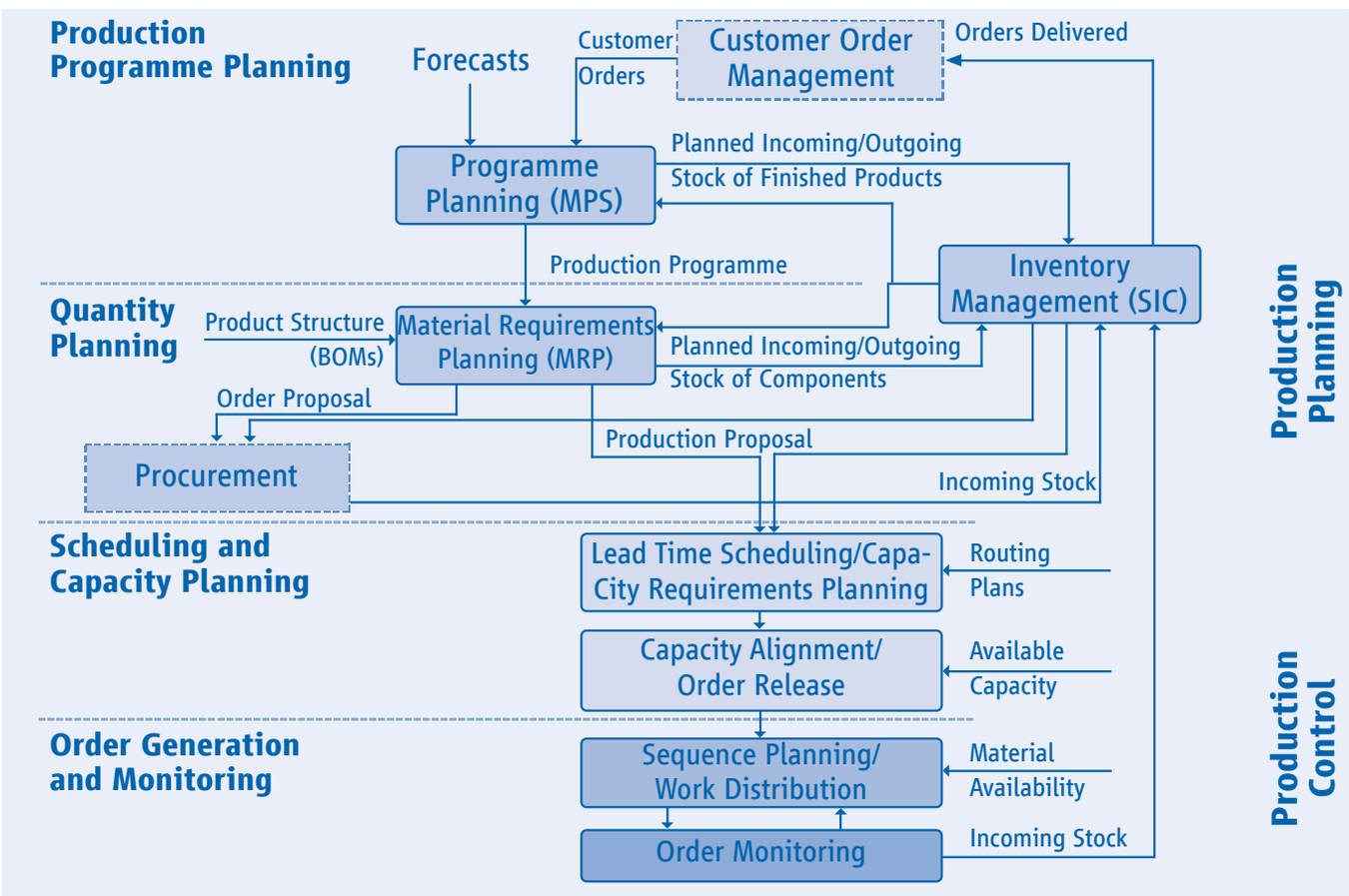


Figure 26: Complete process flow of a PPC system in an ERP landscape[44] (Copyright ZVEI)

43 Hribernik, Ghrairi and Carl, 2011

44 Heiserich, Helbig and Ullmann, 2011

Industries with long cycle times require early capacity planning. The relevant coordination processes take place at several levels.

according to the push principle and utilise capacities, the pull principle ensures supply replenishment exclusively based on consumption. Thus, material required for production

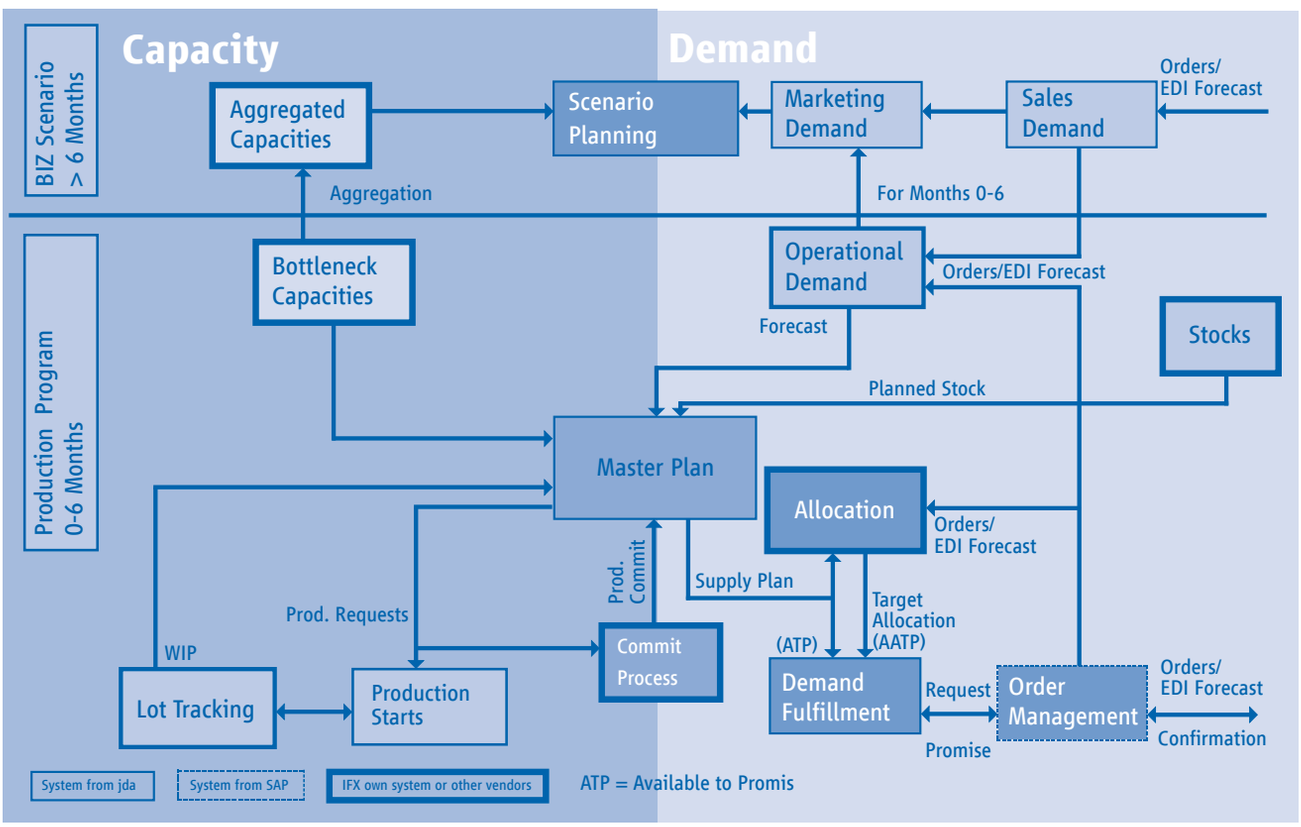


Figure 27: Extended planning landscape of Infineon (Copyright Infineon Technologies)

Input

Safeguarding *initial* (*input*) *risks* requires sufficient system-supported process transparency. Information on higher wastage rates during the production process or defective goods received must be forwarded early on to the responsible party. Short, closed quality loop control systems are pivotal in this context.

Queuing times within production areas are often the result of illcoordinated processes, different line cycle times or problems within existing information flows. To remedy this situation, it is necessary to create smooth-flowing and steady processes to eliminate friction losses between internal customer-supplier relationships. To reach this goal, the logistics area uses pull systems as self-controlling and demand-oriented logistics systems. Unlike conventional control logistics, which operate can be requested early on without the risk of bringing too much material into the production areas. In addition to providing better protection for production systems against long queuing times, the application of pull systems also optimises the supply process. Pull systems are primarily realised via Kanban control systems. All information required for the delivery process (material, quantity, delivery batch, place of delivery, etc.) is summarised on a card (Kanban is Japanese for 'sign board') and assigned to a material unit (container). After a unit has been consumed, the relevant card is passed on as a resupply order.[45]

45 Durchholz, Klenk and Boppert, 2013

In the past, pull systems have been manually operated without any connection to existing systems. Consequently, developments in this area are increasingly focused on system-integrated solutions. The importance of cards used as triggers for resupply orders is decreasing and being replaced by automatic scan or RFID solutions. This is in line with the further development of system-supported logistic systems aimed at increasing process reliability.

The following figure illustrates the difference between conventional and consumption-oriented supply systems.

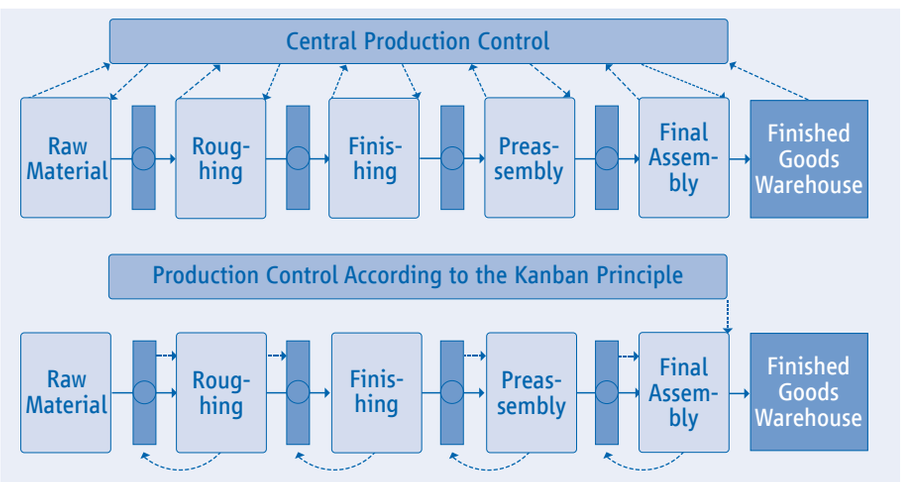


Figure 28: Difference between conventional and consumption-oriented supply systems[46] (Copyright ZVEI)

Process

It is also recommended that a system be used to record downtimes and failures in order prevent or reduce performance losses caused by production process disruptions. Creeping performance losses can therefore be identified early on and counter-measures initiated. Downtime analyses or a *Total Productive Maintenance System* (*TPM*) could, for example, be used in this context.

In the event that a repair becomes necessary, preventive service contracts stipulating short response times should be agreed.

The *Failure Mode and Effects Analysis* (*FMEA*) is an established method of systematically recording and tracking failures. It reviews failure modes that may possibly arise for the object of investigation (product, manufacturing process, process changes, etc.) with regard to the cause and potential risk. The failure modes are then classified according to a risk factor and prevention measures are defined. After the measure has been implemented, a new review is conducted. In the final step, the result is evaluated comparing the evaluations according to their key performance indicators to check if the measures are effective.[47]

Output

In addition to the FMEA analyses/evaluations mentioned in the *Process* section, it is necessary to check products during and after the manufacturing process according to the defined and documented product-specific quality requirements in order to assure their quality. The result of a successful quality test and inspection must be documented in a traceable manner. It is also necessary to define quality loops and action control limits to be able to respond early if the quality deteriorates (e. g. production stop after three consecutive errors of the same type). This also helps prevent the scrapping and renewed production of large production batches due to quality defects.

To ensure that the production department manufactures the correct product variants, does not use unplanned component parts for wrong variants and utilises capacities as planned, it is necessary to transmit the manufacturing programme systematically, early on and without any errors.

46 Heiserich, Helbig and Ullmann, 2011

47 Syska, 2006

KPI systems

For monitoring the performance, it has become evident that the processes and information flows along the supply chain need to be designed in a transparent and measurable manner. Process-oriented key performance indicator systems are usually used for controlling. This involves the definition of action control limits for the individual processes. In the event that the KPIs fall below or exceed these limits, traceable countermeasures are initiated as soon as possible.[48] Many companies use standardised action plans (e. g. *PDCA – Plan Do Check Act*) for this purpose. There are a variety of adaptable system applications available to ensure KPI controlling is as efficient as possible.

2.6.2.5 Deliver

The *Deliver* process creates the direct interface to the customer. Performance errors in this area directly impact the delivery performance or, rather, the level of delivery service to the customer. To ensure a process as error-free and reliable as possible from the acceptance of products from upstream areas (*Make* or *Source*) to the actual hand-over to the customer, it is suggested that a system support for 'delivery date scheduling', 'order picking' and 'shipping be provided'.

A system-supported provisioning process uses backward scheduling, based on the hand-over date to the customer and considers the necessary upstream processes (outsourcing, order picking, provisioning, shipping). This ensures that necessary process cycle times are considered and adhered to. Order picking processes have become increasingly complex over the years due to higher variant diversity. To prevent errors such as wrong labels, incorrect assignment to customers or product mix-ups during order picking or shipping processes, it is recommended that scanner-supported processes be implemented. These ensure that the VDA product label is correct with regard to the original label and to check the assignment of the products to the individual shipments.

To respond early to delays or disruptions that prevent on-time delivery to the customer, alternative shipping routes should be in place, taking into account political, geographical, infrastructure-related or administrative conditions.

Since shipping is a key process in most supply chains, risk-prevention measures should start with minimising the risk in the transportation process and, obviously, selecting the appropriate means of transport. The means of transport to be used should be selected with regard to the goods to be shipped and the topographic conditions, according to shipping quality criteria such as speed, reliability, flexibility and network density, since interruptions may damage the goods and cause time delays.[49]

48 Note: These can be complemented by control cards with statistical control limits.

49 Kersten, Hohrath and Winter, 2008

In view of the on-going market globalisation, companies also often stockpile products to protect their supply chains against disruptions which may impact their delivery performance. There has been an increasing trend from multiple warehousing toward single-stage warehousing over the last few years, meaning that the final stockpiling takes place at the consumer's end (i. e. the customers) in consignment warehouses. Consequently, supply chains are better protected while inventories can be reduced along the entire supply chain.

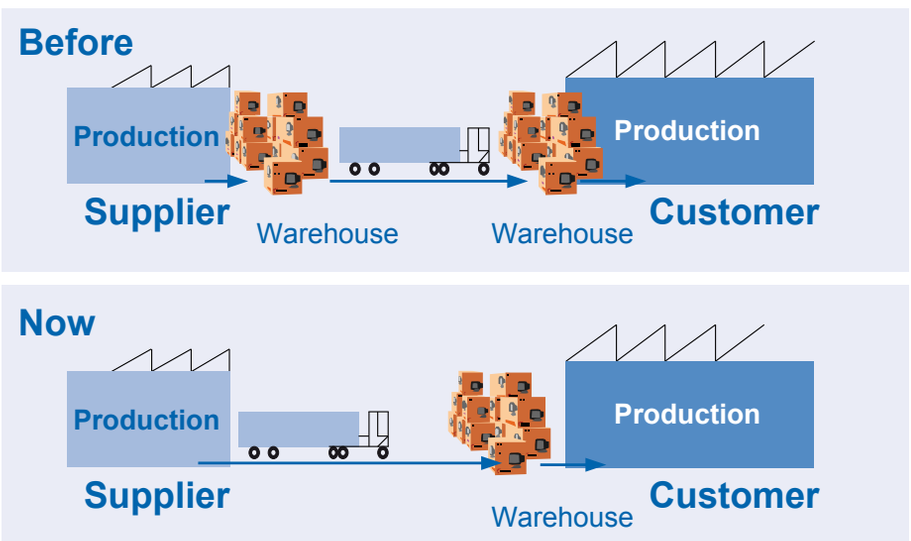


Figure 29: From a multiple-stage to single-stage warehousing strategy (Copyright Leopold Kostal)

2.6.3 Organisation

In addition to the conceptual risk management design regarding risk identification and preventive measures in supply chains, the question of organisational integration and implementation of these approaches in a company needs clarification.[50]

A distinction is made between organisational approaches before a risk occurs, i. e. prevention, and after a risk has occurred, i. e. minimising the impact.

Many companies employ a central risk manager who reports directly to the board of directors/management. Typically, the risk manager works with a risk committee which operates across different divisions.

The risk committee represents a central control, monitoring and steering unit within the risk management organisation. Its main task is to independently analyse risks from an overall company perspective. The committee should be primarily composed of senior executives who deal with risk management issues on a daily basis as part of their line function: managers from the areas of Controlling, Strategy, Treasury, Law, Quality Management, Purchasing or Environmental Safety and IT Security. The management board can also be a member of the committee.

Here is an overview of a committee's possible organisation and tasks:

- small number of members to ensure swift responsiveness,
- members are appointed by the management board,
- members work in teams, no task distribution,
- committee meets regularly,
- analyses major risks from an overall company perspective,
- questions existing remedial actions,
- agrees and coordinates risk management programmes and measures,
- monitors limits and checks whether decisions are observed and whether measures are effective,
- supports the risk manager during the development of the risk management system.

Risk managers are responsible for collecting information on potential risks, conducting standardised evaluations and presenting these to the board of directors/management board.

50 Kersten, Hohrath and Winter, 2008

The assignments of a risk manager (not necessarily a full-time assignment) should include:

- ensuring a suitable risk management system is in place and functioning,
- internal risk reporting and preparation of the risk report for the annual management report,
- coordinating and organising the risk committee as a permanent member,
- supporting the organisation by providing methods and tools,
- devising and further developing the risk management guideline and ensuring it is fulfilled.

Experts of the individual company divisions (risk owners) should provide operational support for risk managers by conducting risk analyses and evaluations for their divisions and addressing the implementation of the risk strategy.

The tasks of risk owners are often defined as follows:

- bearing the responsibility for the implementation of the measures according to the list of measures for their area of responsibility (risk management),
- setting up risk teams to improve coordination,
- assessing risks on a regular basis,
- internal reporting.

It is also recommended that, in the event that a risk occurs, the assignment of authority and responsibility be prepared and that questions clarified in advance as to who may take what decisions at short notice in the event of a crisis.

In the long term, the risk committee should ensure that risk criteria are considered when taking decisions on business strategies, e. g. selection of location, dividing teams between different locations, etc.

Ultimately, risk management is not to be seen as an isolated parallel organisation but as a process integrated into existing management structures with interfaces to other business processes.

What is generally valid for risk management is especially valid for risk management along the supply chain. Here, the extreme risks, such as the risk of natural disasters, which resulted in such devastating events (ash clouds over Iceland, the tsunami in Japan or the floods in Thailand), are not the focus. Supply chain risk management must consider risks, such as those triggered by changing customer demand, risk of new product ramp-up or risk of sudden problems in global manufacturing networks. Identifying the scope and impact of the risk quickly is essential for containing the consequences along the supply chain. Companies often address risks internally by responding quickly with a flexible supply chain network that offers alternatives. If this does not solve the problem, end-to-end collaboration along the supply chain, i. e. from the supplier's supplier to the customer's customer, is decisive in this context.

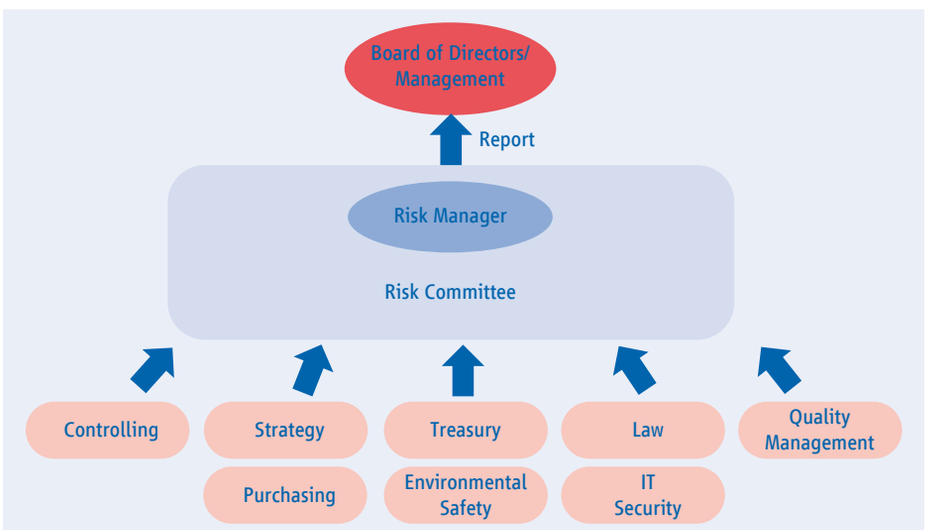


Figure 30: Organisational integration of risk management in the company (Copyright ZVEI)

Communication in risk management

Availability and fast communication are of vital importance in the event of a crisis. The information flow of *internal risk management* should run both ways, i. e. *top-down* and *bottom-up*:

Top-down: The management board should maintain adequate top-down communication to risk owners and employees to ensure they understand clearly which risk policy and strategy they need to focus their efforts on and which projects are planned as part of the set-up, introduction and monitoring of the risk management system.

Bottom-up: Conversely, there is the need for reliable communication of relevant information from the risk owners and/or risk managers 'up to' the management board.

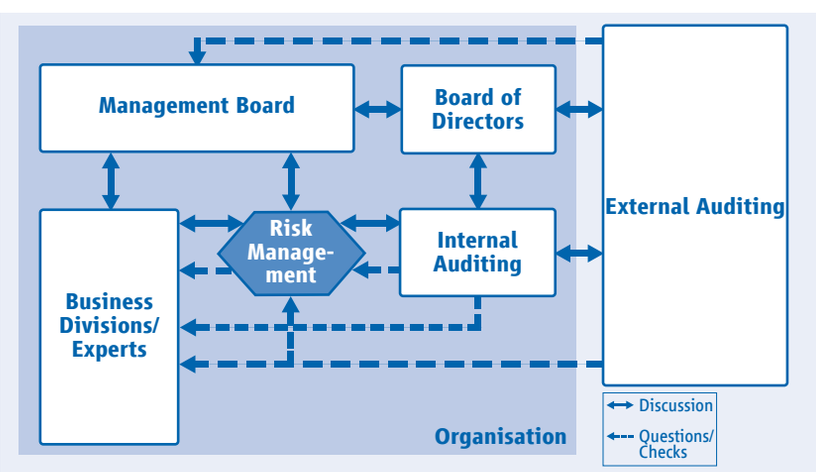


Figure 31: Internal communication within the context of risk management (Copyright ZVEI)

The management board should receive risk-relevant information from the business divisions and/or question their risk assessments. Controlling, legal and other experts from central supporting functions assist by offering their assessments (second opinion). The internal auditing and risk management department should share their risk assessment information to ensure the most efficient evaluation of the organisation.

The management board should evaluate the risk profile of the organisation, approve and monitor risk limits and define key points of the risk management in *formal risk committees*. *Regular risk reports* inform about risks and possible loopholes in the control system.

Small preventive measures such as address lists with emergency phone numbers/emergency telephone lists (who needs to be informed when about what in the event of a crisis) can help control the situation and ensure transparency at all times.

External risk communication includes stakeholders outside a company (customers, suppliers, etc.). It is recommended that suppliers are actively involved in risk management.

2.7 Supply chain checklist/ questionnaire

The following *supply chain checklist* is based on the information provided in the preceding chapters, mapping the risks and protective measures of the different supply chain areas.

The questions help you clarify for each area specifically whether your company's processes are adequately safeguarded against potential risks.

If your answer to one or several questions from the different areas is *partly true* or *not true*, this means that there is an increased/ higher risk for these processes and that the supply chain is not safeguarded. We recommend you initiate measures and, if necessary, adapt structures for the areas/processes that are identified as critical to permanently eliminate the risk factors detected.

The tools listed in the supply chain checklist have been kept as general as possible since the scope of system support can vary depending on the business type and size, for example. However, we recommend implementing the fundamental scheme of the listed instruments in your business.

Area	Question	Rating		
		True	Partly True	Not True
Design	Does your company use inter-disciplinary teams during the product development phase/for development projects?			
	Does your company's product development process consider/evaluate information from supply chain areas (preferred suppliers, preferred parts, technology dependence, geographical uncertainties in the procurement market, single sourcing, technical and qualitative feedback from operative divisions, etc.)?			
	Does your company have design concepts (e. g. Design for X (DFX)) in place that have been aligned to the company strategy and consider complexity-reducing aspects (e. g. platform strategies)?			
Plan	Is information about changing requirements or forecasts passed on promptly, correctly and systematically within your company?			
	Are your company's forecast methods sufficiently accurate to provide a basis for upstream supply chain area planning?			
	Is information on existing capacity problems passed on promptly, correctly and systematically?			
	Is information on existing process disruptions passed on promptly, correctly and systematically?			
	Is information on existing quality problems passed on promptly, correctly and systematically?			
Source	Are there systematic procedures to identify, shortlist and analyse suppliers as part of the supplier selection process?			
	Does the supplier use system-supported processes for automated information processing and transmission (e. g. EDI, WebEDI, ASN, etc.)?			
	Does the supplier have adequate references, and have ratings and/or evaluations from any projects in which the supplier is already involved been considered?			
	Is there a process for systematic supplier evaluation?			
	Does your company conduct supplier controlling/management including defined escalation mechanisms (supplier meetings, action plans/supplier development plans, supplier audits)?			
	Is the supplier management process integrated into quality control loops (to systematically record, track and remedy logistic or qualitative performance failures in terms of third-party goods)?			
Make	Are the information flows within your company supported by systems?			
	Is information, e. g. changing requirements, passed on promptly using system support?			
	Is secure master data management in place to prevent master data errors?			
	Are process disruptions systematically recorded/made transparent, analysed and remedied?			
	Is waste occurring during the production process recorded/made transparent and are systematic remedial actions conducted?			
	Is there a system-based process for capacity monitoring to identify short/medium and long-term shortages or bottlenecks early?			
	Is information about disruptions occurring during the production process passed on promptly and systematic to the party responsible?			
Deliver	Does your company perform system-supported backward scheduling based on the customer's arrival/collection date and considering current process cycle times (outsourcing, order picking, provisioning, transport)?			
	Is there a system-supported process to prevent incorrect labelling or product mix-ups (e. g. VDA labels, correct cargo assignment to transports, etc.)?			
	Has a selection of reliable hauliers to realise transport been defined?			
	Are there alternative routes defined to be used in the event of unforeseen circumstances?			
	Is there a system for measuring delivery performance towards the customer (measurement of delivery and quantity reliability, external delivery service level, etc.)?			
	Are requirements of the downstream source process considered in the delivery process (e. g. comparison of external delivery service level with delivery performance measurement at the customer's end)?			
		Available		
		Yes	No	
Tools*	Forecast system			
	Team meetings, interdisciplinary regularly scheduled meetings			
	Supplier evaluation (operative/strategic)			
	Internal process audits			
	External supplier audits			
	Certification audits			
	Supplier relationship management (SRM)			
	Quality management			
	Systematic acquisition of production and machine data (PDA/MDA)			
	Transparency and control KPIs (system)			
	Material requirements planning (MRP), production planning and control systems (PPC)			
* Degree of system support may vary subject to company type and size				

Table 3: Supply chain checklist (Copyright ZVEI)

2.8 Conclusion to robust supply chains with a high level responsiveness and flexibility

Globalisation offers opportunities to save costs and increase flexibility. Companies that focus on their core expertise and ensure that the relevant processes are safeguarded, along with their supply chains, have an advantage in today's global and ultra-competitive marketplaces. These companies can better manage fluctuating demand and the pressure to reduce costs further at the same time. This chapter described the possibility of reducing the bullwhip effect with a high level of responsiveness and measures to improve forecast accuracy. Specific recommendations for action and metrics to measure the flow factor or SMAPE and MAPE formulas were presented.

To master the higher complexity caused by increasingly global markets and greater variant diversity, a robust supply chain is essential for ensuring continuous supply availability and hence contributes decisively to a company's market success.

A look at the closely connected processes and areas involved in the supply chain clearly suggests that it is not enough to review just one area to achieve a robust end-to-end supply chain.

Instead, it is necessary to install a cross-company risk management system that identifies potential risks along the value chain and minimises these risks with preventive safeguarding measures. The risk management process must be integrated into the company structure in terms of structure and organisation.

A supply chain that is as transparent as possible, controlled by KPI systems with defined action limits, provides the possibility to respond to changes early on. These system can also help take advantage of new opportunities as they arise and aide risk prevention measures.

3 External Framework Conditions

It is very important to look into a number of external framework conditions to be able to maintain a robust supply chain. For instance, excellent knowledge of the laws and regulations is required when dealing with customs and tariffs as well as export control in international freight traffic. Minor instances of carelessness in terms of regulations can quickly result in many days of waiting time until the goods are cleared from customs. Infringements may even lead to high penalties. Under German law, the export compliance manager in any company – the highest-ranking person with responsibility for exports, a member of the management or executive board – is personally liable for violations of export regulations. The officer cannot invoke ignorance or misunderstanding of the relevant regulations.

The subject of *transport* and *services* is also often underestimated, and issues dealing with sustainability are becoming increasingly important for all supply chain parties. The following chapter aims to provide a comprehensive overview of the key aspects of this area and suggests some ideas to identify and exclude related risks for the supply chain early on.

3.1 Export control

The basic principle of the German Foreign Trade and Payments Act (*Außenwirtschaftsgesetz*) says: "The trade in goods, [...] with foreign territories, [...] is, in principle, not restricted." However, the export requirements should always be clarified before shipping the goods, i. e. necessary documents, existing export restrictions and applicable formalities.

The goods to be exported as well as the final destination, final usage and final recipient are to be checked closely according to the following criteria:

- *List-related licence requirements:*
  These requirements are based on the nature of the goods. All goods mentioned in the Export List (Ausfuhrliste, AL) require an export license if, for example, special properties also allow their use for military purposes.
- *Use-related licence requirements:*
  These requirements are based on the intended use of the goods. Military or nuclear applications always require an export licence. (Key word: *dual-use*, i. e. item may be used for civil and military purposes).
- *Person-related licence requirements*:
  These requirements are based on the recipient of the goods.
- *Country-related licence requirements*:
  These requirements prohibit shipments to a specific country.

The Federal Office of Economics and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA*) in Eschborn/Germany is responsible for granting all German export licences.

Figure 32: The economic relations of companies are intertwined worldwide. (Copyright Infineon Technologies)

For more information on export control, e. g. regulations, laws, items lists, embargo regulations, etc. consult the BAFA website.[51] Information on existing prohibitions and licence requirements as well as an overview of the licensing requirements and procedures can also be found on the Internet.[52]

Violating legal procedures and duties of the exporter are considered an administrative offence against the *German Foreign Trade and Payments Act* (*AWG*) and German Foreign Trade and Payments Ordinance (*Außenwirtschaftsverordnung, AWV*) and fined with penalties of up to € 500,000.

Software support

Checking business partners (customers, suppliers, service providers, etc.) with regard to existing sanctions lists (EU anti-terrorism legislation, regulations pertaining to embargoes imposed on individual persons, U.S. blacklists, other national lists) are an integral part of export control.

The great number of listed items and frequent changes makes it impossible to reliably handle this task manually. It is suggested that suitable software is used to check automatically. Software providers like SAP, AEB, CSF, etc. offer good support.

The contents of the sanctions lists are also available on CD-ROM and can be ordered from Bundesanzeiger Verlag (HADDEX sanction lists of the BAFA). The CD-ROM is regularly revised and can be updated online. The data can be used for checking individual addresses, names, companies, etc. and require no interface to any other system (e. g. for companies with only a few, sporadic transactions).

3.2 Customs law

A person who, in the course of his/her business, is involved in activities covered by customs legislation, i. e. import and export transactions, requires an EORI (*Economic Operators Registration and Identification*) number.

The EORI number should be applied for prior to the conduct of import and export transactions. However, this can also be done during the first customs operation.

EORI registration can take several days, though. The EORI number must be used for all electronic customs declarations.

Figure 33: It is important for all parties in a global supply chain to be familiar with the customs regulations of the countries involved. (containers at customs border – Copyright Calado-fotolia)

51 www.bafa.de
52 www.ausfuhrkontrolle.info

3.2.1 Authorisations and simplified procedures

Authorisations and simplified procedures that facilitate customs clearance play a major role in the daily import and export transactions of globally operating companies.

As part of the two-step clearing procedure, goods must normally be presented at the site of the customs office of export (inland customs office) after declaration and to the customs office of exit (EU's external borders) during opening hours. If a company also needs a preference document in the form of an EUR.1 or EUR-MED movement certificate for the same export transaction, these must be applied for individually at the relevant customs authorities usually for shipments whose total value exceeds € 6,000.

Thanks to simplified procedures, companies can design their logistical import and export processes more effectively and above all become more flexible. *Authorised exporters*, for example, are exempt from having to present their goods to the inland customs office. *Approved exporters* are granted by the customs authorities the status of being able to make out an invoice declaration (i. e. statement of origin on invoice) for consignments of € 6,000 and above. This also eliminates the need to go to the customs office.

The main simplified procedures that facilitate customs clearance for companies are:

- authorised exporter,
- approved exporter,
- authorised importer,
- local clearance procedures for imports,
- simplified declaration procedure for imports,
- additional facilitations and relief from customs duties can be claimed when placing goods under inward/outward processing. Inward processing refers to goods that are imported from outside the EU (third country goods) for processing, while outward processing refers to goods exported from the EU to third countries for processing. It must be noted that the origin of the goods may change under certain circumstances.
- Companies may also be able to obtain relief from customs duty by placing imported goods under customs control and entering goods for free circulation for end use.

Customs procedures with economic impact are subject to certain conditions and must be applied for at the main customs office responsible.

3.2.2 Tariff classification

The customs tariff system is a systematic list of goods, also referred to as nomenclature. All goods that may cross the border as part of international shipments are included in this customs tariff schedule, i. e. each good is assigned a specific code number. Classifying the goods in the appropriate customs tariff is essential for smooth and standardised customs clearance. To determine the customs tariff, the goods are assigned a specific number to encode the description of the goods. For imported goods the code can have up to 11 digits, for exported goods up to 8 digits. In addition to the classification of the tariff rates, cross-border movement of goods also entails other legal obligations as to whether:

- bans and restrictions need to be observed,
- import or export licences are required,
- separate statistical information pertaining to international trade is required,
- additional documents must be provided to enable further customs clearance,
- specific measures must be notified,
- anti-dumping regulations apply to the goods or,
- quotas can be used or a suspension of duties is possible.

The *Harmonised System* (*HS*) provides the basis of the 11-digit code number. It is maintained by the *World Customs Organisation* (*WCO*) and determines the first six digits of the code number. The purpose of the HS is to name and code commodity groups to achieve uniform classification of goods worldwide.

Binding Tariff Information (*BTI*) issued by the customs authorities of the EU Member States provides legal certainty with regard to the classification of goods into the Common Cus-

toms Tariff of the EU. The BTI is currently only binding on the EU Member States customs authorities towards the holder of the information. A BTI is valid for six years, however, only in respect of the classification of the goods. It usually takes several months for a BTI to be issued.

Figure 34: Commodity Classification for Foreign Trade Statistics published by the German Federal Statistical Office. (Copyright Statistisches Bundesamt)

3.2.3 Origin of goods

A distinction is made between *non-preferential* and *preferential origin of goods*.

3.2.3.1 Non-preferential origin of goods

Many of the regulations governing the international trade of goods pertain to non-preferential origins and are primarily intended to safeguard the economic interests of the European Community or their trade partners.

The non-preferential origin of goods provides the basis for several legal measures. The origin is not necessarily derived from the place of shipping, but confers an 'economic' nationality on goods, The *Community Customs Code* (*CC*), Articles 22 to 26, lays down the scope and provisions to determine and document the origin of goods for the European Union Member States.

Non-preferential origin is used to determine:

- the application of the Customs Tariff of the European Union, especially when it comes to imposing anti-dumping tariffs; however, it must not be used for the reduction in or suspension of duties according to the relevant preferential legislation,
- the application of measures other than tariff measures, established by the Community provisions governing specific fields relating to trade in goods, especially foreign trade licensing requirements,
- provisions pertaining to exports in the country of destination.

A Certificate of Origin usually serves as proof of origin and must be issued by an authorised body of the exporting country. In Germany, non-preferential certificates of origin are always issued by the Chambers of Industry and Commerce, Chambers of Trade and Chambers of Agriculture.

Goods whose production involved more than one country have their origin in the country, where they underwent their last, substantial, economically justified processing or transformation, and resulting in the manufacture of a new product.

3.2.3.2 Preferential origin of goods

Preference rules may qualify goods imported into the Community or exported to the respective countries of destination for a customs reduction or suspension if documentary proof of the preferential origin (originating status) or of the customs status of the goods (free circulation status) is provided. The individual rules differentiate between:

- *standard preference documents* issued by a customs office or competent authority. These include the movement certificates EUR.1, EUR-MED and A.TR as well a GSP Form A,
- *simplified preference documents* issued independently by any exporter up to a certain value of exported goods or by an Approved Exporter upon authorisation for simplified procedures.

3.2.4 Authorised economic operator (AEO)

(Copyright European Union)

Companies within the European Union involved in customs clearance processes have been able to apply for *Authorised Economic Operator* (*AEO*) status since January, 1st 2008. Since Authorised Economic Operators are considered to be particularly reliable and trustworthy they are entitled to benefit from facilitations of customs controls relating to security and safety as well as simplifications of the customs rules.

The status is granted by the customs authorities in all Member States. Three types of certificates can be applied for within the EU:

- Customs Simplifications AEO certificate (AEOC),
- Security and Safety AEO certificate (AEOS),
- Combined Customs Simplifications/Security and Safety AEO certificate (AEOF).

Holders of an AEOS or AEOF certificate are entitled to reduced data sets for entry and exit summary declarations (also called prior notifications), and in addition there should be fewer controls of goods and documentation. Moreover, consignments are treated with priority if selected for further control as a result of a risk analysis conducted by the customs authorities.

The purpose of the introduction of the AEO status was to secure international end-to-end supply chains from the manufacturer of a good to the end consumer. International recognition of the AEO status is therefore a prerequisite. To this end, agreements have been signed with Switzerland, Norway, Japan and the United States.

Applying for AEO status is not mandatory for companies involved in international business. All previously granted customs facilitations remain valid. AEO status is no prerequisite for being admitted to new customs simplifications and receiving permission for special customs procedures with economic impact, but it makes it much easier to obtain customs simplifications for the entry and exit of goods. Moreover, companies may also benefit indirectly, e. g. process optimisations, improved control mechanisms and thus less theft or unexplained loss of goods.

In addition, many customers require their supplier to be AEO certified, especially in the United States, which has signed an agreement with the European Union to mutually recognise the *C-TPAT* (*Customs-Trade Partnership Against Terrorism*) and AEO programmes. After all, the status of an Authorised Economic Operator is considered an international seal of quality that also provides competitive benefits.

3.2.5 ATLAS

ATLAS stands for *automated tariff and local customs clearance system* and is used in Germany to submit electronic export (from the EU to a third country) or import declarations.

The aim is to facilitate the processing of imports and exports for customs authorities and declarants. It significantly speeds up customs clearance since it is usually not necessary to present documents such as invoices or preference documents at the time of the clearance and it also eliminates the need to go to the customs office. Thanks to the greater transparency this provides, efficiency of the risk management system also increases.

To participate in ATLAS, which is mandatory in Germany, economic operators require an EORI number, software certified for the intended use and a *BIN number* (*Beteiligten-Identifikations-Nummer*), which is a participant identification code and replaces the handwritten signature in the electronic data exchange with customs authorities.

ATLAS is used to file electronic declarations for goods imported into Germany before they are released for free circulation or forwarded to inward processing, processing under customs control procedures or handling under customs warehousing procedures.

The transit procedure with ATLAS (also *NCTS – New Computerised Transit Systems for Europe*) allows for the temporary suspension of duties, taxes and commercial policy measures that are applicable at import. It allows the transport of goods that have not been cleared by customs within the EU since the customs clearance formalities take place at the destination rather than at the point of entry into the customs territory. In the European Union, the T1 procedure applies to the movement of non-Community goods.

Using the ATLAS system, it is much easier for authorised exporters to place goods under the export procedure since they are not required to present the goods to the customs office of exit and, if applicable, submit an export declaration which might not contain all the information.

As of January, 1st 2011, economic operators are obliged to lodge entry and exit summary declarations in electronic form using ATLAS-EAS. The information provided in these declarations enables authorities to conduct IT-supported risk analyses before the goods enter or exit the Community's customs territory. This is based on the rules and regulations established by the European Commission since April, 1st 2004.

As mentioned beforehand, specific hardware and software is necessary to participate in ATLAS, whereby different access options are offered by certified software providers. The person involved in the electronic data exchange with customs authorities must not necessarily have the required software himself, but can also go through a third party. The third party transmits the data, but does not become the person's appointed customs representative. Although the service/processing of the customs declaration is transferred to a third party, the responsibility always lies with the importer or exporter.

The decision to use an in-house solution or a service provider should be based on the number of export and import transactions. In addition, other aspects such as range of products, trade partners, customs/export control knowledge or the company's IT structure should also be considered.

Thanks to its 24-hour availability and defined processes, ATLAS has become a major factor in optimising supply chains to be able to meet legal requirements, secure high process reliability and speed up international commodity flows.[53]

53 For more information, visit the website of the German Customs Office www.zoll.de.

3.2.6 Movement of goods during business travel

Carrying goods such as tools, devices, spare parts, samples for demonstration purposes in one's personal luggage may cause customs and tax problems for employees and companies when leaving and entering the country (suspected tax and customs fraud).

The delivery note/pro forma invoice must be presented to the customs office at the airport before leaving the country to have the identity (comparison of the information on the delivery note/pro forma invoice and on the goods) confirmed by customs.

Figure 35: Carrying goods when travelling on business requires careful preparation. (Copyright Infineon Technologies)

Employees who carry goods in their personal luggage when on business trips must be able to provide evidence that these goods are professional equipment and company property. This can be sufficiently documented by a delivery note or pro forma invoice with the following information:

- name of the traveller,
- destination,
- length of stay,
- quantity and type of good(s) transported,
- name, inventory, series and machine number,
- value of good(s),
- HS code number,
- country of origin (non-preferential origin).

When returning to Germany and if requested by the customs office, employees can prove that the goods had already been in their possession on exit and hence not purchased abroad.

3.3 Statistics (intrastat/extrastat)

Intrastat reporting is used to statistically record the actual movement of Commodity goods between the 28 Member States of the European Union. The statistics created from the Intrastat reports help provide current data on intra-Community trade.

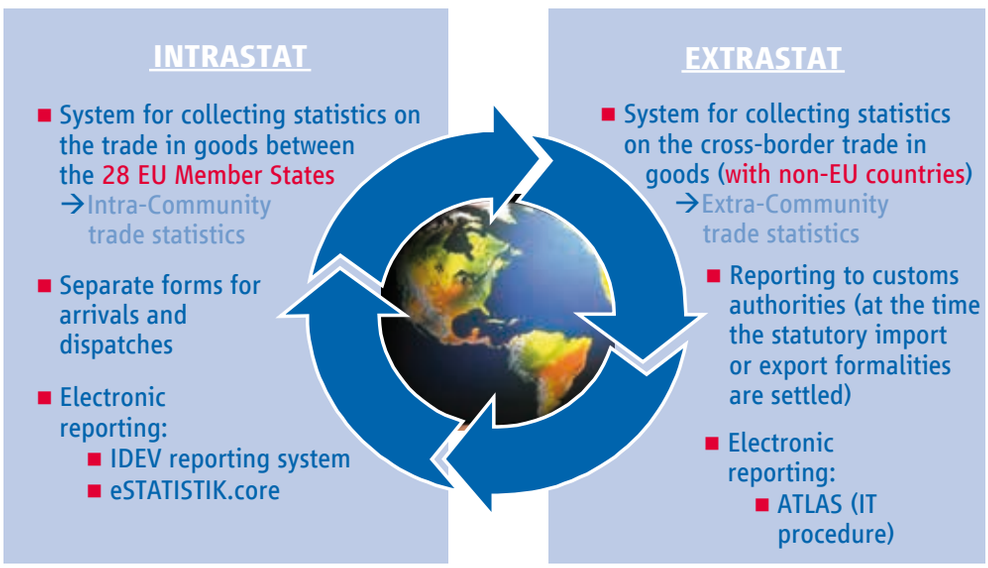


Figure 36: When collecting information on goods for statistical purposes, differentiation must be made between intra-Community trade statistics and international extra-EU trade statistics. (Copyright Infineon Technologies)

When shipping goods, the party responsible for providing information is usually the person dispatching or providing for the dispatch of an intra-Community consignment under the value added tax regulations. When receiving goods, the party responsible for providing information is usually the person taking delivery of the intra-Community consignment under the value added tax regulations. Arrivals and dispatches must be declared separately. The party responsible for providing Intrastat information may transfer the task to a third party, who must be based in the EU. In Germany, VAT-registered businesses whose scope of dispatches to other EU Member States or scope of arrivals from those countries did not exceed the specified threshold of € 500,000 each in the previous year are exempted from reporting. Operators need only provide information for the direction of trade – either arrivals or dispatches – exceeding the threshold. If the amount is exceeded in the current calendar year, the obligation to provide information will begin with the month the threshold is exceeded. Declarations can only be submitted in electronic form. This can be done via *IDEV* (*Internet data collection system*) or the *eSTATISTIK.core* procedure.[54]

54 More information is provided in the 'Intra-Community Trade Statistics General Guide' that can be downloaded from the website of the German Federal Statistical Office (Statistisches Bundesamt) (www.destatis.de) bereit.

The extra-EU trade statistics covers the trade of goods between Germany and third countries (outside the European Union). The customs authorities are generally responsible for collecting the extra-EU trade data as part of the statutory import and export regulations. The ATLAS electronic system (see chapter 3.2.5) is mostly used as a source of information since it contains all data on imports and exports.

3.4 Taxes

This chapter explains some of the major tax-relevant terms such as the *recapitulative statement*, certificate of entry, chain transactions and consignment warehouses.

3.4.1 Recapitulative statements

Recapitulative statements, also known as European Community Sales List or ECSL, are a core piece of the VAT control procedure within the European Union. The control procedure is based on the exchange of specific data within the European Union. In Germany, this data is stored by the *Federal Central Tax Office* (*Bundeszentralamt für Statistik, BZSt*). The data collection is based on the VAT registration number, which is issued in Germany by the Federal Central Tax Office. Holders of a VAT registration number can ship goods at zero rates to other EU Member States if the recipient also has a valid VAT registration number and if the purchased item is subject to the provisions pertaining to value added taxation

in the other EU Member State. In Germany, companies can contact the Federal Central Tax Office to confirm the validity of their international customers' VAT registration number. Conversely, international companies may ask their competent central authority to check the validity of the German VAT registration number.

The obligation to complete a recapitulative statement applies to any entrepreneur engaged in zero-rated intra-Community supplies of goods/services within the reporting period (usually one calendar month) and/or intra-Community triangular transactions or providing (since January, 1st 2010) other cross-border services to companies, on which the final customer based in the other EU Member State has to pay VAT (*reverse charge* procedure regulated in Germany in the 'Turnover Tax Act' Section 13).

Small undertakings are exempt from this obligation under the rules of Section 19/1 German Turnover Tax Act (according to Section 19/1, second sentence, the total of sales made in the previous year did not exceed € 17,500 and will presumably not exceed € 50,000 in the current year).

Recapitulative statements must not be confused with the Intrastat reporting, which must be submitted to the German Federal Statistical Office in Wiesbaden (see chapter 3.3).[55]

3.4.2 Certificate of entry

All zero-rated intra-Community deliveries must be confirmed by the recipient, assuring that the shipment has reached its final destination. In addition to a duplicate of the invoice, the certificate of entry (*Gelangensbestätigung*) can be used for evidence, containing the following information:

- name and address of recipient,
- quantity and standard commercial name of the object of supply, including the vehicle identification number if the delivered object is a vehicle,
- place and month (not day) the transportation of the object of supply ended, i. e. it was received in the Member State. This also applies if customers collect and ship the goods themselves. The collection as well as the arrival at the place of documentation must be documented.
- Date of issuance,
- signature of the recipient or a third party authorised to accept the object of supply.

No signature is required for the electronic transmission of the certificate of entry, provided that the electronic transmission recognisably begins in the customer's or representative's sphere, which can be verified, for example, via the used e-mail account of the recipient.

The certificate of entry may consist of several documents. It is also possible to submit a summary declaration for the supplies within a quarter, stating the relevant months when the transports ended. In chain transactions, the recipient and final customer can both send the confirmation.[56]

55 More information about what has to be reported when and the consequences that will occur if a recapitulative statement is sent in late or not at all, is provided by the Hamburg Chamber of Commerce and Industry (www.hk24.de) or the Federal Central Tax Office in Bonn (www.bzst.de).

56 For more information on this subject, please visit the websites of the German Federal Ministry of Finance (www.bundesfinanzministerium.de) or Hamburg Chamber of Commerce and Industry (www.hk24.de).

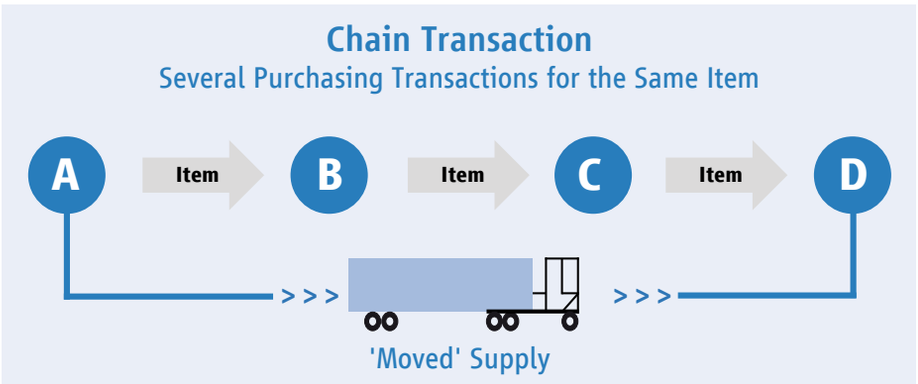


Figure 37: Several purchasing transactions for the same item (chain transactions) (Copyright ZVEI)

3.4.3 Special case: chain transactions

In *chain transactions*, several companies conclude purchasing contracts for the same item and this item is directly shipped from the first company to the last company along the chain.

A chain transaction consists of one 'moved' supply and one (or several) 'unmoved' supplies, but with only one physical movement of goods. This movement is referred to as 'moved' supply. VAT exemption for intra-Community or export supplies can only be applied to the 'moved' supply (for export supply see Section 6 German Turnover Tax Act, intra-Community supply Section 6a German Turnover Tax Act). The 'moved' supply is defined by which party arranges for the transportation, i. e. performs the transport and commissions the freight forwarder. This also determines who may be required to provide Intrastat information.

All other supplies along the chain involve no actual physical movement. Consequently, invoices must be made out stating the foreign tax which may then require entrepreneurs to register for VAT in the relevant country and submit a tax return.

3.4.3.1 Intra-Community triangular transactions

Intra-Community triangular transactions are a special case of intra-Community chain transactions. It is a simplification measure enabling the intermediate supplier to avoid an obligation to register for VAT in the country of arrival. It is a general requirement that the object of supply is actually moved from one Member State to the other Member State and arrives there. Moreover, the following three conditions must be met:

- three companies must be involved in a classic triangulation situation,
- the parties involved use VAT registration numbers from three Member States,
- it must be possible to allocate the shipment to the first supply along the chain. Simplification is possible if the first party is responsible for the transport. Conversely, no simplification is possible if the last party collects the goods.

  Example: The German company D buys goods in Belgium and sells them to an Italian company. The goods are transported directly from Belgium to Italy. Intrastat returns must be made in Belgium (dispatch) and Italy (arrival), i. e. in the EU Member States where the physical movement took place.

3.4.3.2 Indirect exports

Indirect exports refer to the direct shipment of goods to a third country (non-EU), while the recipient of the invoice is based in the European Union. In terms of customs, this is considered a zero-rated supply since the goods are physically moved to a third country, however, the EU-based recipient of the invoice must be the exporter of records.

There are two different scenarios:

- the recipient of the invoice (exporter of records) is based in Germany.

  In this case, the party sending the goods must submit an *incomplete export declaration* in direct representation of the recipient of the invoice, which must then be replaced by a supplementary declaration fully completed by the recipient of the invoice and submitted to the relevant customs office of exit. The supplementary declaration must state the recipient of the invoice as exporter. If an export licence is required, the export licence of the recipient of the invoice is to be used.

- The recipient of the invoice (exporter of records) is based in another EU Member State.

  In this case, the sender must create a fully completed export declaration, stating the

invoice recipient as exporter and also mentioning the direct power of representation. If an export licence is required, the export licence of the recipient of the invoice is to be used.

It is important that triangular transactions or indirect exports are identified as such to prevent the application of standard procedures. Since a routine approach to these cases can often result in errors, it is always recommended that customs or tax experts are consulted in case of doubt.

3.4.4 Special case: consignment warehouse

A *consignment warehouse* refers to a warehouse, usually set up in close proximity to the customer. The specific nature of this is that the supplier remains the owner of the goods until the customer removes them from the warehouse. Since the material is not invoiced until removal from the warehouse, less capital is tied up.

If the supplier and consignment warehouse are located in different countries of the EU, it must be checked which procedures or rules apply, because some simplification measures exist only in some countries.

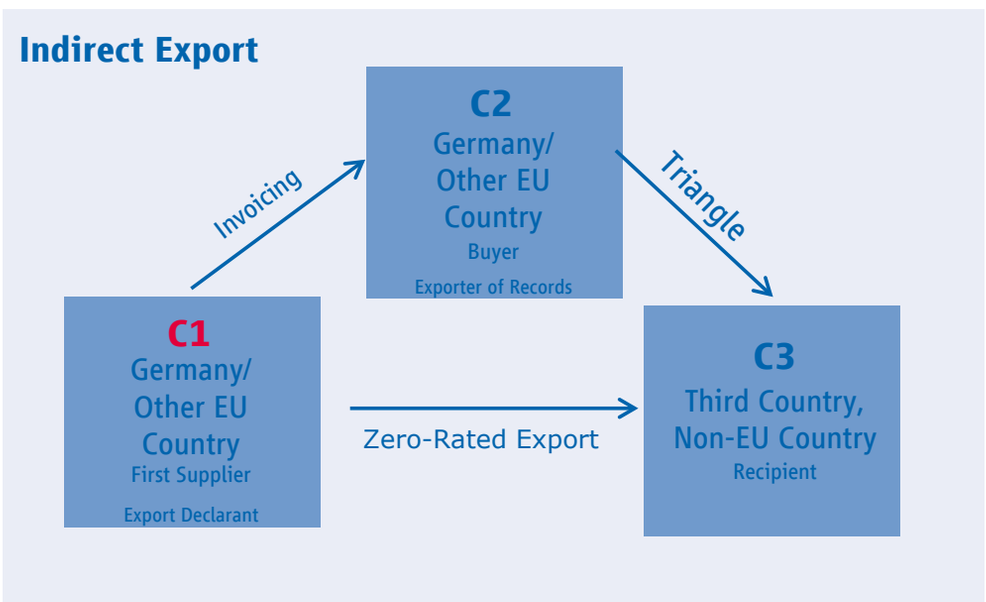


Figure 38: Indirect exports (C = Company) (Copyright Infineon Technologies)

In this case it is assumed that a zero-rated intra-Community supply is performed at the time the goods are removed from the warehouse.

If there is no simplification measure in place, the supplier is required to register for VAT in the country, where the consignment stock is located, and submit the relevant declarations. This may also include Intrastat reporting subject to the sales volume and tactical thresholds.

If the consignment warehouse of a supplier is filled from a third country with an Incoterm® (see chapter 3.5.1) other than DDP, and if the supplier is not VAT-registered in the EU, the customs warehousing procedure must be applied when importing the stock. The physical removal of the stock marks the point of time the goods are cleared into free circulation.

3.5 Traffic/transport/services

This chapter examines the aspects Incoterms®, Known Consignor, cargo safety/lorries and transport of dangerous goods as well as documentation guides for international shipments.

3.5.1 Incoterms®

The International Commercial Terms or *Incoterms®* were published first in 1936 by the *International Chamber of Commerce* (*ICC*) and have been periodically updated since. They are used between buyers and sellers and include rules on the place and time of delivery as well as means and ways of transport. They do not address the transfer of ownership, warranty issues, payment processes and the like. Incoterms® are only legally binding if the relevant rule regarding the place of delivery and relevant version is part of the contract.

These rules apply to national and international contracts and thus also facilitate customs clearance.

The main purpose is to set out the responsibilities of all contract partners as well as the transfer of costs and risks for a defined route.

They also govern the duties to provide information and who is to check the packaging of the goods and the contents of the shipment, who is responsible for insuring the goods and who provides the goods and transport documents or has to pay for customs duties if these should arise. They also determine who has to bear the costs incurred by these activities.

On January, 1st 2011, the seventh revision of the Incoterms® came into force, classifying the 11 rules according to the mode of transport. While the rules *EXW*, *FCA*, *CPT*, *CIP*, *DAT*, *DAP* and DDP apply to all modes of transport, *FAS*, *FPB*, *CFR* and *CIF* may only be used in connection with sea or inland waterway transport. Although old Incoterms rules are still valid, it is advisable to start using the new terms.

Figure 39: Shipping goods requires compliance with the specifics and regulations regarding the different ways and means of transport. (types of transport – Copyright 3ddock-fotolia)

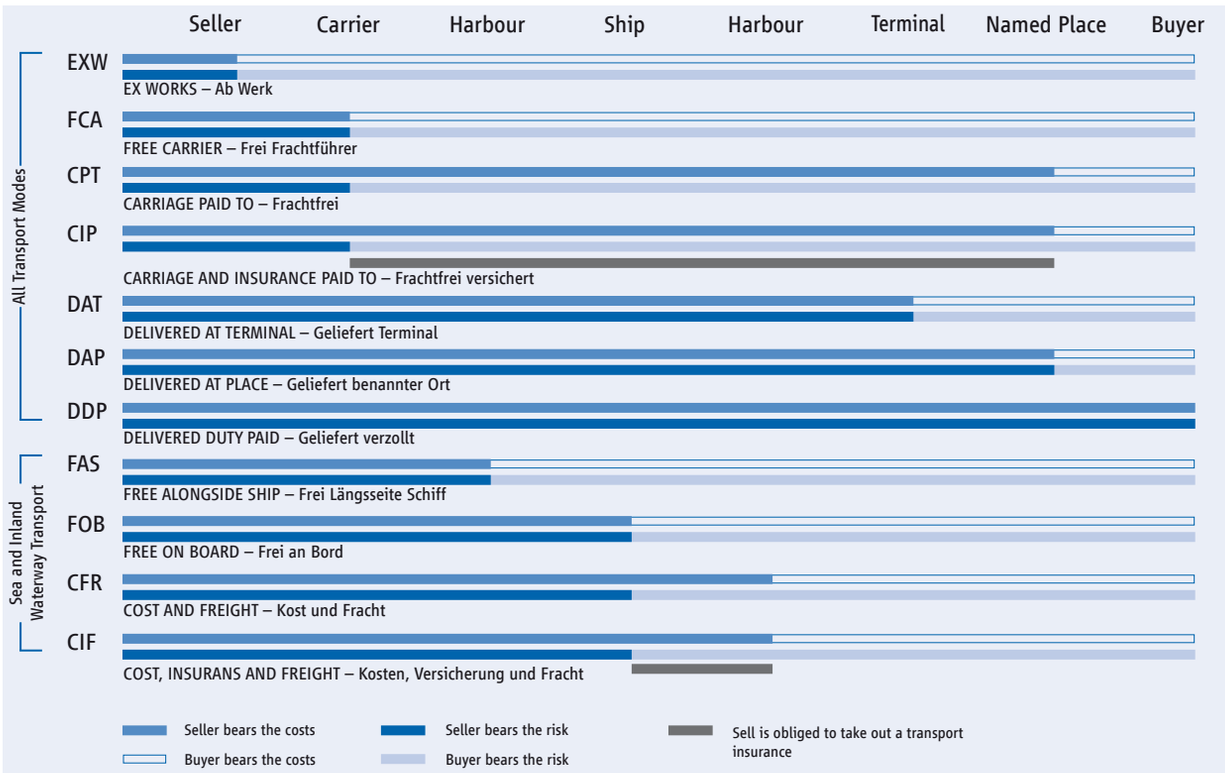


Figure 40: Overview of Incoterms® rules by mode of transport (Copyright ZVEI)

The sequence illustrated in figure 40 reflects the increasing responsibility of the seller. The following provides tips from practical experience on some sample Incoterms®.

Ex-works (*EXW*) means the buyer bears the full costs and risk involved in the transport. However, problems may arise during loading if the carrier is not adequately equipped to load the shipment. In this case, if the seller arranges for the loading of the goods, the seller is not insured in the event of any damage. Since *EXW* also means that the seller is not responsible for any customs and clearance formalities, this rule only makes sense in the trade of goods at national level.

Conversely, *FCA* clearly stipulates that the seller is responsible for loading the goods cleared for export and that the transport costs and risk are transferred to the buyer after loading.

The *C-rules* (*CPT*, *CIP*, *CRF* and *CIF*) are characterised by the fact that the passing of risk and passing of the costs takes place at two different points of time (two-point clause).

Also *DAT* and *DAP* clauses stipulate that the buyer is responsible for all import formalities. *DDP* means that the seller is responsible for the transport, bearing all costs right to the destination point where the buyer is responsible for unloading the shipment.[57]

3.5.2 Known consignor

According to EU-wide safety regulations that came into effect in April 2013, air cargo shipments of a company are provided with a 'safe' status only if the exporting or shipping company holds the status of officially approved *Known Consignor*. In Germany, the Federal Aviation Office (*Luftfahrt-Bundesamt, LBA*) is responsible for conducting the validation and approval. Without Known Consignor status, the carriage must be comprehensively checked by a *Regulated Agent* authorised for this purpose or by the aviation company in question. This may result in higher costs and delays. Known Consignors are approved by the appropriate authority of the Member State in which the site is located, e. g. the Federal Aviation Office for Germany. The company must

57 For more information, go to www.iccwbo.org.

appoint a person responsible for air cargo safety and a relevant security programme. Once all relevant staff have been trained and all necessary measures in terms of the physical safety (processes, staff, buildings/access) been implemented, approval is granted after passing a final reliability check.

The advantages that arise from an accreditation include simplified shipping procedures and hence shorter lead times, greater secrecy of product-related information and lower costs for security services (no x-ray scanning of shipments) as well as lower packaging risks during manual inspections. An accreditation is always required if the cargo should not be x-rayed or scanned, e. g. large units or special packaging (e. g. ESD protection). The Known Consignor status can also give a competitive edge. For instance, this is always required by customers in the automotive industry.

The goods of a Known Consignor can be shipped by a *Regulated Agent* (accredited haulier) or a non-accredited haulier to the airport. In the latter case, the *haulier* must provide the Known Consignor with a signed haulier declaration, confirming compliance with the requirements pertaining to people (training courses, training history, etc.) carrying out the transport and the transport process to ensure the safety and security of civil aviation. The people carrying out the transport must present appropriate identification when picking up the goods or delivering them to the airport.

In Germany, a template of the haulier declaration can be downloaded from the website of the Federal Aviation Office.[58]

58 www.lba.de (website of the German Federal Aviation Office)

3.5.3 Cargo securing/lorry

On July, 1st 1998, the *German Transport Law Reform Act* (*Transportrechtsreformgesetz, TRG*) introduced a new freight law to the German Commercial Code (*Handelsgesetzbuch, HGB*) and cancelled the former provisions pertaining to the waybills stipulated in the German Motor Traffic Ordinance (*KVO*) and German General Terms and Conditions for Short Distance Hauling (*AGNB*).

According to Section 412 of the German Commercial Code, the sender is responsible for loading the goods in a manner that is safe for operation, irrespective of the type of good and haul distance. The law follows closely the provisions of the Convention on the *Contract for International Carriage of Goods by Road* (*CMR*).

Figure 41: Cargo safety is particularly essential when it comes to shipping sensitive electronic components.
(Lorry – cargo ratchet strap – Copyright Jürgen Fälchle-fotolia)

Loading goods safe for transport includes the stacking, stowing, lashing, blocking, stacking and securing of the cargo with suitable aids to ensure that neither the goods nor the vehicle is damaged under normal transport circumstances as specified in the contract.

Experience shows that cargo is often insufficiently or incorrectly secured. Proper securing significantly increases road-traffic safety since inadequate securing measures could cause injury to persons in addition to damage to the cargo. Under German law, the shipper, haulier and driver as well as the vehicle owner are all responsible for securing the cargo. If a routine traffic control finds

that a vehicle's cargo is not properly secured, the driver of the vehicle may be ordered to stop the vehicle and secure the cargo before proceeding, and be charged with a road traffic offence including a fine and penalty points. In the event of a traffic accident due to improperly secured cargo causing material damage, the driver will be charged with a road traffic offence including a fine and penalty points, and in the event of personal injury, criminal charges will be pressed involving a fine or even imprisonment.[59]

3.5.4 Transport of dangerous goods

(Copyright ZVEI)

Dangerous goods are substances, preparations (mixtures, solutions) and objects containing substances the transport of which may pose a risk to public safety or order, in particular to the general public, important public property or jeopardise the life and health of people, animals and other objects due to their nature, physical or chemical properties or state. Within the meaning of the German Transport/ Cargo Law, dangerous goods are also those materials that are harmless by themselves but must be classified as dangerous during transport.

Numerous regulations and conventions govern the transport of dangerous goods by road, rail, water or sea, e. g. in terms of packaging, secure loading, marking and shipping. In addition to the safe handling of dangerous goods transports, the purpose of these regulations is to provide quick and fast information for emergency teams to identify an incident as a dangerous goods accident and hence take appropriate measures.

All parties involved in the transport of dangerous goods must provide evidence of the relevant knowledge of dangerous goods regulations. To obtain this knowledge, they must regularly attend training courses. Companies involved in the transport of dangerous goods are usually required to appoint a person responsible for dangerous goods.

Drivers of all vehicles carrying dangerous goods must have an ADR training certificate. They also need to carry personal protective clothing (PPE), spillage and fire-fighting equipment as well as aids to secure the accident site as stipulated in the instructions in writing (and subject to the relevant dangerous good). In addition, the consignment items must be appropriately marked and labelled and be accompanied by certain paperwork, e. g. the transport document. The transport document must state the name and address of the consignor and consignee.[60]

3.5.5 Consular and model rules

The *consular and model rules* (German *Konsulats- und Mustervorschriften, K&M*) are a German reference work for export business. It provides information on shipping documents and regulations that are required and must be observed for the international trade of goods. In addition, it details packaging, labelling and origin marking requirements, contains information on harbours and customs airports as well as on legalisation provisions and consular fees, provides contact data of Germany's diplomatic missions, consular posts and trade representations abroad as well as German Chambers of Commerce (*Außenhandelskammern, AHK*). This set of rules also includes basic knowledge on the trade of goods with third countries.

59 For more information, go to the website of the German Federal Institute for Materials Research and Testing www.tes.bam.de or refer to the information on load securing provided under www.tis-gdv.de.

60 For more information go to http://en.wikipedia.org/wiki/Dangerous_goods or refer to the website of the German Federal Ministry of Transport and Digital Infrastructure. (www.bmvbs.de).

It has been published by the German Chamber of Commerce in Hamburg since 1920. The team of authors consists of staff of the Hamburg Chamber of Commerce with practical export consulting experience. The reference work has since been revised every two years and as of its 40th edition, it is released by the Mendel Verlag (publisher) in Witten/Germany.[61]

3.6 Compliance/ethics/environmental protection

Social responsibility as well as directives and regulations of the European Union are important topics in the area of compliance/ethics/environmental protection.

3.6.1 Social responsibility

Social responsibility and environmental management are two terms that have become established as key elements in supply chains over the last few years. The world has realised that economic success based on the exploitation of the environment and people is no longer acceptable. The term *sustainability* has been considered for several years as an approach towards a future-oriented and long-term development of mankind. Future-oriented management means: We have to leave our children and grandchildren an intact ecological, social and economic system. The one cannot be achieved without the other.

Operating a business successfully in today's global economy increasingly requires companies to provide proof that sustainability is an integral part of their companies' principles. After having arranged for the in-company implementation of a *Code of Conduct* (*CoC*), big companies have been increasingly facing the challenge over the last few years to ensure the sustainability rules and requirements are also implemented and complied with along the entire supply chain.

3.6.1.1 ZVEI Code of Conduct

ZVEI and its member companies affirm their Corporate Social Responsibility as a part of their global business activities (internationally known as 'CSR'). By signing this self-imposed obligation, companies signal the market that they follow recognised industry guidelines. This Code of Conduct includes statements on working conditions, social and environmental compatibility, transparency, collaboration and dialogue that are marked by trust. It also includes key reference points such as the United Nation's Universal Declaration of Human Rights (UN Resolution 217 a (III)) of 1948, the United Nations Convention against Corruption of 2003 and several other ILO Conventions (e. g. ILO No. 138 of 1973 and No. 182 of 1999 relating to child labour).

3.6.1.2 United Nations Global Compact

The *UN Global Compact* is a strategic policy initiative for businesses that are committed to aligning their operations and strategies with ten universally accepted principles in the areas of 'human rights', 'labour', 'environment' and 'anti-corruption'. By doing so, business, as a primary driver of globalisation, can help ensure that markets, commerce, technology and finance advance in ways that benefit economies and societies everywhere.

This ever-increasing understanding is reflected in the Global Compact's rapid growth. With over 12,000 corporate participants and other stakeholders from over 145 countries, it is the largest voluntary corporate responsibility initiative in the world.

61 Mendel Verlag (www.mendel-verlag.de)

3.6.1.3 Conflict minerals

The subject of *conflict minerals* is a recent example of the increasing pressure exercised by politics and economy, which ultimately ensures that social responsibility finds its way into legislation.

'Conflict minerals' include the raw materials columbite-tantalite, also known as coltan, tin (casserite), wolframite (tungsten) and gold. Many of the sites where these ores are mined are located in the Democratic Republic of Congo and its nine adjoining countries (Angola, Burundi, Central African Republic, the Republic of the Congo, Rwanda, South Sudan, Tanzania, Uganda and Zambia). These mines are often controlled by different armed rebel groups that finance their fighting with the export of these ores. On July, 21st 2010, President Barack Obama signed the Dodd-Frank Wall Street Reform and Consumer Protection Act, Section 1502. It forces companies listed on the New York Stock Exchange to disclose their consumption of conflict minerals.

To this end, the electronics industry started major queries along its entire supply chain in 2012 and 2013 to trace their value chains back to the mines. Many customers request the use of an 'EICC Conflict Minerals Reporting Template', which has become a widely accepted global standard. The EICC report documents, among other things, the smelters identified along the supply chain. One of the objectives is to audit and certify as many smelters as possible as 'conflict-free' and thus ensure that smelters no longer use conflict minerals.

3.6.2 Directives and regulations of the European Union

More detailed information on the *RoHS Directive*, the *ELV Directive* and *REACH regulation of the European Union* is given below.

3.6.2.1 RoHS directive

The *Restriction of Hazardous Substances Directive* (*RoHS*) originated in the European Union and took effect in 2006. It restricts the use of certain hazardous substances in new electrical and electronic equipment put on the market. It was revised in 2011 (RoHS 2 Directive 2011/65/EU) and had to be implemented at national level by January 2013. In Germany, for example, the rules of the Directive were transposed to a new ordinance 'ElektroStoffVerordnung', which came into force on May, 9th 2013.

It restricts the use of the following substances to a maximum concentration value in homogeneous materials:

Lead	0.1% by weight in homogeneous materials
Cadmium	0.01% by weight in homogeneous materials
Hexavalent Chromium	0.1% by weight in homogeneous materials
Polybrominated Biphenyls (PBB)	0.1% by weight in homogeneous materials
Polybrominated Diphenyl Ethers (PBDE)	0.1% by weight in homogeneous materials
Mercury	0.1% by weight in homogeneous materials

Table 4: Maximum concentration levels of homogeneous material according to the German ‚ElektroStoffVerordnung' (Copyright ZVEI)

These requirements apply to new products placed on the market. However, final manufacturers also expect their component suppliers to deliver RoHS-compliant component parts. RoHS compliance must therefore be ensured along the entire supply chain.

There are numerous exemptions relating to substance restrictions, transfer periods, marking requirements (CE marking) and conformity assessments. More information is provided in the brochure 'ElektroStoffVerordnung – Handlungshilfe für Industrie und Handel zur Kommunikation entlang der Lieferkette', which is available from the ZVEI.

3.6.2.2 ELV Directive

The *End of Life Vehicle Directive* (*ELV*) passed into European Law in October 2000 and took effect in Germany on June, 21th 2002 when the ELV Ordinance was adopted, regulating the surrender, take-back and eco-friendly disposal of end-of-life vehicles.

It governs the recycling and material recovery of vehicles within the European Union and contains certain substance bans for lead, cadmium, mercury and hexavalent chromium similar to the RoHS Directive. It also stipulates the provision of conformity proofs by the manufacturer and supplier.

3.6.2.3 REACH Regulation

REACH stands for *Registration, Evaluation, Authorisation and Restriction of Chemicals*. Adopted in summer 2007, this regulation is the first fundamental reform launched to standardise the European chemicals policy. Its purpose is to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry.

In principle, REACH applies to all chemical substances, not only those used in industrial processes but also in our day-to-day lives, for example in cleaning products, paints as well as in articles such as clothes, furniture and electrical appliances. Therefore, the regulation has an impact on most companies and industries across the EU. The electronics industry as a downstream user is also directly affected by the REACH requirements. This is the result of the technological bandwidth of the electronics industry and the use of its products in many different customer industries.

REACH establishes procedures for collecting and assessing information on the properties and hazards of substances. Companies must register their substances and, if necessary, collaborate with other companies for this purpose. Communication along the supply chain is a core element of the REACH regulation.

Since non-compliance with the duty to communicate may result in high fines, it is recommended that REACH experts be consulted in case of doubt. First points of contact are the ZVEI[62], the Federation of German Industries (*Bundesverband der Deutschen Industrie*)[63], the European Chemicals Agency (*ECHA*)[64] or the REACH-CLP-Biocide Helpdesk of the German Federal Authorities.[65]

As with many other EU Directives and regulations, non-European countries are also interested in introducing similar REACH legislation. China leads the way again (as was the case with RoHS and ELV) and introduced a regulation on the registration of new chemicals initiated by the Ministry of Environmental Protection of the People's Republic of China as early as October 2010.

62 www.zvei.org
63 www.bdi.eu
64 www.echa.europa.eu
65 www.reach-clp-biozid-helpdesk.de

3.7 Conclusion on external framework conditions

The chapter on *external framework conditions* clearly shows that influences impacting on the supply chain from outside must not be underestimated.

Not only may insufficient knowledge of possible customs, export control or transport regulations significantly increase shipping times, violations of legal procedures and duties may, in the worst case, be deemed as an administrative offence, e. g. against the German Foreign Trade and Payments Act or applicable duties to inform and sanctioned with fines.

For instance, the innocent performance of chain transactions may result in tax-relevant registration duties in a country, which in turn can substantially increase costs and efforts.

This is why economic operators should always study any relevant legal requirements intensively before taking up the assignment and consult external advisors in case of doubt (customs, export control, tax experts, etc.).

4 Supply Chain Management Education and Training

Supply Chain Management is carried out by people. This is a fact which sometimes is forgotten: Solutions in the area are often perceived as depending on tools, a concept typically associated with IT solutions. Tools, however, cannot manage the supply chain. They can only serve as what they are, tools that support supply chain specialists. No less, but also no more.

Key supply chain management concepts: Flexibility, speed, efficiency – can be achieved by your employees!

Staff from every department and every hierarchical level are responsible for your supply chain and its performance. Their skills and capacity to act are decisive and make a significant contribution to the success of your enterprise on the international stage. Ensuring that employees are both challenged and supported as they develop their skills and expand their qualifications is a central task for management.

Developing human capital secures the future.

Ensuring you will be able to draw on skilled and capable specialist staff in the future must be seen as an investment. Neglecting to invest in this area can lead to gaps opening up that can potentially undermine the functioning and the very existence of an enterprise. Neglecting to invest in capital goods is a mistake that can be remedied at a stroke if need be. In other words: you simply purchase the capital good!

But in the area of human capital development, a year or two of inactivity cannot be remedied so easily: staff shortages or skills shortages cannot be resolved at short notice, at least not without paying a huge premium. The required human resources are simply not (or no longer) available.

Human capital development has a positive cost-benefit ratio!

The *hot spots* presented below, zone in on skills and qualifications that are increasingly needed along the supply chain and shows that the topics highlighted by the survey are not optional, but essential for a functional supply chain and for business success!

Topics such as sales planning and forecasting, vendor-managed inventory (VMI), process organisation or Kanban, reduce costs directly. In areas such as foreign trade and customs, the level of customs and import duties payable depends on the specialist expertise of your staff, as do logistics costs and possible extra penalties or charges.

For turnover in a particular market to translate into the creation of real value, excellent employees with intercultural competence, foreign language skills and specialist SCM expertise are needed. The further away from the company headquarters a new market is, the more acute this need becomes!

The considerable risks associated with global supply chains can only be mitigated by excellent employees!

Under German law, the export compliance manager in any company – the highest-ranking person with responsibility for exports, a member of the management or executive board – is personally liable for violations of export regulations. The buck stops with the export compliance manager: he or she cannot plead ignorance of regulations or blame problems on misunderstandings. Ensuring an enterprise maintains its capacity to deliver and enjoys import and export concessions is only one example for the importance of developing specialist expertise in companies and ensuring it is always on hand.

4.1 Process-oriented skills management

An efficient and effective supply chain depends on skills management based on an understanding of how processes are linked and designed to tap the potential of employees in relevant functional areas, in individual functional roles and at every level within the enterprise through a holistic long-term approach.

It is key that skills development is oriented towards the real work situation and anchored to actual job requirements and concrete work processes. Task-based process descriptions and the skills needs derived from these can be used to generate and implement education, training and qualification strategies for individual employees and for the enterprise as a whole.

The following tables give an overview of how individual SCM functional areas and their respective SCM role profiles match up with the five process categories described in the SCOR® model. The SCM role profiles are divided into operative and strategic roles. Operative roles are directly involved in the execution of work processes. Strategic roles typically involve larger spheres of responsibility and correspondingly greater accountability for budgets and human resources.

A system of colour marking also shows which role profiles, with their typical tasks and activities, form core areas or areas more tangentially involved in the respective SCOR® process categories. Depending on the size of the enterprise, its organisational structures and the nature of its operations (make-to-stock, make-to-order or repair and maintenance) specialists may be involved in one or several of the five basic SCOR® process types in one or more role profile. Education, training and qualification pathways must be tailored to the particular tasks and job specifications of staff.

Functional SCM-role profiles	Synonyms	Plan	Source	Make	Deliver	Return
Supply Chain Manager	Logistics Manager					
Industrial Engineer	Strategic Planner					
Logistics Planner						
SCM Application Developer	Process coordinator					
Purchasing Manager						
Project Purchaser	Commodity Procurement					
Goods Receipt Manager						
Inventory Management Coordinator						
Warehouse Manager						
Production Manager						
Dispatch Manager						

Table 5: How strategically important functional SCM role profiles map to process categories in the SCOR® model (Copyright ZVEI)

Functional SCM-role profiles	Synonyms	Plan	Source	Make	Deliver	Return
Customer Order Handler	Customer Service Staff (Order Processing)					
Order Manager	Demand Planner					
Launch Support Professional						
Production Planner	Production Scheduler					
Order Fulfillment Planner						
Material Planner						
Commodity Procurement	Strategic Purchaser					
Goods Receipt Employee						
Goods Receipt Quality Control Employee						
Warehouse Employee						
Order Picker						
Production Supervisor	Production Line Supervisor					
Skilled Worker	Production Line Employee					
Packer						
Transportation Manager	Transportation Planner					
Driver						
Complaint Management Staff						
Foreign Trade and Export Expert	Customs Expert					
Dangerous Goods Safety Advisor						
Waste and Reclaim Expert						

Table 6: How strategically important functional SCM role profiles map to process categories in the SCOR® model (Copyright ZVEI)

SCM Departmental Areas	Synonyms	Plan	Source	Make	Deliver	Return
Demand & Supply Planning	Demand Planning	■	■	□	□	
Procurement (Strategic →Contracts)	Strategic Procurement	■	□			
Procurement (Operative →Orders)	Operative Procurement	■	■		□	□
Customer Service	Order Management	■			■	□
Receiving (Area)			■		□	■
Warehousing		□	■		■	□
Order Fulfillment		■		■		
Production		□		■		
Order Management	Delivery	□	□		■	□
Goods Transport (Internal)	Internal Transport/Picking/ Readying for Dispatch		□		■	
Goods Transport (External)					■	

Table 7: How SCM functional areas map to process categories in the SCOR® model (Copyright ZVEI)

Key to symbols: ■ Core area □ Related area

4.2 Hot spots for skills development

Following a survey of multiple enterprises, one-page guides dealing with 11 hot spots for skills development and qualification were developed. Before the topics are treated individually, a note on the survey design and on the thinking behind the individual one-page guides follows.

4.2.1 Enterprise survey as departure point

ZVEI members were surveyed to arrive at an up-to-date assessment of the areas in the electrical and electronics industry that have the greatest need for skills development in the area of supply chain management.

Members were presented with 50 SCM keywords and asked to identify the areas in which they perceive a need for skills development or have already started implementing measures of their own.

The working group then prepared brief overviews of the top ten hot spots. The one-page guides that resulted are presented in this chapter. Each gives a quick overview of the respective topic and the main functions and areas it relates to.

Because of their importance, the hot spots *goods labelling* (rank 13, chapter 4.2.12) and *Kanban* (rank 15, chapter 4.2.13) were also included in the one-page guides. In addition, the hot spots *classic* and *WebEDI* were summarised in one guide, as they are closely-related.

4.2.2 How to use the one-page guides

The guides have been designed to cover the key hot spots highlighted by the survey in a form which can be taken in at a glance and can serve to guide the actions of decision-makers.

Not only are these guides intended to assist enterprises in discovering the right staff by focusing on initial vocational training, university education and advanced vocational training, but they are also intended to demonstrate how companies can develop and upgrade the skills of their staff through company education and training programmes and continued education measures.

Each of the hot spots was assigned to one of three areas: *field of action*, *tools* and *processes*. Symbols for these areas are displayed on the appropriate pages so that readers can see at a glance which area each guide addresses.

Field of Action	
Tool	
Process	

Table 8: Symbols for matching hot spots to areas (Copyright ZVEI)

Each one-page guide is structured to take in the following points (each indicated with its own symbol) so that readers can orient themselves rapidly and intuitively:

Definition		Briefly outlines the significance of the focus topic. The SCOR® map shows which categories of the SCOR® model are affected. This should make it easier to see how the focus topic links to processes. The processes that participants identified **in the survey** as areas affected in their own enterprises are marked in red, processes in upstream or downstream areas that are usually also affected in pink.
Aims		Shows purpose of focus topic.
Potential		List of positive effects for the enterprise.
Skills Content		Shows which learning content should be dealt with in qualification programmes to generate a solid understanding of the respective focus topic.
Target Group		Illustrates which functional roles on the strategic and operative sides of the organisation should be targeted for specific training. Depending on the size of the enterprise, an employee may have several roles.
Relevant Functions		Illustrates which functional areas along the value chain in the enterprise that come into contact with the focus topic (red background).

Table 9: Symbols to aid orientation (Copyright ZVEI)

4.2.3 Sales planning and forecasting

Rank 1

Definition

Forecasting of market demand for a product.

Figure 42: Sales Planning and Forecasting in the SCOR® model (Copyright Osram OS)

Aims

Precise planning of sales volume per product.

Potential

- Optimised capacity utilisation rate, higher delivery service level, lower capital commitment,
- smoothing of procurement, production and distribution quantities through coordinated planning between supplier and customer,
- voidance of unnecessary costs resulting from incorrect planning of material, machinery or personnel,
- avoidance of the bullwhip effect.

Skills content

- Sales plan as basis for an enterprise-wide projection of all relevant resources,
- derivation of sales volume from bills of materials and production plans in order to coordinate personnel, machine capacity and order quantities,
- consideration of seasonal fluctuations, short-term fluctuations and external factors through continuous planning,
- opportunities and need to communicate regularly and closely with customers, e. g. through (Web)EDI.

Target groups

Strategic	*Operative*
Supply Chain Manager	Order Manager, Order Fulfillment Planner
Purchasing Manager	Production Planner, Production Scheduler
Order Fulfillment Manager	Materials Planner
Production Manager	Inventory Management Coordinator
Production Supervisor	Order Manager

Table 10: Sales planning and forecasting target groups (Copyright Osram OS)

Functions affected (shown against red background)

Figure 43: Functions affected by sales planning and forecasting (Copyright Osram OS)

4.2.4 Customs and international trade[66]

Rank 2

Definition

International trade is the exchange of goods, services and capital across international borders or territories.[67]

In Germany, the *customs authorities* are subordinate to the Federal Ministry of Finance and are tasked mainly with the *collection of tax* in general, the *levying of excise duties* in particular, the *provision of clearance procedures*, *risk analysis* for the trade in goods, the enforcement of *market regulations* and debt collection on behalf of the Federal Republic.[68]

Figure 44: Customs and international trade in the SCOR® model (Copyright Osram OS)

Aims

Aims here fall into two categories: the (once-off) task of creating the prerequisites for developing new markets, and the medium/long-term safeguarding of a cost-effective, low-risk, and high-quality (and therefore also high-speed) supply chain.

Potential

- Opportunities to make strategic decisions about entering foreign markets – in advance,
- avoidance or minimisation of legal risks,
- knowledge and therefore also consideration (possible avoidance, minimisation) of tariff and non-tariff barriers to trade,
- securing the stability of the supply chain (for example through transparency, processes, documentation),
- avoiding time delays (e. g. customs clearance formalities, processing of payments, issues with documentation or labelling),
- reduction of costs (temporary storage unrelated to transportation, interfaces and media discontinuity, duration of transportation, customs and import duties, costs of finance and risk mitigation).

Skills content

- Finance instruments for simplifying import and export activities, reducing capital investment needs and simplifying cash management,
- international sales law as the basis for low-risk multinational trade relations,
- precise drafting of international sales contracts as a precondition for the successful pursuit of legal remedies in foreign countries,
- delivery and payment terms and the application and significance of payment, trade, insurance, customs and foreign trade documentation,
- implementation of risk analyses and of strategic and operative management of the main goods, currency, country-specific, payment and product liability risks,

66 A more detailed guide to customs and international trade can be found in Appendix 5.7.

67 http://en.wikipedia.org/wiki/International_trade

68 www.zoll.de

- ability to plan around key aspects of foreign trade law, including customs, taxes, registration requirements and market regulations,
- application of import and customs clearance procedures and types of customs duty, ability (in connection with this) to work within rules governing contingents, the origin of goods and preferential tariffs,
- application of standard and simplified customs clearance procedures and ability to factor in both country-specific characteristics and aspects of export control related to the specific nature of the goods.

Target groups

Strategic	
Senior Management, Executive Board	Manager of Legal Department
Head of Sales	Head of Product Development
Head of Procurement/SCM	Head of Production
Head of Finance	Head of Logistics

Operative	
Sales Controller	Admin Staff in Legal Department, Legal Advisor
Admin Staff Responsible for Exports, Key Account Managers, Project Managers	Admin Staff in Product Development
Strategic Purchaser	Production Planner
Accountants, Admin Staff in Credit Administration, Customs Clearance and Accounting	Dispatch Staff, Admin Staff Handing Imports or Logistics

Table 11: Customs and foreign trade target groups (Copyright Osram OS)

Functions affected (shown against red background)

Figure 45: Functions affected by customs and foreign trade (Copyright Osram OS)

4.2.5 Simulation-based optimisation

Rank 3

Definition:

Optimisation of complex, real business processes using results from computerised simulation models.

Figure 46: Simulation-based optimisation in the SCOR® modell (Copyright Osram OS)

Aims

Optimisation of real business processes.

Potential

- Optimal utilisation of human resources and machines,
- optimal layout and integration of logistics and production,
- avoidance of expensive implementation errors,
- timesavings through more rapid results from computerised simulation of alternatives.

Skills content

- Opportunity to become familiar with different simulation systems – how they work, areas of deployment, characteristics, strengths and weaknesses,
- system support for implementation of detailed planning of production and logistics workflows showing machines, equipment set-up, material, personnel, information (such as orders), etc.,
- opportunity to become familiar with a selection of system-based optimisation algorithms that can help to pick the best course of action,
- opportunities for dynamic representation of different levels of demand to reflect fluctuation during the day, week, and month, seasonal trends within specific sectors, etc.,
- development of solutions for over/under-utilisation of manufacturing capacities, and bottlenecks that arise at particular junctures (machines, personnel, infrastructure),
- opportunities to simulate the entire supply chain across enterprise boundaries,
- computerised or manual calculation of optimisation plans.

Target groups

Strategic	*Operative*
Supply Chain Manager	Logistics Planner
Production Manager	Production Planner, Production Scheduler
Production Supervisor	Materials Planner
Warehouse Manager	Inventory Management Coordinator
Order Manager	

Table 12: Simulation-based optimisation target groups (Copyright Osram OS)

Functions affected (shown against red background)

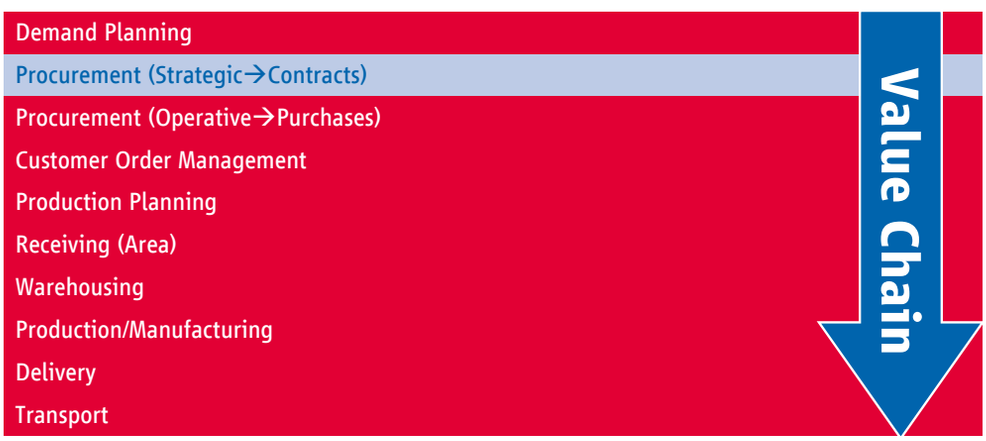


Figure 47: Functions affected by simulation-based optimisation (Copyright Osram OS)

4.2.6 Vendor managed inventory (VMI)

Rank 4

Definition

Inventory managed by supplier/seller.

Figure 48: VMI in the SCOR® model (Copyright Osram OS)

Aims

Improved capacity to deliver with simultaneously reduced costs.

Potential

- Smoothing of production and distribution quantities,
- reduced complexity and administrative overhead for article management for customers and suppliers,
- reduced storage of stock at supplier, elimination of the bullwhip effect,
- fewer errors and faster throughput time due to automation,
- reduced transport costs and better utilisation of transportation capacity,
- improved service quality,
- strengthening of business relationship between customer and supplier.

Skills content

- Opportunities for and possible variants of vendor self-management,
- necessary information for vendor self-management,
- distribution of responsibilities with vendor self-management,
- necessary communication,
- automation and electronic connectivity with vendor self-management,
- binding agreements governing electronic connections,
- appropriate VMI combinations.

Target groups

Strategic	*Operative*
Supply Chain Manager	Logistics Planner
Purchasing Manager	Production Planner, Production Scheduler
Warehouse Manager	Inventory Management Coordinator
Production Manager	Warehouse Staff
Production Supervisor	Materials Planner
Logistics Planner	Order Manager
Project Manager	Customer Order Handler
Transport Manager	Transport Scheduler
	Logistics Planner

Table 13: VMI target groups (Copyright Osram OS)

Functions affected (shown against red background)

Figure 49: Functions affected by VMI (Copyright Osram OS)

4.2.7 EDI classic and WebEDI

Rank 5 and 8

Definition

EDI (*Electronic data interchange*) allows data to be exchanged between company or state agency computer systems without interruptions. For example, business processes such as orders, order confirmations, delivery notifications, and invoices can be processed via EDI. WebEDI portals are designed for systems in which one of the business partners cannot support classic EDI.

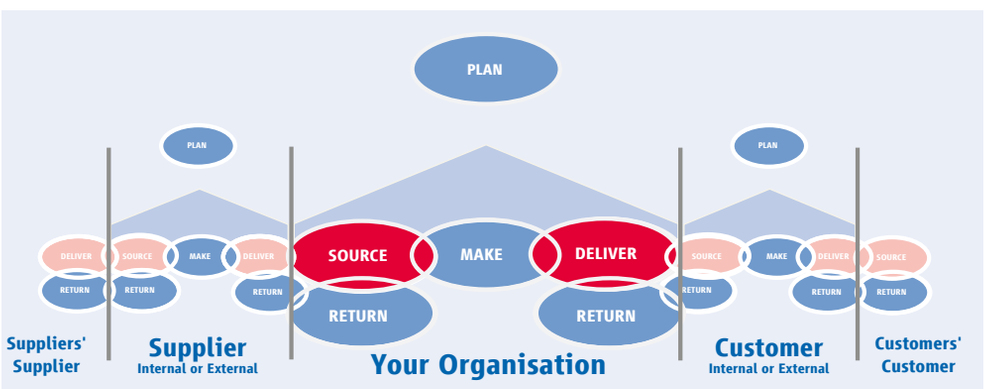


Figure 50: EDI classic and WebEDI in the SCOR® model (Copyright Osram OS)

Aims

Avoidance of media discontinuity, and support for *lean* supply chain management strategies.

Potential

- Time savings and minimisation of costs and errors in business transactions with external partners,
- strengthening of relationship between supplier and customer,
- automation of business processes with external partners that lack EDI infrastructure,
- more rapid exchange of data,
- minimisation of redundant data.

Skills content

- Overview of the most common EDI standards (including EDIFACT, ANSI X12 and RosettaNET),
- practical examples showing EDI support for processes such as placing orders,
- demonstration of differences between the various EDI methods and their requirements (with WebEDI, for example, one partner is always EDI enabled, while the other is not),
- WebEDI examples from everyday life, such as the deployment of WebEDI at Amazon.

Target groups

Strategic	*Operative*
Supply Chain Manager	Commodity Procurement
Purchasing Manager	Project Purchaser
SCM Application Developer	Strategic Purchaser
	Customer Order Handler
	Foreign Trade and Export Expert

Table 14: EDI classic and WebEDI target groups (Copyright Osram OS)

Functions affected (shown against red background)

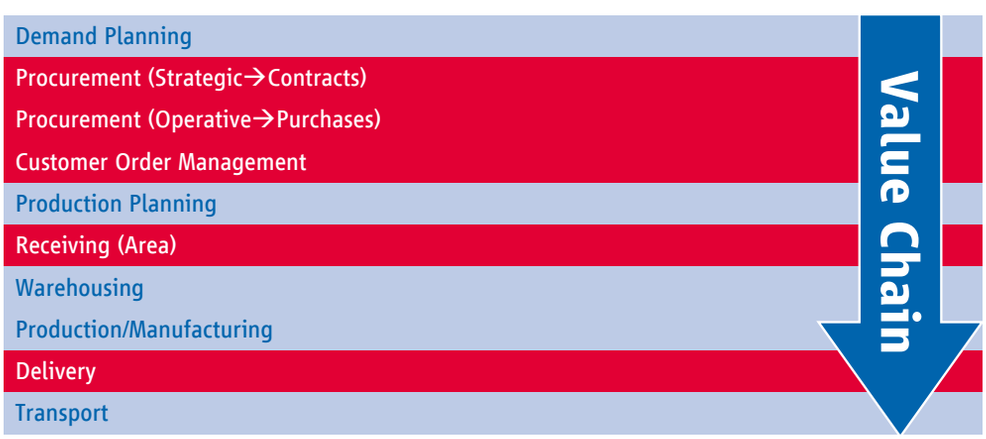


Figure 51: Functions affected by EDI classic and WebEDI (Copyright Osram OS)

4.2.8 Tracking and tracing

Rank 6

Definition

Consignment tracking and tracing makes it possible to monitor and verify the status of deliveries both before and after their arrival.

Figure 52: Tracking and tracing in the SCOR® model (Copyright Osram OS)

Aims

Makes it possible to identify the location, path and status of goods/consignments within the supply chain.

Potential

- Rapid identification of errors,
- easy to detect wastage (waiting time, unnecessary movement of goods, throughput time, etc.),
- savings from making standardised information available to different partners/interested parties,
- opportunity to respond rapidly to customer complaints; improved communication with customers,
- supply chain security,
- avoidance or minimisation of theft,
- identification of counterfeit or black market products,
- rapid tracing of errors and elimination of their causes through data availability.

Skills content

- Opportunities presented by tracing of shipments (with reference to, for example, parcel delivery services),
- options for labelling products and reading labels (scanning methods = codes, optical image recognition, etc.),
- opportunities and methods for visualising flows of goods.

Target groups

Strategic	*Operative*
Supply Chain Manager	Customer Order Handler
Industrial Engineer	Materials Planner
Logistics Planner	Order Manager, Order Fulfillment Planner
Warehouse Manager	Warehouse Staff
Dispatch Manager	Transport Scheduler

Table 15: Tracking and tracing target groups (Copyright Osram OS)

Functions affected (shown against red background)

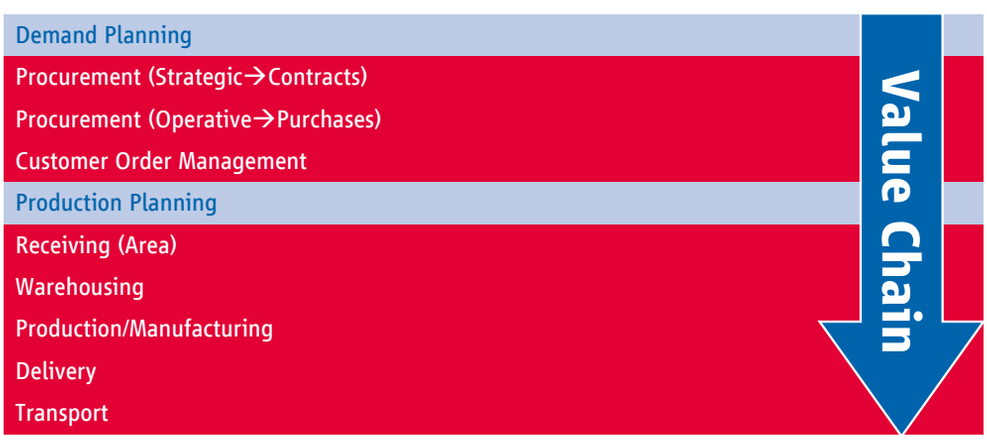


Figure 53: Functions relevant to tracking and tracing (Copyright Osram OS)

4.2.9 Process organisation

Rank 7

Definition

Process organisation represents an enterprise in terms of its business processes. These can be classified further as core processes, supporting processes and management processes.

Examples for core processes could include: marketing, production, material and logistics processes. In the SCOR® model, these processes could be summarised under the concepts *Plan*, *Source*, *Make*, *Deliver* and *Return*. The support or management-oriented area is described using the concept *Enable*.

Potential

- Minimisation of waste through concentration on activities that create value and are therefore paid for by customers,
- minimisation of errors and their cost through greater transparency and greater control over workflows,
- higher employee motivation through more varied tasks (cross-functional areas).

Skills content

- Organisational structures and procedures,
- reasons for process organisation,
- structure of process organisation.

Figure 54: Process organisation in the SCOR® model (Copyright Osram OS)

Aims

- Laying down foundations for flexibility and adaptability,
- representation of activities as they are linked in the flow of goods and services through the enterprise,
- intensive focus on customer-specific requirements.

Target groups

Strategic	*Operative*
Supply Chain Manager	
Industrial Engineer	
SCM Application Developer	
Logistics Planner	
Purchasing Manager	
Production Manager	

Table 16: Process organisation target groups (Copyright Osram OS)

Functions affected (shown against red background)

Figure 55: Functions affected by process organisation (Copyright Osram OS)

4.2.10 Shipment guidelines

Rank 9

Definition

Set of rules showing which forwarder should be used for which loads, as distinguished by weight, volume, load carrier, deadlines, classification as dangerous goods and a large range of other criteria.

Figure 56: Shipment guidelines in the SCOR® model (Copyright Osram OS)

Aims

Ensure goods are transported with approved transport providers at negotiated prices.

Potential

- High potential for savings on transportation services,
- better selection of transportation service providers for all relevant criteria.

Skills content

- Negotiated transport terms for optimal cost-benefit ratios at a defined quality standard,
- structured and systematic selection of service providers,
- table with weight limits, volume limits and load carriers showing which transport providers should be used in which cases,
- fixed rules per region, country, type of goods (e. g. dangerous goods), for national and international road haulage and air and sea freight.

Target groups

Strategic	*Operative*
Supply Chain Manager	Transport Manager
Purchasing Manager	Dangerous Goods Safety Advisor
	Foreign Trade and Export Expert

Table 17: Shipment guidelines target groups (Copyright Osram OS)

Functions affected (shown against red background)

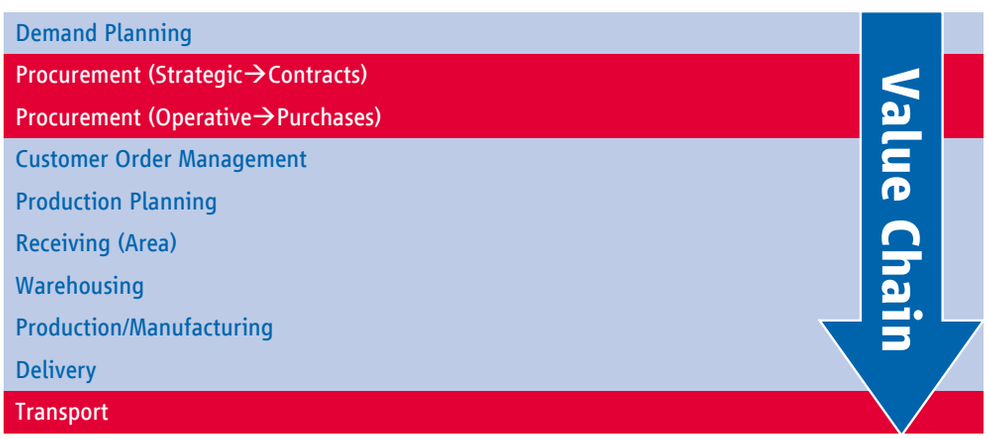


Figure 57: Functions affected by shipment guidelines (Copyright Osram OS)

4.2.11 Consignment

Rank 10

Definition

Consignment stock refers to stock of a supplier or service provider held in the company of the buyer. It remains the property of the supplier until it is removed by the buyer. The merchandise is only paid for when it is taken from consignment stock. This form of inventory management is known as consignment.

Figure 58: Consignment in the SCOR® model (Copyright Osram OS)

Aims

- Improved availability on the customer side and improved performance on the supplier side,
- lower inventory levels across the entire supply chain.

Potential

- Minimisation of process costs,
- minimisation of transportation costs,
- optimisation of set-up costs (free choice from supplier's production batches),
- strengthening of customer-supplier relationship,
- transfer of the risks and rewards of ownership delayed. Depending on the arrangements made for settling accounts, a longer term of credit may also result,
- in intercompany transactions, the entire inventory appears based on production costs in the general ledger account of the supplier; once country-specific regulations are taken into account, this can have non-recurrent tax effects.

Skills content

- Options for representing consignment stock in inventory management systems,
- contract drafting basics and variations, including, for example:
  - storage location, cost absorption, delayed acceptance of goods,
  - warehouse operators, rights and responsibilities of the contracting parties,
  - liability issues, transfer of ownership, and invoicing,
  - insurance,
  - inspection of goods,
  - beginning of validity period/termination,
  - any other terms and conditions (place of jurisdiction, references to further agreements),
  - individual supplemental agreements (such as the type of packaging to be used, minimum or maximum orders),
  - rolling forecast/inventory, etc.

Target groups

Strategic	*Operative*	
Head of SCM	Customer Order Handler	Complaint Management
Purchasing Manager	Order Manager	Goods Receipt Employee
Warehouse Manager	Materials Planner	Goods Receipt Quality Control Staff
SCM Application Developer	SCM Application Developer	Warehouse Staff
	Inventory Management Coordinator	Order Picker
		Foreign Trade and Export Expert

Table 18: Consignment target groups (Copyright Osram OS)

Functions affected (shown against red background)

Figure 59: Functions affected by consignment (Copyright Osram OS)

4.2.12 Goods labelling

Rank 13

Definition

Goods labels (for example MAT labels, GTL) contain information such as article numbers, descriptions and possible further data that must remain with the goods to facilitate their unambiguous identification.

Figure 60: Goods labelling in the SCOR® model (Copyright Osram OS)

Aims

- Machine-readable, unambiguous identification and traceability,
- standardised and uniform labelling, for example using the ANSI system (American National Standards Institute),
- efficient receipt and onward expediting of material.

Potential

- Higher degree of automation, improved throughput times, reduced identification errors,
- deployment of technical aids such as scanners, PDAs, etc. for quick and reliable identification and further processing or expediting,
- rapid cross-check against database to verify correctness of labels.

Skills content

- Options for unambiguous labelling and description of materials, containers and packaging, for example MAT label, RFID tags or GTL (Global Transport Label),
- machine-readable labels (optical scanning technologies, RFID readers, etc.),
- necessary information for ensuring traceability such as date code, humidity class, RoHS compliance, etc., see also the ZVEI-guide on 'Identification and Traceability in the Electrical and Electronics Industry',
- options for and benefits from tracing the flow of material and information along the entire supply chain from suppliers via manufacturers all the way through to customers,
- examples for current labels that account for industry sector guidelines, goods characteristics, etc.

Target groups

Strategic	*Operative*
Supply Chain Manager	Goods Receipt Employee
Purchasing Manager	Goods Receipt Quality Control Staff
Goods Receipt Manager	Warehouse Staff
Dispatch Manager	Complaint Management Staff
Industrial Engineer	Customer Order Handler
Transport Manager	Packer
Logistics Planner	Order Picker
	Skilled Worker

Table 19: Goods labelling target groups (Copyright Osram OS)

Functions affected (shown against red background)

Figure 61: Functions affected by goods labelling (Copyright Osram OS)

4.2.13 Kanban

Rank 15

Definition

Kanban is an inventory management strategy in which replenishment is triggered by consumption. The advantage of this method is that complex planning is not needed to trigger a replenishment signal. Kanban is especially helpful as a means of ensuring efficient supply chain workflow management across different areas.

Figure 62: Kanban in the SCOR® model (Copyright Osram OS)

Aims

Maximum availability, minimum stock – the result of consumption being managed by coordination between two parties.

Potential

- High potential for cost-savings in inventory management,
- supports lean production workflows.

Skills content

- Functions as self-regulating feedback loop connecting production and consumption,
- differences between push and pull principles,
- ensures human resources and inputs are deployed flexibly by giving control over short-term workflow management to the employees executing the relevant tasks,
- use of Kanban cards as information system,
- prerequisites for introducing a Kanban system,
- understanding and knowledge of lean strategy.

Target groups

Strategic	*Operative*
Supply Chain Manager	Order Manager
Purchasing Manager	Production Planner, Production Scheduler
Warehouse Manager	Materials Planner
Production Manager	Inventory Management Coordinator
Production Supervisor	Warehouse Staff
	Skilled Worker

Table 20: Kanban target groups (Copyright Osram OS)

Functions affected (shown against red background)

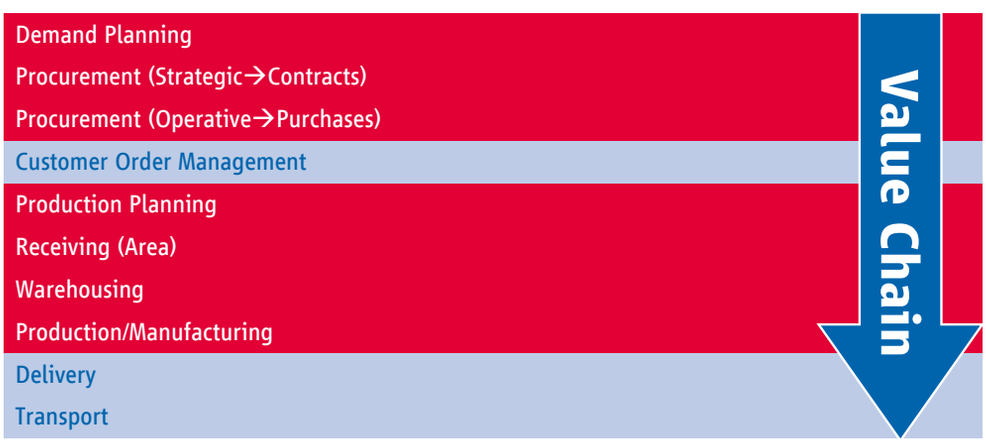


Figure 63: Functions affected by Kanban (Copyright Osram OS)

4.3 Education, training and skills development

This subsection begins by shedding light on the current situation and on the need for action to address current and future skills demand in the area of supply chain management. This is then followed by a more detailed exploration of various training and education options which include initial vocational training, degree programmes at institutions of higher learning, advanced vocational training, continued education and company training.

4.3.1 Situation and need for action

In the past, enterprises tended to work at optimising individual functional areas like purchasing, warehouse management and distribution. Today, the focus tends to be on implementing and fine-tuning the entire supply chain in line with the SCOR® model to achieve lower costs, faster throughput times and improved product and service quality – even as product life cycles become ever shorter. Optimising value streams within a single enterprise is no longer enough. Potential for increasing productivity and saving time while creating value is now sought and realized across the entire supply chain. Skilled staff at every level is the key to success here.

Business-oriented vocational education and academic degree programmes still tend to deal with materials management, procurement, and logistics in the 'classic' manner. The supply chain management approach, with its interlinking of different areas and the emphasis on processes and data which connects it to *product life cycle management* (*PLM*), has been integrated into the relevant curricula only hesitantly. For the necessary change to happen, both vocational and academic programmes will have to open up to change, extension or adjustment, or they will be swept aside by more holistic and global approaches.

The needs highlighted by enterprises (with convincing justifications) in this white paper are also supported by operational practices in enterprises. In what follows, various different starting points and possibilities are sketched, along with examples for some of the best approaches and ideas to come out of academic and vocational education programmes and continued education and training measures. The concept of supply chain management, as used here, always refers to the entire supply chain, from the supplier's supplier all the way down to the customer's customer – broken down into the processes *Plan*, *Source*, *Make*, *Deliver* and *Return*, which also include classic logistics.

4.3.2 Training and education pathways

The illustration shows a number of possible training and education options for developing skills in the area of supply chain management.

- *Initial Vocational Education and Training:* within the framework of the dual system, apprentices acquire skills required for operative tasks,
- *Academic Degree Programmes:* students acquire skills required for operative and strategic tasks at traditional universities, universities of applied sciences and vocational academies,
- *Advanced Vocational Education and Training:* qualifies candidates for specialist tasks and leadership roles,
- *Continuing Education:* qualifies participants for specialist tasks.

Figure 64: Education, training and skills development pathways in the area of supply chain management (Copyright ZVEI)

Conclusion:

- opportunities for skills development in the field of SCM are varied,
- the relevant vocational and academic learning content is complex and cross-linked.

The text which follows below will create much-needed transparency.

4.3.3 Initial vocational training in the dual system

The space afforded by the general training plans and framework curricula governing apprenticeships is discussed below before the potential for incorporating more SCM content in both areas is explored. The authentic example of Zollner Elektronik will then be presented as a practical case-study.

4.3.3.1 Room for manoeuvre in general training plans

The general training plans included in the specific training regulations for each occupation are conceived of as guidance that should be used to create enterprise-specific training plans. Large swathes of time are left free for deepening and broadening the skills that are to be acquired. It follows that SCM content can be integrated into the three apprenticeship programmes depicted in the following (two business-related programmes and one from the manufacturing sector) at any point without difficulties. The three apprenticeship training programmes dealt with here are those with the greatest potential for integrating SCM learning content into training in the area of electronics manufacturing.

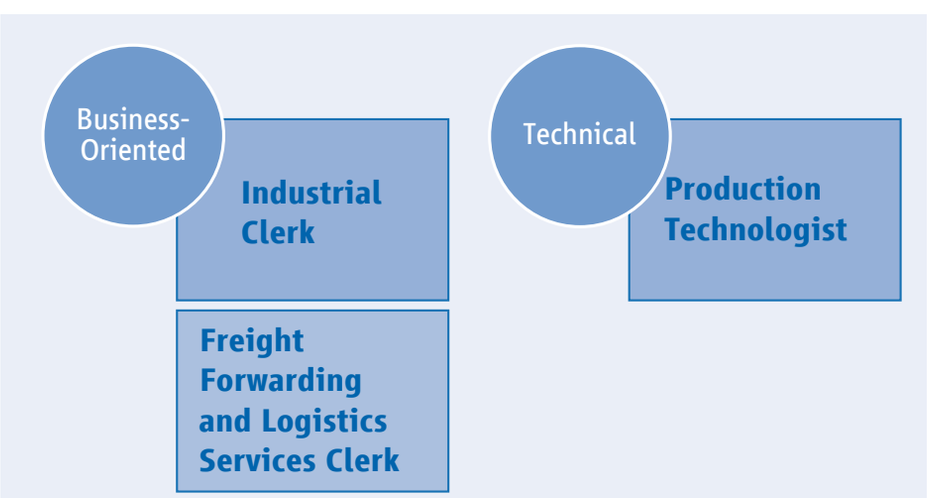


Figure 65: Overview of the apprenticeship programmes in electronics manufacturing with the greatest SCM potential (Copyright ZVEI)

4.3.3.2 Supply chain management content in general training plans and framework curricula

The extent to which supply chain management content is already anchored in general training plans (*Ausbildungsrahmenpläne*), framework plans that serve as a basis for developing company-specific training and in the framework curricula (*Rahmenlehrpläne*) that govern the learning content dual system trainees cover in vocational school, will be shown in the following:

4.3.3.2.1 Industrial clerk

Occupational profile requirements of relevance for supply chain management in general training plan governing company training:

- logistics (4.1),
- exploratory/preparatory phase of acquiring orders (5.1),
- order handling (5.2),
- order handling and customer service (5.3),
- demand planning and scheduling (6.1),
- placing of orders (6.2),
- inventories and inventory control (6.3).[69]

69 see www.bibb.de, core area ‚career' (only available in German)

Learning fields of relevance to supply chain management in vocational school framework curriculum:

- plan, monitor and manage value creation processes
  (learning field 5),
- plan, monitor and manage procurement processes
  (learning field 6),
- plan, monitor and manage sales processes
  (learning field 10).[70]

4.3.3.2.2 Freight forwarding and logistics services clerk

Occupational profile requirements of relevance for supply chain management in general training plan governing company training:

- process-oriented performance of services in freight forwarding and logistics (4),
- goods dispatch and transport (5.1),
- inventory logistics (5.2),
- groupage and groupage networks (5.3),
- international freight forwarding (5.4),
- logistics services (5.5),
- contracts, liability and insurance (6),
- dangerous goods, protective measures and safety (8).[71]

Learning fields of relevance to supply chain management in vocational school framework curriculum:

- compare transport modes and process road freight orders
  (learning field 4),
- process groupage orders
  (learning field 5),
- process intermodal freight transportation
  (learning field 6),
- plan, monitor and manage procurement processes
  (learning field 8),
- provide and coordinate warehouse services
  (learning field 9),
- process export orders
  (learning field 10),
- process import orders
  (learning field 11),
- provide and organise procurement logistics
  (learning field 12),
- provide and organise distribution logistics
  (learning field 13),
- adjust dispatch and logistics-related business processes in line with prevailing economic conditions
  (learning field 15).[72]

4.3.3.2.3 Production technologist

Occupational profile requirements of relevance for supply chain management in general training plan governing company training:

- planning and preparation of production orders (1.1),
- execution of production orders (1.2),
- finishing production orders (1.3),
- organization of logistics processes (5.4),
- IT systems and networks (3.2),
- product and process data management (3.3).[73]

Learning fields of relevance to supply chain management in vocational school framework curriculum:

- project analysis and project management
  (learning field 8),
- setting up material flow and handling systems
  (learning field 9),
- analysis of production processes
  (learning field 10),
- optimisation of production processes
  (learning field 12),
- organisation of logistics processes
  (learning field 13).[74]

70 see www.bibb.de, core area ‚career' (only available in German)
71 see www.bibb.de, core area ‚career' (only available in German)
72 see www.bibb.de, core area ‚career' (only available in German)
73 see www.bibb.de, core area ‚career' (only available in German)
74 see www.bibb.de, core area ‚career' (only available in German)

4.3.3.3 Case study: Zollner Elektronik – supply chain management training scheme

Trainees undergoing initial vocational training at Zollner Elektronik in Zandt, Bavaria spend six months in the supply chain management department following the company's own training scheme. The material covered by the trainees takes in the following topics: EDI, WebEDI, inventory control (and inventory sampling), connectivity to customers and suppliers, Incoterms®, goods labelling by suppliers, the MAT label, and container management.

The enterprise has registered that trainees find the programme stimulating, are clearly motivated by it, and often express an interest in working in this department after completing their traineeships.

The 'Business Process Optimisation / Supply Chain Management' manual:

Over and above this, a print guide has been developed in order to give participants in vocational training and other relevant groups (students with academic backgrounds completing work placements or thesis-related projects) a preliminary grounding in the tasks and content of supply chain management. Key concepts in supply chain management, business process optimisation, and structures and workflows in the SCM area are covered. The last section of the manual describes the various tasks handled by the SCM department individually and in terms of how they relate to one another. These different specialist areas are shown in depth.

Figure 66: Front cover of the 'Business Process Optimisation and Supply Chain Management' manual issued by the enterprise Zollner Elektronik. (Copyright Zollner Elektronik)

Points used to structure the manual:

Explanation of key concepts

Supply chain management, business process optimisation, and management in logistics:

- reasons for SCM, results of effective SCM,
- idea and strategic concept behind SCM, implementation of SCM strategies,
- demarcation from logistics, practical implementation of SCM.

Task descriptions for trainees and students on work experience placements taking in the following areas:

Theme: Goods receiving

- incoming goods in parcels and on pallets,
- identification of goods and data logging to ERP and MES systems,
- incoming goods inspection and logging, generation of quality notifications.

Theme: Warehouse management

- suitable storage,
- carrying out an inventory,
- picking and dispatching orders,
- inventory adjustments/materials analyses/ inventory.

Theme: Dispatch

- dispatch handling and dispatch process planning,
- dispatch labels,
- electronic data exchange (EDI) and message types.

Theme: Inventory

- inventory procedures,
- inventory process (before, during, after an inventory),
- create and process inventory documents.

Theme: Goods labelling
Theme: Materials flow and storage technology, intralogistics
Theme: Statistics in the SCM database

4.3.4 Degree courses at institutions of higher learning

An overview of key academic degree courses with relevance for supply chain management is given below, as is an overview of the current offering of logistics courses. The learning content of these courses is then explored further before conclusions are drawn regarding the further development of courses and the possible implementation of supply chain management modules.

4.3.4.1 Key courses of study in the supply chain management area

The following illustration shows key degree programmes that are relevant for supply chain management. As supply chain management extends beyond the scope of classic logistics. The terms SCM and logistics are handled here synonymously.

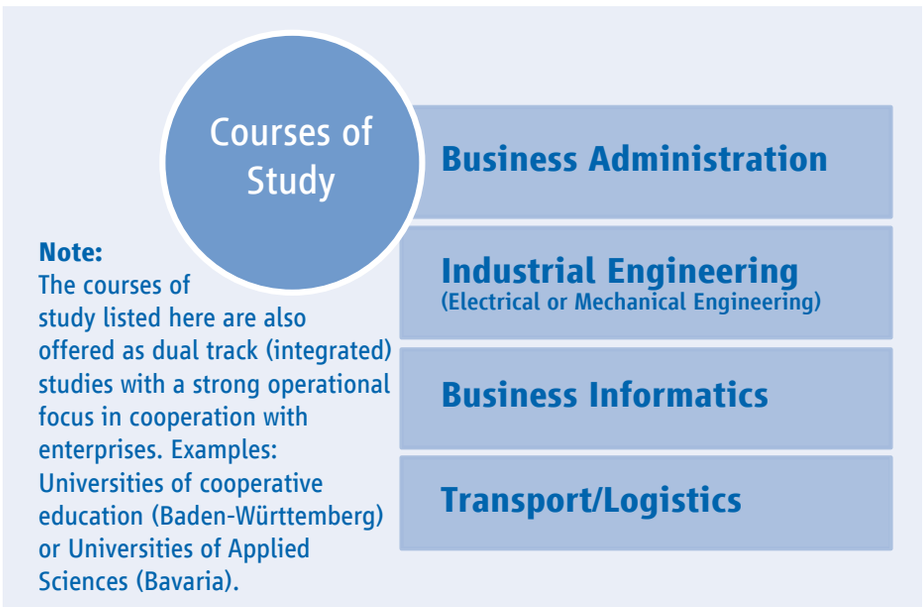


Figure 67: Overview of key academic degree programmes in the supply chain management area (data from 2013) (Copyright ZVEI)

4.3.4.2 Degree programmes offered in logistics

In the year 2008[75], 127 higher education institutions throughout Germany offered logistics courses covering 210 specialist areas. The distribution among the different types of institutions of higher learning was as follows:

- 43 universities,
- 69 universities of applied sciences (*Fachhochschulen*),
- 15 vocational academies *(Berufsakademien).*

Training in logistics seems, thus far, to have kept pace with developments within the area and its increased significance. In the future, it can also be expected that "[...] the ongoing expansion of new specialist fields within logistics will continue to be matched by an expansion in education and training provision [...]"[76]

4.3.4.3 Analysis of degree course content

- Learning content in technical degree programmes barely places any emphasis on processes. Business courses are not process-oriented enough,
- graduates generally have a comprehensive grasp of their specialist areas, but lack awareness of operational processes in SCM,
- graduates need both emotional intelligence and very well-developed problem-solving skills.

4.3.4.4 Conclusions for ongoing course development – more focus on process-orientation

Essentially from the perspective of industry, it is clear that learning content in the area of supply chain management must be covered in a process-oriented fashion. Guidance on this comes from from asking questions such as:

- How are enterprises structured with regard to SCM processes?
- What factors influence SCM processes?
- What effects and results are reached through these?
- What functional roles and tasks do university graduates take on in this process?

75 More current data is unavailable.
76 Hildebrand and Roth, 2008

4.3.4.5 Implementation of supply chain management study modules

Learning content in this area could be enhanced by developing and implementing supply chain management modules for business and engineering courses of study. Such modules should be developed. The content can be drawn from a special certificate course for company-based training encompassing the following thematic areas:

- supply chain structures and processes,
- *Plan*: Supply chain planning strategies and processes,
- *Source*: Procurement strategies and processes,
- *Make*: Production strategies and processes,
- *Deliver*: Distribution and logistics strategies and processes (see chapter 4.3.5.2.3),
- *Enable*: Concepts and methods for analysing the value chain,
- *Return*: Reverse logistics strategies and processes.

4.3.5 Advanced vocational training

An overview of the advanced vocational training courses and qualifications currently offered in the SCM area will be followed by more detailed exploration of the learning content of individual courses.

4.3.5.1 Key advanced vocational training courses in the supply chain management area

The following illustration shows key advanced vocational training programmes in the area of supply chain management.

4.3.5.2 Supply chain management – related content in individual courses of study

The supply chain management-related learning content of three advanced vocational training courses will be explored in depth below. The three relevant qualifications are: Bachelor Professional of Management for Industry (CCI), Master Professional of Technical Management (CCI), and Bachelor Professional of Freight Transport and Logistics (CCI). The suffix CCI indicates that these qualifications are awarded by the Chambers of Commerce and Industry in the respective regions.

4.3.5.2.1 Bachelor professional of management for industry

In the field of *production processes*, competence in production planning and control is to be demonstrated, along with the capability to assess technical background conditions that are relevant for production. Candidates must also demonstrate that workflows from product development up to the handover of a product to the sales department have been understood and can be matched to specific stages and situations in production. To this end, it must be demonstrated that the enterprise-wide function of supply chain management has been grasped, and that the SCM sub processes relevant for production can be explained. A detailed description of the field follows:

6. production processes,
6.1 assess production planning,
6.2 analyse production control,
6.3 assess technical background conditions for production,

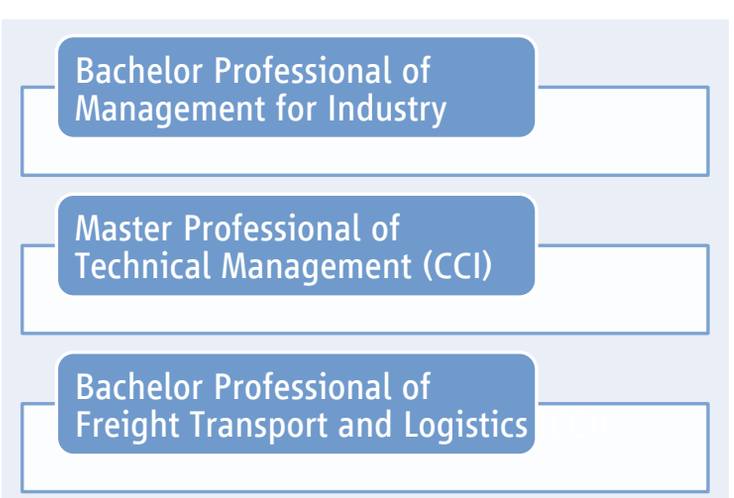


Figure 68: Overview of the key advanced vocational training courses in the area of supply chain management (Copyright ZVEI)

6.4 logistics as enterprise-wide function,
6.5 execute demand analysis,
6.6 structure procurement and purchasing,
6.7 compare warehousing and transport options,
6.8 explain reverse logistics.

4.3.5.2.2 Master professional of technical management (CCI)

In the examination area materials, production and marketing management, candidates must demonstrate the capacity to understand connections and interdependencies in supply chains from the supplier's supplier through production and on to customers. They must be in a position to analyse the causes and effects of clashes between objectives and to make or prepare the ground for decisions that need to be made from the perspective of the enterprise as a whole. In detail, the scope of this area for examination purposes is as follows:

4. materials, production and marketing management,
4.1 assessment of market conditions and the market positioning of the enterprise, mastery of marketing instruments[77],
4.2 assessment of the product life cycle, assistance with product planning (including consideration of industrial property legislation)[78],
4.3 application of purchasing policy and purchasing marketing instruments and demand planning methodology, mastery of procurement processes, assessment of the enterprise-wide effects of procurement decisions on enterprise workflows,
4.4 consideration of legal aspects of purchasing and sales and of the trade terms that find application in the international movement of goods,
4.5 mastery of different material flow and warehousing systems and logistics strategies,
4.6 assessment of systems for planning and controlling production,
4.7 assessment of the deployment of production factors, the different types of production and the ways production can be organised.

4.3.5.2.3 Bachelor professional of freight transport and logistics (CCI)

The following supply chain management topics are dealt with within this advanced vocational training qualification:

1.2 evaluation of developments in national and international markets for logistics and the transportation of goods, and derivation of steps to be taken,
1.5 development of work processes,
2.1 planning, controlling and optimising goods transport and logistics service,
2.6 implementation of internal and external requirements to ensure the safety of the supply chain,
2.7 consideration of foreign trade regulations when planning supply chains.

4.3.6 Continued training and education

The overview of current continued education and training options in the area of supply chain management presented below is then followed by more detailed exploration of the idea of developing a certificate course in supply chain management.

4.3.6.1 Continued education and training opportunities in the supply chain management area

A distinction must be made between continued education programmes leading to recognised qualifications and other courses (such as one-day seminars). Recognised qualifications could include, for example:

- logistics manager,
- Bachelor Professional of Inventory Management and Control (CCI),
- Bachelor Professional of Materials Procurement and Logistics (CCI), Diploma in procurement,
- Diploma in purchasing management.

77 This module also covers topics extending beyond supply chain management.
78 This module also covers topics extending beyond supply chain management.

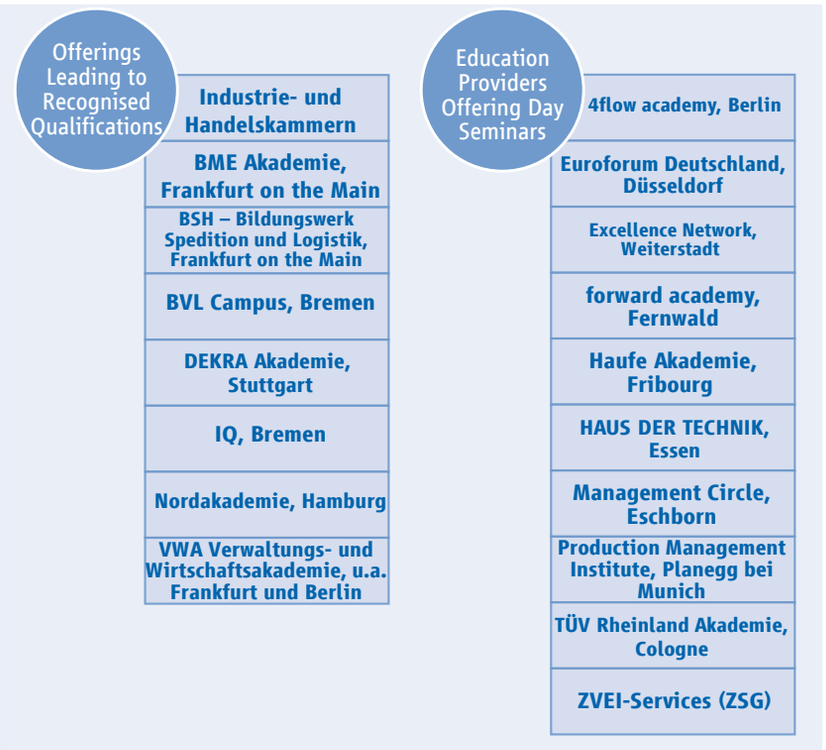


Figure 69: Selected continuing education providers in the area of supply chain management[79] (Copyright ZVEI)

4.3.6.2 Suggestion from an industry perspective: development of a certificate course in supply chain management

A certificate course geared to the specific requirements of supply chain management in the electrical and electronics industry could be developed and offered by ZVEI's service company ZSG (ZVEI-Services Gesellschaft). See also chapter 4.3.4.5.

A preliminary outline for such a course could be represented as follows:

ZVEI-academy certificate course *'Supply Chain Management in Electronics Manufacturing'*

Participants in the certificate course Supply Chain Management become familiar with the central relationships and functionality involved in supply chain management. In four modules, participants gain an understanding of how processes along the value chain, in the direction of suppliers and customers, can be optimised, costs reduced and efficiency increased. Following this training programme, participants can deploy methods and instruments of supply chain management in a targeted fashion to optimise the value chain within their respective enterprises in a systematic and lasting fashion.

Module 1: Supply chain structures and processes

- the value chain (supply chain),
- tasks, aims, and benefits of supply chain management,
- organising structures and procedures, work process organisation,
- functionally-oriented key supply chain management processes according to SCOR® model (Plan, Source, Make, Deliver, Return, Enable),
- planning and controlling instruments,
- sales/capacity planning,
- collaborative planning,
- forecasting and replenishment (CPFR),
- detailed planning: Advanced planning system (APS),
- Kanban,
- efficient Consumer Response (ECR),
- backlog handling.

79 www.berufswelt-logistik.de

Module 2: Concepts and methods for analysing the value chain

- simulate, visualise and analyse the flow of goods and materials,
- ABC analysis, XYZ analysis, SWOT analysis, cost structure analysis, potential analysis,
- fundamentals of supply chain controlling.

Module 3: Production strategies

- make-to-stock (MTS), make-to-order (MTO), engineer-to-order (ETO),
- capacity utilisation rate, throughput time, reliability in meeting deadlines,
- production control strategies: push/pull, Kanban, 'supermarket',
- buffering against fluctuations in demand,
- fundamental relationships within and impact of demand fluctuations on the supply chain.

Module 4: Distribution and logistics

- warehousing steps/delivery strategies: Just-in-time (JIT), just-in-sequence (JIS), consignment stock, vendor-managed inventory (VMI),
- transport strategies: milk runs, cross-docking etc.,
- shipment guidelines,
- customs and foreign trade,
- goods labelling,
- change drivers, developments, trends in distribution and logistics.

Each module to be covered over two subsequent days, with gaps of around 4-6 weeks between modules. During this period, participants work on defined tasks and on their own practically-based project work.

Methods

Lectures, discussion, practical exercises, case studies, simulations, models and checklists that have been tried and tested in practice

Certificate

For the certificate to be awarded, participants must prepare and present a practical project. The presentation and discussion demonstrate that the course content has been mastered and can be integrated operatively. Marks are awarded for examination performance.

Course leaders

These would include experienced experts from relevant specialist fields within the electrical and electronics industry. Development of courses would possibly be in partnership with an appropriate department in a traditional university, or a university of applied sciences (*Fachhochschule, FH*).

Further steps

A certificate course *Supply Chain Management* will be developed by the ZVEI academy. This course will be offered as a certificate course in the portfolio of courses offered by the ZVEI academy. Another option would be to also implement this certificate programme within the context of a teaching and research institution.

4.3.7 Company training

Within the general framework of company training, it is key to distinguish programmebased approaches to continuing education and training from process-oriented approaches. The differences will become clear in the notes below. An example of the former will be treated with reference to two concrete case-studies from enterprises with supply chain management education and training programmes. The latter option, process-based education and training, will be described on a more general level.

4.3.7.1 Continuing education and training programmes

Continuing education and training in coordinated programmes will be illustrated in the following two case-studies based on the experiences of Infineon and Osram Opto Semiconductors.

4.3.7.1.1 Case study: company training at Infineon

Infineon has reacted to the shortage of SCM expertise with the launch of two programmes, its *Supply Chain Trainee Programme* and its *Senior Expert Development Programme*.

Supply chain staff development pathways are based both on Bachelor and Master courses at the company's *SC Academy*, and on job rotation within the SC departments.

The increasing complexity of processes and automation is tackled at the SC Academy through the use of a mix of computer-aided learning, webinars and classroom training sessions.

It has become clear that the supply chain needs talented employees who have both mastered the relevant processes and possess a high degree of emotional intelligence. Staff needs to have strong problem-solving skills and a background in *operations research* to manage contacts with suppliers and customers.

The training goes beyond classic university teaching. The company-internal SC Academy offers employees the chance to take iLearns and to participate in interactive webinars from anywhere in the world. Staff/students and customers can also take a Diploma in Supply Chain Management at the University of Limerick.

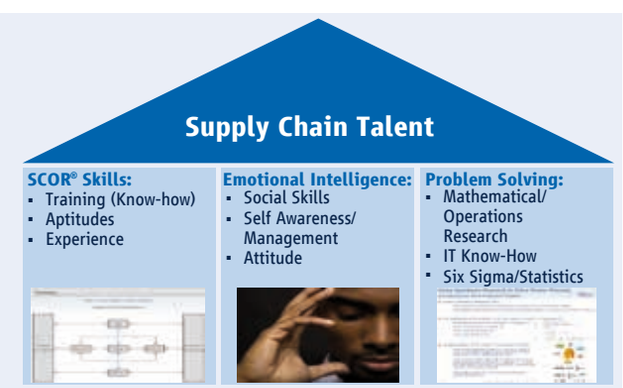


Figure 70: Supply chain talent at Infineon: Processes (SCOR® skills), emotional intelligence, towards customers and suppliers, engineering skills like operations research and Six Sigma (Copyright Infineon Technologies)

Figure 71: Aims of the supply chain academy at Infineon (Copyright Infineon Technologies)

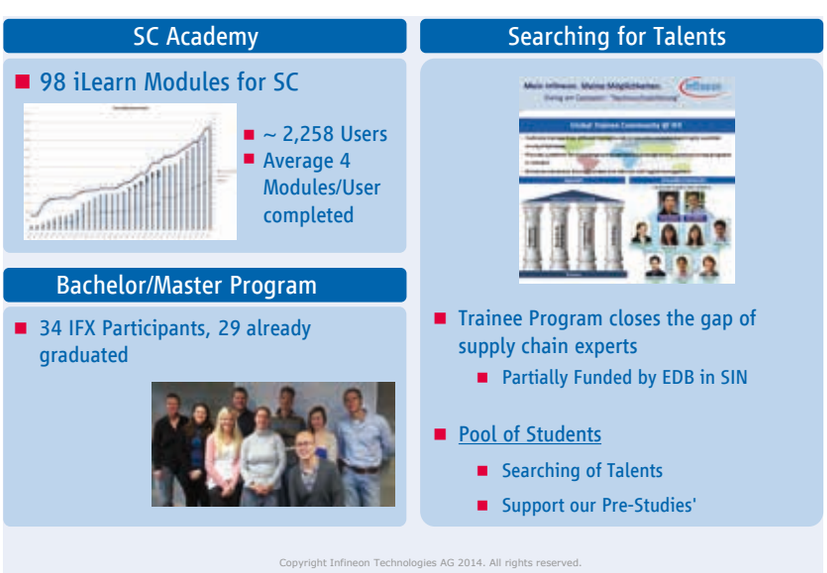


Figure 72: People development at Infineon (as in June 2014, Copyright Infineon Technologies)

Today, Infineon has over 98 iLearn modules with about 2,258 users in the supply chain area.

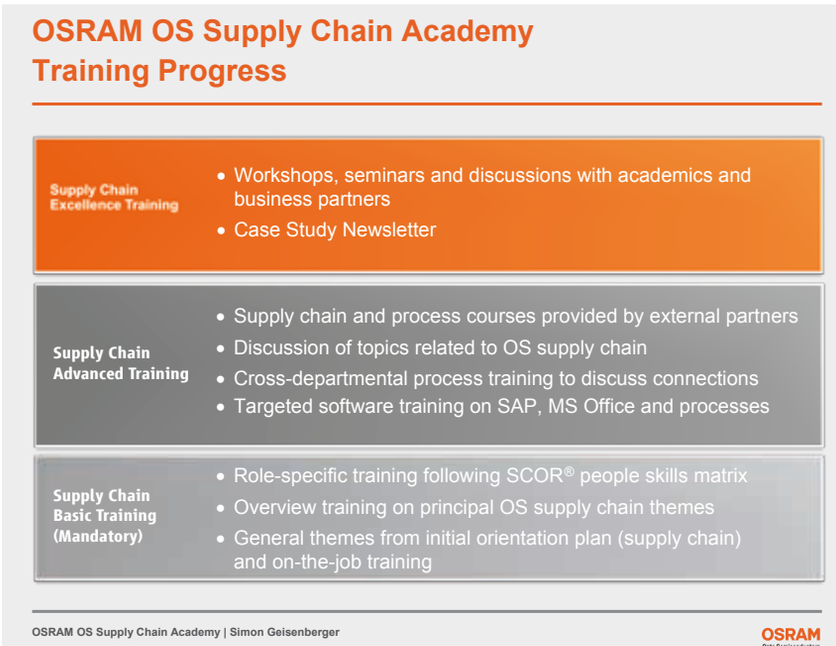


Figure 73: Overview of the organisation of training areas at Osram Opto Semiconductors (Copyright Osram OS)

4.3.7.1.2 Case study: company training at Osram Opto Semiconductors

Osram OS also runs its own *Supply Chain Academy* in order to strengthen staff skills in the area of supply chain management.

Figure 73 shows how training units in the company-internal supply chain academy build on one another.

Organisation of employee training around SCOR® people skills

Within the Osram OS supply chain, all functional roles have uniform titles and structures which apply worldwide and have been mapped to specific *SCOR® people skills*. In figure 74, this mapping process is shown using the role of the *Demand Planner* as an example. The main tasks involved in the job description are outlined and also mapped to the skills needed in the role.

In the SCOR® handbook, every skill can be linked to particular training courses, areas of experiences and aptitudes. As such, every functional role has a profile which is then adjusted in line with the qualifications and skills of the relevant specialist and the demands of SCM/ logistics processes. As the SCOR® handbook is oriented towards the English speaking-world, some of the training it describes relates to content which German trainees encounter at quite an early point in their careers, since it forms an integrated part of training plans and curricula. This simplifies the appropriate implementation of the handbook content in Germany. The profiles generated in this way are linked, in a second step, to existing Osram OS training courses to determine training needs on an individual basis.

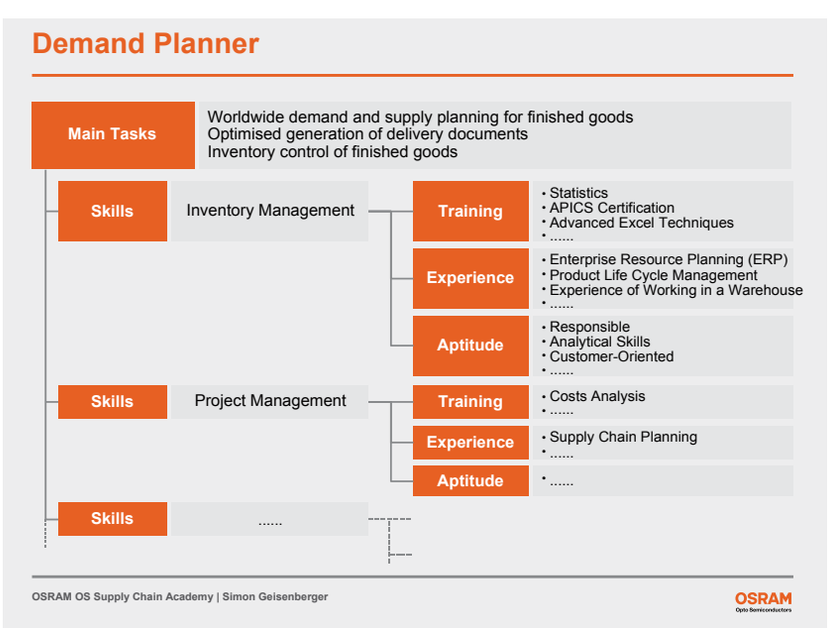


Figure 74: Example for mapping of SCOR® People Skills at Osram Opto Semiconductors (Copyright Osram OS)

Collaboration with institutions of higher learning

As the opportunity to exchange expertise with institutions of higher learning is seen as very important, the supply chain academy at Osram OS maintains close links with the technical university OTH Regensburg (see figure 75). This gives students a chance to gather professional experience and work on their Bachelor and Master theses at Osram OS. Students also have the option of solving current problems at Osram OS as participants in a project seminar linked to the M.A. in Logistics course offered at OTH Regensburg.

Within the framework created by these contacts, regular discussions between professors and company representatives cover current developments and topics and discuss what the company expects of graduates in the supply chain area.

Many institutions of higher learning also offer various forms of continuing education. The supply chain academy at Osram OS has organised in-company education and training sessions in collaboration with the Centre for Adult Education and Knowledge Management (ZWW) at OTH Regensburg. These are tailored to the specific requirements of the enterprise, and have been welcomed warmly by both participants and trainers. A further point of collaboration relates to access to the university libraries. Almost all media held by the university library can be accessed and borrowed to carry out the necessary literature research for supply chain projects.

4.3.8 Continued education and training in processes

Process-oriented continued training in supply chain management is described from a universal point of view below. Key aspects to be explored in depth include the integration of learning into day-to-day processes, the role of superiors as promoters of skills development, the creation of conditions which support learning, key elements of skills development and qualification strategies, and the integration of skills, human capital and organisational development.

Grounding learning in the day-to-day running of the company

An efficient and effective supply chain requires competent staff at every level with a comprehensive and shared understanding of supply chain management processes.

Education and training-oriented towards work processes forms a link between training and the day-to-day handling of SCM workflows in the enterprise. Almost nobody performs routine tasks all the time. And as challenges crop

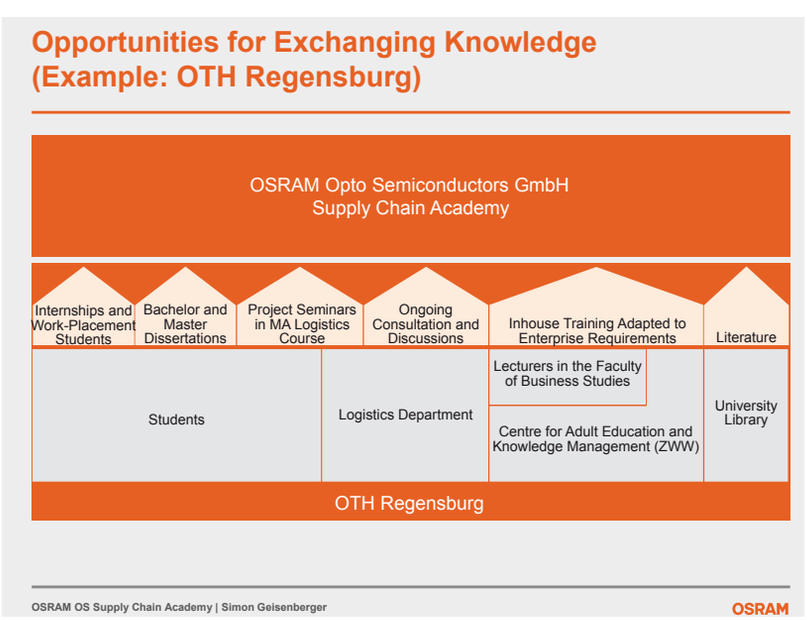


Figure 75: Examples for the exchange of knowledge with third-level institutions (Copyright Osram OS)

up, people are pressured to react to them. Specialised employees learn simply by performing their jobs, as well as by acquiring new skills and knowledge in a targeted fashion. Up to now, little has been done to promote such informal learning systematically. Formalised training regimes (as described in chapter 4.3.7.1) with clearly defined learning targets and preordained learning pathways are still the norm.

Work-process-oriented continuing education and training is also a formalised learning opportunity, but one that draws on and supports informal learning processes. The challenges which arise in day-to-day work are seen as challenges to learn. Specialists cope with these challenges, and learn in the process. Skills acquired in this way can be demonstrated and certified within the context of education and training regimes.

Such learning through work processes is, however, not automatic. It takes a process of reflection to turn experiences at work into a resource that can be tapped into in the future. Only this conscious reflection of what has been learned makes it possible to draw abstract conclusions from it and to apply the new specialist expertise to other new situations. Where such practical learning succeeds, more is learned (and retained in the long term) than would ever be the case in a seminar featuring more traditional educational methodology. And the highlight: Learning like this ties in with what specialists have already experienced and provides answers to questions which are pressing: the motivation to learn and the transfer of what has been learned into practice are almost automatic.

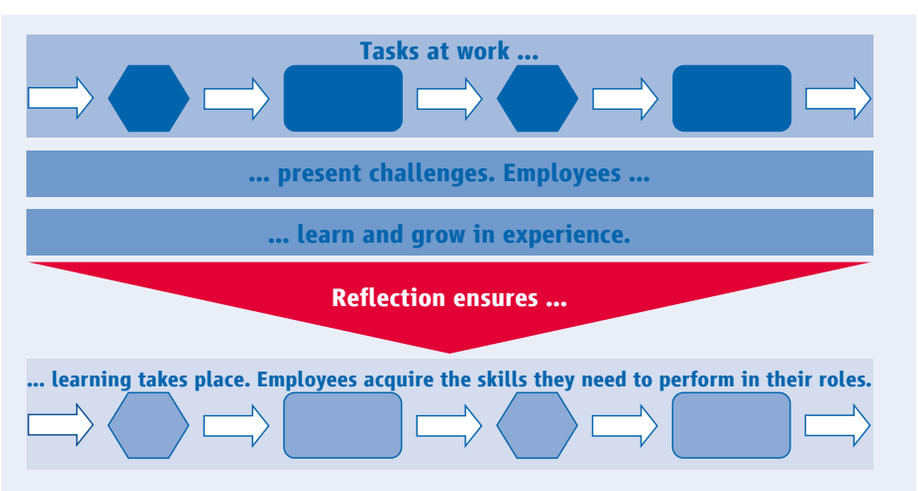


Figure 76: Process-oriented learning along the supply chain (Copyright ZVEI)

Managers as promoters

Work-oriented continuing education is of central importance for all who manage staff directly and need to foster the skills and capabilities of employees. Creating the conditions for successful learning during work processes nurtures the ability of staff directly. In small- and medium-sized enterprises, work-process-oriented continuing education can be a good way to get a companywide strategy for the internal development of specialist expertise off the ground. In large enterprises, guidelines can give managers and supervisors, human resources development staff and those responsible for education and training additional methodological tools.

Managers have a particular role to play in implementing skills development in the area of supply chain management, and a particular responsibility.

Managers are the promoters who must demonstrate leadership when it comes to work-oriented continuing education, since they:

- are familiar with the specialist requirements of their respective areas of accountability,
- are familiar with the tasks and skills of individual staff members,
- can analyse skills needs and determine necessary measures on this basis,
- can promote the skills development process and take responsibility for it,
- can ultimately control the performance of their own units in this way,
- foster the development of staff in line with current best practice and current requirements,
- can ensure that learning is permanently anchored in the work process, and that learners influence their own skills development actively.

Mentors, experts and coaches may also have a role to play as promoters alongside managers. They can come from within or outside the company.

Conditions that promote learning

Work process-oriented continuing education and training can only succeed when the necessary requirements and a solid base of support for the respective employee have been put in place. Managers have a crucial role to play here:

- they ensure that the education and training structures have been approved at executive level,
- they ensure that work structures and learning conditions are designed to promote learning,
- they ensure that colleagues support the process of skills development,
- they provide employees with specialist advice and learning process support,
- they ensure staff are enrolled for relevant education and training offerings (a ZSG certificate course, for example),
- they ensure information is exchanged at regular intervals,
- they ensure that skills development is demonstrated in a form that conforms to standards,
- and they ensure that the skills development and qualification process is integrated into a long-term human capital development strategy.

Modern supply chain management coaching is also regularly targeted at teams or project teams. The focus here is on how methods and tools acquired in the course of a project can support the learning organisation.

Shaping conditions which support learning does not require the delineation of new spheres of responsibility. The key person responsible for promoting skills development is the respective manger: the role lies at the epicentre of his or her ambit of responsibility.

Key elements in the education and training strategy

In contrast to courses of instruction and seminars, work process-oriented continuing education is tailored to the specific needs of employees and enterprises. Operative actions are central to the qualification process. Experience, knowledge and methods are integrated in a targeted fashion. The development of skills that directly affect the capacity of staff to perform in their roles is particularly fostered. These include personal, social and methodological skills along with self-management and the capacity to reflect on learning. Employees themselves shape how and what they learn at work, but with learning process support, and support from specialist advisers. Continuing education integrates learning and work in the form of authentic, company-specific projects and workflow.

Integration of skills, human resources and organisational development

The individual development of skills and the learning processes in an enterprise are closely related. Introducing work process-oriented continuing education is a step on the path towards becoming a learning organisation. This demands and promotes a new culture of learning with comprehensive support for continuous and lifelong employee learning. As such, change processes affect more than company training. They also impact on the processes of value creation in the enterprise.

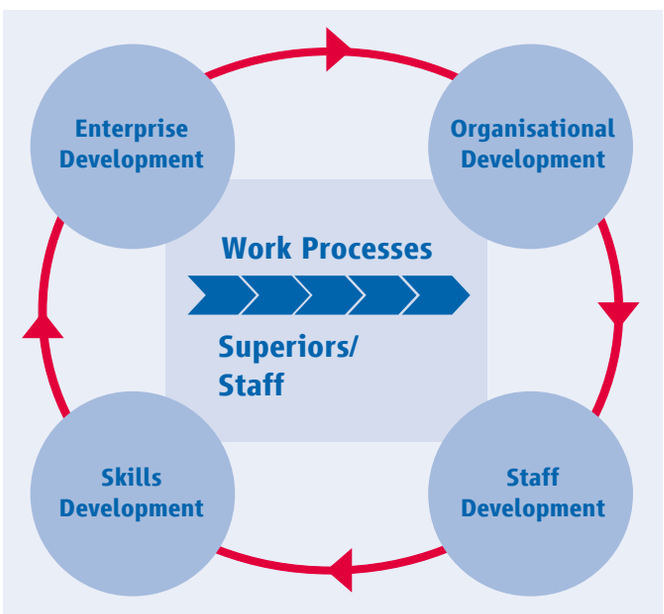


Figure 77: Process-oriented development of specialist staff (Copyright ZVEI)

4.4 Conclusion on education and training in supply chain management

Supply chain management is performed by people, not by tools. Flexibility, speed and efficiency in a global environment can only be achieved and boosted further with highly-trained competent staff. As such, well-organised human capital development is an investment in the future for any enterprise. The themes which are currently seen as high priorities in the area of SCM have been presented in the format of one-page guides.

The necessity of covering supply chain management issues comprehensively in initial and continuing education and training has also been dealt with in depth. Three company examples have shown different forms of organising company education and training at different levels: apprenticeship training, academic study, advanced vocational training modules and other forms of initial and continuing education and training should all increasingly integrate and apply process-oriented education and training (or, better still, work process-oriented continuing education) as a further step on the pathway towards becoming a learning organisation.

5 Appendix

5.1 Participating companies and individuals

Editorial team and group leaders

 **Hans Ehm**	• **Infineon Technologies** offers semiconductors and system solutions in the areas of energy efficiency, mobility and security. Infineon has 26,700 employees worldwide and reported sales of € 3.843 billion for the 2013 fiscal year (running to the end of September). • **Principal Supply Chain Management** 30 years of professional experience, supervisory board member at camLine Holding AG, supply chain management lectures at universities, member of European Leadership Team at the Supply Chain Council (since 2012 also chairperson).
 **Lars Pötzsch**	• **Harting** develops, manufactures and sells electrical and electronic connectors, device terminations, network components and factory-prefabricated cable assemblies for signal, power and data transmission in industrial plants. Harting employs 3,815 people. Sales in the fiscal year 2013 (running to the end of September) totalled € 484 million. • **Manager Global Supply Chain Processing** Within the area of Global Supply Chain Management, Lars Pötzsch is responsible for the systematic development of the supply chain, with the aim of continuing to optimise the flow of material and information across separate plants.
 **Manuela Zeppin**	• **Infineon Technologies** offers semiconductors and system solutions in the areas of energy efficiency, mobility and security. Infineon has 26,700 employees worldwide and reported sales of € 3.843 billion for the 2013 fiscal year (running to the end of September). • **Senior Manager Operations Corporate Supply Chain Logistic Customs** 16 years of professional experience, including 7 in supply chain management. Head of Central Customs from March 2012 onwards. Also a member of the ZVEI working group 'Customs'.
 **Tom Effert**	• **Kostal** develops and manufactures technologically advanced electronic, electromechanical and mechatronic products for major industrial enterprises, including in particular all leading automotive manufacturers worldwide and their suppliers. The global Kostal group has 15,000 employees at 38 locations in 17 countries on three continents and generated total revenue of € 1.973 billion in 2013. • **Director Production Control, Procurement Disposition** 17 years of professional experience in the automotive electrical systems sector in a range of logistics and production roles.
 **Simon Geisenberger**	• **Osram Opto Semiconductors** is a subsidiary of Osram GmbH, one of the world's leading manufacturers in the illumination sector. Osram Opto Semiconductors is headquartered in Regensburg, Germany, and offers solutions based on semiconductor technology in the areas of illumination, sensing and visualisation. • **Initiator Supply Chain Management Academy** Multiple years of international professional experience in the area of continuing training in enterprises. Responsible for setting up and expanding the Osram Opto Supply Chain Academy.

Klaus Neuhaus

- **Sanmina** is a world-class EMS provider with an impressive global footprint. In the fiscal year 2013, the enterprise generated revenue of 5.92 billion USD with 44,000 employees at 75 locations in 25 countries. As an international EMS enterprise, Sanmina offers a comprehensive portfolio of services encompassing innovative product design and product engineering, the entire manufacturing process, test solutions, logistics and post-manufacturing services.
- **Customer Supply Chain Manager**
  With years of experience in purchasing and supply chain management for various automotive and aerospace customers.

Dirk Rimane

- Functional safety is the promise made by **Sasse Elektronik** – an enterprise in the EBE Group – to the customers the enterprise realises product ideas for. Sasse Elektronik is an engineering, manufacturing, and services partner for devices which must meet high standards of safety and reliability. The primary focus of the company is on the area of medical technology. Sasse Elektronik understands the ideas and problems of its customers and finds reliable solutions for people, machines and users.
- **Chief Operations Officer**
  18 years of professional experience in the areas of materials and production management, enterprise management, process and project management. Six Sigma Greenbelt. Extensive practical experience as a lean expert. Lectures at higher education and other institutions on the topics of lean management, lean organisation, and process management.

Daniel Geiger

- **Siemens** (Berlin and Munich) is a global powerhouse in electronics and electrical engineering, which operates in the fields of industry, energy and healthcare as well as providing infrastructure solutions, primarily for cities and metropolitan areas. In the fiscal year 2013 (running to September 30, 2013), revenue from continuing operations totalled € 75.9 billion. At the end of September 2013, Siemens had around 362,000 employees worldwide on the basis of these continuing operations.
- **Graduate in Business Engineering**
  Team leader within the Components and Vacuum Technology Division business unit of Siemens Healthcare, with responsibility for the 'Deliver' process.

Ernst Kastenholz

- **Zollner Elektronik** provides its customers with technology and development expertise across a range of sectors and the necessary process depth along the entire value chain. Zollner has grown organically and established itself among the top 15 enterprises in the EMS services sector worldwide. Standardised equipment and processes are deployed at all 17 international locations, all of which conform to the same high standards of quality, flexibility and security.
- **Director Supply Chain Management**
  Computer science graduate with 26 years of professional experience in IT, production, logistics and SCM. Member of BVL, BME and the MAT Label working group. Speaker and consultant in various contexts. Deputy leader of ZVEI SCM project, leader of the task group for talent development and training in the areas of Supply Chain Management and logistics.

Christian Schober

- **Schober Unternehmensentwicklung** is a consultancy specialising in Supply Chain Management and logistics that offers and implements solutions in the areas of transport management, warehousing, production and hospital logistics throughout Europe. The team of consultants is committed to optimising supply chain costs measurably while also boosting quality indicators.
- **Senior Consultant and Entrepreneur**
  35 years of experience in the transport business, managerial position with DACHSER, graduate in transport management and operations, proprietor at SCHOBER since 1998. Accredited consultant with RKW, DtA/KfW, LfA. Member of BVL, AMMPL, WBU, LCS and the transport committee of the Munich/Upper Bavarian CCI. Also active as a lecturer and trainer, various specialist publications.

Michael Ginap

- **Avineo – balancing supply chains** has been offering tailor-made solutions for optimising the performance of client supply chains in diverse sectors since 2005. Avineo applies an individual 'learn to do-it-yourself' approach and supports companies as a partner with diagnostics, training, coaching and expert counselling in the field of Supply Chain Management and Customer Service Excellence – from strategic planning through to implementation support.
- **Founder and Owner**
  Over 30 years of experience in logistics and Supply Chain Management, lecturer at universities in the field of supply chain management, member of European Leadership Team at Supply Chain Council (former chairperson) and SCOR® Instructor.

In addition to the working committee, the following persons and companies have been involved in various working groups:

Martin Eitler
Advantest Europe

Alessandro Bonara
ASM Assembly Systems

Volker Sindel
ASM Assembly Systems

Christof Blumenröther
Belden Electronics

Dr. Hans-Jürgen Springer
Belden Electronics

Erwin Stöckinger
cms Electronics

Artur Kreus
Electronic Service Willms

Detlef Potthoff
Elmos Semiconductor

Ludwig Krieger
Epcos

Markus Hühn
Escha Bauelemente

Sascha Reitz
Escha Bauelemente

Torsten Schmid
Geutebrück International

Michael Kraft
Göhre

Bodo Eilken
Infineon Technologies

Christoph Hurek
Ingenieurbüro Weiss

Michael Kaps
ITT Cannon

Özer Kürekci
Lacroix Electronics

Thomas Jacob
Mazet

Patrick Stieb
Mektec Europe

Paschasia Bisscho
Melexis Technologies

Ellen Rombouts
Melexis Technologies

Anett Sauerwald
Melexis Technologies

Manuela Dobesch
Osram Opto Semiconductors

Dr. Volker Kuckhermann
Philips Technologie U-L-M Photonics

Christoph Hron
Productware

Marco Balling
Productware

Nicolai Dortmann
Rittal

Roland Glück
Schweizer Electronic

Michael Frosch
Siemens

Stefan Klinke
STMicroelectronics Application

Andre Kremsreiter
Sumida Components & Modules

Martin Hamberger
Sumida Components & Modules

Markus Herckner
Sumida Lehesten

Eric Weimer
TQ-Systems

Stefanie Falk
TTTech Computertechnik

Stella Hofbauer
Tyco Electronics AMP

André Schlesiger
Wago Kontakttechnik

Manuel Uphoff
Wago Kontakttechnik

Jörn Schiller
Weidmüller

Jürgen Ostheimer
Wika Alexander Wiegand

Sebastiano Marsala
Wisi Communications

Edda Ulpkeit
X-Fab Semiconductor Foundries

Rudi Köhler
X-Fab, Dresden

Marius Rieger
ZVEI

Karlheinz Müller
ZVEI

5.2 List of abbreviations

Abbriviation	*Meaning*
2D	Two-dimensional
8D report	Eight disciplines problem solving method
A.TR	Customs document used in trade between EU members and Turkey
AAZ	German for '*Arbeitsablauf-Zeitanalyse*' (MTM Methods-Time Measurement)
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road (Accord européen relatif au transport international des marchandises Dangereuses par Route)
AEB	AEB is a leading provider of IT solutions for global trade and logistics
AEO	Authorised Economic Operator
AEOC	Customs simplifications AEO certificate
AEOF	Combined Customs Simplifications/Security and Safety AEO certificate
AEOS	Security and Safety AEO certificate
AGNB	German General Terms and Conditions for Short Distance Hauling (*Allgemeine Beförderungsbedingungen für den gewerblichen Güternahverkehr mit Kraftfahrzeugen*)
AHStG	German Law on General Higher Education (*Allgemeines Hochschul-Studiengesetz*)
AL	German export list (*Ausfuhrliste*)
ANSI	American National Standards Institute
ANSI X12	Accredited Standards Committee (ASC) X12 within the American National Standards Institute
APICS SCC	APICS Supply Chain Council
APS	Advanced Planning System
APS	Advanced Planning and Scheduling Systems
ASN	Advanced Shipping Notification
ATLAS	German automated tariff and local customs clearance system (*Automatisiertes Tarif- und Lokales Zollabwicklungssystem der dt. Zollverwaltung*)
ATLAS_EAS	German automated tariff and local customs clearance system for summary entry and exit declarations (*Automatisiertes Tarif- und Lokales Zollabwicklungssystem Eingangs- und Ausgangsmeldungen summarisch*)
ATP/AATP	Available to Promise/Advanced Available to Promise
AWG	German Foreign Trade and Payment Act (*Außenwirtschaftsgesetz*)
AWV	German Trade and Payments Ordinance (*Außenwirtschaftsverordnung*)
B.A.	Bachelor of Arts
BAA	Bavarian Academy on Foreign Trade (*Bayerische Akademie für Außenwirtschaft*)

Abbriviation	*Meaning*
BAFA	Federal Office of Economics and Export Control (*Bundesamt für Wirtschaft und Ausfuhrkontrolle*)
BI	Business Intelligence
BICC	Best In Class Companies
BIN	German abbreviation for '*Beteiligten-Identifikations-Nummer*', which is a participant identification code required for ATLAS
BTI	Binding tariff information
BZSt	German Federal Central Tax Office
Capa_PU	Capacity per Production Unit
CAx system	Computer Aided Design / Manufacturing /... systems
CC	Community Customs Code
CE	Communautés Européennes
CFR	Cost And Freight, shipping terms for seafreight
CIF	Cost, insurance and freight paid to named place of destination
CIP	Carriage and insurance paid to named place of destination
CMR	Convention on the Contract for the International Carriage of Goods by Road (French: Convention relative au contrat de transport international de marchandises par route)
CoC	Code of Conduct
CPFR	Collaborative Planning, Forecasting and Replenishment
CPT	Carriage paid to named place of destination
CRM	Customer Relationship Management
CSF	CSF (*Computersoftware für Fachanwendungen*) is a German provider for specialist software
C items	Items with the lowest consumption value according to the ABC analysis
CIP	Continuous Improvement Process
CT	Cycle Time
C-TPAT	Customs-Trade Partnership Against Terrorism
d/a	Documents against acceptance
d/p	Documents against payment
DAP	Delivered At Place (named place of destination)
DAT	Delivered At Terminal (named terminal at port or place of destination)
DCOR®	Design Chain Operations Reference Model®
DDP	Delivered Duty Paid (named place of destination)
DFF	Delivery Flow Factor
DFX	Design for X

Abbriviation	*Meaning*
Dipl.	Diploma
ECR	Efficient Consumer Response
ECSL	European Community Sales List, also known as recapitulative statements
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange For Administration, Commerce and Transportation
EDP	Electronic Data Processing
EICC	Electronic Industry Citizenship Coalition
ELV	End-of-Life Vehicles
EORI	Economic Operators Registration and Identification System
ERP	Enterprise Resource Planning
ESD	Electrostatic discharge
eSTATISTIK.core	Common on-line raw data entry system developed by the German statistical offices to automatically report statistical data from ERP systems
EtO	Engineer-to-Order
EU	European Union
EUR.1	Name of a form used in the movement of goods across national borders (movement certificate).
EUR-MED	Similar to the EUR.1 form. It is used when goods can only meet the rules of preference origin by taking into consideration material from Mediterranean countries not in the EU
EXTRASTAT	System for collecting information and producing statistics on the trade in goods between countries of the European Union and third countries
EXW	Ex works named place
FAMPS	Failure Analysis and Maintenance Planning System
FAS	Free Alongside Ship (named port of shipment)
FCA	Free Carrier (named place of delivery)
FF	Flow Factor
FH	Universities of Applied Sciences (*Fachhochschule*)
FMEA	Failure Mode and Effects Analysis
FOB	Free on Board (named port of shipment)
Form A	Certificate of origin for goods exported from a beneficiary country to the Community
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GMMOG/LE	Global Materials Management Operations Guideline/Logistics Evaluation

Abbriviation	*Meaning*
GR	Going Rate (throughput)
GTL	Global Transport Label
HADDEX	Handbook of German Export Control (*Handbuch der deutschen Exportkontrolle*)
HGB	German Commercial Code (*Handelsgesetzbuch*)
HS	Harmonised System or tariff nomenclature maintained by the World Customs Organisation (WCO)
ICC	International Chamber of Commerce
IDEV	Internet-based data collection of the German statistical offices
IHS	Information Handling Services
ILO	International Labour Organization
Incoterms®	Rules for the use of domestic and international trade terms maintained and released by the International Chamber of Commerce
INTRASTAT	System for collecting information and producing statistics on the goods trade between European Union countries
IT	Information Technology
JIS	Just-in-Sequence
JIT	Just-in-Time
K&M	German reference work for export business containing consular and model rules (*Konsulats- und Mustervorschriften*)
KVO	German Traffic Ordinance (*Kraftverkehrsordnung*)
KWKG	German Law of War Weapon Control (*Kriegswaffenkontrollgesetz*)
L/C	Letter of Credit
LBA	German Federal Aviation Office (*Luftfahrt-Bundesamt*)
M.A.	Master of Arts
M4SC	This methodology introduced along with the SCOR® model in the mid-90s has proved to be reliable for the practical analysis and design of supply chains and can also be used for the strategic coordination of aforementioned methods thanks to its top-down approach. Only recently, this (project) methodology has been expanded to include the 'Management for Supply Chain' (M4SC) concept.
MAPE	Mean Absolute Percentage Error
MAT label	Standardised material label
MES	Manufacturing Execution System
MPS	Master Production Schedule
MRP	Material Requirements Planning
MRP II	Manufacturing Resources Planning
MTM	Methods-Time-Measurement

Abbriviation	*Meaning*
MtO	Make-to-Order
MtS	Make-to-Stock
NCTS	New Customs Transit System for Europe
Non-BICCS	Non-Best in Class Companies
OEM	Original Equipment Manufacturer
OTH	Technical University of Applied Sciences in Regensburg, Germany
OTIF	On-Time In-Full
PBB	Polybrominated biphenyls
PBDE	Polybrominated diphenyl ethers
PDA	Personal Digital Assistant
PDA/MDA	Systematic acquisitioin of production and machine data
PDCA	Plan / Do / Check / Act = problem solving process
PLM	Product lifecycle management
PPC	Production planning and control system
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
REFA	Name of German Association for Work Design/Work Structure, Industrial Operation and Corporate Development
RoHS	Restriction of Hazardous Substances
RosettaNET	Organisation set up by leading information technology companies to define and implement a common set of standards for e-business
RPT	Raw Process Time
S&OP	Sales & Operations Planning
SAP	SAP, German software provider
SC	Supply Chain
SCM	Supply Chain Management
SCOR®	Supply Chain Operations Reference Model®
SIC	Inventory Management
SMAPE	Symmetric Mean Absolute Percentage Error
SMI	Supplier managed inventory
SRM	Supplier Relationship Management
T1/T2 procedure	Procedure used for goods moving between the EC and EFTA countries
TPM	Total Productive Maintenance
TRG	German Transport Law Reform Act

Abbriviation	*Meaning*
TSCMS	Total Supply Chain Management Costs
TÜV	German Technical Inspection Agency (*Technischer Überwachungsverein*)
UNO	United Nations Organisation
VTA	Value added tax
VAT reg. no.	Value added tax registration number
VDA	German Association of the Automotive Industry (*Verband der Automobilindustrie*)
VDA label	Standardised label developed by VDA
VMI	Vendor managed inventory
VWA	*Verwaltungs- und Wirtschaftsakademie*
WebEDI	Web-based (WWW) interface for the electronic data interchange system (EDI)
WIP	Work in Progress / unfinished products in production
WCO	World Customs Organisation
WSTS	Word Semiconductor Trade Statistics
WTO	World Trade Organisation
ZSG	ZVEI's service company
ZVEI	German Electrical and Electronic Manufacturers' Association
ZWW	Centre for adult education and knowledge management (*Zentrum für Weiterbildung und Wissensmanagement*)

5.3 Symbols

5.4 Figures

5.5 Tables

5.6 Bibliography

- APICS Supply Chain Council (SCC). (2014). ‚www.supply-chain.org'. accessed am October, 1st 2013 (footnote 4)
- Becker, T. (2005). ‚*Prozesse in Produktion und Supply Chain optimieren*' (1st Edition). Springer. (footnote 21)
- Becker, T. (2007). ‚*Prozesse in Produktion und Supply Chain optimieren*' (2nd Edition). Springer. (footnote 17)
- Beckmann, H. (2004). ‚*Supply Chain Management: Strategien und Entwicklungstendenzen in Spitzenunternehmen*'. Springer. (footnotes 3, 18, 20)
- Blecker, T. und Kaluza, B. (2000). ‚*Flexibilität – State of the Art und Entwicklungstrends*'. Springer. (footnotes 2, 8)
- Christopher, M. (1998). ‚*Logistic and Suply Chain Management: Strategies for Reducing Cost and Improving Service*' (2nd Edition). Pitman Publishing. (footnote 1)
- Cohen, S., & Roussel, J. (2013). ‚*Strategic Supply Chain Management: The Five Core Disciplines for Top Performance*'. New York, NY, McGraw-Hill (figure 4)
- Corsten, D. und Gabriel, C. (2004). ‚*Supply Chain Management erfolgreich umsetzen: Grundlagen, Realisierung und Fallstudien*' (2nd Edition). Springer. (footnotes 24, 38)
- Dumke, D. (2013). ‚*Strategische Ansätze zur Risikoreduktion im Supply Chain Netzwerkdesign*'. Josef Eul Verlag. (footnote 19)
- Durchholz, J., Klenk, E. und Boppert, J. (2013). ‚*Schlanke Logistikprozesse*'. Springer. (footnote 45)
- Gruber, Dr. Kurt. (2012). ‚*Key Note Presentation European Supply Chain Council Conference*'. Madrid, (Powerpoint slide page 22). (footnote 33)
- Günthner. (2007). ‚*Neu Wege in der Automobillogistik: Die Vision der Supra-Adaptivität*'. Springer. (footnote 9)
- Heiserich, O.-E., Helbig, K. und Ullmann, W. (2011). ‚*Logistik: Eine praxisorientierte Einführung*'. Springer. (footnotes 44, 46)
- Hildebrand, W.-C. und Roth, A. (2008). Führungskräfte für die Logistik – Akademische Ausbildung in Deutschland. In ‚*Das beste der Logistik*' (page 69-79). Springer (footnote 76)
- Himpel, F., Kaluza, B. und Wittmann, J. (2008). ‚*Spektrum des Produktions- und Innovationsmanagements*'. Gabler Verlag. (footnotes 41, 42)
- Hopp, W. J., und Spearman, M. L. (2011). ‚*Factory Physics*'. Long Grove, IL, Waveland Press. (footnote 13)
- Hribernik, K. A., Ghrairi, Z. und Carl, H. (2011). Co-creating the Internet of Things – First experiences in the participatory design of Intelligent Products with Arduino. ‚*IEEE*' (page 1-9). (footnotes 36, 43)
- Kajüter, P. (2007). Risikomanagement in der Supply Chain: Ökonomische, regulatorische und konzeptionelle Grundlagen. ‚*Risikomanagement in Supply Chains*' (S. 13-27). (footnote 30)
- Kersten, W., Hohrath, P., Winter, M. (2008). ‚*Risikomanagement in Wertschöpfungsnetzwerken: Supply Chain Risk Management*'. Fachhochschule des bfi Wie Gesellschaft. (footnotes 22, 49, 50)
- Kilger, Ch., Müller, A. (2002). ‚*Integration von Advanced Planning Systemen in die innerbetriebliche DV-Landschaft.*' Gabler. (footnote 32)
- Lasch, R. und Janker, C. (2007). ‚*Risikoorientiertes Lieferantenmanagement*'. Vahrenkamp (page 111-132). (footnotes 23, 39, 40)
- Lasch, R., Bogaschewsky, R. und Essig, M. (2011). ‚*Supply Management Research – Aktuelle Forschungsergebnisse 2010*'. Gabler Verlag. (footnote 37)

- Lee, H. L. (2004). ‚The Triple-A Supply Chain'. Harvard Business Review (page 1-10)
- Lee, H. L., Padmanabhan, V. und Whang, S. (1997). *‚The Bullwhip Effect in Supply Chains. Sloan Management Review'*. (footnotes 14, 15)
- Lu, N. (2004). ‚Plenary Talk'. ISSCC
- Moore, G. E. (1998). *‚Cramming more components onto integrated circuits. Electronics. Reprint in Proceedings of the IEEE'*. (page 86(1), 8285). (footnote 5)
- Nienhaus, J., Ziegenbein, A. und Schönsleben, P. (2006). *‚How human behaviour amplifies the bullwhip effect – A study based on the beer distribution game online'*. Produktion, Planing & Control. Vol. 17, Issue 6 (S. 547-557). (footnote 16)
- Pfohl, H.-C. (2004). *‚Logistikmanagement: Konzeption und Funktionen'* (2nd Edition). Springer. (footnote 12)
- Rogler, S. (2002). *‚Risikomanagement im Industriebetrieb: Analyse von Beschaffungs-, Produktions- und Absatzrisiken'*. Deutscher Universitätsverlag. (footnotes 27, 28)
- Schulte, Ch. (2012). *‚Logistik: Wege zur Optimierung der Supply Chain.'* Vahlen (footnote 35)
- Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., und Bishop, W. (2007). *‚Designing and Managing the Supply Chain'* (3rd Edition). McGraw Hill Higher Education. (footnote 10)
- Syska, A. (2006). *‚Produktionsmanagement: Das A – Z wichtiger Methoden und Konzepte für die Produktion von heute'*. Gabler Verlag. (footnote 47)
- Vahrenkamp, R., und Siepermann, C. (2007). *‚Risikomanagement in Supply Chains: Gefahren abwehren, Chancen nutzen, Erfolg generieren'*. Erich Schmidt Verlag. (footnotes 25, 31)
- VDA-Projektgruppe Programm- und Produktionsplanung – Forecast (2008). *‚VDA-Empfehlung 5009 (Forecast Qualitätskennzahl: Definition und Anwendung)'*. Frankfurt, Verband der Automobilindustrie. (footnote 7)
- Wannenwetsch, H. (2005). *‚Vernetztes Supply Chain Management: SCM-Integration über die gesamte Wertschöpfungskette'*. Springer. (footnote 34)
- Wildemann, Univ.-Prof. Dr. H. (2002). *‚Supply Chain Management'*. TCW Transfer-Centrum. (figure 3)
- Zhang, G. Q., und Roosmalen, A. c. (2009). *‚More than Moore'*. Springer-Verlag. (footnote 6)
- Ziegenbein, A. (2007). *‚Supply Chain Risiken: Identifikation, Bewertung und Steuerung'*. vdf Hochschulverlag. (footnote 29)
- Zschorn, L., und Käschel, J. (2007). Ein Ansatz zur Quantifizierung von auftragsbezogenen Unsicherheiten in Produktionsprozessen. In *‚Risikomanagement in Supply Chains: Gefahren abwehren, Chancen nutzen, Erfolg generieren'*. (page 149-160). Erich Schmidt Verlag. (footnote 26)

5.7 Customs and foreign trade guide (long version)

Introduction

Skills in customs and foreign trade are critical for enterprises seeking to become or remain competitive in international markets.

As EU enlargement simplified trade between EU member states over the last 20 years, expertise that used to be available in every company with an international presence became rare. Now, however, increasing globalisation and the international division of labour are triggering a sharp and ongoing increase in the number of business contacts with 'third countries'. Handling trade with these countries expertly is now an essential component in business success.

Under German law, the export compliance manager in any company – a member of the management or executive board – is personally liable for violations of export regulations. The buck stops with the export compliance manager: he or she cannot plead ignorance of regulations or blame problems on misunderstandings.

Some of the skills required for tasks relating to customs compliance and foreign trade are already present in enterprises – but distributed over a range of positions and functional areas. Often, individuals or groups within an enterprise are not conscious of their own position within the supply chain.

It follows that all companies with international operations must create **internal organisational structures** that reflect these structures of personified responsibility appropriately and respond professionally to the alarming laxity with which the area of foreign trade is often handled.

Definition

International trade is the exchange of goods, services and capital across international borders or territories (source: Wikipedia). In Germany, the **customs authorities** are subordinate to the Federal Ministry of Finance and are tasked mainly with the *collection of tax* in general, the *levying of excise duties* in particular, the *provision of clearance procedures*, *risk analysis for the trade in goods*, the enforcement of *market regulations* and debt collection on behalf of the Federal Republic (Source: www.zoll.de).

Aims

Aims here fall into two categories: the (**once-off**) **task of creating the prerequisites for developing new markets**, and the **medium/long-term safeguarding of a cost-effective**, **low-risk** and **high-quality** (**and therefore also high-speed**) supply chain.

Potential

- Opportunities to make strategic decisions about entering foreign markets – in advance,
- avoidance or at least **minimisation of legal risks**,
- knowledge of and therefore also consideration (and possibly avoidance or **minimisation**) **of tariff and non-tariff barriers to trade**,
- **securing the stability of the supply chain** (for example through transparency, processes, documentation),
- **avoiding time delays** (due for example to customs clearance formalities, processing of payments, issues with documentation or labelling),
- **reduction of costs** (temporary storage unrelated to transportation, interfaces and media discontinuity, duration of transportation, customs and import duties, costs of finance and risk mitigation).

Content

1) Finance
   a) Optimised/adapted cash management,
   b) export and import finance, including letters of credit,
   c) mid-term and long-term project financing,
   d) state subsidies or loans.

2) Sales law
   a) Preliminary contracts, contract drafting,
   b) specific aspects of international contract law,
   c) applicable law,
   d) evaluation of contractual partners.

3) Pursuit of legal remedies abroad
   a) The role of contracts, contract quality,
   b) mediation, international arbitration,
   c) legal disputes, place of jurisdiction.

4) Delivery and payment terms
   a) Payment, trade, and insurance documentation,
   b) (import and export documents for foreign trade),
   c) (customs documents),
   d) delivery terms/INCOTERMS®,
   e) payment terms (for example: DP, DA, LC).

5) Risk management in roreign trade
   a) Risk strategy,
   b) risk analysis and evaluation,
   c) awareness raising,
   d) the *most important* risks: goods, currency, country-specific, payment and product liability risks.

6) Foreign trade law, including customs law
   a) Foreign trade regulations, e. g. the German Foreign Trade & Payments Act, Turnover Tax Act, Combined Heat and Power Act and WTO/GATT rules,
   b) customs law,
   c) tax law,
   d) mandatory reporting (German Foreign Trade Statistics Act , Extrastat, Intrastat, movement of payments and capital),
   e) market regulation.

7) Import and export clearance
   a) Import clearance:
      i. import procedures,
      ii. types of customs tariffs,
      iii. contingents,
      iv. duties and rating,
      v. origin of goods and preferences,
      vi. customs procedures (including partial relief from import duties, re-exporting etc.).

   b) Export clearance:
      i. normal export clearance procedures,
      ii. customs procedures (for example T1, T2, TIR, inward/outward processing),
      iii. export controls (restrictions depending on countries and goods, dual use, export list).

Target group:

strategic *and* operative roles!

Possibilities for meeting requirements – depends on content (see above)

1), 6)c. und 6)d. enterprise finance department,
2) und 3) enterprise legal department,
5) enterprise management,
4), 6)a., b., e. und 7).

Initial vocational training in recognised occupations

- Management assistant in wholesale and foreign trade – specialising in foreign trade,
- foreign trade assistant (supplementary qualification taken alongside an apprenticeship such as forwarding clerk, open to school leavers with a university entrance qualification (*Abitur*) and a training contract),
- business economist (foreign trade) (supplementary qualification taken alongside an apprenticeship, open to school leavers with a university entrance qualification (*Abitur*) and a training contract).

Advanced vocational training

- Business economist (foreign trade) (taken at a training centre by students who have completed a recognised apprenticeship after leaving school with a university entrance qualification),
- management assistant for foreign trade,
- bachelor in financial management.

Institutions of higher learning

- **International business administration and foreign trade**,
- various specialist courses – mainly distance learning,
- for example: IBA International Business Administration and Foreign Trade at *Hochschule Worms*,
- (B.A., M.A. and Diploma courses).

Company training

1. On-the-job

Opportunities exist here only in very well-staffed enterprises. **Exchange programmes across enterprises** could possibly be organised (for example between ZVEI members).

2. Off-the-job

A broad range of seminars and continuing education options is available. Examples and providers – the list is incomplete and in no way intended as a ranking – include:

- Chambers of Commerce and Industry
- Chambers of Commerce
- TÜV Nord, TÜV SÜD
- DAA (Deutsche Angestellten Akademie)
- BVL (Bundesvereinigung Logistik) – Customs Expert Certificate (three modules dealing with imports, exports and customs).
- HZA (Hamburger Zollakademie) www.hza-seminare.de
- ZAK (Zoll- und Außenwirtschaftskolleg) www.zollseminare.de
- AHV (Akademie Hamburger Verkehrswirtschaft) www.ahv.de
- BAA (Bayerische Akademie für Außenwirtschaft) www.bayerischeakademie.de
- SGD (Studiengemeinschaft Darmstadt,) for example Foreign Trade and Export Management course leading to CCI certificate

Additional notes:

- Former customs officers from the middle and higher grades of the customs service who are in pre-retirement or wish to switch to private-sector employment make particularly suitable candidates.
- The *official curricula* for the qualifications 'Forwarding clerk' and 'Bachelor professional (CCI) of transport management and operations' demand only a rough (inadequate) knowledge of customs and foreign trade.

ZVEI
Die Elektroindustrie

ZVEI - German Electrical and Electronic
Manufacturers' Association
Lyoner Straße 9
60528 Frankfurt am Main, Germany

Phone: +49 69 6302-0
Fax: +49 69 6302-317
E-mail: zvei@zvei.org
www.zvei.org

www.zvei.org