WHY YOUR PRODUCT VARIETY MANAGEMENT STRATEGY MAY FAIL: BARRIERS IN THE REDUCTION OF THE PRODUCT VARIETY

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ABSTRACT

Product variety management is a multi-faceted field built on the contributions from the marketing, economics, and operations management domains. Product Variety can be introduced for strategic purpose or for increasing the market share. However, with the increasing variety may also come increasing costs and customer confusion due to difficulty in distinguishing products from one another. Many CEO's would like to reduce product variety, but fail to implement it in their organization or meet difficulties in implementing the reduction of product variety in the pace and to the degree they would prefer. The aim of this paper is to identify the most important challenges in the implementation of a product portfolio simplification strategy, analyzing the barriers found in the literature and, based on a case study, identifying new barriers not yet described in literature. Product Variety Management and stock keeping unit (SKU) rationalization are highly researched subjects both from an academic and a practitioner vantage point. Different case studies and research project studied the impact of an assortment reduction. Nevertheless, a collection of the main barrier in the implementation of a product variety management strategy is not present in the academic literature. We found that the main barriers are not only related to the business and organizational context, but they are deeply affected by the culture and the personality of the people involved in the implementation of the SKU rationalization strategy. The contribution of this project is a list of barriers that can be used by managers as a guide for implementing a SKU rationalization. Such an overview would reveal where the management should focus attention and resources in order to overcome skepticism and even resistance in the implementation of the strategy. This research indicates which aspects should be considered more in the further research on SKU reduction. The case study provided additional barriers not considered in the literature.

Keywords: SKU Rationalization, Barriers, Product Variety Management, Complexity Management.

1. INTRODUCTION

Product Variety (PV) is a term with an agreed upon definition amongst researchers as the number of finished goods produced by a firm (Trattner et al., 2019). High product variety implies important trade-offs. On the positive side, the image of the firm is improved, demand may be more stable, and it can offer the potential to expand markets, increase sales volume and revenue (Ramdas, 2003; Elmaraghy et al., 2013). On the negative side, it may cause problems with excessive setups, over-inventories, and it may increase the complexity of the supply chain processes. Moreover, customers might be confused about the differentiation among product variants and experience long lead time before making a choice (Ramdas, 2003; Elmaraghy et al., 2013; Hu et al., 2008). Product Variety Management (PVM) is the process of making decisions related to the product offering of a firm. These decisions are made at different times and in different functions of the business (Ramdas, 2003). The main goal of PVM is to reduce variety induced complexity and its associated costs. Different methods and strategies have been introduced in order to analyse and manage existing product portfolios. Examples of such methods and strategies are product ABC classification, pooling, modular product architectures, product family design, delayed differentiation, etc. (Hvam et al., 2019; Alfaro and Corbett, 2003; Elmaraghy et al., 2013).

Many CEO's would like to reduce PV, but fail to implement it in their organization or meet difficulties in implementing the reduction of PV at the pace and to the degree they would prefer. As indicated by Elmaraghy et al. (2013), variety literature inadequately explains and predicts the cost and value of PV. Moreover, literature regarding the difficulties and the challenges that are met during the application of a PVM strategy is very limited and not further explored. In this article, we firstly conducted a systematic literature review (SLR) to search existing knowledge on the barriers in implementing a PVM strategy. In order to make the research more complete and clear, we reported, when possible, the reasons why a company decided to initiate a PVM program, the methods applied and the business context. As the literature resulting from the SLR was limited, we decided to enrich the research by analyzing other publications related to variety management. At this point, a case study research methodology was adopted to understand the challenges of applying a portfolio rationalization in a real case company. The purpose of the case study is to verify if the case company had met the same challenges in implementing a PVM program previously discovered in the SLR and to find new challenges.

This research makes two contributions. First, it collects a list of barriers in the implementation of a PVM strategy described in the recent scholarly literature, and reveal directions for future research using a structured literature review. The motivations of the portfolio simplification and the methods used are also indicated. Second, the case study confirms some of the barriers already described in the existing literature and introduces new ones. Additionally, practitioners will benefit from knowing and anticipating the barriers they will meet while pursuing a PVM program. Such an overview would reveal where the management should focus attention and resources in order to overcome skepticism and even resistance in the implementation of the strategy.

The paper has the following structure. In the next section, the methodology used for conducting the research is presented. This is followed by the results from the systematic literature review, the literature review enrichment and the case study. In the next section, the list of barriers and motivating factors found in the results are summarized in a table, followed by the conclusion from the research and recommendations for future work.

2. METHODOLOGY

A mixed method approach was used by the researchers to perform the study. A SLR was first conducted to search existing knowledge on the barriers in implementing a product variety reduction strategy. Afterwards, the researchers analyzed other articles and book chapters about product complexity and PVM that were not found in the SLR results. Finally, a case study approach was chosen with the purpose of find new barriers not jet described in the literature.

2.1 Systematic literature review

The main difference between systematic literature reviews and traditional narrative reviews is that a SLR employs a replicable, scientific and transparent process that summarizes and provides a critical assessment of the available literature on a specific subject (Petticrew and Roberts, 2006), while traditional reviews might go more in depth on a specific topic, but doesn't provide a high level overview and does not allow for replication. Following the approach proposed by Tranfield et al. (2003) we divided the SLR in three phases: planning, conducting and reporting. In the first phase, a search string was developed to explore the literature about the challenges of portfolio rationalization. Keywords were chosen to balance precision and specificity, being sufficiently broad to not artificially restrict the number of studies but specific enough to bring only the studies related to the topic (Cooper, 2010). The initial search string was developed in collaboration with other researchers to guarantee a complete overview and reduce the risk of omitting keywords and synonyms. Two literature databases, Scopus and Web of Science, that cover relevant management and engineering journals were selected to conduct the research. Using the advance search in both databases, with the limitation to search only for English-languages papers, we collected and stored 34 articles. The search string used for Scopus (Elsevier) database is:

TITLE-ABS-KEY ("product complexity reduction" OR "product vari reduction" OR "sku rationalization" OR "product vari* management" OR "product portfolio rationalization" OR "product portfolio reduction") AND TITLE-ABS- KEY ("barrier*" OR "challenge*" OR "problem*" OR "issue*") AND LANGUAGE (English).*

The search string used for Web of Science (Thomson Reuters) database is*:*

TS= ("product complexity reduction" OR "product vari reduction" OR "sku rationalization" OR "product vari* management" OR "product portfolio rationalization" OR "product portfolio reduction") AND TS= ("barrier*" OR "challenge* OR "problem*" OR "issue*"); additional filters applied: LANGUAGE: (English).*

The search results after removing duplicates arising in both WOS and Scopus were 24 papers. Hereafter, abstract criteria were applied to the remaining articles. The articles that discussed the application of PVM methods or the impacts of PVM strategy in the abstract were assessed for full-text reading. The abstract screening resulted in a sample of 14 articles. Finally, a full-texted screening was performed and a final sample of 6 articles was identified as the core of this literature review (Figure 1). The text of one article was not accessible.

There may be some related works which are not captured with this keyword structure. Therefore, the researchers decided to expand the analysis to other works found in the SLR papers' references and in previous projects (e.g. Trattner et al., 2019).

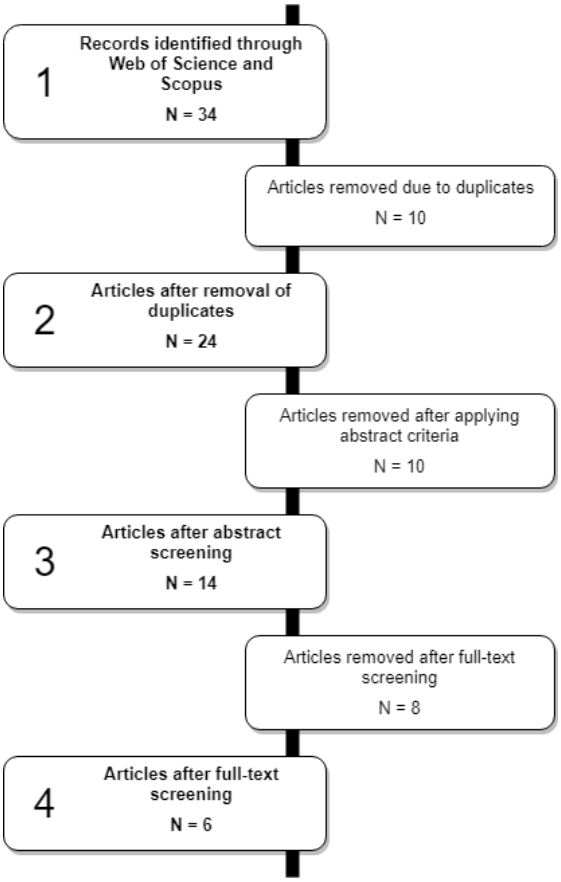

Figure 1. Steps in the systematic literature review

2.2 Case Study

A case study research methodology was also adopted to understand the challenges of applying a portfolio rationalization in a case company. The purpose of the case study is to verify if the case company had met the same challenges previously discovered in the SLR and to find new ones. A case study is defined as "a study that investigates a contemporary phenomenon (the 'case') in depth and in its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin, 2018). This is especially meaningful for the present study as the barriers in a PVM implementation strategy are not evident, predictable and might be influenced by the market context.

The company selected for the case study is a mineral wool production facility located in Europe. The company has a market leading position in the building materials industry and operates over 20 global production facilities with over 10,000 employees. It is composed of 18 individual business units (BU) operating in different markets, with each BU managing its own assortment. Led by the CEO, the company pursued a product variety reduction program in 2015 and achieved operational and financial benefits across multiple factories and sales units. At the beginning of the project, the product proliferation was increasing as new variants were added to existing product lines upon customer request. The sales department wasn't applying any process for removing SKUs from the assortment and, in the production, the negative effects of additional product variants were evident.

The use of multiple investigators was chosen to enhance the creative potential of the study and to enhance confidence in the findings (Eisenhardt, 1989). One of the researchers collaborated with the supply chain team between two and four days per week during the entire project period (three and half years). The main role of the researcher was observing the project team in the SKU rationalization tasks: development of the program, methodology, quantification of the impact and reports to the management. During the PVM program, the researcher had full access to financial and operational data of the company.

3. RESULTS

3.1 Systematic literature review

Bech et al. (2019) conducted a case study within a Danish manufacturer of bread and pastry, with the goal of investigating challenges and experiences on product and process variety management in the process industry. The reasons for adopting initiatives of product and process variety management are related to the long development phase of new products that involves high costs in relation to product development, prototyping and pilot production, which increases time-to-market. The authors identified four main challenges regarding variety management: (1) Difficulties in delaying the point of product differentiation due to the nature of the process utilized in the food industry. Delaying the point of product differentiation represents an effective means of addressing product variety. (2) Difficulties in product testing and determining the effects of the tests: the knowledge of the production process and the products was lacking and the effects of the tests were not documented. (3) No standard interfaces between the parts of the product and cognitive complexity in the production setup. Due to the nature of the product, there is no standard interfaces between parts of the product. The production process is solely operator driven and lacks information of the product performance in production. (4) Challenge in translating the customer requests to parameters of the product and process. Thus, the process variety and the product variety are not closely linked with the customer wishes.

Escobar-Saldìvar et al. (2007) adopted a product variety management approach in the painted sheet metal industry. The project was applied in a Mexican firm who produces galvanized and painted sheet metal products. In the painted sheet metal industry, offering a large variety of colors is an important competitive factor, but it can lead to excessive setup costs/times, inventory costs, and administrative complexity. The main reason for reducing the product offering was to maximize profitability. More in detail, the goals of the project were to reduce the number of colors to have a direct effect on inventory and number of setups, and to eliminate the discontinue colors that are not profitable for the firm. The authors proposed several methods, both exact and heuristic, to optimize the variety of colors the firm offers. The challenges met by the authors during the PVM approach were not indicated in the paper.

Malinowski et al. (2018) applied SKU rationalization in the form of a variant of product substitution, towards an industrial packaged supply chain problem which includes production, allocation, and distribution decisions. After developing a mixed-integer programming formulation, the author tested it in a company in the industrial gas application sector. The motivations for rationalization was to entail lower production and transportation costs, and to simplify operational complexity. The challenges met by the authors during the PVM approach were not indicated in the paper.

Ferreira & Correia-Stein (2017) presented a systematic literature review concerning the impact of product variety on operations management. The authors identified a main challenge in

the product variety management: "Product Variety has been one of the key conflicts between manufacturing and sales departments".

Elmaraghy et al. (2013) presented the drivers of product variety, its benefits, associated complexity and cost throughout the entire products life cycle. The authors indicated that product variety creates both challenges and opportunities for the firms, and highlighted how product variety leads to a conflict between supply chain managers and marketing managers. While marketing managers are rewarded with higher revenue when they increase product variety to satisfy customer request, supply chain managers prefer less product variety to increase efficiency.

Alfaro and Corbett (2003) analyzed the pooling effect under suboptimal inventory policies and nonnormally distributed demand. They investigated the value of pooling using highly erratic but characteristic demand data from a chemical manufacturer. The company, because of the inflexibility of the process, needs to make to stock. The reasons for being interested in applying a SKU rationalization strategy are stockouts and excessive inventory costs that the company continuously experienced. The challenges met during the process were not indicated by the authors.

3.2 Literature review enrichment

George and Wilson (2004) discuss how portfolio simplification (rationalization) is a key aspect for managing complexity in a company. The authors state that with the elimination of low Economic Profit products and services, a company can free up resources to provide better services to the customer and to allow them greater focus on the remaining (profitable) products/services. In this chapter, we identified 3 barriers that may arise when adopting a rationalization strategy: (1) while most companies understand the dynamic of product/service life cycle, very few companies have methodologies in place for managing the end of a lifecycle. Consequently, functional groups in the organization tend to lame each other for the creation of complexity. (2) Companies may believe that their product and service represent significant diversification and stability of revenues, and a reduction of the portfolio's breadth means a permanent reduction in revenue. (3) If the product/service rationalization include a large section of the portfolio, managers and staff responsible for that segment of products may think they will lose the job.

In the book, the authors introduce the case of Intel, a multinational semiconductor manufactory company. Intel was well known as a producer of computer memories and that was their core business. The company was also developing microprocessors for specific customers. When the memory market started to become more capital intensive with tighter margins, the CEO decided to apply a portfolio simplification strategy with the intent of focusing on microprocessors and scuttling memory. During the rationalization process the CEO met 2 main challenges: (1) the majority of Intel managers and executives, who had memory as a core competence, didn't support the transition and became obstructive for the process. Their internal competency represented Intel's main barrier to taking the rationalization action. (2) The other impediment was concern over what the company's customer would think.

Sloot et al. (2006) evaluated short- and long- term effects of a 25% item reduction on category sales. The case study was conducted in collaboration with a Dutch retailer. The retailer aim was to save costs in the supply chain and to reduce complexity by lowering the number of items in different categories. The original plan was a major assortment reduction with an estimated cost savings higher than four million euro per year. However, the company feared that a big assortment reduction might affect its category sales. Therefore, the researchers conducted a pilot project in one category. Regarding the execution of the assortment reduction, the authors highlighted a big barrier that might happen: a sole focus on short-term sales effects that leads to

wrong conclusion. The time span for analyzing the effect of an assortment rationalization should be long enough to include long-term effects.

3.3 Case Study

Led by the CEO, the company set the reduction of product portfolio complexity as a top priority in 2015 and initiated a program to develop methods to address increasing product variety. As mentioned in the section 2.2 the company consists of 18 individual BUs operating in different markets, with each BU managing its own assortment. Fifteen of the BUs participated in the SKU rationalization project. The main goal of the SKU reduction was to create additional throughput on the production lines. Unprofitable and low volume SKUs were targeted for rationalization so that more profitable SKUs could be sold in their place. For determining if a SKU was considered profitable or unprofitable, a threshold was set to 2000 EUR in contribution margin per year per SKU. Reductions in operational costs resulting from the project were sought by some BUs, but this was not the primary objective of the rationalization.

The collaboration for the full time of project with the company allowed the researcher to observe the challenges of implementing a portfolio reduction program within an international organization. The challenges observed during the SKU rationalization have different reasons: (1) In the building materials business, some products are sold primarily to building project contractors and, to win a project bid, the company must be able to provide all requested products, including the low-volume SKUs with low profitability. The potential revenue of high-volume SKUs is linked to the availability of the low-volume SKUs. Therefore, the company-wide approach to assess profitability at SKUs level couldn't be applied for this product segment. (2) The threshold for unprofitable products was heavily critiqued by top managers as being too high for special products that are produced to satisfy large customers. (3) Not all the BUs implemented a cross-functional portfolio review to drive assortment changes. In order to not immediately impact the customer base, some BUs focused on the simpler task of closing unsold SKUs. In other words, instead of rationalizing the sold SKUs they just removed the SKUs that had not been produced in over one year. (4) The change management process in an organization with distributed decision-making power was really complex. In the first year of the project the BUs were often questioning and criticizing the methods for managing the SKUs and for evaluating the BUs results. After about one year, some trainings were needed to explain the expectation of SKU rationalization to the BUs management. (5) It is important to clearly communicate the expected business benefits of the portfolio simplification to all the actors involved on it and link both business and operational strategies to the project. During the first 2 years of the project the expected business benefits didn't permeate the top management, and resistance to the project was evident.

4. DISCUSSION and CONCLUSION

In this collaborative research project, we investigated the most important challenges in the implementation of a portfolio simplification strategy, analyzing the barriers found in the literature. Although the literature on this subject is limited, this study contributes to the research on product variety management in that we (1) collect the barriers described in previous publications, (2) analyze the reasons why a company decide to initiate a PVM strategy. In addition, (3) we conducted a case study that partially confirms the barriers discovered in literature and enrich the list with new ones. The barriers are listed in table 1.

After an in-depth analysis of the final sample of articles, the most common barriers in implementing a PVM strategy seems to be the conflict between departments and the big resistance from the top management. The causes of the top management resistance are varied. In the Intel

case study, in example, George and Wilson (2004) indicated the internal competency of the managers as Intel's main barrier for taking the rationalization action. The core competence of the managers was the computer memory. When the CEO decided to cut memory products and to focus on microprocessors, most of Intel managers and executives would not make the transition and became obstructive to the simplification strategy. In the case study that we conducted at the insulation company, the main reason of the management resistance is related to a not clear communication of the methods and the expected benefits of the PVM strategy. The poor communication led to a delay in the implementation of the strategy and a re-frame of the project was necessary. This barrier revealed the importance of a clear communication of the expected benefits of the SKU rationalization to both business and operations management. The conflict between departments was indicated as a barrier in three articles (Ferreira & Correia-Stein (2017), Elmaraghy et al. (2013), George and Wilson (2004)). Ferreira & Correia-Stein (2017) and Elmaraghy et al. (2013) identified the same cause of the conflict: Product variety creates both opportunities and challenges for firms and it requires a trade-off between balancing the increase of revenues and the corresponding costs. While marketing managers are rewarded with greater revenue when they increase product variety, supply chain managers prefer less product variety to increase efficiency and decrease operational costs. Therefore, firms face a conflict between marketing and operations departments when they implement a PVM strategy. George and Wilson (2004), instead, state that the reason of the conflict is related to the lack of knowledge on managing the end of a life cycle. Most companies don't have methodologies for systematically managing the end of a life cycle. Thus, departments in the organization tend to blame each other for the creation of complexity. Another common barrier is related to fears and negative beliefs that companies and employs have at early stage of a PVM strategy. Examples of these common beliefs are indicated in literature by George and Wilson (2004) and Sloot et al. (2006): a concern over what the client would think, a fear that big assortment reduction might affect the category sales, a belief that a reduction of portfolios means a reduction in revenue, a fear of losing the job from the staff responsible for the products affected by rationalization. Both in the case study and in Bech et al. (2019) publication, few barriers related to the nature of the product were identified. The food manufacturing company tried to address product variety through the delayed product differentiation. However, delaying the point of product differentiation was not possible since the product couldn't be kept in stock in a semi-manufactured condition. Moreover, the variety of the pastry products often consist of a dough recipe, a shape with a filling and a topping. There are not standard interfaces between these parts of product. According to the author, this create challenges in terms of product and process variety management. In the insulation case company, as described in section 3.3, for some product segments it was not possible to apply the PVM strategy because of the nature of the product.

Table 1. List of barriers

Barriers	Reference	Motivations for a PVM strategy	Business Context
Due to the nature of the process, it difficult to delay the point of product differentiation	Bech et al. (2019)	Long development phase of new product (high development costs and time-to-market)	process industry, food manufacturing company
of knowledge of the production process and the products			

No standard interfaces between products and lack of information of the product performance			
Challenging in translating the customer requests to parameters of the product and process			
icts between manufacturing and sales departments	Ferreira & Correia-Stein (2017)	-	-
Conflict between supply chain managers and marketing managers	Elmaraghy et al. (2013)	-	-
Lack of knowledge of how to manage the end of a lifecycle. Consequently, functional groups in the organization tend to lame each other for the creation of complexity	George and Wilson (2004)	-	-
Companies may believe that a reduction of the portfolio's breadth manent reduction in revenue		-	-
Managers and staff responsible for the segment of products affected by rationalization may think they will lose the job		-	-
A concern over what the company's customer would think		Focus on a different type of products with higher margins	semiconductor manufactory company
Most managers and executives with a core competence on the "rationalized" products didn't support the transition and became obstructive for the process			
The company feared that a big assortment reduction might affect its category sales	Sloot et al. (2006)	Save costs in the supply chain and reduce complexity	Dutch retailer
A sole focus on short-term sales effects that leads to wrong conclusion			
In the construction business, the company must be able to provide all requested products. The potential revenue of high-volume SKUs is linked to the availability of the low-volume SKUs Therefore, the company-wide approach to assess profitability at SKUs level couldn't be applied for this product segment	Case Study	Create additional throughput on the production lines	Insulation Manufactory Company
Top managers heavily critiqued the threshold for unprofitable products			
Instead of rationalizing the sold SKUs, some business units just cut the unsold SKUs			

Due to the complex change management, the business units were often questioning and criticizing the methods for managing the SKUs and for evaluating the results			
Big resistance to the project from the top management because the expected business benefits weren't clearly communicated			

4.1 Research Limitation and Further Research

This study has some limitations that may provide worthwhile opportunities for further research. First, the final sample of six articles identified as the core of the systematic literature review is limited. The literature enrichment provided only two more publications related to the study. Additional studies should include the use of new keywords to enrich the used search string, in such a manner, more literature about the challenges of portfolio rationalization might be explored. Second, we provided an unsorted list of barriers. Further research should present a classification of the barriers divided in a structured order and grouped in clusters. This will provide a clearer overview of the argument and will permit to analyze in an easier way the commonality and the differences between the results of different researches. Third, the case study research methodology was applied at aggregated level. This study considered the barriers met during the reduction of product portfolio complexity at the company level. The firm consists of 18 individual BUs operating in different markets, with each BU managing its own assortment. Additional research should study the effects and the challenges of a SKU rationalization at a BUs level. It might be interesting to see the difference between the barriers met by the same company at the aggregated and at the disaggregated level. However, more research is required both at the aggregated and at the disaggregated level because the number of studies on the challenges in implementing of a PVM strategy is still limited.

The proposed method, a systematic literature review followed by a case study, is useful to obtain an overview of the existing knowledge in the recent literature, and to verify and enrich it with a more qualitative study in a real case company. Using this project as a starting point, additional research should confirm the barriers presented in this paper and develop them through case studies research in companies that want to rationalize their product offering.

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