Production Management I

Lecture 12
Complexity Management

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Anmerkungen:
The increase of over-capacities, the loss of innovation and technology head starts and a lack in differentiation in performance lead to substantial pricing pressure. In order to avoid hard price competition, enterprises try to make use of capacities by offering specialized products. However, due to variant-induced extra costs such a strategy can lead to a decrease in sales profitability.
Vicious Circle of Complexity Management

- Competitive disadvantage due to uncontrolled cross-subsidisation of exotic models by standard models.
- Minimal variant diversity = optimal variant diversity
- Maximum net value = optimal variant diversity
- Aimed cross-subsidisation creates competitive advantage

Decrease in competitive ability of company
Stagnation of sales
Product diversity is increased by serving niche markets
Costs are rising for the whole product range
Complexity costs are increased without a significant rise of market share

Source: Rommel u. a. 1993

Anmerkungen:
Eight Duties of Complexity-Management

1. Correct balance of complexity drivers
2. Well-directed cross-subsidisation of variants
3. There is an optimal variant variety
4. Ensure price quality by configuration logic
5. Precisely meet customer needs
6. Avoid self-competitiveness
7. Degree of communality through modularisation
8. Output-oriented management of sales

Complexity Management has emerged to be the essential part of any management. Only if all drivers of complexity are well balanced, an economic optimum of variety can be achieved. To identify and establish this point is one of the most challenging tasks of each individual company. With respect to the marketplace optimised variety offers opportunities to protect markets against competitors, to meet customer needs exactly, to avoid effects of variant cannibalism and to realise high price levels. Internally, variety can be attained by an adequate commonality degree, by additional services as well as yield driven sales strategies. This lecture outlines pitfalls and requirements for Complexity-Management.
1. Correct balance of complexity drivers

Model variety | Individualisation for customer | Innovation cycles | Price policy | Development & value added in partner networks

Legend: SCM – Supply Chain Management

Anmerkungen:

Complexity drivers – such as model diversity – have effect on the whole chain of economic value added. R&F efforts will rise for example when the model diversity increases. Likewise the marketing activities has to be adjusted.

Suppliers production as well as the own production have to be prepared technically and organisationally. Furthermore there are highly connected interdependencies between these complexity drivers.

To manage variety means to balance complexity drivers. In case an enterprise wants to reduce his part-variety, there a several approaches to do so: standardisation and product modularisation. Both approaches support the commonness to use the same parts.

On the other hand, a reduction of innovation cycles could result in a reduction of part-variety by means of discontinuing old product families.

Which method is more suitable, depends on the business model and the economic evaluation. It is not reasonable to apply both methods simultaneously.

Anyway, the complexity drivers never should positioned in extremes, but rather should be calibrated under consideration of their interdependencies.
2. Well-directed cross-subsidisation of variants

Compensation of decreasing turnover with extra variants

Competitive disadvantage due to uncontrolled cross-subsidising of exotic models by standard models

Targeted cross-subsidising creates competitive advantage

Quantity - price - costs

Fair allocation of costs according to the input involved

Prices

Competitive disadvantage

Loss

today yesterday

Frequency scale

Anmerkungen:

Strategic mistakes in a company’s product and performance planning often leads to the following situation:

Beginning with an original simple product program which only incorporates one standard model (volume model) and few basic types, the variant variety increases drastically, i.e. the frequency distribution shifts in view of more exotic products and fewer standard products. A substantial problem is the missing transparency of the costs, which is connected to the increase in variant variety. The exotic products in the product spectrum are therefore typically sold at prices below the costs actually caused. This (often unconscious) transverse subsidization inevitably results in a competitive disadvantage compared to companies offering a less variant-rich product spectrum.
3. There is an optimal variant variety

Anmerkungen:

The maximum profit to back out of variety, neither depends in radical avoidance of variants nor in imprudent enhancement of the product programme.

The difference of variety profit and costs constitutes the maximum net profit.

Radical avoidance of variants leads to the fact, that customer needs couldn’t no longer be fulfilled. This matters significant impacts on the gross-profit, which can be achieved on the market.

The net-profit decrease and contrariwise the achievable (gross-) extra-profit increases only in a digressive way along with the variety. Because of in many times the costs increase in an exponential way along with the variety, the net profit will decrease.

There is an economic optimum for variety between those two extremes. The major challenge for just every business is to find the optimum between profit and cost of variety.
4. Ensure price quality by configuration logic

Offering of a low-priced basic version

Classification of requirements:
- basic,
- performance,
- enthusiasm features

Increased margin by customer-eligible individual features

Anmerkungen:

It is essential to know and to structure customer needs especially for markets with highly value on diversity. According to the Kano-Model customer Needs and requirements could be structured in basic-, Basis-performance and enthusiasm features.

Basic features – these are presumed by customers and in general are not the major argument to buy a product – have to be offered for a minor price.

Performance features are important to differ from competitors. For those features the pricing has to be adjusted on competitors. Enthusiasm features are impulsive, emotional product features. Especially for those features the price quality could be enhanced.

Automotive OEMs are using configurators to give customers the ability to configure their own customised car. A simple and staggered configuration - with special commandments and prohibitions – makes this possible.

Basic equipments are offered as cheap as possible. The OEMs margin only increases with customised extra features.

Such a configuration logic could be used to generate different scales on price-value combinations and to achieve a higher price quality.
5. Precisely meet customer needs

Slight noticeable variance for the customer in single markets

Big variance in company because of market specific basic conditions

Prevention of variety with overlapping of markets

Anmerkungen:

A company’s competitive ability is a result of its ability to satisfy current and future market needs with capable products. In order to cover market needs, the company establishes an internal diversity of parts and variants (internal complexity). This is portrayed by the market service offered, the product- and service variants and the increase in complexity in the performance-creation-process. Variant management is the interface between external complexity, defined by market needs, and the resulting internal complexity. Optimally the internal complexity is equivalent to the external complexity.
6. Avoid self-competitiveness

When generating the product programme it is necessary to avoid self-competitiveness between different products.

Self-competitiveness means a contrary influence of a single variant on another variant in terms of quantity of sales. For example the increasing of the sales quantity of a single variant is leading to a decrease of sales quantity of the other variant.

Enterprises with a high product diversity within a single market sector are periled for self-competitiveness. Overlapping of single market segments is the major risk for self-competitiveness – to avoid overlapping is the most important challenge. Market segments have to be distinguishable.

As seen in the example above, diversity could be achieved along with avoidance of self-competitiveness. Indeed it is important to bear in mind, that market volume could be portioned only once. With increasing model diversity the sales rate per model will decrease.

The effort-value relation of diversity is of major importance.
7. Degree of communality through modularisation

Increased reuse of components/parts between series and product lines (communality)

Consequent reuse of components/parts between previous and follower products (carry-over)

When the optimal degree of diversity is defined, the internal variety should be implemented as efficient as possible.

Modularisation is a structural approach for variant oriented product optimisation. Parts with different degrees of variety are connected over standardised interfaces. Major target is to build up diversity with only a few parts – to concentrate variety on these parts.

Result of such a product structuring are three types of parts: standard-parts, variant-parts and customised-parts.

Modularisation could be used on each assembly level.

The cost-advantage of modularisation leads to the fact, that higher degrees of communality could be achieved. By using modularisation risk concerning of product use as well as economies of scale could be realised.

Even though higher R&D costs for developing more sophisticated product structures come along mentioned advantages.
8. Output-oriented management of sales

Separation of customer specific single solutions and disabled variants from "active" product range offered

Installation of a release process for customer-specific individual solutions

Systematic blocking of old solutions (residual waste)

An output oriented management of sales offers economic potentials. The definition of active standards is very helpful.

By defining of active standards, customer-specific individual solutions and und blocked variants ("residual waste") will be divided from the active product offer.

The active standard contains modules and products, with are actively on sale. Customer specific individual solutions are those products, which are not listened in the programme. Established singel solution could be transferred in the active standard. Residual waste are former active standard products or customer specific individual solutions, which have to be produced due to law or contract reasons. They ar not intended for the active sales market.

A structures product programme has to be defined against the background of sales volume and real cost. Furthermore the product programme has to be economically evaluated with scenarios.
Control Circuit of Complexity-Management

Anmerkungen:

Following the Failure Mode and Effects Analysis (FMEA) the Variant Mode and Effects Analysis (VMEA) was developed for early detection and prevention of variants referring to the problem of variant diversity. VMEA is a systematic procedure, which contains technical and cost relevant control of variant diversity. Divisions such as product program planning, product development, production and distribution are involved at an early stage in planning and composition of product variants.

For the easy use and implementation of VMEA the variant-tree was designed to show the product-structure. It clearly displays the essential information concerning the cause of variants and number of variants of the assembly group by illustrating the variant and part diversity on the horizontal axis and the installation order on the vertical axis. This instrument allows structured and transparent mapping of the variant diversity of a product-program. This permits the reduction of variants and simultaneously accounting for special customer wishes.
Methods and additives for variant management

Scenario analysis with the Complexity-Manager

Anmerkungen:

The „Complexity Manager“ is a modular designed IT-System for description, analysis and solution of complex problems in variant and complexity management.

The „Complexity Manager“ offers tools for optimization of product variety and complexity costs.

Product variants are clearly structured on the basis of functional product characteristic and different parameter value and displayed graphically in consideration of technical and market limitations. With the gained high level of transparency it is possible to make simulations in case of new product planning or analysis of existing products. Simulations provide information which are used to support decisions about strategic focuses in product programme. Furthermore the „Complexity Manager“ allows systematic and complete technical presentation of variants.
Innovation Strategies – Release Engineering

Anmerkungen:
Release-Engineering is a principle of software engineering which can be transferred to complex mechanical and mechatronics systems. This approach allows to increase R&D effectiveness and to manage rising system complexity. Simulations based on features show significant reduction of internal complexity. Without reduction of the marketwise necessary diversity, a time wise bundling of component changes lowers the systems complexity exponentially.

Release-Engineering of systems can generate a trade-off from the dilemma between capturing market niches and overwhelming internal complexity over the product life-cycle. R&D-processes especially in the automotive industry are essentially constricted by too many and possibly unnecessary design changes of the different, highly interdependent components over their life-cycle. Present design change processes suit fine in early stages of the Product Development Process (PDP) while relocating design changes to former developing stages of the product.

The approach allows a major step towards more significant innovation programmes by rather suitable, dedicated R&D efforts on system variants. Another meaningful implication of Release-Engineering is its impact on the innovation frequency as an enabler to significant increases in innovation rates.
Feature Based Commonality-"Road Map" under consideration of dynamics

More variants
Speedily made possible

More variants
principally possible

Anmerkungen:
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The aforementioned Building of Release-Units needs to take place along three dimensions.

• These are the product sequence, the product programme, and the product structure.

• The Building of Release-Units needs to reflect the Product Structure.

• A Carry-Over of Parts needs to be ensured along the product sequence.

• The freezing of Release-Units or modules must take place across various product groups.
Literature PM I V12


Anmerkungen:


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