Chapter 10
Challenges in Choice Navigation for SMEs

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10.1 Introduction

Since mass customization was introduced by Davis [1] and later popularized and described more in detail by Pine in 1993 [6], it has been introduced and implemented in a large number of industries in different countries.

Much of the literature found on mass customization focuses on cases of large enterprises. The majority of cases which are presented in research and which are highlighted in literature as examples of successful mass customizers are usually from manufacturers oriented toward consumer markets such as consumer electronics or automobiles, which are typically dominated by very large players.

However, although mass customization was originally described as a way for mass producers to increase variety to increase sales and prices, other types of companies have also utilized the principles of mass customization. This includes cases of engineer-to-order companies, which have originally had a very high variety, but can utilize the principles of mass customization to become more efficient, by applying, e.g., modularization, product configuration, etc. This tendency has become more common as mass customization has gained recognition in many different industries and as the methods and technology for implementing mass customization have become more mature and more broadly known. This has also implied that not only large companies pursue mass customization, but more small and medium enterprises (SMEs) are also beginning to implement mass customization, and even startups are founded where the initial idea is providing mass-customized products.

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However, referring to previous literature reviews on general mass customization, very little literature has been published specifically on mass customization in SMEs [2, 8]. A literature search performed on Thomson Reuters Web of Science and Elsevier Scopus revealed only 39 contributions directly or indirectly focused on mass customization in SMEs, whereas almost 3000 contributions could be identified for mass customization in general. Hence, a research focus on mass customization in SMEs is almost absent. However, it is reported by multiple contributions that mass customization holds a great potential for SMEs in terms of growth and profitability [3, 9].

From the literature search, only a few case studies were found which document the advantages and challenges when SMEs implement mass customization. One case study focused narrowly on how automation of welding processes could be utilized in a metal furniture manufacturer [4]. By Ismail et al. [3], two cases are presented, involving companies manufacturing children's playground equipment and luxury domestic showers illustrating how tools from mass customization can benefit SMEs. Finally by Orsila and Aho [5], a case study was presented of how an e-commerce system could improve business processes in a manufacturer of custom semiconductor products. The authors however believe that it would be beneficial for both researchers and practitioners to understand the mechanisms of mass customization in SMEs leading to benefits and challenges, which is the focus of this paper.

Salvador et al. [7] introduced the three fundamental capabilities of mass customization: (1) solution space development, "identify the product attributes along which customer needs diverge"; (2) robust process design, "reuse or recombine existing organizational and value-chain resources to fulfill a stream of differentiated customers needs"; and (3) choice navigation, "support customers in identifying their own solutions while minimizing complexity and the burden of choice." These capabilities are generic and must thus be possessed by large enterprises as well as SMEs. However, as it has long been recognized that SMEs are fundamentally different in terms of strategy, operation, etc. [11], it is expected that the approach to implement these capabilities will differ between large enterprises and SMEs.

In this paper, the primary focus will be on choice navigation and how SMEs can utilize choice navigation to improve business. The research question of the paper is:

What are the benefits which SMEs can gain from utilizing choice navigation, and which challenges may occur in doing so?

In this study, we apply the definition of SMEs from the European Union, i.e., maximum of 250 employees combined with a limit of maximum EUR 50 million annual turnover or a maximum of EUR 43 million annual balance sheet.

10.1.1 Forms of Choice Navigation

Choice navigation is basically the capability to help customers define which product matches their requirements and preferences and help them purchase this product. Choice navigation thus involves presenting the customers with which options they can choose from, allowing them to review combinations of these options and obtain information about the products in terms of different properties such as performance,

appearance, price, delivery times, etc. What is commonly associated with choice navigation is the type of software, which is called product configurators. A product configurator is a software tool, which presents the user, who may be a customer or a sales person, with different options to choose from, and the user can by selecting different options configure a product. Many different types of product configurators exist; some are intended for back-end configuration and thus focus primarily on obtaining all the information needed for creating a quotation or providing information of the subsequent manufacturing, while front-end configurators are intended for usage by the end customers, and thus, the focus is more on communicating the different options to choose from and also frequently to visualize the appearance of the products.

However, choice navigation covers more than just product configurators. Another approach is what is called "assortment matching" or "product selectors." This concept differs from product configurators, since product selectors aid the customer in choosing from predefined variants. Product configurators on the other hand allow users to choose from predefined options within a certain solution space, and it is thus not necessary to choose from a range of predefined variants. Assortment matching or product selectors are also software tools, which can be used by either end customers or sales people.

An even simpler form of choice navigation however also exists. Arguably, the simplest form of choice navigation is simply presenting customers or sales people with the products and options that can be chosen from using lists or catalogues. This may be software supported but may also be paper based. This form of choice navigation has no constraints on whether products are predefined or configurable. While this approach "supports customers in identifying their own solutions," which is part of the choice navigation capability, it does not to the same extent as product configurators and product selectors "minimize complexity and burden of choice" which is also part of the choice navigation capability.

Another form of choice navigation, which is presented by Salvador et al. [7], is "embedded configuration." This is defined as "Products that understand how they should adapt to the customer and then reconfigure themselves accordingly" [7]. In this case, the user does not do anything explicitly to configure the product. Examples of this include cars that change the driving dynamics according to different situations, e.g., driving on the freeway vs. parking, or a cell phone, which detects a low battery level and reconfigures to minimize power consumption and maximize remaining battery life. In this type of choice navigation, there is no distinction between front-end and back-end configuration, as no users do explicit configuration.

10.2 Methodology

To answer the research question, a multi-case study was selected. The case study approach was selected to be able to do an explorative investigation of choice navigation in industry. The choice of a multi-case study was made to increase generalizability, which can, in some cases, be a challenge for single-case studies.

The cases, which were included in the study, were chosen among participants in three different projects focusing on development of mass customization capabilities in industry, which also included SMEs. The projects were run by SINTEF in Norway and Aalborg University in Denmark (AAU). The criteria for selecting case companies were that they must (1) be SMEs, (2) do mass customization, and (3) have some experience with choice navigation. Company names are not mentioned to ensure anonymity.

Throughout the projects, SINTEF and AAU have been in close collaboration with the case companies and have significant insight in their approaches to the three mass customization capabilities including choice navigation. The case studies are based partly on this insight and partly on interviews conducted specifically for this research.

Based on this knowledge, each case is described below, where the characteristics of each company are outlined; the form of choice navigation applied is described together with benefits gained from this as well as challenges.

10.3 Case Studies

10.3.1 Case 1

Case company 1 is a manufacturer of high-end building components used for private homes and public buildings such as museums, offices, etc. The products are sold for new building projects as well as for renovations of existing buildings. The core of the business is to manufacture highly customized products of very high quality, and the company does thus not compete on the low-end market with high price sensitivity. The company serves different types of customers; however, products are never sold directly to the end user but rather through a retailer. Usually the sales process will go through an architect or a contractor; however in rare cases, end users will have direct contact to the case company. The company has approximately 30 employees.

Addressing their approach to choice navigation, the case company currently does not apply product configurators or product selectors; however, a list of product types and options (although not complete) is available to end customers, which to some extent helps customers in choosing the right product. Internally, choice navigation is handled by using Spreadsheet templates, which state exactly which information is needed before a product can be produced. These spreadsheets however do not have any data validation ensuring that the options selected or the dimensions specified are within what can actually be manufactured. The benefits however are that no product is sold, without sufficient product information that is present for the manufacturing processes.

The company has a wish to establish a product configurator, which they expect customers to be able to use. This will enable customers to configure products themselves, potentially increasing revenue and reducing the load on internal sales

people, sales supporters, and the technical department. The main challenges in doing this however are however partly to chose an appropriate product configurator software and partly to define the variety to be offered in the configurator. The reason for the latter being a challenge is that the company wishes to offer a range of configurable "standard" products accounting for the majority of the revenue, but still keep the door open for "special" products which are outside the configurable scope, but attractive to sell due to much higher markups. The distinction between "standard" and "special" products has proven very difficult for this company.

10.3.2 Case 2

Case company 2 manufactures simple components used for equipment and machinery installed in buildings, primarily used in the manufacturing industry. The products are assembled from a number of very simple components. The products are included as parts of products delivered by the customers of the case company. A sales organization of agents and specialized B2B sub-suppliers are in charge of selling the company's products.

With the use of catalogs and option lists and supported by external sales representatives, product configurations are made to match customer's equipment and machinery; the configured products will have a unique part number. In regard to planning, scheduling, and supply chain, the part number has no references internally, which in busy periods often cause huge delays. Engineering department will process new customer part numbers (new assembly/new configuration) before the order can be processed by manufacturing. Scheduling (estimating) a delivery time of each new or recurring order is based on manually counting of availability of individual parts included in the customer part number.

The company has decided that future development of new products or options should be applicable to an online product configurator, making the customers able to select their product options themselves, fulfilling their specific needs, and making the case company able to decompose the part number into individual parts, for scheduling, planning, and supply chain purposes. An analysis has shown that the existing product lines and product families' product architecture cannot support these requirements. Developing an initial product family (a forerunner) and introducing the online configurator indicates large potential; not only a major reduction in involvement of engineering department in all orders but also the potential of decomposing the customer product into individual parts for scheduling, planning, and supply chain purposes has been very promising. One major challenge for the case company is to convince customers to change their unique product to a new product—same product from a functionally point of view, but with slight physical changes and with a new part number.

10.3.3 Case 3

Company 3 is a manufacturer of heavy high-quality machinery equipment that facilitates bulk material handling and transport for the agricultural, industrial, and waste sectors. The company has built up a strong market position with focus on high-quality and customer service, despite a price-focused market. Their products are offered in different models, which are further adjusted to specific market requirements. Products may also be customized to the needs of individual customers. The company is represented on all continents via a network of distributors and agents. Customers are typically companies in the agricultural sector that sell and distribute the company's products to individual farmers. However, end users have direct contact with the company's service support, and end customers may also buy the products directly from the company. The company has 75 employees.

The company offers about 30 customer choices that are available via a list of product models and options. A salesperson is often involved in the product selection process helping the customer to specify the needed product features options and individually customized features. The production process typically starts before the final order is confirmed. The company purchases and produces parts and subassemblies based on forecast, while products are assembled based upon customer orders. Products mainly consist of standard parts, and the majority of options are introduced in the final assembly process.

The company has recently introduced a new product range, with low production volumes in an initial phase. As product volumes increase, the company is aware of the need for a product configurator to support the sales process. Today, most sales are carried out via distributors. A configurator may support the expansion of the internal sales organization of the company, with more sales directly to end customers.

Most challenges are related to complexity, competence, and resources. The company has limited resources to invest in a new complex and often expensive software and implementation project. Necessary internal IT competence and resources to maintain and use the solution must be in place. Since the sales process is mainly carried out by external partners, training is needed to utilize the tool. In addition, distributors may have to deal with a wide range of different product configurators depending on the number of suppliers. With regard to end users, a configurator might be challenging to use, for instance, by farmers with limited IT familiarity. The company also sells its products to customers all over the world, so the configurator must be adapted to users in a wide array of geographical markets, risking to increase complexity further.

10.3.4 Case 4

Case company 4 has approx. 25 employees and manufactures and sells kitchen equipment. Mostly their own products and designs but also imported brands from foreign manufacturers are kept on stock and sold in Norway. Customers are

primarily Norwegian kitchen manufacturers, but also private persons that renovate their homes or cabins can order new products directly. Increasingly, entrepreneurs offer customers to specify this kind of equipment as part of the contract when signing for a new house or flat.

First, customers can choose between many models, and on all domestic manufactured types, customers can specify dimensions and colors to fit their needs optimally. To some extent, the functionality can be customized too. For custom products, the company charges a premium price, exploiting the business potential in mass customization.

Sales are primarily done through contracts with kitchen manufacturers. Buying a new kitchen is a big investment, and customers often go into discussions with more than one supplier to get different prospects and offers. In these design and decision processes, also case company 2's products are discussed and decided upon as an integrated part of the kitchen. For this purpose, the case company has developed brochures and a website as their front-end solution, to be used both by the kitchen sales personnel in meetings and end customers at home.

When orders are placed, they are sent to the case company on either mail or fax. The company then registers orders manually into their business system before printing necessary manufacturing documents. On these documents, customer-specific solutions are written as text into designated fields. For several reasons, the company wishes to implement an electronic configurator solution. As they say, "…this would save us resources, reduce risk of human errors, and speed up processes." The market for customized products, and hence the volume of communication with customers, is increasing, and the company is starting to look into configurators suitable to them.

The main reason for not having an electronic configurator in place already is that technology costs and that they lack knowledge in this field of software. Also, to implement a front- and back-end solution is a time- and resource-consuming process that has so far been put on hold. There is probably an optimal time for changing over to using a configurator, somewhere along the increasing demand for these products among customers. In the beginning, the volume of specific orders is manageable manually, but at one time the amount of unique orders calls for an automated system. It might be that the company has over passed this time now.

10.3.5 Case 5

Case 5 is a winter sports equipment manufacturer. With its approx. 80 employees, the company is a major player within winter sports globally, being the second largest manufacturer of these high-quality products in the world. Sales are through sport shops, but the company considers end users their customers too.

It is of great importance that every customer gets a product that is suited to his/her body measures and qualifications to be able to perform on top level. At the same time, for capacity and employee reasons, products are made year round, and not only in the winter season when the products are sold and used. The company

therefore has to manufacture products during summer months without knowing the exact need of every customer. Hence, the strategy is to actively differentiate product characteristics continuously within defined limits during summer production, in order to have a range of slightly different products ready for the high season. This way there will most likely be a suitable product for you available in the shop. In winter, products can be tailor-made to some extent for single customers in parallel with ordinary deliveries to retailers. Direct customer orders can be fulfilled in a week or two, which is sufficient for dedicated athletes. They are normally well prepared and plan for achieving new products way ahead.

The company keeps track of all products unique characteristics using embedded RFID tags. The products then are matched to each single customer during the new sales process in the shops. To solve this, an online tablet connected to the product database is used to enter customer-specific data and find a perfect match every time.

The system is best described as a matchmaking system, or a front-end system. But, sales data are recorded and can be used to replace products at the retailers, forming a sort of back-end functionality.

Previously products were sold by more or less skilled sales personnel at retailers and sport shops. This had some disadvantages: first, sales took much longer time per customer, because several products had to be fetched, measured, and tested with the customer. Now the optimal product is identified electronically based on customer input and just collected from the shelf. Second, the accuracy was lower leading to some sales ending with customers getting the wrong product. This of course leads to disappointed customers, complaints, and possibly lost future sales. Another advantage with the new system is the mentioned sales-data back-loop to the manufacturer.

The new system required a lot of resources and time to develop, but has ended as the most "high-tech" solution in the market and hence contributes to branding among young people.

10.3.6 Case 6

Case 6 is small-sized workwear company, with approximately 12 employees. The company setup is similar to the majority of textile companies, organized with design department, operations department, and sales department, and with major manufacturing in Far East and minor manufacturing in Poland. The case company sells its workwear products primarily to the service sector both private and public customers, half of it as direct sales supported by own sales force and the other half sold through service providers to the service industry, all B2B sales. Most direct sales are based on a standard product catalogue, with minor customization as logo prints or embroidery, and sales to service providers are often customized standard products with minor design changes as well as prints and embroidery. The case company does the prints, and locally based sup-suppliers do the embroidery for direct sales standard products mainly, because of the volume in small-medium size, whereas

sales through service providers often are significantly higher volume which makes it possible to have all products fully customized by the Far East manufactures. The case company had some year ago designed a product family specifically for medium-sized customers in a specific sector in the service market, where the level of customization was raised significantly. The company developed a product that was customizable both in design, in combination of parts, and pattern of textile and additional design features as pockets, piping, zippers, and buttons. The business strategy was aiming for a market which the case company has difficulties to reach, mainly because the volume was low and customization was high and the sensitivity on price was low. The business setup of this customizable product family was direct sales supported by a selector—originally it was the idea to have a tablet product configurator, but due to cost, they decided to make a manual selector, presenting the solutions space with a selector tool like you choose the color of paint or children playing with cutout dolls. Further, because the expectation was low volume, they made a supply chain and operations setup with Polish sup-suppliers, with direct delivery to end customers.

The case company closed the product family after a year, mainly because they did not have orders; minor reason was difficulties in the operations setup.

The case company has based on its experiences chosen not to open for further choice navigation direct to customers, neither with selectors nor product configurators in a similar setup. They have decided that product configuration as an internal tool can be valuable in several relations, and there is a potential to reduce design cost and operation cost with the use of product configurator. Based on this, they are now considering how they will organize the future design approach and are considering how a product architecture approach can assist such strategy.

10.4 Results

Comparing all of the six cases included in this study, all of them are mass customizers and all of them apply choice navigation in some form. One company applied assortment matching, which has been very successful, in reducing load on sales organization, branding the company and ensuring a better fit between customer needs and the sold product. The remaining five have considered implementing a product configurator. The reasons for wanting a product configuration system are quite similar across the five cases and include:

- Increase sales by allowing direct sales to customers rather than through traditional sales channels
- Reduce resource load on sales organization by “outsourcing” the choice navigation process to customers
- Reduce load on the technical department by automating the sales delivery process using information from the configurator

- Support expansion in sales volume, sales organization, and geographical sales area
- Reduce the risk of human errors by validating input and by eliminating manual type in of orders
- Reduce design cost

It should be noted that these reasons are expected benefits of implementing a product configuration systems, and this case study thus cannot report if these expected benefits are realized. However, the expected benefits are very similar to what has been reported from larger companies and are thus considered feasible to achieve.

Although great benefits may be expected from implementing a more sophisticated system for choice navigation, such as product configurators, significant challenges can be expected in relation to this. As with the expected benefits, the challenges reported are very similar across the case companies. The challenges highlighted the most by the case companies are as follows:

- Selecting the right software for the specific application.
- Defining the solution space to be introduced in the choice navigation system.
- Resistance toward or lack of skills from customers in relation to using the product configuration system.
- Large software and implementation investment is a barrier especially in SMEs.
- Lack of internal IT competences to implement systems.
- Adaption to different geographical markets.

As with the advantages highlighted above, the challenges related to choice navigation are mostly expected challenges, as they relate primarily to, e.g., product configuration systems, which are not implemented yet. However, these expected challenges can be interpreted as barriers toward implementing more sophisticated systems for choice navigation.

10.5 Conclusion

The objective of this paper was to investigate the benefits and challenges related to choice navigation in small and medium enterprises. This was addressed by performing multiple case studies in six different SMEs in Norway and Denmark. It was found that all of the SMEs were applying choice navigation, although most of them in a very simple form, using catalogues, list of product families and options, and manual order entry forms. One SME had great success with implementing an assortment matching system, whereas a second system failed in implementing an "analogue configurator." The expected benefits of implementing a product configurator, which five of the six companies were considering, were quite similar across the cases, related primarily to saving resources, increasing sales through direct sales, and reducing errors. The challenges and expected challenges if implementing

product configuration systems almost all related to investment, resources, and skills and to some extent also resistance toward adopting product configuration systems and configured products.

When interpreting the results, it seems that many SMEs have potential in utilizing more advanced forms of choice navigation, such as product configuration, to increase sales and reduce resources per sold product. However, many SMEs are reluctant to implement these systems for various reasons, which may limit their growth potential. Reasons why the SMEs are reluctant may be related to the fact that an investment in such systems is rather large compared to their profits and thus involves some risk. Furthermore, the resources needed to run an implementation project may be significant compared to the total available resources in the organizations, limiting the free resources for, e.g., product development projects. These risks are less significant in large enterprises, which is why implementation in SMEs must be handled differently than in large enterprises. As reported above, very little literature exists on choice navigation in SMEs, and it is thus recommended by the authors that more research be done within this specific area.

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