Prioritizing Products for Profitable Investments on Product Configuration Systems

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Abstract. Product configuration systems are among the most popular expert systems for automating sales and manufacturing processes. Therefore, there are numerous studies on the qualitative benefits and quantitative profitability of configurators considering the required investments. This paper uses real case company data to demonstrate the most cost efficient and viable products for investment in configurators by calculating the profitability of the product types. ABC analysis (A, B and C categorization) is conducted to calculate the net profit and gross margins to be able to classify the products based on the available 3-years data. We categorize the products into A-, B- and C-products based on ABC analysis and Pareto principle to calculate both the net profits and sale quantity of different product types. The demonstrated case study reveals that the analysis of the products based on ABC analysis of the quantity of sales and net profits will be a suitable solution to prioritize and predict the most financially viable investments for the future configuration projects.

1 INTRODUCTION

Configuration systems are the expert systems developed through incorporating information about product features, product structure, production processes, costs and prices [1]. Configuration systems support decision-making processes in the engineering and sales phases of a product, which can determine the most important decisions regarding product features and cost [2], [3]. Configuration systems can bring substantial benefits to companies such as, shorter lead time for generating quotations, fewer errors, increased ability to meet customers' requirements regarding product functionality, use of fewer resources, optimized product designs, less routine work and improved on-time delivery [1], [4]–[6].

Although advantages of configuration systems are evident, there are still some difficulties associated with required high investment [1], [7] and the chances of failure [8] in their implementation phase. Hence, researchers attempt to provide the empirical data from case companies to illustrate the potential expectations and risks associated with configuration projects [3]. Besides, increasing complexity is considered a major cause for rising costs and deterioration of operational performance, leading, in particular, to decreased quality, long delivery times, delayed deliveries, and low process flexibility [9]. Therefore, companies need to control the levels of complexity and how reductions in this regard can positively affect their competitiveness in the market.

To be able to gain the benefits of configurators, great effort and investment must be accepted [3]. There are several research which discuss about the high investments on configuration projects [8], [10]. This research uses a case study to provide some guidelines on how to prioritize and decide about the investment on configuration projects. Although the literature provides a variety of methods to support the decision about the investments on configuration systems, there are enough guidelines to determine the most profitable projects and receive the highest benefits from configurators' development. Hence, the companies need to decide about the types of products to be prioritized for Configurators' developments.

The aim of this paper is to evaluate the investment on configuration systems and predict their profitability using the data from the product portfolio at the case company. More specifically, the objective of the paper is to do the ABC analysis in order to categorize different groups of the products based on the net profit and sale quantity to be able to prioritize them. This prioritization will guarantee the profitability of the configuration project and the correct decision to invest on configuration systems' development. The paper will investigate the following question:

RQ. How can industrial companies increase the benefits through a profitable investment on the configuration systems by prioritizing the products?

In this paper, we chose a case study with highly engineered products and evaluate one of the whole product family to determine the most profitable products. Through the ABC analysis, company can decide to invest on configuration systems for the most profitable product types.

Firstly, we carried out the ABC analysis on a specific product portfolio from 2011 to March 2013. Secondly, we classified the products as A-, B- or C- by calculating their sales quantity and net profits. In this research, we query the real data from the selected case company to compare different products and suggests the company to invest on configuration systems based on this analysis.

2 LITERATURE STUDY

In this section, the relevant literatures for analyzing the complexity of the products and process in enterprises are reviewed which will then be utilized to support the choice of ABC analysis. Then, ABC analysis is introduced. The ABC analysis will then be used to determine the most suitable investment for the configuration projects in the future.

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2.1 Product and process complexity

Product architecture is widely recognized as the main factor of product complexity [11], and product architecture management enables the efficient design of new products that are targeted at individual market requirements [12]. Besides, product architecture would help control the structure of the product and the number of product variants, both of which affect the performance of sales, engineering, the production/supply chain, distribution, and after-sales service [13].

One of the main reasons for increasing product complexity is the vast product variety to be offered to the customer [14]. However, researchers offered various approaches and techniques to both recognize and solve the complexity challenges in the product range [15]. Blecker et al. [16] described how to apply mass customization to eliminate the process complexity caused by the increasing variation in the product architecture, inventory, and order-taking process. On the one hand, applying a pure customization strategy would results in increasing product variety and the customer-order decoupling point moves towards the front end [16].

2.2 ABC Analysis of the product range

The analysis of the product range is another fundamental step towards developing a configuration system [2]. It should help to provide an overview of the company's product range and describe the necessary product knowledge to be incorporated into the configuration system. One approach is to start the modularization and standardization project before starting a configuration project, so that basically a 'clean up' is performed in the product program and the associated IT systems [17]. Another approach, for instance in sales configuration system, is to consider which variants are to be offered to the customers [2]. After this, it is 'market mechanisms' that decide which variants of the products are needed.

In order to clarify which variants should be offered to the customers, a project team should clarify some important facts about the company's product line, such as the product range readiness to be dealt with in a configuration system, the most profitable products, variants to be offered to the customers, etc. [7], [10]. One way to create an overview of the product range, as well as defining what should be entered into the configuration system, is to set up an ABC-analysis. The purpose of applying this type of analysis is to identify (and, later, possibly eliminate) product variants that contribute only minimally to revenue but add significantly to the complexity. The ABC-analysis is a categorization method for dividing items into three categories; A, B and C. A-items are the most valuable economically, while C-items are the least valuable [12]. This method aims at drawing attention to the critical few A-items and away from the many trivial C-items.

The ABC-analysis is based on the Pareto principle, which states that 80% of the overall revenue comes from only 20% of the items. In other words, demand and profit is not evenly distributed between items: top sellers vastly outperform the rest. The ABC approach states that, when reviewing the product range, a company should rate items from A to C, based on the following rules [17]:

A-items are goods, where the economic value is the highest. The top 70-80% of the total annual revenue of the company typically comes from only 10-20% of the items.

B-items are the interclass items, with a medium dollar value. Around 15-25% of the total annual revenue typically comes from 20-30% of the items.

C-items are, on the other hand, items with the lowest dollar value. Around 5% of the total annual revenue typically comes from 50-60% of total items.

The ABC-analysis therefore gives the company the possibility to focus their energy on a few critical items. However, a similar analysis can be undertaken for the customers of the product range to determine which ones are the most profitable. Therefore, for each customer (or group of customers), the contribution margin and the revenues are plotted in a diagram in the same way as described for products [18].

3 RESEARCH METHODOLOGY

The relevant literature was reviewed to clarify the present study's position in relation to existing research. In this respect, the literature related to product and process complexity has been studied. Moreover, the literature demonstrates the solution to identifying the product/process complexities and ABC analysis which will determine the most profitable product types. The complexity identified by calculating the net profit and gross margin.

In this article, we use single case study to evaluate the propositions in one ETO (Engineer To Order) company. The single case study can be described as having a holistic, representative design with a single unit of analysis (the case company) [19]. The case is representative because the company is typical of many major manufacturers that have had problems managing product and process complexity. As this type of case study methodology pertains to a single case, it is possible to generate only an analytical generalization, as opposed to a statistical one [19]. We analyzed the results from product portfolio during the 3 years at the case company. Case-based research seeks to find logical connections among observed events, relying on knowledge of how systems, organizations, and individuals work [20], [21].

The entire project was followed by three researchers. The initiative of the research was the decision of the case company to invest on configuration systems and their challenges regarding the product prioritizations. Hence, the research idea was to explain the product portfolio complexities and profitability. However, the main goal was to illustrate the most profitable products and help improve ROI (return on investment) for successful implementation of configuration systems.

4 THE CASE STUDY

The company is an international business Engineer-To-Order enterprise which provides specialized solutions within the field of marine tank management for marine and offshore industries. Within some of the areas of valve remote control, ballast and service tank gauging, as well as cargo monitoring, the company strives to open up new possibilities for more uptime, higher productivity and safer, more reliable conditions for all types of ships and offshore units. This project will focus exclusively on the products ranges in the valve remote control systems at the case company and their after sales department. The reasons for selecting the case company are: (1) it has highly engineered and complex products, (2) there is an urgent need for developing configuration

systems and elimination of time and resources for sales and after sales processes; (3) the company has a huge range of product types with different net profits and sales quantity; (4) it offers a unique level of access to project data.

The whole product range in the remote valve control department has been investigated and all the relevant data related to the net profits, gross margins and quantity of the sales has been extracted and analyzed. If the case company uses configuration systems instead of the ongoing situation, they could save up to 1.162.505 DKK per year by using a web-based configuration system.

In order to invest on the configuration systems, the first step is to categorize and determine the business cases by reviewing the product ranges and determine the most profitable products (among all product types) in valve remote control system to invest in. One approach is to start a modularization and standardization project before starting a configuration project, so that basically a 'clean up' is performed in the product program and the associated IT systems. Another approach is, for example, in sales configuration system, to consider which variants are to be offered to the customers more often with higher profitability. After this, it is 'market mechanisms' that decide which variants of the products are needed or which ones are the customers' most popular and company's most profitable products.

In order to clarify which variants should be offered to the customers, a project team should clarify some important facts about the company's product line, such as: is the product range ready to be dealt with in a configuration system? Which products are the most profitable? Which variants are to be offered to the customers? etc. To make this clear, it is necessary to carry out a process in the company, where all the different stakeholders (sales staff, product developer, production staff, purchasers etc.) come together to form a team, to create an overview of the overall product range and determine which variants can be offered via configuration system.

5 RESULTS

In order to find out which products are the most profitable within the case company, an ABC classification was made based on how many percentages of the total net profit the different products return. The idea of an ABC analysis is to categorize the products into three different categories; A-, B- and C- products. This is done in order to estimate the importance of the products sold at the after sales department. A-products are the most important, while C-products are the least important.

In accordance with the Pareto principle, this analysis has categorized the products that return 80% of the total net profit as A-products, while the products that return 15% are B-products and the products that return the remaining 5% are C-products. Figure 1 demonstrates an ABC classification of the 4345 types of products that were sold in the period from the beginning of 2011 to March 2013 at the case company.

The ABC analysis shows that only 389 (9%) of the 4345 products are A-products, 744 (17%) products are B products, while a staggering 3212 (74%) products are C-products. This classification provides a general overview of the products, which are the big sellers that should be kept under very tight control, but also of the products that are not so profitable, and which may take up too much inventory space thereby tying up too much capital investment. The classification of products can be helpful in the process of selecting those products, which should be entered into the configuration system.

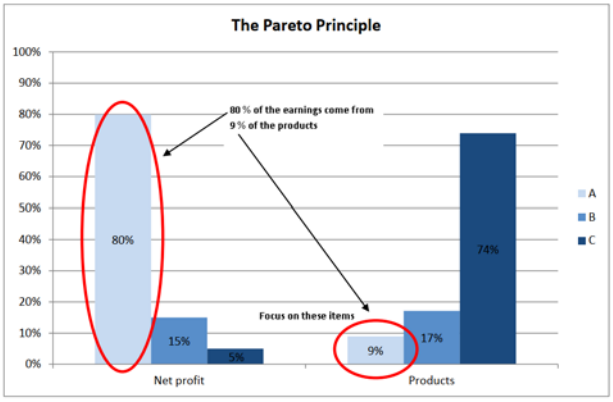

Figure 1. ABC classification of the product ranges based on Gross margin and net profit

Figure 2 illustrates the relationship between the net profit of the categories and the amount of products in the categories. The figure shows that 9% of the products return 80% of the total net profit, while 74% of the products only return 5% of the total net profit. Figure 2 also confirms the theory of the 80/20 rule in the Pareto principle (see Section 2.2), and illustrates that a small part of the case company's products return the vast majority of the earnings. Hence, the case company should be especially attentive to their class A-products. In terms of selecting products for the configuration system, we suggest that inserting the A-products into the configuration system should have first priority.

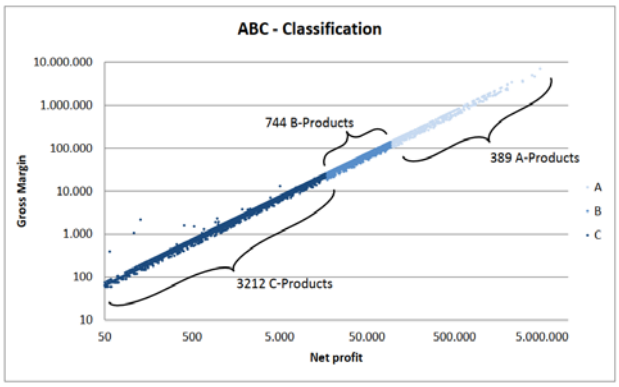

Figure 2 Relationship between the net profit of the categories and the amount of products in the categories

Figure 2 also shows that B-products (17%) return 15% of the total net profit. If or when the configuration system should be extended beyond inserting A-products. Finally, 74% of the products return only 5% of the total net profit. However, this means that the order-sales process takes up an excessive amount of time and resources on handling the sales of small and unprofitable products.

Table 1 shows a selection of product types that were classified as A-, B- or C-products. The products belonged A-, B- or C-categories are grouped in different types based on the highest to lowest net profits. The reason for using "Type" is to avoid the products names due to the confidentiality. This means, that for

instance the type 1 cell under "A-products" shows the total sales numbers of all the variants of type 1 that were classified as A-products; while the type 1 cell under "B-products" shows the total sales numbers of all the variants of type 1 that were classified as B-products. When selecting product types to appear in Table 1, the A- and B-products were selected by the highest net profit, while the C-products were selected based on the highest quantity. The reason was that C-products doesn't have significant net profit while the company might sell them in high quantity.

Table 1 illustrates, that it is advantageous to insert the Type 1 variants from Class A into the configuration system, since they alone return almost 21% of the total net profit. If or when B-products should be inserted into the configuration system, then it would be advantageous to first insert the product variants that are the most profitable. The table also shows, that in C-product, for example type 1 and many other small products are sold in big quantities, but are not contributing much in the total net profit. In order to save time and resources on selling these unprofitable products individually, case company should stick to selling them only in package solutions (set of seals, common parts etc.). In a configuration system rules could be made in order to make sure, that these small products can only be sold in packages, which could be helpful for the salespersons because configuration system would automatically reduce time and resources in the order-sales process. However, it is obvious that configuration system can save significant amount of time for the products with high quantity in case the case company desires to continue with the same scenario.

Table 1. Selection of product types that were classified as A-, B- or C-products

A-products	Net profit	QTY	B-products	Net profit	QTY	C-products	Net profit	QTY
Type 1	42.219.776	4.711	*Type 1*	3.345.487	354	*Type 1*	42.910	27.609
Type 2	15.722.870	6.215	*Type 2*	2.135.903	924	*Type 2*	600.151	6.470
Type 3	5.859.767	9.236	*Type 3*	1.442.432	5.444	*Type 3*	39.787	5.914
Type 4	5.194.738	3.218	*Type 4*	1.297.569	87	*Type 4*	105.109	3.180
Type 5	4.217.715	260	*Type 5*	1.004.666	231	*Type 5*	242.776	3.064
Type 6	3.858.531	23	*Type 6*	886.308	1.021	*Type 6*	35.222	2.510
Type 7	3.584.171	1.028	*Type 7*	776.489	978	*Type 7*	85.984	1.876
Type 8	3.427.903	2.075	*Type 8*	686.272	188	*Type 8*	30.194	1.339
Type 9	3.356.950	692	*Type 9*	601.362	311	*Type 9*	27.881	1.202
Type 10	3.153.570	1.140	*Type 10*	589.302	3.509	*Type 10*	54.186	1.180

6 CONCLUSION

The aim of this study was to prioritize the products in one product portfolio in order to have the most profitable investment on product configuration systems. The empirical data is gathered from an ETO company based on the analysis of 3 years' worth of data. In detail, the gross margin and net profits calculations verifies the Pareto principles (which states that 80% of the overall revenue comes from only 20% of the items). For this specific example, 80% of the net profits is coming from 9% of the products. Then, more calculation is done to determine the quantity of the sale. The categorization of the products is carried out and tabulated for cross examination.

In addition to the ABC analysis, the inventory turnover was investigated in order to see if there were any items lying still and thereby tying up too much capital. Furthermore, it was investigated whether or not the after sales department is creating orders, which are not returning any profit for the company, for example if the resources spent on handling the order exceed the profit of the order. It was found that 2% (122) of the orders were not returning any profit. This was not investigated further, since the number was not considered critical. However, it should be mentioned that a configuration system would have eliminated unprofitable orders altogether.

The analysis led to the conclusion that the investment on configuration systems can be done based on the product prioritization. The first reason is that they are the most profitable products at the company and the benefits are remarkable. The second reason will be due to the high quantity of sales which means the amount of time and resources to produce and sell these product types are significant. Hence, developing a configuration system for these product types will save a considerable amount of man-hours and a striking market benefit.

This research in the first step is using the ABC analysis method to prioritize the product types. Secondly, we did some additional analysis to categorize the product for a profitable investment in configuration projects. This study considers only one case company and one case product and assumed as an exploratory research. Therefore, it requires further research and additional cases to use ABC or other methods to prioritize the products to develop configuration systems. Also, the verification of the results is appreciated which requires a longitudinal study after years of configurators' implementation at the company and in a comparative case study.

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