

# Market-oriented Variant Management (position paper)

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**Abstract.** The mega trend individualization drives product manufacturers towards offering more and more variants of their products. As seen in mass customization scenarios, product configuration based on a modular strategy is an enabler for this trend.

The key idea of variant management is to optimize the number of product variants that can be offered to a specific market segment, i.e. *outer variety*, while reducing the complexity of product development and manufacturing. Production costs are typically kept low by producing a small amount of modules that are generic and common for multiple products within the modular strategy, i.e. *inner variety*.

Classic variant management is driven by the idea of reducing costs between the fields of product design / engineering and manufacturing / logistics. Hence, we see this as efficiency. We apply the same method of optimizing the interplay between outer variety and inner variety to the sales-level; i.e. between the fields of logistics processing and sales / marketing. The product variants that are offered to a specific market segment should be aligned with the market needs. Hence, we see this as effectiveness. We show how the two views on variant management complement one another and how they relate to business economics, namely the economies of scale and the economies of scope.

We suggest using a combination of both efficiency and effectiveness to assess the capability of change of product manufacturers that are based on modular systems. Market-oriented variant management involves a number of business processes. A management-ready presentation of the potential that changing these processes has, can significantly influence a company's willingness to invest in such a change.

## 1 INTRODUCTION

The mega trend *individualization* is the main reason why the interest in mass customization strategies is continuously growing. This mega trend is supported by the fact that nowadays it is easier than ever before to get information about products and to compare them. The *digital product representation* enables lots of services like product selection, configuration or comparison. Using this digital product representation it is possible to get all the relevant information for deciding which products best fit the customers' needs; without going from one shop to another. It is this information that can also be used for market-oriented variant management.

*Variant management* is a holistic approach to control and optimize product diversification with respect to production costs and market strategy (see e.g. [1]). The term variant management has been around for quite some time. The key idea of variant management is to optimize the number of product variants that can be manufactured, i.e. *outer variety*, while reducing the complexity of product development and manufacturing. Production costs are typically kept low by manufacturing only a small amount of different modules that are common and recurring for multiple products, i.e. *inner variety*. These modules can then be manufactured in large scales.

Within mass customization, product configuration is seen as the key enabler for being able to communicate product variety into the market (see e.g. [2]). *Product configuration* describes the task of composing a product from a set of pre-defined modules; the modular system. In this sense a product configurator is a tool for managing the interaction between the inner variety, i.e. the modules, and the outer variety, i.e. the products.

The first occurrences of the term variant management stem from the area of product design, engineering and production. The base idea is to separate the development and manufacturing of recurring modules from the manufacturing of products that are based on these modules. In this sense the product manufacturing process is separated into two parts. The first part is an order-neutral process: pre-manufacturing the modules. The second part is an order-specific process: combining modules.

Defining the scope of outer variety, i.e. defining the right amount of product variants, is one of the major activities for effective sales. Optimal product diversification therefore must be based on the market's demand.

This is why *market-oriented variant management* goes one step further and uses the idea of modular strategy on another level: between manufacturing, or: logistics in general, and sales / marketing. In this sense, optimizing product diversification for a given market segment is managing the outer variety (from the sales view). At the same time, optimizing product development and manufacturing is managing the inner variety (from the logistics view).

The remainder of this paper is organized as follows. Chapter 2 describes our understanding of market-oriented variant management in general as well as the distinction between the logistics view and the sales view. Chapter 3 describes work-in-progress on how the capability of change of business processes related to variant management can be measured and assessed in general and applies these ideas to market-oriented variant management. Chapter 4 discusses related work and finally, Chapter 5 gives a conclusion and discusses future work.

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## 2 MARKET-ORIENTED VARIANT MANAGEMENT

We have already explained that market-orient variant management distinguishes two levels of optimizing product diversification: the logistics view and the sales view. In principle, this distinction can be made on an arbitrary number of levels, e.g. between product design and engineering, between engineering and manufacturing, between manufacturing and logistics, between logistics and sales. As we will see later in Chapter 3, distinguishing between the logistics view and the sales view has an important impact on companies' business strategy. This impact also affects the most crucial business processes of companies that are based on modular systems: new product development, quote generation and order processing. Therefore, we will focus on these two views in the following.

Before we detail the two views on variant management, we give a short insight into relevant aspects of business economics; namely the economies of scale and economies of scope.

### 2.1 Economies of scale and economies of scope

The *economies of scale* describe reducing engineering and production costs per unit as fixed costs are spread out over more units of output [3]. This is the base principle of mass production: the price per unit decreases with larger lot sizes. The *economies of scope*, on the other hand, are based on the common and recurrent use of modules. Thus, they describe lowering average costs by sharing production costs or recurring resources, for example sales or marketing activities, over a variety of products [4], [5]. When economies of scope are based upon the common and recurring use of proprietary knowhow or specialized and indivisible physical assets, the product diversification is an efficient way of organizing economic activity [6].

With a large outer variety of products that is based on a small inner variety of modules, the recurring modules can be pre-produced order-neutrally in large scales. In a second step these modules are assembled specifically for one customer order. Thus, mass customization strategy benefits from both, the economies of scale and the economies of scope.

While the economies of scale do plateau in an efficient state which delivers high-margin revenues, economies of scope may never reach such a state. But still, it is worth trying (see e.g. [7]). Managing the ongoing scope-learning process is one of the most essential activities in business strategy, in particular for companies manufacturing products that are based on modular systems.

While optimizing the scope of modularization belongs to the logistics view on variant management, finding the right scope for product diversification is an activity within the sales view on variant management.

### 2.2 Logistics view on variant management

The logistics view on variant management focuses on an optimal interplay between outer variety and inner variety from product design and engineering via manufacturing towards logistics; i.e. supply chain management, shipping and so on. The major activity within this view is optimizing the scope of modularization. This

means that we want to benefit from both, the economies of scale (by producing modules in large scales) and the economies of scope (by sharing production costs and other related resources over a variety of products).

This view is the "classic" variant management approach that is around in literature for quite some time already. Therefore we refer the interested reader to [1] and in the following focus on the sales view.

### 2.3 Sales view on variant management

The key aspect of the sales view on variant management is to offer exactly those product variants that a specific market segment desires. Not less but also not more than those. The simple case of designing the range of product variants can be described as portfolio management. In this sense a company aligns its product portfolio according to the markets needs and has market-driven product development and manufacturing processes.

However, offering optimal product variety can be more complex than this. European product manufacturers are currently under pressure in order to compete with the low-price mass production in countries from Asia. This is why a lot of *component manufacturers* that have been *component vendors* turn into *system vendors*. With the term *component* we describe products that are used in larger contexts: the component itself has no direct benefit for the customer's application but a combination of components that complement one another builds up functionality with extra benefit. Both terms *product combination* and *system* can be encountered within the business strategy of companies that manufacture components. For the purpose of this paper we treat both terms as synonyms and in the following stick to the term *system*.

A system may consist of discrete products, configurable products or a combination of both, possibly together with components that are not sold independently. *Discrete products* are non-configurable products that are described by and selected from a set of characteristics and that do not offer customization options. *Configurable products* on the other hand are customizable products that are available in a large variety. Typically, configurable products are based on a modular strategy and need to be configured in order to obtain a sellable product.

The challenge of advertising, configuring and selling systems is not to be underestimated. The most important part of selling systems is to support the customer in the buying decision process. Identifying the right combination of components is even more complex than configuring a single product.

Additionally, customers often do not know which products they need. However, what a customer does know is the application problem for which he needs a solution. This is why we see a solution configuration as one of the major improvements in sales-oriented variant management. The term *solution configuration* describes a configuration process that is started with a problem definition for which a solution is sought. The main difference compared to usual product configuration is that the customer does not decide on the product's characteristics but enters characteristics of the application. Selecting the best-fitting product and inferring the products characteristics from the application characteristics is hidden from the user.

In order to achieve this encapsulation, the configuration model is separated into layers: on top of the technical layer containing configuration knowledge about buildability or the sales layer

containing configuration knowledge about sales-oriented customization options, an *application layer* containing configuration knowledge about the product's application domain is added. This application layer guides the customer during product configuration. Thus, the customer can focus on describing his problem situation and is not distracted with technical details he does not know about.

## 2.4 Interplay between the logistics view and the sales view

In the previous sections we distinguished the logistics view and the sales view on variant management. Furthermore, we have described their influence on optimizing the scope of modularization and finding the right scope of product diversification, respectively.

Obviously, both activities of scoping influence one another. Reducing the set of modules which are manufactured order-neutrally in order to increase the gain of the economies of scale, i.e. reducing the modular system, has impacts on the possible product variety. Vice versa, broadening the variety of products that are offered to a specific market segment in order to increase the gain of the economies of scope, i.e. enlarging product diversification, has impacts on the modular system.

Nevertheless, it is important that both scoping activities are addressed individually:

- The activity of scoping modularization affects the efficiency of related business processes. The efficiency of modularization and of product manufacturing in general lies in being able to provide the expected outcome, i.e. the products, with the least possible use of resources. Note that besides low production costs this also includes fast time-to-market and delivery times.
- The activity of scoping product diversification affects the effectiveness of related business processes. The effectiveness of product diversification for product manufacturers that are based on modular systems lies in being able to provide exactly those products that the addressed market segment desires; at the right time and at the right place and most importantly at the right price.

Both scoping activities are carried out by different business units and can be initially set up, maintained, assessed or optimized individually. But companies manufacturing products that are based on modular systems will only be successful when addressing both of the scoping activities. Only then it will be possible to deliver the right products at reasonable prices but also to generate high-margin revenues.

## 3 CAPABILITY OF CHANGE

Variant management is an approach to control and optimize product diversification. In this sense, variant management significantly influences business processes like the new product development, quote generation and order processing. Business processes are crucial for companies and are typically not changed unless really necessary. The decision to change a business process therefore needs management-ready analysis and presentation of the change's potential.

In the following we present work-in-progress on how the *capability of change* for business processes of product

manufacturers can be assessed and improved. The first step towards this goal is being able to measure business processes. We present first ideas on how to do that in general (Section 3.1) and apply these ideas to market-oriented variant management (Section 3.2). The second step towards this goal is being able to define a metric which compares the current state of a business process with its target state (Section 3.3). Such a metric can be used to describe the potential impact of a change in the business process and significantly influence the willingness to invest.

### 3.1 Measuring business processes in general

The efficiency of a process describes how good *the things are done right*. A process efficiency can be measured using several criteria including but not limited to total processing time, resource utilization per unit of output, non-value added cost, non-value added time, cost of quality, and so on [8]. Furthermore, any deficiency in training or skills of the workers or any delay from the related processes that provide inputs for the measured process will also show up.

The effectiveness of a process describes how *the right things are done*. Measuring processes effectiveness begins with outlining the customers' expectations and needs in detail. These expectations would then be converted into measurable targets. Customer expectations are not readily available or clearly specified. This is what makes it hard to set up a quantifiable measurement [8]. Typical customer expectations are, among others, product quality, frequency of new products or updates, quality of service and the overall customer experience.

To the current state of our work-in-progress we do not have a process to generate quantified numbers or formulae, but here are some first thoughts:

- If we do exactly one thing in a perfect way, then we assume to have an efficiency of 100%. If we do the same thing with half the efficiency, then we expect to have an efficiency of 50%.
- If we do one perfectly right thing, then we assume to have an effectiveness of 100%. If we do one thing that is half as effective, then we assume to have an effectiveness of 50%.
- If we do one perfectly right thing with half the efficiency, then we assume to have an overall process performance of 50%. Vice versa, the same holds for doing a thing with half the effectiveness, but doing it perfectly efficient.

Hence, in order to measure the performance of a business process we need to measure both its efficiency and its effectiveness and then we need to generate a reasonable overall measurement including the input of both values.

### 3.2 Measuring market-oriented variant management

Classic variant management focuses on efficiency: optimizing the scope of modularization. The main reason for variant management on the logistics level is cost reduction. Managing the sales view focuses on effectiveness: finding the right scope for product diversification. The main reason for variant management on the sales level is selling more products. While effectiveness is most important from the point of view of external customers, efficiency is most important internally.

Efficiency and effectiveness of market-oriented variant management relate to different business processes. Efficiency is related to new product development and setting up the required tools for logistics processing, quote generation and order processing. Effectiveness, on the other hand is related to marketing and sales strategies and their influence on a customer's buying decision.

### 3.3 The potential of a change in the business process

The ideal performance of a process is assumed to be 100% – we do the right things and we do them right. But nevertheless, a desired target state for a business process may be less than 100%, e.g. when reaching the ideal status is expensive and a company wants to invest in smaller amounts. In such a case it may be viable to set a target state of, for example, pareto-optimal 80%.

The potential, that the process optimization can raise, is the distance between the current state and the target state. A management-ready presentation of this potential can significantly influence the decision whether to change the company's business process or not. Low potential will lead to low willingness to invest whereas high potential may also lead to investments although there are risks along that way.

## 4 RELATED WORK

In this paper we make use of business economics. Namely, these are the economies of scale [7] and the economies of scope [6], [8], [9]. The interplay between these two economies also has been researched earlier (see e.g. [10]).

There is also earlier research in the area of managing product variety and manufacturing complexity [9], [10], [11]. Also the research fields of variant management (see e.g. [1]) and mass customization (see e.g. [2]) give a lot of input on managing variety and scoping product diversification.

However, there are only few articles on using the economies of scale and economies of scope to explain or analyze economics for product manufacturers that are based on modular systems. One notable article is [12] in which a performance measurement system for modular product platforms is proposed. However, this article focuses on measuring the setting up and the maintenance of modular product platforms based on a set of criteria that is defined during the measurement process.

This paper presents a novel approach with the term *market-oriented variant management*, i.e. adding a sales view as another level on top of the logistics view that classic variant management deals with. Another novelty in this paper is relating the scoping activities of modularization and product diversification to the terms efficiency and effectiveness, respectively, and using them to measure the performance of business processes and to calculate the potential of changing business processes.

## 5 CONCLUSION AND FUTURE WORK

We introduced the term market-oriented variant management as a combination of classic variant management, which we see as the logistics view and an additional sales view that both use the same method of optimizing the relation between inner variety and outer variety. We have shown how the two views on variant management

complement one another and how they relate to business economics, namely the economies of scale and the economies of scope.

Furthermore we introduced an approach that supports calculating the potential of changes to business processes that are related to market-oriented variant management. Such a potential in a management-ready form can significantly influence the decision of changing the company's most crucial business processes.

It is up to future work to fully understand the relation and interplay between the well-established research areas product configuration, mass customization, variant management and business economics.

Also, we need to research how the potential of a business process can be presented in meaningful numbers. Obviously, a calculated number in terms of percentage would significantly improve the statement of potential. But in order to get there, we have to go some steps: defining how to measure both the efficiency and the effectiveness of a business process, doing this for both, the current state and a target state of the relevant processes and then defining a metric for presenting the potential of the actual change. Another open topic is the influence of different products on the measurement. Perhaps it is necessary to define a weighting for the different products, for example based on sales numbers or revenue.

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