



Learning Objectives for This Chapter

- Role of purchasing, procurement, and sourcing in SCOM
- Basic elements of sourcing process
- Make-or-buy vs. outsourcing
- Organizational issues in sourcing
- Sourcing strategies according to number of suppliers, geographical supplier distribution, and sourcing principles
- Methods of spend analysis and supplier selection
- Elements of supplier relationship management (SRM)

5.1 Introductory Case Study “New Logistics Concept (NLK: Das Neue Logistik Konzept) at Volkswagen”

In 2011, new goals for 2018 for the Volkswagen Group were announced: 20% cost reduction; 50% fewer complaints about defects in new vehicles; 30 great innovations; higher employee satisfaction; perfectly trained workers; only 8 weeks between start and full operation of serial production—and all of this with 25% less environmental damage. These seven commandments have to be carried on an aluminum card by each VW production manager.

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The new Volkswagen production system (VPS) and the new logistics concept (NLK) at Volkswagen (VW)

Despite many achievements, the Volkswagen Group also faces many challenges concerning productivity, which is mainly influenced by production and logistics. While its biggest competitor, Toyota, produces on average 30 vehicles per employee each year, at VW this number is only 17.

Other challenges are: different production processes at globally distributed VW locations; demand variations and missing flexibility in production and logistics; larger stocks as a consequence of separated production and logistics planning; and the continuous development of new technologies (e.g., hybrid and electrical vehicles).

Toyota's success can be traced back to lean production. Just-in-time (JIT) (no -on-stock production and logistics), Kaizen (continuous improvement) and Jidoka (avoiding errors through intelligent automation) are the three pillars of lean production. The new Volkswagen production systems (VPS) and the new logistics concept (NLK) should improve production and logistics performance.

Through the new VPS-System, costs per vehicle should decrease by about 1500 €. This should be achieved through:

- introduction of flexible assembly lines, producing various models (e.g. the new VW plant in China can produce two different Golf models, as well as two different Audi models on the same assembly line);
- standardization of production processes (e.g. one painting procedure for all 90 plants instead of 90 different ones as is now the case);
- reduction in the number of variations (e.g. only 28 variations of air-conditioning instead of 102 as is now the case).

The VW Group follows an ambitious strategy with VPS and is facing big challenges ahead. In the future, more models of different brands need to be produced in one factory to be able to react more flexibly. VW is, as of now in its factories in emerging markets, building models of Skoda, Audi, and Volkswagen in one factory. This has never happened in the past. The logistics concepts of the last 20 years no longer fit here.

NLK is used on a broad basis at AUDI and in the overall Volkswagen Group. The aim is the optimization of the supply process between suppliers and the Volkswagen Group. Through exact matching of supply schedules with shorter lead times, improvement in the flow of goods will be achieved. Advantages for shipment handling on the supplier side will result in: shorter lead times; better planning of production through "frozen periods"; and a reduction in production materials.

In the past, VW used inventory to supply production. To be able to react to any demand from production, materials had to be stored. But if material only sits without moving, no value is added for VW. It is a waste which will be sustainably eliminated in the new system.

The idea is to make processes leaner and thus reduce lead times. The production and logistics processes must be synchronized. If production has a cycle time of

1 min, meaning that every minute one vehicle leaves the assembly line, then VW will also apply this cycle time to logistics, from the line back to the supplier: this is new. One can imagine it working like this: there is cycled traffic in the direction of the line to the material input. If there are 20 parts in a bin, the bin needs to be exchanged after exactly 20 cycles; VW needs to apply the same cycle time back to suppliers.

In the development of the concept and its implementation, all parties are intensively involved and make substantial contributions. Collaboration with the factories' logisticians is very important. Mr. Stein, head of the NLK project said (Automobil-Produktion 2014):

We are optimizing ourselves from inside to outside. We have a number of internal and external customer relationships within our processes, so the assembly line worker is a customer of the supplier. The optimized interaction within production was the starting point for consideration. We are speaking of a triangle; that means the assembly worker has a spot at the vehicle he is working on and a bin from which he gets the needed materials. Now the material availability is organized in a way where he literally does not have any walking routes and therefore the focus is on value-adding activities. Formerly, the materials were stored in multiple bins; today we are sequencing the material before sending it to the assembly line. This sorting is already happening, if possible, on the supplier side.

Such a concept is called "supermarket". The materials are apportioned and prepared for each sequence in the line.

The IT systems are also one of the success factors of the project. As the Volkswagen Group has focused on reducing lead times, it is necessary to adjust EDI (electronic data interchange) flow by planning exact pick-up and delivery times. This way, during a pick-up of goods, the freight forwarder does not need to stop at only one supplier, but can make multiple stops along a fixed route (so-called milk runs). This process must be visible in the new EDI flow. New to the NLK process is the use of the order message system, EDIFACT GLOBAL DELJIT, which documents precisely the order process for the goods.

It looks like this. The *retrieval module* processes the preview received for production planning. It is used for rough classification of the scheduled pick-ups. More detailed orders/fine planning are processed through dispatch calls. In the *JIT module*, the dispatch calls received are shown. An overview of all orders can be seen and additionally printed out. The *JIT monitor* shows the orders, supervises all of the orders, and tells the supplier when the next delivery is needed. On the JIT monitor, information is split up in DELJIT by date and customer. The current delivery statuses are shown on the monitor and provide information about all materials delivered. Each delivery is announced through an EDI *delivery note*. The transfer of delivery notes should be made during the dispatch of transport by the supplier. The goods that are to be delivered should also be marked with a goods label. The former VDA4902 barcode label is replaced by the new *global transport label (GTL)*. There also exist optional modules for direct connection to the ERP systems. Radio-frequency identification (RFID) is also employed in material logistics. Meanwhile, the readability of active and passive transponders is excellent. However, it will be

some time before there is broad implementation. The tags with which the bins have to be equipped are, at the moment, still too expensive.

The concept will be implemented step by step at all worldwide locations. Naturally, not everything can be achieved at once. The time frame is greatly influenced by product start in the factories. With a new product, new processes will also be used. Therefore complete implementation will stretch over the coming years. During this type of planning, there is a program that is constantly changing, unlike a project which is completed after a few years. VW has started to optimize their in-house area, and now they are starting to step outside, into supply and transporting networking. Close collaboration with suppliers and service providers will change the in- and outbound processes step by step.

Discussion

- Describe the new development of production and logistics concepts at VW as follows: problem description → target → solution/changes → implementation → results.
- Which sourcing strategy is the VW group following?
- What is lean management?
- What do you understand by the term “cycle time”?
- Why is the synchronization of logistics and production processes important?
- Which information technologies are being used at VW in the new project?

5.2 Sourcing Process and Principles

5.2.1 Procurement, Purchasing and Sourcing

This section deals with the definition of procurement, purchasing, and sourcing which can be differentiated as follows (see Fig. 5.1).

According to Lysons and Farrington (2012), *purchasing* is “the process of procuring the proper requirement, at the necessary time, for the lowest possible cost from a reliable source”. Purchasing deals mostly with commercial activities and is related to transactional, ordering processes.

Procurement covers a broader scope than purchasing and covers both acquisitions from third parties and from in-house providers. It also involves options appraisal and the critical “make-or-buy” decision.

Sourcing needs to be understood as the entire “set of business processes required to purchase goods and services” (Chopra and Meindl 2012). The correlated activities range e.g., from the selection of suppliers, to drawing up contracts, product design and collaboration, to evaluation of supplier performance. Broadly speaking, sourcing is the process of establishing and managing supplier relationships in the SC. In the narrow sense, sourcing is related to the activities and processes which provide the enterprise with materials, services, capital equipment, means of production, tools and supplies for work, etc. from external suppliers or partners. In practice, sourcing

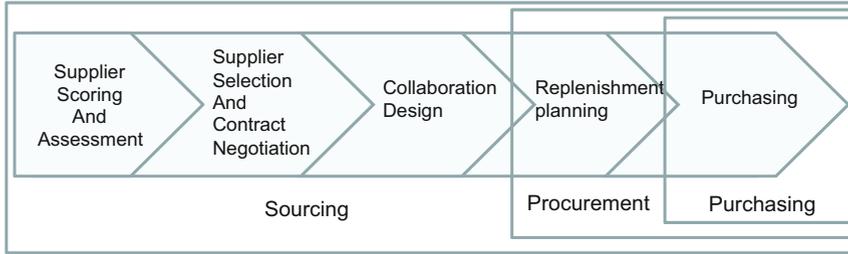


Fig. 5.1 Purchasing, procurement, and sourcing [adopted with changes from Mangan et al. (2008)]

integrates the strategic and operative decision-making levels and coordinates supply strategy, procurement, and purchasing activities. It is a fundamental element of SCOM as it is the linking process which provides the organization with the inputs required for the creation of their products or services.

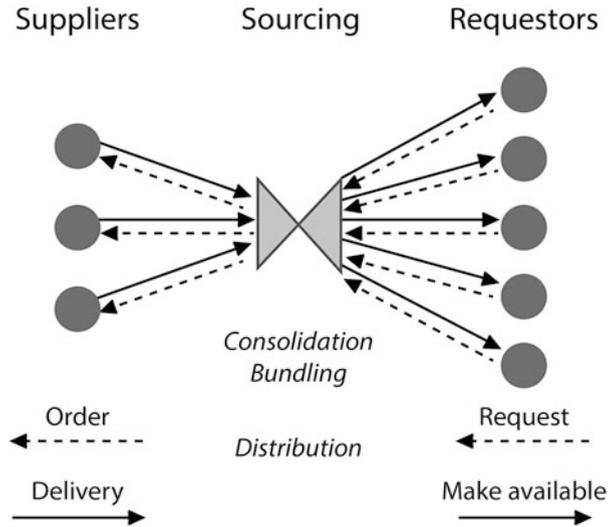
Sourcing is a very important activity in the SC. The purchased parts and materials can account for over 60% of the cost of finished goods; for retail companies within the SC this can be as high as 90%. The quality of purchased material, costs of goods bought, delivery of goods or services on time, supplier management, and supplier relationships are some of the factors that have a significant impact on SC performance and place particular demands on procurement managers. As sourcing is a very important and broad subject, this chapter focuses on the principles, processes and organizational factors around sourcing strategies in SCOM and related activities.

5.2.2 Sourcing Process

In general, the *sourcing process* connects the supply side with the demand side, so that the so-called sourcing objects will be made available to the requestor. This is illustrated in a simplified way in Fig. 5.2, which depicts the high-level linkage between the requesting and the supplying side. In order to better understand the details behind these processes, it is important to develop a clear understanding of the content and objectives of sourcing activities, which include the following elements:

- *Determination of material requirements*: the type, composition, configuration, quality, volume, location, and timing for the delivery of the sourcing objects;
- *Order management*: determination of order volumes, frequencies, times, and specification of logistical conditions. Also the supervision of accurate deliveries, goods reception, invoice control and approval can belong to the generic sourcing process;
- *Supplier base research, observation, and analysis*: analysis and evaluation of the supplier base, assessment of potential new partnerships, and elaboration of (strategic sourcing) recommendations, preparation of negotiations, contracts, etc.

Fig. 5.2 Generic sourcing process [based on Kummer et al. (2013)]



- *Make or buy decisions:* identification of internal/external value adding scope depending on the core competencies, but also comparison of capacities, lead times, costs, etc.
- *Supplier management:* auditing suppliers, running performance management assessments, e.g., regarding on-time deliveries, quality, reliability, flexibility, etc. This is also related to supplier development or initiation of a substitution of suppliers.

It must be understood that sourcing objects can be product and non-product related. For example, in a restaurant, there are SCs both for food (i.e., product related sourcing) and for kitchenware (i.e., non-product related sourcing). Table 5.1 shows a selection of related examples, but of course the table could be extended by additional items.

The examples in Table 5.1 also indicate that a company is dealing with a large number of different suppliers on a daily basis and firms are also in regular contact with potential new suppliers. To make this a little bit more specific, we will show an example of companies from the heavy investment goods industry (like turbines, planes, trains, etc.), in which approximately 35,000 suppliers are documented in the SRM System.

It is important to mention that not all of these suppliers are of equal importance. The company will deal with some suppliers on a very regular basis and with others more occasionally. Out of these 35,000 suppliers, for example, perhaps 500–600 form the core supplier base.

Table 5.1 Examples of sourcing objects

Examples for product related sourcing objects	Examples for non product related sourcing objects
Raw material (e.g. metal plates, wood, stones, ...) Auxiliary supplies (e.g. screws, nuts, bolts, glue, ...) Consumables/operating supplies (e.g. oil/grease, gasoline, ...) Purchased parts (e.g. sparks, valves, muffler parts, ...) Purchased assembled modules (e.g. navigation system; bumper with grill and fog lights ...) Purchased developed systems (e.g. development and pre-assembly of the complete HVAC System fitted to the front module ...) Trade goods (e.g., bag for a notebook, DVDs for the camcorder. ...)	Capital intensive equipment (e.g. cranes, milling machines, warehouse shelves and equipment ...) Spare parts for production or for maintenance (e.g. drillers, cutting-disks, machine spare parts, lightbulbs ...) Office supplies (e.g. paper, pens, staplers, ...) Personnel (e.g. via recruiting-firms, hiring consultants or temporary staff, ...) Information and business related services (e.g. competitor analysis, planning and conduction of exhibitions, events, business travel bookings, ...) Capital or financial services (obtaining loans, external financial support ...)

5.2.3 Make-or-Buy and Outsourcing

“*Make or buy*” is a strategic decision that determines if the sourcing objects are internally made or externally sourced. Such strategic decisions might also be related to the question of core competencies. Companies might even have their own in-house suppliers, which prepare certain modules or systems and present them to the assembly line once they are needed (this could be an exclusive steering wheel that is handmade for one car customer and which is presented to the assembly line). It could also be that propulsion components for railway manufacturers are pre-assembled by in-house suppliers or internal wing components pre-assembled for an aircraft producer.

- ▶ **Practical Insights** For example, a car manufacturer keeps the creation of the tools they use to produce metal components such as fenders, doors, hoods, etc. in-house in order to avoid characteristics regarding the outward appearance of the car being handed over to competitors in the very early stages of the design phase. This decision for “make” is mainly driven by the desire to avoid imitation of the car design.

Make-or-buy decisions have an impact on the overall level of in-house value creation; respectively, it is closely linked to decisions around production strategy. When we talk about make-or-buy, the sourcing team will need to decide jointly with manufacturing experts whether external purchasing (“buy”) might be the economically preferable solution or if the respective part should be produced in-house (“make”). As detailed earlier, a detailed analysis of the TCO (*total costs of ownership*) is highly recommended for make or buy decisions. Such a decision will also

need to consider competitive factors regarding core competences or the fear of providing external parties with knowledge that would offer the opportunity for imitations. In such cases the in-house “make” will be the preferred choice, even when external sourcing might be considered the economically more attractive alternative.

On the other hand, if the relevant value adding processes have historically been performed by an organizational unit’s own people and the decision has been made to externalize certain processes (i.e., to buy), so-called outsourcing takes place. This means that *outsourcing* is a result of a make-or-buy decision. Some of the common issues in outsourcing analysis are as follows:

- lower production cost
- better use of available resources
- focus on core competencies
- cost restructuring
- reduction of time-to-market
- risk sharing
- know-how sharing
- quality issues
- flexibility
- tax benefits.

► **Practical Insights** False outsourcing decisions may ruin a company. A supplier for a ship building yard decided to outsource a welding process that was placed exactly in the middle of its technological process. However the order quantity was quite low (this was the reason for outsourcing) and new subcontractor always scheduled these orders as unimportant since it was not interested in maintaining a high service level for such an unimportant customer. As a result, the lead time for deliveries at the ship building yards increased from 10 days to 35–40 days. The procurement manager needed to contact the subcontractor frequently and ask them to speed up the orders. In a few months, the ship building yard cancelled the agreement. In the case of low machine utilization at a process step, it can be more sensible to try to in-sourcing additional orders for this machine rather than outsourcing a part of technological processes, especially if it is in the middle of the process.

Make-or-buy is not only connected to pure manufacturing processes. For example, raw materials or single loose parts can be evaluated; it can also be applied to modules or services, such as IT services, transportation logistics, or management of facilities (e.g. cleaning, maintenance, or security services). Furthermore, mixed solutions between buying and making are also possible in order to match market demands.

The following selection provides a summary based on Kummer et al. (2013) reflecting on possible parameters that might be considered when a company is deciding whether to “make” or “buy”:

- *Core competence/strategic fit*
 - What are the unique capabilities that are very difficult to imitate?
 - What are the strategic objectives the company needs to meet?
 - Does the focus on lean production require an adaptation of the production depth?
 - Is it necessary to buy more in new markets because of local content requirements?
- *Variety and/or stability on the demand side*
 - What is level of demand we can stably meet with our existing capacity and when is it recommended to increase peak capacity needs by temporary supplementary external sourcing?
- *Production capacity on the sourcing side*
 - Are there existing contracts (e.g. purchasing agreements or sales orders) that need to be fulfilled and which will impact the make-or-buy decision?
- *Autonomy*
 - Do we jeopardize our competitive position by providing external parties with confidential drawings, intellectual property rights, new research results, etc.?
 - Is there a risk that we might even create a future competitor by going for a buy decision that will lead to a know-how transfer?
- *Dependency on suppliers*
 - By increasing the level of external purchases, dependency on suppliers, their quality, reliability, and punctuality can significantly influence the organization’s own reputation: Do we have a strong or weak market position and how does it look for suppliers?
- *Evaluation of the cost structure*
 - In the case of “make” decisions, the corresponding costs are linked to e.g., material and labor costs, salaries, or the depreciation cost of the equipment in use. In the case of “buy”, the decision will be related to purchasing, transportation, handling, storage, or transportation costs.
- *Financial shortage or need for capital*
 - Especially at times of financial shortages, the decision to externally source parts, modules or services is an important factor as it relieves cost pressures.
 - In practice, decisions will, in addition to the qualitative criteria, be combined with quantitative methods to further substantiate the selection process.

5.2.4 Organization of Sourcing Processes

The last dimension in the management of the sourcing process is related to the *organization of sourcing activities*. This dimension is focused on the organizational set-up of the buying party or parties. A company can buy goods on its own individually, but it could also be that a few companies jointly specify the goods that should be sourced from one supplier. This means that these few companies are organizationally creating a sourcing alliance.

In terms of the appropriate terminology, we could summarize that, in contrast to the individual sourcing process, collective sourcing might be a reasonable strategy. Heizer and Render (2013) give as examples small manufacturers of motorboats that formed such alliances in order to aggregate their demand for motorboat engines; or hospitals that ordered clinical supplies in a cooperative, thus benefiting from the effects of larger ordering volume.

In the case of a global player in the telecommunications industry, a company might be in a supplier–customer relationship with approximately 20,000 suppliers in 80 countries. Many different suppliers and different parts exhibit different characteristics: it is important to stress that a company needs to define a sourcing strategy that fits its individual purpose. Sourcing strategies will be considered in the next section.

5.3 Sourcing Strategies

Sourcing strategies can be classified according to three basic features:

- number of suppliers (single, dual, and multiple sourcing);
- geographical supplier distribution (local, national, international, and global sourcing);
- sourcing principles (sourcing on-stock, JIT, particular sourcing).

Let us consider these strategies in detail.

5.3.1 Single vs. Dual and Multiple Sourcing

In this area, the task is to manage the supplier base with the objective of determining the right number of suppliers. By reducing the supplier base, larger volumes can be ordered from one supplier (*single sourcing strategy*) with the objective of generating volume bundling (scale) effects. However, dependence on one supplier might be too high risk.

- ▶ **Practical Insights** Focusing on single sourcing provides many efficiency advantages. However, a number of recent disruptions have forced SC

managers to rethink this lean sourcing strategy since cost savings can be overwhelmed by disruption impacts (Chopra and Sodhi 2014; Ivanov et al. 2014). Companies which used single sourcing with suppliers in Japan or Thailand were drastically affected by the tsunami and floods in 2011. Many production factories worldwide were stopped for several months. Intel claimed to have lost \$1.0 billion in sales during the fourth quarter of 2011. In 2010, the eruption of a volcano in Iceland interrupted many time-sensitive air shipments in global SCs. A fire in the Phillips Semiconductor plant in Albuquerque, New Mexico in 2000 caused its major customer, Ericsson, to lose \$200 million in potential revenue. Nokia was also affected by this disruption, but found alternative supply sources within 3 days. However, this was very costly. Another risk of single sourcing is related to product standardization. If the sole supplier produces items which are used in many different models of a product, the impacts of a disaster can ripple very fast through the SC, as was the case for Toyota in 2011. This is why many companies like Samsung tend to have at least two suppliers, even if the second one provides only 20% of the volume (Sodhi and Lee 2007).

Thus, it might also be a reasonable strategy to cooperate with a second or third source for a part or module. This supplier strategy is in contrast to a single sourcing strategy and is referred to as *dual sourcing* or, with more than two, a *multiple sourcing strategy* which both better balance the global flows of material and provide risk reduction. For example, ZARA produces their trendiest items in Europe, close to highly dynamic and changing demand. Slow-moving items are produced in Turkey and Asia, since lead time is not crucial and cost reduction can be achieved in manufacturing. Li & Fung Ltd, a contract manufacturing company from Hong Kong, has a variety of supply plans that enable them to flexibly shift production among suppliers.

The discussion above allows us to formulate some critical issues when deciding on single vs. dual or multiple sourcing. They include:

- volume
- product variety
- demand uncertainty
- lead time importance
- disruption and other risks
- transportation costs
- manufacturing complexity
- coordination complexity
- post-sales issues.

Some of the *advantages of single sourcing* are as follows:

- long-term agreements
- price stability
- suppliers included in the product development process at a very early stage
- low transactional costs
- scale effects.

Shortcomings of a single sourcing strategy include:

- inefficient price policy;
- lead time, quality, and service issues;
- lack of collaboration with many suppliers.

5.3.2 Local vs. Global Sourcing

Looking at the location of suppliers is another aspect of a sourcing strategy. This is related to the *geographic sourcing area strategy*. There are two extremes, starting from *local sourcing* (limited number of suppliers, but same norms, language, currency, shortest distance, and thus fastest reaction time in case of changes) versus *global sourcing* (offering the broadest supplier base, but suffering from e.g., long distances, different currencies, norms standards, etc.). In between these, there is also national or continental sourcing.

In order to avoid bad decisions that might be made based only on purchasing price, practice shows that a stringent focus on the TCO approach is highly recommended. Due to shrinking time-to-market and the need for agile management of the SC, the pure advantage of a low purchasing price can easily be eliminated by the need to order large lot sizes; these may travel around the globe for weeks, resulting in higher safety buffers, inventory, and transportation costs.

- ▶ **Practical Insights** Of the 17 Louis Vuitton (LV) manufacturing shops for leather goods, 12 are located in France, 3 in Spain, and 2 in the United States. All manufacturing processes and development are handled at a central workshop in Italy. LV uses external manufacturers only to supplement its manufacturing segment and achieve production flexibility in terms of volume. It purchases its materials from suppliers located around the world, with which LV has established partnership relationships. The supplier strategy implemented over the last few years has enabled requirements to be fulfilled in terms of volume, quality, and innovation (Heizer and Render 2013).

Table 5.2 Analysis of global sourcing decisions

	Local sourcing	Global sourcing
Advantages	<ul style="list-style-type: none"> • Same norms/standards • Easy to reach/short distances • Same culture, same currency, same political climate • Good basis for JIT deliveries • Lower disruption risks for overall SC 	<ul style="list-style-type: none"> • Broadest variety of available vendors • Largest portfolio of products or services • Best opportunities to compare and negotiate with suppliers due to broadest supplier base
Disadvantages	<ul style="list-style-type: none"> • (Very) limited supplier base or no supplier base • Possibly limited bargaining power of buyer because of limitations on supplier side 	<ul style="list-style-type: none"> • Longer travel and transportation times • Longer response times in the event of changes • Possibly larger lot sizes • Potentially different norms/standards • Different cultures, currencies, and political uncertainty • Higher disruption risks for overall SC

For *global sourcing*, items of high volume, steady demand, and low transportation costs are most preferable. However, different *chances and risks* in regard to costs, service, quality, and sustainability should be included in the analysis.

- Costs: labor, taxes, transportation, insurance, transshipment, duties, and transactions.
- Quality: bill-of-materials, quality control, after-sales service, certifications.
- Service: on-time delivery, responsiveness, flexibility, technical equipment, image, reliability.
- Sustainability: political, economic, social issues.

Issues regarding global sourcing decision analysis are presented in Table 5.2. Global sourcing offers access to the broadest available range of suppliers (in contrast to local or national sourcing) and this provides many advantages. At the same time, greater efforts and certain language skills are required to establish relationships with global vendors or partners.

Global sourcing also requires more time for travel to suppliers and for the transportation of goods. Factors such as currency risks or political instability can be very influential and of very high importance, along with different cultures, norms, or standards.

Table 5.2 shows some advantages and disadvantages of the two extreme geographic sourcing strategies: local versus global sourcing. Between these two extremes, there are also opportunities for following a national sourcing strategy; this would be related to an expansion of the sourcing radius, i.e., increasing the number of potential vendors, but continuing to keep risks at a low level. A continental sourcing strategy would further enhance the accessible supplier base, but would still limit the risk of very long transportation times and large volumes.

- ▶ **Practical Insights** In practice, per commodity and part, a reasonable strategy has to be determined by evaluating the corresponding opportunities and risks. In many cases, a mixed strategy with a combination of local and global sourcing elements can be a good choice. For example, Amazon prefers holding fast-moving items in distribution centers while slow-moving items tend to be stored centrally. Apple localized production in China, but the distribution network is global. Such SC segmentation also helps to reduce disruption risk implications (Chopra and Sodhi 2014).

Case-Study “iPhone”

First the iPhone is developed in California. Then the engineering team creates a bill of materials for all the necessary components. Jointly with supply management, the engineering team finds the best combination of equipment and producibility. Since Apple’s SC works globally, this will require components from international suppliers. This is why a camera is produced in the USA, high frequency components are made in Germany, and displays come from South Korea.

All the components are delivered to Shenzhen (China) where they are assembled in the Foxconn factories. Then the customer can order the iPhone via the Apple Online stores and UPS (United Parcel Service) and Fedex deliver directly to the customer. All remaining iPhones are shipped to the central warehouse in Elk Grove, California, after which they are distributed to Apple Stores and their designated partners.

The time from designing a product until actual production is usually 10 months. To accelerate the introduction of a new product, Apple acquires additional licences and, if necessary, entire third-party businesses. In some cases, Apple employs advanced payments to ensure access to strategically important raw materials. Furthermore, Apple not only builds relationships with its suppliers, but also supplier to supplier to guarantee that the SC is not interrupted.

Generally speaking Apple relies on a few suppliers, which enables it to maintain efficient supplier management. Another advantage of focusing on a few suppliers is that Apple can concentrate on supplier development and try to improve its performance. In addition, relevant key performance indicators (KPIs) support the impression that Apple’s SC is highly efficient. The Gartner study (2014) showed that Apple’s inventory turnover of 69.2 is significantly higher than that of Samsung’s, which is 18.1.

Discussion

Which KPIs could measure the efficiency of a SC?

What is the main procurement strategy followed by Apple?

What is a bill of materials?

What is your opinion of Apple’s supplier management? What phases does it consist of?

What is your opinion of the product lifecycle of the iPhone? What is its influence on its SCM?

5.3.3 Just-in-Time

In order to have a sound understanding of Just-in-Time (JIT) principles, let us first have a look at the definition provided by the American Production and Inventory Control Society (Lysons and Farrington 2012):

JIT is a philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product from design engineering to delivery and including all stages of conversion from raw material onward. The primary elements include having only the required inventory when needed; to improve quality to zero defects; to reduce lead time by reducing set-up times, queue length and lot sizes; to incrementally revise the operations themselves; and to accomplish these things at minimum cost.

Making what the customer needs, when it is needed, and in the quantity needed using the minimum resources of people, materials, and machinery—this is the core idea of JIT. JIT was developed in the 1950s by Toyota in Japan. Along with the development of Toyota Production System (TPS), JIT became a core element of the lean production concept. It is focused on meeting exact demands following a production-synchronous replenishment mode, which is activated by a customer order and is linked to all predeceasing value adding steps. JIT principle closely connects the functional disciplines of production, procurement/sourcing, logistics, and sales. Furthermore, JIT requires the successful close cooperation of internally and externally involved parties since it is based on the pull principle.

JIT allows the reduction of inventory at the production site, cutting of lead times, and the increasing of productivity and responsiveness. High-value materials with good demand predictability and steady demand can be especially recommended for JIT.

Case Study “Just-in-Time and Just in Sequence at Volkswagen Saxony”

The Volkswagen Saxony production plant is located in Mosel. The new plant was built as a “green-field” concept in the early 1990s, looking back at a long car manufacturing tradition in Saxony. It was one of the largest construction sites in Europe. In the body plant, processes are highly automated with the help of robots. Painting is also automated and designed with environmental considerations.

The plant produces VW Golf and Passat as well as car bodies for Bentley. The painted bodies receive a barcode for final vehicle assembly depending on the specification order by the customer. Assembly takes place on the assembly line. Readers scan the barcodes on the bodies. The material requirements are

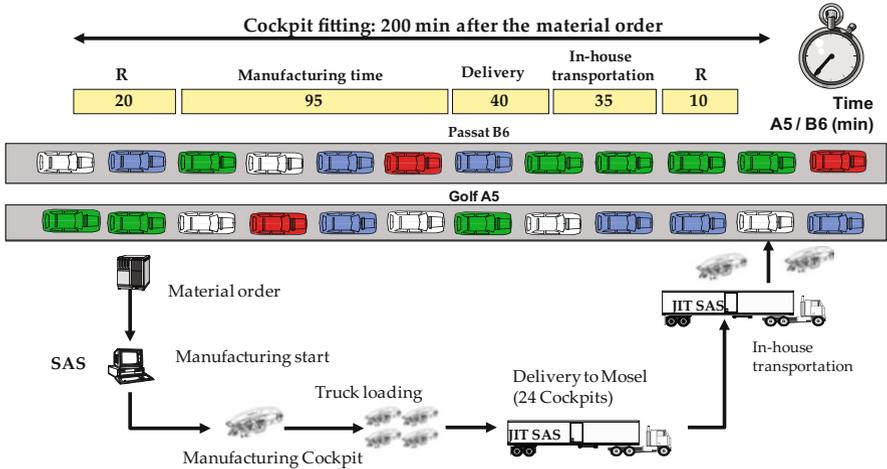


Fig. 5.3 Example of the JIT collaboration between the cockpit manufacturer SAS and VW [based on Olle and Ivanov (2009)]

automatically generated and sent to suppliers. They deliver the required modules JIT and JIS (just-in-sequence) for each individual vehicle. Consider an example of the JIT collaboration of the cockpit manufacturer SAS and VW (Fig. 5.3).

SAS manufactures the cockpits three kilometers away from Mosel. Perfect timing is crucial for success. While SAS assembles the cockpits, production at VW continues in a parallel operation. This saves time and money. VW Saxony received the German Logistics Prize for this concept of “synchronized production in partnership”. The completed modules arrive JIT at the assembly line.

5.4 Supplier Relationship Management

When selecting a sourcing strategy, the following aspects of SRM should be considered in practice (Geissbauer and D’heur 2010) (see Table 5.3)

SRM can be divided into four areas:

- supplier analysis
- supplier selection
- supplier integration
- supplier development (Fig. 5.4).

Let us consider these areas in detail.

Table 5.3 Sourcing strategy and SRM

Elements of the sourcing strategy	Corresponding sourcing activities
Supplier selection	Composition of an optimized supplier portfolio
Supplier evaluation	Systematic assessment of supplier capabilities and performance
Supplier development and integration	Increase supplier potential and capabilities
Supplier risk management	Prevention, reduction, or elimination of supplier risks
Supplier phase-out	Optimization of supplier portfolio
Supplier relationship management	Sustainable activities to improve supplier performance
Supplier information management	Information systems for administration of supplier data
Supplier audit	Identification of performance and technology level

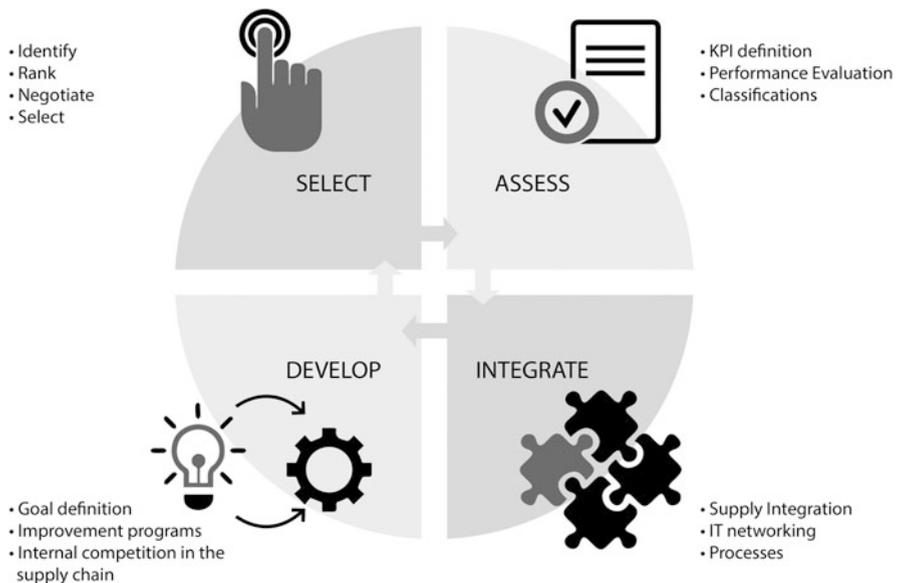


Fig. 5.4 Supplier relationship management functions

5.4.1 Strategic Supplier Analysis

First, the sourcing department is obliged to perform a *spend analysis* in order to analyze which supplier for which sales volume is covered for what type of part or commodity. This means the number of purchased items requires careful analysis to generate a basis for developing improvement scenarios. Such scenarios could be related to adjusting (increasing or reducing) the number of suppliers or to transferring additional responsibilities to the supplier. In general, *the opportunities are assessed* in the first step of the strategic analysis phase.

The *second strategic step* is focusing on creating profiles for categories (e.g. paper, metal, rubber or seats, wheels, lamps etc.) and to cluster materials or services in order to identify repetitive sourcing patterns.

In order to develop a sourcing strategy in *step three*, the TCO has to be identified. This is important for developing comparable decision papers that will also be used to support make-or-buy decisions. The result is a condensed overview that highlights which items will be externally sourced compared to the parts or components that will be produced internally.

In *strategic step four*, potential suppliers need to be identified and screened. It might well be that new suppliers are added after they have submitted a promising offer. Based on defined supplier selection criteria, the supplier base will need to be critically evaluated. A set of pre-defined selection criteria captures and clarifies distinct attributes. These help to facilitate and speed up the assessment process (Baily et al. 2008).

When business experts talk about a *spend analysis*, it means understanding how many suppliers there are and what the monetary exchange per supplier is. Bozarth and Handfield (2013) state that a “*spend analysis is the application of quantitative techniques to purchasing data in an effort to better understand spending patterns and identify opportunities for improvement.*” The spend analysis can be used to answer the following questions:

- What categories of products or services significantly influence company spending?
- How much are we spending with various suppliers?
- What are our spending patterns in different locations?

The main idea behind this analysis is to obtain a good understanding, based on data analysis, about the spending behavior of a company with its suppliers or partners. Depending on the question that needs to be answered, a corresponding path needs to be taken for review of the existing quantitative information. For example, practice shows that a company will spend a very high amount of their sourcing costs with only a very small number of supplying or service partners.

For the analysis of such a case, the Pareto analysis is a good solution. In other cases, where a large number of data requires careful attention, a regression analysis is also a good approach. The teams elaborating such analyses require good skills and competences to run such data segregation.

Along with the spend analysis, some other methods are used in practice:

1. *Supplier industry analysis*—Review of the suppliers, their market shares, financial strengths, geographic coverage to obtain a structured overview of the suppliers for certain goods and services including an understanding of the role these suppliers play in the SC (is it a local raw material provider or a globally acting partner who provides sub-assemblies?).
2. *Cost and performance analysis*—Examination of the cost drivers for the sourced goods and services as well as developing a solid key performance indicator (KPI)

model. It is recommended to analyze the value adding steps on the supplier side and then to map cost drivers and performance drivers/influencers against the various transformation processes.

3. *Supplier role analysis*—Identification of the roles suppliers play in the design of the SC: which are the suppliers that will play an active role or coordinate parts of the SC versus vendors that only deliver their goods or services (e.g. diesel fuel refilling) in passive mode.
4. *Business process analysis*—Assessment of the business processes between the purchasing and selling parties. In practice this analysis will help answer the question of who from the customer side will exchange with whom how often and how with the suppliers of the corresponding commodity. This relates to the frequency of data exchange, processes of cooperation, documents to be transferred, and also the tools (e. g. EDI, WebEDI or supplier portals) that need to be used in order to facilitate a structured and harmonized exchange of information, so that the business process becomes practically alive.
5. *Business benefit analysis*—Quantification of the saving potential per commodity and usage of these identified benefits for transparent target setting purposes. Furthermore, such a substantiated business benefit analysis will also help senior management to make decisions.
6. *Commodity plan implementation and execution*—Elaboration of a structured plan showing for what type of commodity with which supplier what type of strategy and tool should be implemented by whom from the organization and by when. This means the principles of project management play a significant role in converting the strategy into a plan with defined tasks and work packages.

Since the commodity sourcing strategy has a huge impact on the entire design of the SC, it is recommended that, in addition to the sourcing specialists, representatives from e.g. manufacturing, logistics/SC, quality, engineering, and finance should be part of a cross-functional commodity sourcing strategy team. Of course, the individual composition of the team needs to be identified case by case depending on the enterprise, its global footprint, and industry, but overall, a jointly developed strategy which considers the inputs and contributions of multiple relevant functions should be the objective.

5.4.2 Supplier Selection

In this phase, the sourcing team will *create a supplier short list* based upon the identified supplier selection criteria. Different approaches are possible, but in principle the task is to assess to which degree the capabilities of the suppliers meet the customer's selection criteria. Either they are completely fulfilled, or to a certain degree fulfilled, or they will not be fulfilled by the supplier. This means in order to identify the most appropriate vendor, commonly developed and accepted vendor selection attributes and processes will need to be defined and applied inside the organization.

The selection of vendors is a multi-criteria problem which includes qualitative and quantitative measures. According to Amid et al. (2011), the relative importance of the criteria, sub-criteria, and, in many cases, the weighting factors are determined by top management and purchasing managers. It is important to emphasize that careful and proper selection of suppliers is a crucial and important element in sourcing activities, because the performance of the overall SC significantly depends on every single party involved.

Once the short list is created, detailed contractual discussions and *negotiations* will be initiated. Then, in this *step*, commercial conditions especially are on the agenda, but logistical requirements (e.g. packaging instructions, lot sizes, transportation devices, item identification tags, or delivery notes) are also part of the agreements. When the contractual negotiations are finalized and the contracts are signed, these specified agreements will become part of the daily operational processes.

In practice, *weighted models* are frequently used in order to respect priorities or to focus on more important criteria. For example, this might be quality, cost, or sustainability. The factors of cost, quality, and delivery performance as well as capacity, experience, service, technical capability, and financial status are used in practice. In addition, supplier risk exposure became an important evaluation factor in recent years (Simchi-Levi et al. 2015; Ivanov et al. 2017; Ivanov 2018; Dolgui et al. 2018; Yoon et al. 2018). The consideration of these factors facilitates long-term relationships with possible vendors or partners.

Task 5.1 Supplier Selection

To better understand the principle behind such systematic supplier selection, let's assume we are employees of a company and it is our task to evaluate two alternative suppliers against the list of supplier selection criteria for our company. In our example, we should have the following supplier selection criteria with the corresponding importance weighting next to it (see Table 5.4). The sourcing department will have created a standard containing the relevant selection criteria. This list of criteria will be used for all suppliers in order to ensure comparability of the supplier selection that has been made in the past and for the selection of future suppliers (Table 5.4).

Next to the company specific selection criteria are the individual weighting percentages. In total we will always have a 100%, split over the selection criteria. In addition, standard weighting factors will be used in practice to ensure the consistency and reproducibility of supplier selection.

In practice you will find that the relevant sourcing department has agreed on requirements in order to assign points for each criterion. This will be multiplied line by line in order to calculate the overall supplier rating value. In our example, supplier A achieves in total a rating of 5.7 points, and for supplier B the total sum is 6.1 points. We would therefore select supplier B.

As the ratings in the table above are quite close to each other, one might also think about maintaining good relationships with supplier A, possibly for a future

Table 5.4 Scoring analysis for supplier selection

Criteria	Weight (%)	Scores for supplier A	Supplier A rating	Scores for supplier B ^a	Supplier B rating
Cost of purchased items	20	6	1.20	7	1.40
Quality of purchased items	20	4	0.80	6	1.20
On time delivery (OTD) performance	15	7	1.05	4	0.60
Sustainability standards compliance	25	6	1.50	8	2.00
Reputation of supplier in the market	10	3	0.30	4	0.40
References from other customers	5	8	0.40	4	0.20
Global footprint of supplier	5	9	0.45	6	0.30
Total	100		5.70		6.10

^aThe scale ranges from 0 points (very poor) up to 10 points (excellent)

evaluation. Of course, it is not one supplier alone that is evaluated by the sourcing department: there are multiple companies that are assessed.

Finally, since the usage of the factor-ranking method for supplier selection is very subjective, a *sensitivity analysis* should be performed in the event similar evaluations of some suppliers. Such an analysis helps to identify the impact of changes in weights and scores on the overall supplier evaluation.

5.4.3 Supplier Integration and Development

In principle the repetitive process of sourcing execution and SC collaboration starts now. Practice has shown that traditional purchase orders tend to be considered inflexible, because quantities and delivery dates are fixed (simplified view). In contrast to purchase orders, *scheduling agreements* (flexible agreements) are preferred in business practice, because the exact demand date and quantity will be communicated from the ordering party to the supplier at a later stage. In this context concerning how to conduct sourcing execution and SC collaboration more practically, usage of IT should also be mentioned. *Supplier collaboration portals* (e.g., SupplyOn, see Chap. 3) enable communication between partnering companies and thus represent an intelligent platform in which to exchange necessary information to initiate the corresponding material flows.

Supplier development is focused on the one hand on improvement of the supplier's ability to implement production improvements, e.g. by practical problem solving or by establishing continuous improvement processes. On the other hand, it strives to improve the supplier's cost, quality, and delivery by having supplier

development teams at the vendor's facility. As the details indicate, process- and results-oriented approaches are complementary.

Supplier development is related to active consulting support and providing the necessary guidance to identify problems, analyze them, and solve them practically. This might include the temporary provision of specialists or even be linked to financial support. Overall, the purpose is to secure, develop, and maintain a solid and reliable supplier base.

Lysons and Farrington (2012) suggested a typical nine-step approach to systematically organizing structure and followed the supplier development process. These steps can be represented as follows:

1. *identify the critical products*
(mainly strategic and bottleneck products);
2. *identify the critical suppliers*
(assess their current and future capabilities; does it make sense to develop them?);
3. *appraise the performance of the suppliers*
(usage of a standardized KPI framework, questionnaires, checklists, or company specific assessment methodology);
4. *determine the gap between current and desired supplier performance*
(identify the gaps from a supply point of view and from a demand point of view, or combined gaps, such as the level of collaboration);
5. *form a cross-functional supplier development team*
(who run the assessments, identify the gaps, and develop and negotiate a possible solution approach);
6. *meet with supplier's top management team*
(to identify the required degree of collaborative relationship, this helps both sides to understand improvement needs and develop a relationship built on trust);
7. *agree how the identified gaps can be bridged*
(e.g. to implement an IT solution, to form joint improvement teams, to execute a quality certification. . . develop a corresponding plan);
8. *set deadlines for the achievement of the improvements*
(having an agreed upon action plan with defined actions, action owners, deliverables, and due dates);
9. *monitor improvements*
(during the implementation of the supplier development actions, but also afterwards to ensure corrective measures are sustained).

In practice, such a development of a supplier is related to the establishment of a long lasting relationship which is based on mutual trust. Furthermore, the employees need to cooperate successfully together in order to align organizations and cultures. This means that besides the theoretical nine steps summarized earlier, soft human and cultural factors play an important role in achieving the objective of jointly improving supplier performance.

5.5 Key Points

In essence, in sourcing activities, the following questions need to be assessed and answers have to be developed in principle for the articles of the commodity categories:

1. *What should be sourced?*—These are the questions regarding the *sourcing objects* (e.g. single loose parts, modules, systems, services or non-product related objects?) It also refers to questions about make-or-buy, which accounts for outsourcing decisions.
2. *How should items be sourced?*—What is the *sourcing tool or process* that needs to be applied (e.g. do we consider manual sourcing or do we use IT tools such as portals or EDI? How well are business processes aligned between the supplying and buying parties?) What is the appropriate *sourcing organization*, i.e. whether to run the purchasing *individually* or to establish an alliance and thus follow the idea of *collaborative sourcing*?
3. *From whom to source?*—With *how many suppliers* or partners do we cooperate (do we focus on a *sole supplier*, do we prefer double sourcing, or is our strategy to purchase the goods or services from multiple vendors?) Which supplier demonstrates good performance or has further potential—who should be developed and who should be substituted?
4. *From where to source?*—Do we focus on *cooperation with local* suppliers, is our scope connected to national or continental vendors, or is the strategy to aim for *global sourcing*?
5. *When to source?*—How should sourcing be scheduled regarding early supplier involvement at the stage of product development in order to jointly develop a part or module and to agree on the most suitable delivery strategy (e.g. *JIT*) including corresponding containers or stock keeping units (SKU)? Alternatively the strategies of *stock sourcing or demand tailored sourcing* might be applied.

In parallel to these five dimensions are other strategic factors concerning long-term relationships with suppliers, measurement of their performance, and the steady analysis of spend patterns which need to be conducted in order to ensure continuous evaluation and the improvement of sourcing activities. Of course, the effort involved will differ from company to company and industry to industry; thus this chapter is intended to provide some guidance on fundamental sourcing strategy considerations, the related processes, and how relationships with suppliers are connected to the SCOM.

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