Chapter 2
Supply Chain Segmentation Scientific Frameworks

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Supply chain segmentation describes an approach for developing differentiated supply chain strategies. This differentiation is based on the creation of distinct segments. A segment comprises a set of products that are allocated according to certain criteria, for example product characteristics or customer requirements. For each of the segments, a unique supply chain strategy is derived that fits the products' or customers' needs (Childerhouse, Aitken, & Towill, 2002; Godsell, Harrison, Emberson, & Storey, 2006; Lovell, Saw, & Stimson, 2005). In this chapter, we give an overview of the segmentation frameworks from the academic literature. We cluster the frameworks according to their choice of segmentation criteria. The existing frameworks can be roughly categorised into three different approaches: market-, product-, and hybrid approaches.

2.1 Market-Driven Segmentation

The market-driven segmentation frameworks seek to define supply chain segments according to market-related criteria.

One of the first market-driven segmentation approaches was introduced by Hill (Hill, 1985), who suggested delivering differentiated customer service by employing different manufacturing strategies. The author characterised different market segments according to Order Qualifiers (OQs) and Order Winners (OWs).

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OQs are the prerequisites that suppliers need to fulfil in order to be considered as a supplier by a customer. OWs are the critical factors that influence the customer's final decision and contribute to winning the order. These OQ/OW criteria may include cost, availability, and delivery lead-time, for instance. According to Hill, manufacturing needs to establish appropriate responses to each segment's requirements. Hence, the author suggests differentiated manufacturing strategies that meet the segment-specific requirements, rather than one single strategy.

While Hill solely focuses on manufacturing strategies (Hill, 1985), the theory of strategic alignment proposed by Gattorna, Chorn, and Day involves the organisation as a whole (Gattorna, Chorn, & Day, 1991). Gattorna, Chorn, and Day recognise that the organisational structure needs to be changed until it aligns with the market or customer segment. Moreover, Gattorna and Walters state that customer service policies are often generic and fail to add any value or competitive advantage (Gattorna & Walters, 1996). The authors propose that customers should be segmented based on their service requirements, and that a differentiated customer service response should be developed (Walters, 2006a). Walters developed the alignment of supply chain processes and market orientation further by introducing a set of customer value drivers (Walters, 2006b). These customer value drivers describe the customer's demand chain profile, which covers the customer's requirements across his entire demand process. Walters furthermore suggests relevant supply-chain response issues for the entire supply chain, from product design to after-sales services (Walters, 2006a, 2006b). Although the alignment theories recognise the importance of identifying the market's needs and responding to them, they remain very theoretical and do not explain how the supply chain strategy could be operationalised in practice.

Christopher and Gattorna contributed to the alignment approach by introducing distinct market segments and proposing specific supply chain types for each segment (Christopher & Gattorna, 2005). The authors segment the market according to customer buying behaviour, including the customers' price sensitivity and demand predictability. The supply chain strategies assigned to the segments range from fully flexible, agile[1] and lean[2] supply chains, to continuous replenishment (Christopher & Gattorna, Supply chain cost management and value-based pricing, 2005).

Finally, Hjort, Lantz, Ericsson, and Gattorna provide a very specific segmentation example in the e-commerce business (Hjort, Lantz, Ericsson, & Gattorna, 2013). The authors propose segmenting customers based on their buying and returning behaviour, and developing a differentiated returns service.

To sum up, the market-driven segmentation frameworks seek to understand customers' requirements and to address them through differentiated service

[1]Agility includes strategies that exploit flexibility in order to respond to volatile markets (Naylor et al., 1999).

[2]Leanness refers to cost-efficient value streams that eliminate waste and ensure a level schedule (Naylor et al., 1999).

responses. Customer orientation is an effective means of serving a market and creating value. For instance, a study showed that customer alignment in Supply Chain Management (SCM) has a positive effect on business performance (Skipworth, Godsell, Wong, Saghiri, & Julien, 2015). However, solely focusing on customer requirements neglects other important criteria. Customers are not the only dimension that brings different requirements; products also have different characteristics that require a certain strategic fit.

2.2 Product-Driven Segmentation

In contrast to the market-driven segmentation approach, the product-driven approach focuses on product and demand characteristics.

The product-driven approach was initiated by Fisher's theory of functional and innovative products (Fisher, 1997). According to Fisher, functional products are stable demand products that have a rather long product life cycle (PLC), low contribution margins, and low product variety. Innovative products are characterised by unpredictable demand, a short PLC, high contribution margins, and high product variety. Fisher matches different supply chains to the different product types. Functional products should be served with a physically efficient supply chain that focuses on decreasing cost. Innovative products, however, require a market-responsive supply chain that enables responses to unpredictable demand. This minimises stock-outs, forced markdowns, and obsolete inventory. This is achieved by keeping sufficient stock of components or finished goods, by ensuring short production lead-times, and/or by using modular product design and postponement—as well as other means (Fisher, 1997).

Lee proposes to segment products not only according to demand uncertainty (i.e., low vs. high), but also by supply uncertainty (i.e., stable process vs. evolving process) (Lee, 2002). The latter segmentation criterion adds the dimension of supply to Fisher's framework (Fisher, 1997). The stable supply process is characterised by fewer breakdowns, fewer quality problems, more supply resources, more reliable suppliers, more dependable lead-time, and fewer capacity constraints. The evolving process depicts the contrary, including a greater vulnerability to breakdowns and more quality problems. By combining supply and demand uncertainty in a 2×2 matrix, four corresponding strategies are derived. Efficient supply chains are assigned to low supply and demand uncertainty. A risk-hedging supply chain is proposed for high supply uncertainty and low demand uncertainty. The risk-hedging supply chain uses inventory pooling and resource sharing (e.g., sharing component safety stock with other companies), as well as multiple sourcing to minimise risks due to supply disruptions. A responsive supply chain deals with low supply uncertainty and high demand uncertainty. This supply chain uses mass customisation processes in order to gain flexibility, for example assemble-to-order (ATO) production policies. Finally, the agile supply chain is used for high supply uncertainty and high demand uncertainty. This combines the

risk-hedging and responsive supply chains so that it can respond to demand changes as well as minimise the risk of supply disruptions. Consequently, it covers uncertainties on both ends of the supply chain.

Another framework that simultaneously addresses supply and demand characteristics is the three-dimensional classification system, proposed by Christopher and Towill (Christopher & Towill, 2002). The authors classify products according to the product type (standard or special), its demand (stable or volatile), and its replenishment lead-time (short or long). However, demand predictability and product type tend to be related, i.e., standard products have predictable demand. Hence, the authors only used the two dimensions of predictability and replenishment lead-time in a later publication (Christopher, Peck, & Towill, 2006). They proposed a continuous replenishment strategy for predictable demand and short lead-time, e.g., one that uses point-of-sale (POS) data or vendor managed inventory. The assembly or distribution of the product is postponed for unpredictable demand and long lead-times, the lean strategies are used for the predictable and long lead-time segment. The last segment, characterised by unpredictable demand and short lead-times, requires an agile solution.

If needed, the tactics can be adapted for each product type (standard/special) within the four strategies. In this way the third segmentation criterion of product type can be taken into account. The authors provide an example of this further differentiation in a case study. For the segment of unpredictable demand and short lead-time, a company applied different supply chain strategies for standard and special products. For special products, it employed an innovative agile pipeline and postponement. For standard products, the demand was separated into base and surge demand. While the base demand was fed by a lean pipeline, the unexpected top-up or surge demand could be served in a quick response pipeline. Thus, one major contribution in contrast to Fisher's framework (Fisher, 1997) is that the authors acknowledge the existence of standard products with volatile demand.

Christopher and Towill also developed the DWV^3 market characteristics (Christopher & Towill, 2000). This classification system also seeks to assign lean and agile principles to different product types. The products are classified according to five variables: **D**uration of PLC; time **W**indow for delivery; **V**olume; **V**ariety; and **V**ariability. These variables have different impacts on the required supply chain strategy. A short PLC, for example, will require a rapid time-to-market strategy. A short time window for deliveries and low volume will require agile strategies. Products with a long time window for delivery and high volume make lean strategies feasible. A high degree of SKU variety often goes in hand with lower volume per SKU and higher demand variability, which then requires agile strategies.

In summary, the product-driven segmentation frameworks seek to segment the product range according to different product, demand, and supply characteristics. These characteristics mainly include product type (standard/special) and demand type (volatility and volume), but also comprise supply characteristics (replenishment lead-time, and supply risk). While recognizing the differences between

products and the impact these have on the required supply chain strategy, the frameworks neglect the customer orientation that we discussed in Sect. 2.1.

2.3 Hybrid Market- and Product-Driven Segmentation

In the hybrid market- and product-driven approach, customer requirements and product characteristics are jointly used to segment products.

Fuller, O'Conor and Rawlinson recognised that companies need to develop market-specific supply chain strategies, but also recommend the use of product characteristics (e.g., sales volume or unit value) when segmenting the product range (Fuller, O'Conor, & Rawlinson, 1993).

Childerhouse, Aitken, and Towill made a major contribution to this approach (Childerhouse et al., 2002). The authors integrated the concepts of DWV^3 market characteristics and OW/OQ into a single segmentation framework. First, they employed only three of the five DWV^3 variables (duration of PLC, volume, and variety) when segmenting the product range. Then, they added a market-perspective by linking the OQ/OW criteria to the segments. They applied the framework to a case study in the lighting industry (Aitken, Childerhouse, & Towill, 2003; Childerhouse et al., 2002). In the case study, four clusters were defined. The first cluster constituted products with a long PLC and low volume, where the OW was availability. Availability was ensured by make-to-order (MTO) policies with common raw material stocks and shared manufacturing resources. The second cluster comprised products with a long PLC, high volume, and low variety. For these products, the OW was short lead-time. Accordingly, a lean demand channel and make-to-stock (MTS) policies were employed to leverage the high volume and low variety of the products, and to ensure short lead-time. The third cluster comprised all products with a short PLC, which were mostly innovative or customised products. For this product segment, agile strategies were used that designed and built the products in short development lead-times. The fourth cluster contained products with long PLCs, high volume, and high variety. A "leagile" strategy was used for these products. We briefly explain the meaning of "leagility" in the following.

Leagility is a combination of agile and lean strategies which Naylor, Naim, and Berry proposed (1999). Agility includes strategies that exploit flexibility in order to respond to volatile markets. Lean refers to cost-efficient value streams that eliminate waste and ensure a level schedule. Leagility integrates both ideas as follows: upstream of the decoupling point, the supply chain is designed lean, while the downstream supply chain is designed agile. Leagility thus focuses on low cost in the upstream part of the supply chain, while at the same time achieving downstream agility to ensure market-responsiveness. Mason-Jones, Naylor, and Towill demonstrate the relevance of leagile strategies by linking the Leagility paradigm to the OW/OQ criteria (Mason-Jones, Naylor, & Towill, 2000). According to the authors, the OW in an agile supply chain is the service level

whereas the OW in the lean supply chain is cost. However, cost is also an OQ for the agile supply chain and availability is an OQ for the lean supply chain. Combining the advantages of both strategies is of crucial importance because customers often require either the leanest agile pipelines or the most agile lean pipelines.

Coming back to the lighting case study, the leagile strategy allowed the company to exploit high volumes through lean strategies, but at the same time ensured enough flexibility to serve a large product range (Aitken et al., 2003; Childerhouse et al., 2002). However well defined these strategies may be at a certain point in time, the authors also recognise that OWs are dynamic and may change throughout the PLC. As a result, they suggest that companies monitor the OWs throughout the PLC and shift products to the evolving strategy.

Aitken, Childerhouse, Christopher, and Towill further developed seven generic delivery pipeline strategies (Aitken, Childerhouse, Christopher, & Towill, 2005), based on a continuum of strategies (Lampel & Mintzberg, 1996), the one-size-does-not-fit-all approach (Shewchuk, 1998), and postponement/speculation strategies (Pagh & Cooper, 1998). These seven strategies range from pure standardisation to pure customisation. The authors support their argumentation by retrospectively fitting the four strategies of the lighting case study (Childerhouse et al., 2002) into their framework. However, the authors do not provide an approach on how to segment products and assign the strategies.

The demand profiling approach by Godsell, Diefenbach, Clemmow, Towill, and Christopher is another framework that is based on the OQ/OW criteria and DWV^3 market characteristics (Godsell, Diefenbach, Clemmow, Towill, & Christopher, 2011). The authors propose to develop a supply chain strategy customer-backwards in a four-step approach. In the first step, customer requirements are analysed using the OQ/OW criteria. The authors then segment customers based on common groupings of the OQ/OW criteria. The third step understands the strategic response from the supply chain. Finally, the last step develops a supply chain strategy aligned to the customers' requirements. However, the authors found that, understanding the customer requirements by using OQ/OW criteria was not feasible in practice. In a case example from the fast-moving consumer goods (FMCG) industry, managers thought that all customers equally wanted the right product for the right cost in the right quantity to be delivered to the right place. Instead of using the OQ/OW criteria to create segments, they conducted a volume-variability analysis, singling out volume and variability as the primary drivers of the DWV^3 variables. All SKUs were plotted in a 3×3 matrix that characterised SKUs according to their volume and variability, ranging on a low-medium-high scale. The products in the resulting nine demand profiles were assigned to lean or agile strategies, so that the target of serving 70% of demand by a lean solution and 30% of demand by an agile solution was met. This target was in line with the pareto-curve, which indicated that roughly 20% of the SKUs accounted for 80% of the demand. For the high volume SKUs that accounted for the majority of the demand, lean strategies should be used; for the slow movers, agile solutions were more suitable (Christopher & Towill, 2011). In order to improve the decisions, Godsell, Diefenbach, Clemmow, Towill, and

Christopher apply additional filters like margin, growth, or strategic alignment at the SKU level. For example, a low volume, high variability product with low margins was delisted. The authors suggest that this SKU "health check" is performed quarterly as part of continuously reviewing supply chain strategy decisions. Demand profiling at the individual SKU level also establishes the link between customer segmentation and product characteristics (Godsell et al., 2011).

Instead of using the DWV^3 market criteria to derive a segmentation approach, Lovell, Saw, and Stimson analysed cost/performance trade-offs in the supply chain (Lovell et al., 2005). The authors identified three primary cost drivers: throughput level, availability, and product value density (PVD). These three key cost drivers constitute a three-dimensional segmentation framework that can be depicted as a cube. For all possible two-dimensional slices through the cube, the authors derived segment-specific network design strategies. While this framework contributes a different set of segmentation criteria, it does not provide a coherent strategy for all segments: the segments that are difficult to deal with are eliminated. With regard to availability and throughput level, they state that higher availability requires higher safety stock. As a result, they recommend centralised inventory holding as it will decrease inventory-holding cost. To offset higher transportation distances, faster transport modes must be utilised. Higher throughput levels, on the other hand, make decentralised inventory and slower transport options more feasible. Looking at availability and PVD, the authors state that high availability and high PVD require centralised inventory because of the high amount of tied-up capital. With regard to the combination of throughput and PVD, the authors recommend decentralised inventory for high throughput and low PVD. For low throughput and high PVD, they recommend centralised inventory because it generates cost savings in inventory holding costs. Products that require high availability but have low PVD are not included in the strategy. According to the authors, companies should question whether they should offer this type of product (Lovell et al., 2005).

In summary, the market- and product-driven segmentation frameworks seek to segment products based on a combination of product characteristics and customer requirements. Most of the frameworks use product characteristics like the DWV^3 criteria to segment the product range and add OQ/OW criteria that consider customer requirements.

The overview of segmentation frameworks makes it clear that the combined market- and product-driven approaches have an important advantage over the other two approaches because they integrate both perspectives. However, the proposed frameworks have three main disadvantages. Firstly, only a few frameworks consider the supply characteristics of the products' components. In general, the range of considered segmentation criteria is narrow. Secondly, many theories try to find universally applicable, generic frameworks with fixed segments. From the variety of industry case studies and proposed frameworks, it can already be seen that there is no generic approach to supply chain segmentation. Circumstances differ greatly among various industries and organisations. Hence, the frameworks need to be individually adapted to the respective industry and organisation. Thirdly, the derivation of segment-specific supply chain strategies needs to focus on

assigning a lean, agile, or leagile operational focus. Further strategic supply chain elements are only considered to a smaller extent (e.g., supply planning, forecasting, and distribution). We concluded that the literature lacks a holistic segmentation framework that integrates all potential segmentation criteria as well as all potential strategic responses across the entire supply chain.

Bibliography

Aitken, J., Childerhouse, P., Christopher, M., & Towill, D. R. (2005). Designing and managing multiple pipelines. *Journal of Business Logistics, 26*(2), 73–96.

Aitken, J., Childerhouse, P., & Towill, D. R. (2003). The impact of product life cycle on supply chain strategy. *International Journal of Production Economics, 85*(2), 127–140.

Childerhouse, P., Aitken, J., & Towill, D. R. (2002). Analysis and design of focused demand chains. *Journal of Operations Management, 20*(6), 675–689.

Christopher, M., & Gattorna, J. (2005). Supply chain cost management and value-based pricing. *Industrial Marketing Management, 34*(2), 115–121.

Christopher, M., Peck, H., & Towill, D. (2006). A taxonomy for selecting global supply chain strategies. *The International Journal of Logistics Management, 17*(2), 277–287.

Christopher, M., & Towill, D. R. (2000). Marrying lean and agile paradigms. *EUROMA* (pp. 114–121). Ghent.

Christopher, M., & Towill, D. R. (2002). Developing market specific supply chain stategies. *The International Journal of Logistics Management, 13*(1), 1–14.

Christopher, M., & Towill, D. R. (2011). An integrated model for the design of agile supply chains. *International Journal of Physical Distribution & Logistics Management, 31*(4), 235–246.

Fisher, M. L. (1997). What is the right supply chain for your product? *Harvard Business Review, 75*(2), 105–117.

Fuller, J. B., O'Conor, J., & Rawlinson, R. (1993). Tailored logistics: The next advantage. *Harvard Business Review, 71*(3), 97–98.

Gattorna, J. L., Chorn, N. H., & Day, A. (1991). Pathways to customers: Reducing complexity in the logistics pipeline. *International Journal of Physical Distribution & Logistics Management, 21*(8), 5–11.

Gattorna, J. L., & Walters, D. W. (1996). *Managing the supply chain. A strategic perspective*. Basingstoke: Palgrave.

Godsell, J., Diefenbach, T., Clemmow, C., Towill, D. R., & Christopher, M. (2011). Enabling supply chain segmentation throught demand profiling. *International Journal of Physical Distribution & Logistics Management, 41*(3), 296–314.

Godsell, J., Harrison, A., Emberson, C., & Storey, J. (2006). Customer responsive supply chain strategy: An unnatural act? *International Journal of Logistics: Research and Applications, 9*(1), 47–56.

Hill, T. (1985). *Manufacturing strategy. Text and cases*. London: Macmillan.

Hjort, K., Lantz, B., Ericsson, D., & Gattorna, J. (2013). Customer segmentation based on buying and returning behavior. *International Journal of Physical Distribution & Logistics Management, 43*(10), 852–865.

Lampel, J., & Mintzberg, H. (1996). Customizing customisation. *Sloan Management Review, 38*(1), 21–30.

Lee, H. L. (2002). Aligning supply chain strategies with produce uncertainties. *Californmia Management Review, 44*(3), 105–119.

Lovell, A., Saw, R., & Stimson, J. (2005). Product value-density: Manageing diversity through supply chain segmentation. *The International Journal of Logistics Management, 16*(1), 142–158.

Mason-Jones, R., Naylor, B., & Towill, D. R. (2000). Lean, agile or leagile? Matching your supply chain to the marketplace. *International Journal of Production Research, 38*(17), 4061–4070.

Naylor, J. B., Naim, M. M., & Berry, D. (1999). Leagility: Integrating the lean and agile manufacturing paradigms in the total supply chain. *International Journal of Production Economics, 62*(1), 107–118.

Pagh, J. D., & Cooper, M. C. (1998). Supply chain postponement and speculation strategies: How to choose the right strategy. *Journal of Business Logistics, 19*(2), 13–34.

Shewchuk, P. (1998). One size does not fit all. *International Conference of Managing Value Chains* (pp. 143–150). Troon.

Skipworth, H., Godsell, J., Wong, C. Y., Saghiri, S., & Julien, D. (2015). Supply chain alignment for improved business performance: An empirical study. *Supply Chain Management: An International Journal, 20*(5), 511–533.

Walters, D. (2006a). Demand chain effectiveness—Supply chain efficiencies. *Journal of Enterprise Information Management, 19*(3), 246–261.

Walters, D. (2006b). Effectiveness and efficiency: The role of demand chain management. *International Journal of Logistics Management, 17*(1), 75–94.

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