A STRUCTURED APPROACH TO REDESIGN DEMAND-DRIVEN SUPPLY CHAINS

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Introduction

Changes in the competitive intensity and, therefore, on the attractiveness of an industry in terms of shareholder value (Rappaport, 1987), trigger often the necessity for a company to review its corporate strategy. As a result, the customer value proposition is assessed and adjusted, leaving the supply chain function the responsibility to deliver it at optimum cost, capital investment and risk exposure.

How to structure a supply chain and its required components (Persson and Olhager, 2002; Shariff et al., 2006) to support the value proposition (Fawcett et al., 2007) is the core of supply chain design. The redesign of an existing supply chain is, however, a challenge for most practitioners. Although academia (Fisher, 1997; Christopher and Towill, 2000, and Lee, 2002), has provided different general frameworks about the different types of supply chain design and emphasized the need to match them to company goals, reality is often too complex and too uncertain to identify, evaluate and select the best design choices along supply chain functions.

Recognizing this challenge, Stevens (1989) asserts that "a structured approach" is "required" for effectively designing a supply chain. However, only a handful of structured and empirically supported approaches do transcend simplified type-match concepts. Addressing this gap, the aim of our study is to provide a practitioner-oriented approach of redesigning a supply chain that aims at selecting the most appropriate supply chain configurations ready to be implemented that deliver both, sustainable competitive advantage and shareholder value while simultaneously considering the risks of implementation. This approach aims not to create theory but to build on existing academic concepts and to link them in a structured way resulting in a novel redesign approach to pragmatically deal with the complexity and uncertainty of demand-driven supply chains as being typical in the fast-moving-consumer-goods (FMCG) sector. The result is a 6-step approach that combines state-of-the-art supply chain theory with lessons learned from case studies to provide a guideline for practitioners.

For the purpose of this research, the case study method (Yin, 2014) was adopted as overarching research strategy while abductive analysis was applied as the methodological approach for qualitative data analysis (Timmermans and Tavory, 2012). Accordingly, a creative iterative process of "theory matching" between literature research and two case studies took place in an attempt to find an approach that combines theoretical knowledge with real-life observations.

The current section gives an introduction on the overall topic, provides the rational and the aim of this research as well as its contributions. In the following sections, the theoretical background of supply chain design in its wider context is established, including a short review of relevant academic literature focussing on the research aim and addressing the research gap. The section methodology provides an understanding of how this research was designed and conducted, containing the justification of the strategy selected. The development of six theoretical propositions deriving from academic literature builds the bridge between theory and empirical results from two case studies that provide insight into practical supply chain design issues and their solutions. As a result, the preliminary redesign approach is developed as a logical result of the previous sections. Finally, the last section summarizes the outcome of this study, outlines its limitations and contribution and refers to further steps.

Theoretical background

The significance of supply chains has been growing since their appearance. The enhancing opportunities and capabilities of supply chain management brought a change in the competition between firms, as today rather supply chains are competing than single companies (Lambert and Cooper, 2000). Supply chain can be defined as a flow-oriented network of companies which secure firstly the flow of

goods from producers towards customers and the efficient flow of information and money in the opposite direction (Mabert and Venkataramanan, 1998), including the management of relationship and cooperation (Lambert and Cooper, 2000).

Although supply chains are of strategic importance for performance, profitability and competitiveness of companies, the structure of these value chains are only rarely the result of a profound planning. They are rather an outcome of trends and evolution without clear guidance. However, without a formal construction plan, an uncontrolled evolution can lead to malfunction hindering the attainment of their ambitions and objectives (Nel and Badenhorst-Weiss, 2010). Here comes the importance of guided and planned supply chain design into the focus of supply chain managers.

For the purposes of this work, we embrace the definition of Melnyk et al., (2014) who define supply chain design as the identification of the desired strategic outcomes for the firm and the development, implementation, and management of the resources, processes, and relationships (within the firm and across the supply chain) that seek to make the attainment of such desired outcomes inevitable over time. Inherently, supply chain design encompasses the development and implementation of a supply chain strategy (Nel and Badenhorst-Weiss, 2010) and is, therefore, a dynamic concept (Melnyk et al., 2014), since it must be adjusted or redesigned as business environment changes.

Supply chain design rules the construction of a supply chain from the most basic principles and contains the decisions or choices taken to build it. It influences the relationship of members in the supply chain, the performance assessment arrangements and the transparency throughout the chain. Furthermore, supply chain design directs the alignment between the environment and the strategy of firms and addresses the problems, the supply chain is dedicated to resolve (Melnyk et al., 2014). The overall goal of supply chain design is to deliver customer value while positively impacting shareholder value (Christopher and Ryals, 1999). However, the formulation of an effective supply chain design can be "extremely difficult" (Kotzab et al., 2003), especially in the demand-driven FMCG industry.

On the downstream side, commercial markets are characterized by sophisticated and demanding consumers that leads to a high fragmentation, i.e. a transition from the old idea of a uniform, homogeneous "mass market" to much smaller segments where consumers seek for individual solutions (Christopher, 1996). While market segmentation is a long-established concept, the implications for supply chain design have not been widely recognized (Godsell and Harrison, 2006), since there are other factors such as products characteristics that might also shape the supply chain. On the upstream side, commercial markets are served by globe-spanning operations that are dynamic networks of interconnected firms and industries. However, those global networks are exposed to different degrees of uncertainty that cannot be neglected (Christopher and Peck, 2004). Obviously, a reliable supply represents a lower challenge in design than an uncertain one.

Lee (2002) structures the design process by providing a typology framework based on the degree of uncertainty at both sides of a supply chain. The four types of supply chain design, efficient, risk-hedging, responsive and agile, represent a high-level guide to identify which sets of choices need to be considered when configuring a supply chain.

Supply chain design choices are manifold. Academia differentiates between fundamental choices that advocate integration as the key success factor of any type of supply chain (Frohlich and Westbrook, 2001), efficiency-oriented choices (Jasti and Kodali, 2015), which strive for higher productivity, waste reduction and thus, optimal cost along the supply chain; and flexibility-oriented choices (Trigeorgis and Reuer, 2017) that focus on real options, as an effective way to deal with uncertainty, limiting supply chain risks while capturing unexpected benefits, increasing flexibility and thus, the resilience of the supply chain (Avanzi et al., 2013). To select the proper choice for each function of the supply chain is a critical step in the construction process. It depends on the supply chain type, its specific goals, and the attributes required for the customer serving process.

The last piece of complexity of supply chain design is added when quantifying its impact on shareholder value. While calculating the economic value added of a supply chain decision in a stable business environment is straightforward (Rappaport, 1987), the same procedure under uncertainty requires different methods, such as the real option valuation theory (Brandão and Dyer, 2005).

Despite of the importance of supply chain design, most of the academic contributions (Fisher, 1997, Christopher and Towill, 2000, Lee, 2002, Cigolini et al., 2004, Martínez-Olvera and Shunk, 2006)

do not transcend the type-and-match approach, barely achieving a level of detail that allows implementation. Recent approaches by Schnetzler (2007), Nel and Badenhorst-Weiss (2010), Melnyk et al. (2013) and Perez-Franco et al. (2016) compensate those weaknesses to a great extent but still miss ways to pragmatically deal with market complexity, identification or selection of design choices or their quantitative evaluation.

Methodology

The suggested redesign approach was developed by adoption of a qualitative multi-method study (Saunders et al., 2012), combining case study research (Yin, 2014) and abduction as guiding principles for gaining empirically based insights. Abduction analysis is a qualitative data analysis approach aimed at generating creative and innovative insights. It emphasizes, that the researcher enters the field with a deepest theoretical base and nurtures surprising empirical findings against theoretical expertise in an inferencing process to move back and forth between data and theory (Timmermans and Tavory, 2012). The suggested preliminary 6-step redesign approach emerged as a methodological result from combining theoretical knowledge and real-life observations from case studies.

Case study research is particularly suitable where prevalent theories are extended to emerging phenomena to derive novel propositions (Eisenhardt, 1989), to capture and formalise the knowledge of practitioners, develop theories from practice, and then move on to the testing stage (Benbasat et al., 1987). It enables to gain rich insights through the collection of contextual data in a contemporary real-world setting (Eisenhardt, 1989). The cases selected are both European manufacturing and distributing companies operating in different FMCG sectors, food/spices and fashion jewellery. This favours to analyse their intuitive redesign approaches and to work out similarities and distinctions.

The lead researcher's role in the explanatory multiple case study was two-fold: as a participating professional practitioner and as an observer. As a professional practitioner, the researcher worked in both companies, actively participating in their supply chain redesign process in 2007-2010 at the spice company and in 2011-2012 at the fashion jewellery company. As an observer, the researcher retrospectively examines data of both organisations, like archival records, personal communications and participant observation. Hence, this study benefits from the alteration of two different paradigms, "inquiry from inside" which is the researcher's involvement in the organization and "inquiry from outside", whereby the researcher is detached from the organizational setting (Everend and Louis, 2001). Thus, the academic work is enriched by the experience of the practitioner that provides deep insights while reliability is increased by the credibility of the researcher (Iacono et al., 2009).

Applying abduction, firstly theoretical propositions were derived from investigating, analysing and synthesizing academic literature. Secondly, conducting case study research strategy, the issues and findings from two FMCG companies in their supply chain redesign process, were analysed looking for evidence to support the scope, sequence, relevance and impact of the propositions raised previously. In the process of data analyses the researcher iteratively moved between data and theory.

To improve the development of theory in the area of supply chain, four stages can be identified: conceptualise, build, test and refine (Zhong, 2015). Whereas the development of the suggested 6-step approach falls into "building" stage, the next stage of "testing" is where the suggested 6-step redesign approach is verified against reality, which currently happens in the context of a 10-month industry project. Test results fall outside the scope of this paper.

Development of theoretical propositions

This section provides the background of academic literature that led to the development of six theoretical propositions (P1 till P6), that were triangulated with the research cases of the following section. They build the backbone of the suggested redesign approach. Whereas P1 investigates the trigger for supply chain redesign, the following propositions (P2-P6) refer to different steps of the redesign process.

The trigger for supply chain redesign

Fawcett (2007) claims that supply chain design is a proactive approach for delivering customer value. Rappaport (1987) stresses that a company's ability to generate future cash flows (an essential element of shareholder value) is the prerequisite for its further existence. Future cash flows can only be generated if a supply chain performs well, following that supply chain performance is dependent on its structural design (Persson and Olhager, 2002).

- *P1: Supply chain redesign in FMCG is triggered by a sustainable decline of shareholder value*

Demand analysis

Today, supply chains are designed from the "customer backwards" compared to previous from the "factory outwards" (Christopher, 2011). Accordingly, demand analysis has been advocated to segment supply chains by academics of the "lean-agile school" (Godsell et al., 2011). To profile demand at item level is a "practical and relatively quick approach" that reconciles the apparently conflicting product and customer-oriented approach, enabling companies to reduce downstream complexity while identifying the different supply chain segments companies need to address (Godsell et al., 2011).

- *P2: An effective redesign starts with a detailed demand analysis at item level*

Supply analysis

Lee (2002) adds the supply side and its level of uncertainty to demand analysis.

- *P3: Supply uncertainty needs to be assessed as well*

Identification of supply chain segments and their goals

Lee (2002) further structures the design process by providing a typology framework based on the degree of uncertainty at both sides of a supply chain, supply and demand. The resulting four supply chain segments, efficient, risk-hedging, responsive and agile, and the goals each segment strives to achieve, represent a high-level guide to identify which sets of supply chain choices need to be considered when configuring a supply chain.

- *P4: Supply chain segments and their specific goals guide the redesign process*

Assessment of current supply chain capabilities and identification of alternative design choices

The framework of Perez-Franco et al. (2014 and 2016) provides a useful approach to assess current supply chain capabilities per segment and function against its goals and to identify alternative design choices if goals are not sufficiently achieved.

- *P5: Supply chain segments needs to be assessed on its degree of goal achievement and alternative design choices need to be identified*

Quantitative evaluation

Rappaport (1987) states that management has to choose alternatives that are expected to deliver greatest sustainable competitive advantage and thus greatest customer value as they also create greatest shareholder value. Rappaport's (1987) shareholder value approach measures the financial impact of supply chain design choices. It is a static valuation method, which assumes that future expected cash flows are known with certainty and risk premium does not change. However, business conditions are often volatile, outcomes are uncertain, investments are high and the risk of losing everything is real. Yet, the upside potential can be huge. To compensate the deficiency of shareholder value approach, it is complemented with real option valuation models (Brandão and Dyer, 2005) that better reflect the flexible nature of decision taking under uncertainty. Real option valuation models (ROV) are considered an integral part of the shareholder value approach. Among the ROV methods aimed mainly at practitioners, binomial-lattice-based models (Gilbert, 2004), Monte Carlo simulations and the Datar-Mathews method (Mathews and Datar, 2007) are the most commonly used.

- *P6: Alternative choices need to be evaluated on their impact on shareholder value*

Case studies

Research cases

Both companies are European real-world companies in the FMCG sector. To conceal their true identities, they are named SpiceCo (spice company) and CrystalCo (fashion jewellery company).

SpiceCo is a regional manufacturer and distributor of spices and seasonings. Founded in 1881, SpiceCo served only its local retailer market until 1991, when it started an aggressive expansion into Central Eastern European markets. In 2007, SpiceCo supply chain consisted of a central production facility and 19 country warehouses that served 20 markets with a total assortment of 4.500 items in 18 different languages. Their product life cycles were rather long, spanning several years.

CrystalCo is a global manufacturer and retailer of fashion jewellery. In 2011, their supply chain network consisted of a global distribution centre and a glass factory in a Central European country plus seven factories located in Asia. Glass components were produced in the main factory in Europe and shipped to factories in Asia where metal frames were moulded and glued together with the glass parts. Eventually, the final product was returned from Asia to Central Europe for global distribution. CrystalCo had a network of 10.000 retail shops in approximately 70 countries and an assortment of 1.500 items, out of which 1.000 items were basic products with product life cycles of 24 months. The remaining 500 items were seasonal products with product life cycles of 6 months. CrystalCo offered two different design collections per year.

Findings

Both cases were retrospectively assessed on the six theoretical propositions that derived from critical review of academic literature as presented in the previous section.

- *P1: Supply chain redesign in FMCG is triggered by a sustainable decline of shareholder value*

SpiceCo: After 15 years of expansion and growth (1991-2006), the controlling department detected a deterioration of operational performance (out-of-stock rate increased from 2% to 6% and the service level decreased from 98% to 93,5%) and a slow but continuous decline of profitability. The latter was not only the result of lower sales prices in the new CEE markets, but also due to a significant increase of supply chain costs (logistics costs, lost sales, penalty costs, inventory costs). After some failed trials for improvement led by the production function, SpiceCo decided to set-up a supply chain organisation and to give its new supply chain manager the responsibility to redesign its supply chain.

CrystalCo: End of 2010, marketing was raising the need of having shorter lead times (4 months) to enable more collections during the year. They considered this as a way to enhance sliding customer traffic in the shops, since new, aggressive competitors entered the fashion jewellery market a couple of years before depriving their market share. To compensate for the loss of volume, CrystalCo had already opened new shops, widened its assortment, increased sales prices and spent more on advertising. Nevertheless, by end of 2010, profits showed a clear downward trend.

Similarities: Changes in the business environment triggered operational inefficiencies that led to customer dissatisfaction. The following deterioration of company cash flows and subsequently declining shareholder value ultimately set in motion the supply chain redesign process.

- *P2: An effective redesign starts with a detailed demand analysis at item level*

SpiceCo's redesign process was production-driven. Running at 98% utilization, production aimed to free up capacity by introducing an integrated planning software that would optimize changeover time and inventory level, based on an accurate sales forecast. However, once SpiceCo started analysing historical demand data, they quickly realised that forecast accuracy was strongly driven by market maturity. Mature markets where SpiceCo had reached more than 30% market share showed an average forecast accuracy of over 75%, whereas younger markets had a more volatile demand with a forecast accuracy below 50%. Latter often triggered unplanned production changeovers, expedite supplier orders and in the end, unfulfilled customer demand.

CrystalCo's redesign process was marketing-driven with a thorough analysis of customer demand on market and product level. The length of a product's lifecycle resulted to be the main driver of forecast accuracy. Basic products that had remained in the assortment longer than 2 years showed an average

forecast accuracy of above 70%, while novelty products with less than 6 months product life cycle had a forecast accuracy of below 40%. Since CrystalCo's market share was significant in all the countries in scope, no other factors seemed to affect forecast accuracy.
Similarities: In a natural reaction of make-to-stock production, both companies were striving for higher efficiency as a result of forecast improvements. They started their assessment with a detailed analysis of their demand at item level resulting in a subsequent demand segmentation: SpiceCo from a market point of view, CrystalCo from a product perspective.

- *P3: Supply uncertainty needs to be assessed as well*

SpiceCo: Both of SpiceCo's demand segments, mature and young markets, were served by one central production facility. Due to its high utilization, the responsiveness of the factory was limited, as unexpected demand fluctuations could not be served shortly. Furthermore, although the general delivery performance of its suppliers (European spice traders) was quite satisfactory (over 90% service level within 2 weeks lead time), there were some critical spices that counted for less than 10% of the total raw material assortment but were essential elements in nearly any final product of spice mixture. These critical spices stood out by their poor availability in times of high price speculation. As these weaknesses on the supply side had a negative impact on the sales performance of SpiceCo, they were quickly identified as critical spots to be addressed and properly solved later on.

CrystalCo: Since one of the redesign goals of CrystalCo was the reduction of production lead times, a detailed value chain analysis along the different steps of the supply side was performed. CrystalCo is to a high degree a vertical integrated company with low uncertainty along their supply side. However, splitting and offshoring of low-added-value production activities to Asia, combined with large lot sizes, were detected as the main reasons for long lead times.
Similarities: The initial demand analysis was complemented by a supply assessment, where the degree of supply uncertainty was evaluated along with the reasons for other supply weaknesses.

- *P4: Supply chain segments and their specific goals guide the redesign process*

SpiceCo quickly realized that it needed two different supply chain segments to serve their mature and young markets. The first supply chain segment basically matched the current efficient configuration characterized by high production utilization, relatively long lead times of 3 weeks and optimal stock levels supported by the high average forecast accuracy of the mature markets. The second supply chain segment for young markets needed to be more responsive, with a lead time below 1 week, in order to cope with the higher demand volatility.
CrystalCo drew similar conclusions out of their demand/supply analysis. The quite predictable demand of basic products could be further served by the current supply chain configuration, since low demand uncertainty along the lead time of 4 months could be simply mitigated by reasonable safety stocks. However, novelty products required a responsive supply chain with a lead time of less than 2 months.
Similarities: Goal formulation for each of the supply chain segments was intuitively done by both companies. It helped to narrow the search of alternative supply chain choices during the next steps.

- *P5: Supply chain segments needs to be assessed on its degree of goal achievement and alternative design choices need to be identified*

SpiceCo: After an evaluation of all functions of their supply chain, SpiceCo identified two bottlenecks that strongly limited their ability to shorten lead times and to quicker react to the unpredictable demand of young markets. The first bottleneck was the high degree of utilization of the production facility. The second was the unreliability of raw materials supply when price speculation occurred. As alternative design choices to the production capacity issue, SpiceCo considered either an investment in additional machines or subcontracting the additional capacity, on a needed basis, to third-party manufacturers preferably located in or close to the young markets. For the raw material supply issue, SpiceCo considered either to source directly in the country of origin or dramatically increase their safety stock level for the affected raw materials from 4 to 12 weeks. An additional choice was the implementation of an integrated planning system, considered as a pre-requisite to improve operations by SpiceCo.

CrystalCo: After a detailed evaluation of the operational feasibility of different design choices CrystalCo concluded that the key to reduce production time was to re-consolidate all three production steps (glass, metal and gluing activities) within one location, eliminating interfaces and enabling a more flow-oriented manufacturing. Therefore, the only alternative was to build a new stand-alone factory for novelty products that could respond to demand within 4 weeks instead of 4 months due to vertical integration.

Similarities: Although both companies excelled during the assessment of their current supply chains, they struggled when identifying alternative choices. In both cases, external consultants had to be involved to support, share best practices and bring in new ideas.

- *P6: Alternative choices need to be evaluated on their impact on shareholder value*

SpiceCo: Using a simulation tool, actual and forecasted demand and production data of the past 260 working days, SpiceCo modelled the necessary additional production capacity required to reduce out-of-stocks from 6% to 3% and to identify the periods when additional capacity was needed. Simulation results showed a need of only 15% additional capacity during 60 days. Therefore, to buy additional capacities from a third-party manufacturer would be cheaper compared to an own investment, despite of decreased profit margin. In the case of raw material supply issue, SpiceCo decided for the increased safety stock rather than direct sourcing. Although direct sourcing showed a higher cash flow, SpiceCo considered, they did not have the necessary skills set to pursue such an international initiative.

CrystalCo's evaluation of the novelty product factory was complex since several aspects had to be taken into consideration. To guarantee shorter lead time, the production flow had to be newly designed including the capacity requirements of each station. Furthermore, the facility location and the resultant divestments in Asia had to be decided. Finally, the potential of additional sales as a result of a higher product availability and more collections needed to be estimated. Confronted with uncertain data, CrystalCo decided to build up a small pilot factory based in Eastern Europe to serve the European market and postpone further expansion based on later results.

Similarities: Both companies insisted on a cash-flow evaluation to support decision-making. In some cases though, the ease of implementation of some choices led the decision into other directions. In other cases, both companies had to use simulation tools or split and delay decisions in order to reasonably deal with uncertainty. Lastly, there was also a case (software implementation) with negative cash flow but positively decided, since that was considered as a fundamental choice for the company.

Preliminary 6-step redesign approach

The results of the case study research guided not only the selection of the appropriate supply chain theories, techniques and aids, but also the decision about the right sequence of the approaches used.

Step 1: Demand profiling

The suggested approach starts by analysing the demand side of the supply chain. Demand profiling techniques (Godsell et al., 2011) are used to identify different market segments by analysing each item on relevant market characteristic criteria as product lifecycle duration, time window for delivery, volume, variety and variability (Christopher and Towill, 2000). To avoid unnecessary complexity, it is recommendable to choose which two criteria are most relevant for demand profiling before collecting and assessing the respective quantitative data. A graphical analysis enables a quick identification of market segments to be served by different supply chain configurations. The formulation of the requirements of each market segment would be the key outcome of this step.

Step 2: Supply assessment

An assessment of the supply side is to be performed across all supply chain functions. It aims to identify not only the degree of supply uncertainty, i.e. the reliability of the supply process in terms of quantity, quality and time, but also any other weaknesses in the current supply chain design that would hinder it to fulfil the requirements of the newly identified market segments.

Step 3: Identification of supply chain segments

Based on the typology model of Lee (2002), the generic types of the targeted supply chain segment(s) (efficient, risk-hedging, responsive and agile) as well as their key attributes to address the market requirements of step 1 and the supply weaknesses of step 2 are identified.

Step 4: Assignment of design choices

We found helpful to develop a list of generic design choices for each supply chain segment type. Generic choices are arranged along the different functions of a supply chain and can be classified as fundamental choices (Frohlich and Westbrook, 2001), efficiency-oriented choices (Jasti and Kodali, 2015) or flexibility-oriented choices (Trigeorgis and Reuer, 2017). The more "agile" a supply chain is, the higher the number of potential flexibility-oriented choices and lower the extent of efficiency-oriented choices will be. In the case of "efficient" supply chains, the relation is the other way around. In both cases, a share of fundamental choices is needed since they set the basis for integration and collaboration in the supply chain. In this sense, generic choices can be acknowledged as an aid for the practitioner when redesigning a supply chain.

The assignment of the most appropriate generic choices to the particular supply chain segment in evaluation is the result of a systematic process where the interdependence among the different functions of the supply chain as well as the alignment with key attributes of step 3 are considered. The approach of Perez-Franco et al. (2016) as a logical bridge between market requirements, supply chain attributes, supply chain functions and generic choices can be used to perform this task. In addition to the selected generic choices, practitioners are encouraged to define customized design choices to address other, still unattended, supply weaknesses identified in step 2.

Step 5: Evaluation and selection of supply chain choices

Supply chain choices are evaluated and selected according to their impact on shareholder value and their ease of implementation. The academic background of the shareholder value approach as measurement of the financial impact of efficiency-related supply chain choices and of real option valuation methods as a measurement for flexibility-oriented supply chain choices was already discussed under P6 in section "Development of theoretical propositions". Ease of implementation takes into consideration current supply chain capabilities, the amount of effort required to achieve the targeted supply chain design and the willingness to change of supply chain stakeholders. The evaluation of the ease of implementation often prevents companies from the unfeasible "perfect solution", without taking into consideration their current and future limitations.

Step 6: Screening for synergies

Lastly, the resulting supply chain choices are screened for synergies before being released for implementation. This step arose from iteration of case studies back to design theory of Ayers and Odegaard (2008), according to which operations of different "spheres" or segments are merged or split, depending on the compatibility of the different supply chain segments. Screening for synergies enables further optimisation of shareholder value through identification of potential for economies of scale by conflating of supply chain operations and their facilities that share the same design solutions.

Conclusion

Our aim was to develop a truly practitioner-oriented approach for the redesign of demand-driven supply chains that targets to select the most suitable supply chain configurations ready to be implemented. The redesigned supply chain is supposed to deliver both, sustainable competitive advantage through delivery of customer value and shareholder value, while considering its inherent risks before being implemented. Our proposed 6-step redesign approach does not aim to create new theory but builds on existing ones. It combines them in a comprehensive way, enriched by empirical findings of this study, to form a unique approach that unifies the best of two worlds: state-of-the-art theories and empirically grounded results.

Reflecting the situation of practitioners, our suggested approach focuses on the redesign of supply chains, which means the reconstruction of existing supply chains that evolved over time,

opposing to from-scratch design of green-field supply chains that are purposefully designed by professional supply chain architects and engineers. In line with this, our proposed redesign approach leads the practitioner step-by-step through a guided process that applies real data analysis, compares the prevailing supply chain design with the targeted one and addresses this gap by the identification of supply chain design alternatives. These design choices are quantitatively evaluated, synthesized and assessed on the limitations of the company before being implemented.

Whereas most approaches start their design journey from company objectives or reviewed customer value propositions that involves supply chain managers into corporate strategizing, our approach keeps supply chain managers on the operational-tactical level they are more familiar with. Demand profiling tool provides a practical and quick means to define relevant demand segments by application of specific variables of single product items. Furthermore, we support practitioners in the most crucial step of the approach, the selection of the appropriate supply chain design decisions by the provision of a predefined list of generic design choices. This predefined list is available per each segment type and functional area of the supply chain and describes its drivers that fit to specific supply chain attributes. The practitioner merely needs to select the most appropriate choice out of this list and assign it to the respective supply chain segment in evaluation.

As to our knowledge, there are no other supply chain redesign approaches that considers an assessment of the supply side to identify its constraints. However, as demonstrated, supply constraints or weaknesses that impede or aggravate the provision of customer value require attention through selection of design decisions that effectively erase or minimize this level of uncertainty. The analysis of the supply side thus massively impacts on supply chain design decisions.

Our redesign approach includes a systematic financial evaluation of the design decisions selected. Depending on the type of choice, either shareholder value approach is considered for efficiency-oriented choices, or real option valuation methods for flexibility-oriented supply chain choices. If the choice does not lead to increased shareholder value, the respective choice is disregarded and replaced by another design decision. Screening for operational synergies further enhances shareholder value through utilization of potential for economies of scale. Depending on the complexity of the ultimate supply chain configuration, multiple and similar supply chain design choices may result. Their consistent segmentation across all operational entities and facilities may lead to unnecessary duplications.

Lastly, reflecting on practical evidence especially from small and medium size companies, the ultimate design decision may exceed a company's capabilities regarding professional skills required or the willingness to change. Even though disregarding the "perfect solution" might entail future limitations, supply chain managers may prefer a design choice that finds undivided support of their stakeholders.

Even though it is not possible to generalise from two case studies, we believe that the suggested redesign approach is robust and capable to provide a solid ground for a practitioner guideline to support them in their supply chain redesign process. The validation of this process against reality takes currently place in the course of a 10-month industry project.

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