The Changing Impact of Product Design for a Company

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Abstract

The paper presents the strategic importance of the manufacturing function for a company with a particular focus on the evolving product design and its importance. The production paradigm has changed from the start of industrial evolution to the mass production era, further to lean manufacturing, and finally to a focus of customization. In the course of changing manufacturing, the product design has also changed. The old pattern of designing products according to customer needs is still valid. In the early days of industrial production customer needs could be fulfilled by product design feasible for mass production. This is no more possible as the requirements of customers have become wider and more specific. Customization in product design includes the idea of serving all the varying customer needs, while carrying out production as effectively as possible. This aim can be reached if modern methods of product design are applied.

The paper shows how advanced product and product family design can influence the competitive advantage of the company. This aspect includes ideas of standardization, modularization, and product platform design. This way many strategic benefits can be achieved. The need for advanced product and product family design is caused by such factors as increasing customer requirements, evolving production paradigm, and opening worldwide market. On the other hand, utilization of modern information systems makes it possible to handle the large amount of information caused by the increased product variation.

The various aspects of evolving product design are discussed, including standardization, modularization, product platform design, and mass customization of products. They all aim to offer the customers exactly the products they need. At the same time, the advanced product and production design makes it possible to serve the customers in a cost effective way. These qualifications have a great impact on corporate strategy and the competitive advantage of the company.

In the opening market the cost advantage in production is seldom a sustaining competitive advantage. The competition from low cost countries cannot be avoided in an open market. It is claimed that the factors of production which have qualitative features being valuable, rare, inimitable and non-substitutable could give competitive qualities for products of a company. With these features the products can avoid direct price competition. If the product and production design can combine customization and cost effectiveness with the features of being valuable, rare, inimitable and non-substitutable, sustaining competitive advantage can be achieved for a while.
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1. Changing Paradigms in Production

The era of industrial revolution has lasted for about 250 years since the middle of the eighteenth century. It started in central Europe when besides handicraft production steel and energy were started to be produced in industrial plants.

The industrial production mode was much more effective than handicraft production mode. Productivity increased at the industry level and economy level simultaneously as the industrial production mode was adopted in various industries. The cost reduction focus was prioritized in the beginning. The more effective production methods made it possible. At the same time, the demand for goods had not yet developed, and the customer demand did not make requirements for better quality. The focus on cost reduction was in fact predominant for a very long time in major industrial countries. It started in the 1770s and continued until the 1980s. This era can be divided at least into three separate periods of production paradigms: the early production concepts in 1770–1880, the scientific management era in 1880–1910, and the mass production era 1910–1980. The early production era can be characterized by labour specialization and specialized parts production. The scientific management era was featured by motion and time studies, process analysis, queuing theories and taylorism. The early management literature stems from this period of time.

The era of mass production followed the era of cost focus. The cost focus era concentrated after all on labour cost reduction. The era of mass production realized the improvement of effectiveness by capital investments. The moving assembly line was expensive as an investment. It could, however, improve the effectiveness of production so much that total productivity improvement was achieved. The moving assembly line, statistical sampling in quality control, aiming at large quantities, linear programming, and material requirement planning characterized the means of optimizing the production lines in the era of mass production. The market demand was growing in this period, but the demand was still higher than the overall supply. Therefore it can be concluded that the market was the supplier’s market. Quality aspects were not very dominant in the marketplace.

By the 1980s, the market had totally changed from the beginning of the century. Most of the European and American countries were welfare societies, and the population had plenty of consumption power. The quality of products started to become an important aspect in production. Perhaps even more important matter was that the educated labour no longer wanted to work along the moving production line which forced the individual workers to repeat exactly the same operations in a predetermined tempo. This led to search for new production methods. The evolution of computing and automation helped finding production methods that freed the labour from the most monotonous and dullest work. The information systems also helped to automate the functioning processes in production. This production paradigm can be called lean production paradigm with quality focus. Lean production means here that the middle management is reduced to the minimum, and different kinds of team work solutions are applied with the focus on quality in terms of both product quality and the quality of the work and working conditions. This quality focus in lean production management paradigm can be characterized by such key concepts as just-in-time, computer aided
design (CAD), electronic data interchange, total quality management, quality management, empowerment, and kanban.

In the 1990s, the supply of all kinds of products increased, and the customers could require any kinds of products they could imagine. A good quality of products was not enough; the products had to be exactly of the type the customers required. In most cases this could not, however, lead back to the handicraft production mode, because the competition pushed the allowed price level of the market so low that it was unattainable without the use of modern technologies. Under the pressure of reducing the unit costs of products, the customization focus developed to the paradigm of mass customization, which is an effort to combine low unit costs and taylor-made product design according to customer requirements in each individual case. This has become possible with the help of modern product design in product development and advanced information systems and / or computer aided product designs in the production.

The paradigm of mass customization is characterized by the utilization of computers in guiding the production processes, the internet, the enterprise resource planning (ERP), innovation in products, organization and business models, learning organization, supply chain management, agile production, and e-commerce. The mass customization paradigm started in the 1990s and is still continuing. In the following I will concentrate on the aspects of product design as a precondition and means of competitiveness in the era of mass customization.

2. Understanding the Reasons behind Changes in Production

Afterwards it is possible to see that in the beginning the driving forces behind the changes in the production paradigms were cost reduction factors and striving to a more effective production mode. Later on the efforts to produce qualitatively high level goods became important, and in the industrial societies also the quality of the jobs became vital. In the final stage both objectives were combined in the stage of mass customization. It is important to offer the customers individual and qualitatively high level products, and to do that at a competitive cost level. It is worth noticing that the production modes do not replace the older ones, they emerge parallel to the existing ones.

It is not very easy to see afterwards which factors were the most important ones in the changes of production modes during the last centuries and decades. Probably changes in the markets and societies, however, were important factors that reflected on production. In the nineteenth century and maybe until the late 1970s, the market required goods in volume as a whole. Generally quality was not the most important competitive factor in the market success. Thereafter in the 1980s, the markets in many industrial societies became effluent and the customer requirements became more demanding. The customers started to demand individual products customized particularly for them. To some extent this was a contradictory requirement to the reduction of unit costs.

3. Marketing Management and Product Design

Since the 1970s, many student generations have studied Philip Kottler’s book Marketing Management. The teaching of Kottler is, in brief, to listen to the customer. This was followed in fact very well in the era of handicraft production, and it was forgotten in the era of mass production as the cost reduction focus became most
important. The quality focus and tailoring by customer demands brought the market requirements back. However, it is clear that the customization of products and reduction of unit costs are contradictory requirements in production. Far-reaching customization cannot be cost effective within the old technology mode, as many products are made from the beginning particularly for certain customers.

In the theories of Research and Development the teaching of Kottler led to third generation R&D theories. The core in the third generation R&D theory is that all the available explicit information and knowledge shall be utilized from the markets. The utilization of tacit knowledge from the market is included in the fourth generation theory R&D, which may mean totally new types of products, maybe revolutionary products and maybe new industrial branches. Tacit or latent expectations are taken into account in this theory.

4. Practical Procedures for Product Customization

Practical means to approach product design are related to deeper understanding of the product content. The core product contains the basic benefit for the customer. Outside the core benefit, the supplier may offer the customer many other benefits in addition to the core benefit. Besides the core benefits and the additional benefits the customer may be offered industrial services.

Modularization and standardization are means to combine the optimization of unit costs and the customization of the products for individual customers. This may be the way to build product families with minimum unit costs and maximum product range to customers. When the actions are taken further, we can speak about mass customization. This has so far been carried out only in very large-scale industries, e.g. in car manufacturing industry. With the help of modularization and intelligent product design, the tailoring of product design in customization can be taken very far, and simultaneous rationalization of production can be reached.

A modern way to realize product and product family design is related to the product platform concept. It is related to market orientation in terms of listening to the customers, but at the same time it is a way to rationalize production. The platform design is based on the normal market segmentation. The platform itself contains market insight, product technology items, manufacturing technology, and means to take care of capability development. The platform is formed out of constant subsystems (subparts) and well defined interfaces to the additional parts to be included in the final product. The constant part and the interfaces form the core of the platform; the additional components connected to the constant core form the final products, i.e. derivative products. The demanded variations can be formed with the help of changing components or modules connected to the core.

The platform is meant to sustain longer than normal product generations. If the lifetime of a product generation is two to three years, the platform should sustain two or three times longer. If the platform design is well and profoundly done, its cost may exceed the normal product design costs of a product generation. However, when the next derivative products are designed, the core of the platform will remain constant, and the new product derivatives can be designed only by designing new modules to the predetermined interfaces. This product variation can be possible with the cost of 20 to 30 per cent out of the original product platform design cost. The platform idea has been applied by the car manufacturing industry, electrical equipment industry, software industry, and machinery industry. However, there is plenty of space to apply this idea further in production.
The quality-oriented fulfilling of customer expectations is still a valid production strategy and approach for product strategy, particularly for small and medium-sized companies. However, at some stage the companies have to decide to which extent to meet the customer requirements and cost reduction approach. In a successful case the platform type of product and production ideology may serve as a way to meet both requirements. It is easily foreseeable that both ideas will be applied in the future in production in industrialized countries. The innovation and renewal can be applied to both product design approaches, as well as to both of the above mentioned R&D generation approaches.

In today’s world the suppliers may work together with customers on various levels. A well-known level is that of an equipment supplier. When the share of services increases the supplier may become a solution provider, maintenance partner, performance partner and finally a value partner. The further the evolution in cooperation rises, the deeper the supplier is tied with the businesses of the buyer. It has to be remembered that any part of the value chain can be nowadays bought, and therefore it may become a service.

5. Learnings from Open Global Markets for Future Competitiveness

The global market emerged, with all its impacts strongly visible, during the last decade. A widely seen aspect is that there are low cost countries with manufacturing capability and capacity of entering the open market with products that have been produced at such a low unit cost as no competition from an industrialized country would be possible. At the same time, of course, the industrialized countries have benefited from high-quality products which the low cost countries have produced for the world market.

A widely repeated belief has been that the increasing technology content and higher education would keep the manufacturing in the industrialized countries. Also the service content has been seen as a success factor for the manufacturing of industrialized countries. Because of rapid technology transfer to low cost industrializing countries, these beliefs have turned to be untrue in a wide sense. The newly industrialized countries are developing their technologies very fast, and they are entering as competitors the markets dominated earlier only by industrialized countries.

At a company level, the success factors are easiest to find from so called VRIN factors, from valuable products produced with production factors having the features being rare, inimitable and non-substitutable. If the production strategies and product designs can use these factors as guidelines, a competitive advantage can be secured at least for some time. These factors are reflected also at the industry level, but the connection is not straightforward. Sometimes also very highly technology intensive products or services can become under overwhelming competition.

Modern product design provides many benefits to add value to products even in the global market. Listening to the customers is an old but still valid advice for the product designer. For most of the small and medium-sized companies it is a relevant approach to form product concepts, products and product families and make the customer inquiries and market research before finalizing the products. With these preparative actions, the market launch can prove successful. In terms of the VRIN framework, this approach is to applying the value creation and value exploitation part.

If the company aims to grow large and its market is some sector in the open global market, the competition may be so varied and tough that simple regional market research is not the solution, as the requirements vary from region to region. Then the approach to build a production system via platform design or mass customization might
be the solution to combine customization and cost effectiveness. These kinds of product and marketing strategies have necessarily a profound impact on company strategies in general.

6. Aspects for Company Strategies and Global Markets

Each company has to find its competitive edges on its own. The VRIN factors, valuable, rare, inimitable and non-substitutable, may help in this effort. Product design and its connection to firm-specific technology in products and production technologies may become competitive factors for a company. However, companies have to follow the market development carefully, as the continuation of production in traditional industrialized countries is under question. The production systems should be viewed as holistic systems taking into account products, processes and enterprise management.

The sustainability of manufacturing in industrialized countries has been discussed recently in many forums. No final conclusions have been made. Evidently some major changes in the balance of manufacturing distribution between the continents occur. Some European companies have emphasized the weight point to move from cost reduction, cheap labour cost, optimized quality and taylorism to high value adding products, sustaining in competition, sustainability in environmental, social and economic terms, and innovation in the knowledge economy and society.

References