THE NEED FOR A "NEW" INNOVATIVE PRODUCT DEVELOPMENT APPROACH

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Keywords: Product development, Innovation, Multi-scientific approach

Abstract: *The competition is becoming truly global with fragmented markets and customers expecting to get the best product at the best price with immediate availability. Economic growth and future jobs are dependent on how present and future industry is able to transform new ideas into successful products and improved processes. The product itself is a smaller part of the complete offering to the customer, with branding, design, financing, services, smart products and other aspects becoming increasingly important. Fragmented markets stress the need for abilities to continuously adapt to new demands and to integrate new technologies. It is thus vital that companies develop innovative product development skills. There is a need to help industry to develop and implement new innovative methods and models that will support and strengthen industry to generate new ideas and realize these into successful products and improved processes. The objective of this paper is first to discuss and compare a "traditional" engineering approach with an "innovation" approach towards product development and second to combine these two approaches to new multi-scientific approach.*

1. INTRODUCTION

Change and uncertainty dominate today's business environment. The competition is becoming truly global with fragmented markets and customers expecting to get the best product at the best price with immediate availability. Global customers today do not care about countries, they are interested in who has produced the product. Economic growth and future jobs are therefore dependent on how present and future industry is able to transform new ideas into successful products and improved processes.

The ability to use and develop new knowledge is considered to be one of the major strategic factors for future competitiveness. Significantly, knowledge is not an additional production factor alongside the traditional ones: it is the most meaningful and important resource today together with innovation. In a competitive environment, where the products have the same performance, quality and functionality, the process of developing innovative products within shorter intervals compared to the competitors becomes increasingly important [12].

Many main suppliers are streamlining their operations, concentrating their efforts on core technologies and competencies, moving towards more external contracting of their key activities. It may also in some cases make more sense to talk about a company's distributed capabilities, instead of its core capabilities due to extensive outsourcing.

The product itself is a smaller part of the complete offering to the customer, with branding, design, financing, services, smart products and other aspects becoming increasingly important. Fragmented markets stress the need for abilities to continuously adapt to new demands and to integrate new technologies. It is thus vital that companies develop innovative product development skills. There is a need to help industry to develop and implement new innovative methods and models that will support and strengthen industry to generate new ideas and realize these into successful products and improved processes.

The objective of this paper is first to discuss and compare a "traditional" engineering approach with an "innovation" approach towards product development and second to combine these two approaches to new multi-scientific approach. An example of the ongoing implementation of a ´product realization centre´ at Mälardalen University with a multiscientific approach will also be presented.

2. BACKGROUND

Two different approaches to product development will be presented below.

2.1. The traditional engineering approach towards product development

The product realization process could be considered as a process of transforming different stakeholders' needs into output information, which corresponds to a manufacturable design, see figure 1. This process includes e.g. scenario planning, idea and technology management, product planning, product development and production development including logistics, maintenance and recycling. The problems with implementing an efficient product realization process can generally be explained by the high number of different phases, and thus disciplines, that all have to collaborate [10].

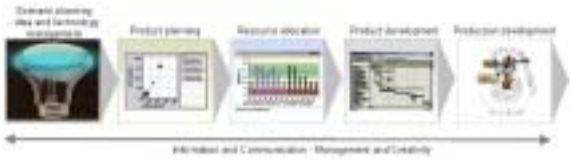

Figure 1: *The product realization process*

Collaboration between main- and sub-suppliers is dependent on the ability to manage the information/knowledge exchange between interfaces for upstream and downstream tasks, different sub-systems and different organisational functions. A large amount of information has to be coordinated in the product development process. An efficient organisation also has to understand the information processing logic and the integration with its environment which requires communication and coordination skills. These skills are needed to manage and control the complexities of the design process, where activities should be carried out 'concurrently' [4]. One important aspect of coordination is how to manage the overlapping of coupled product development activities.

Given target budgets and resources, the challenge also becomes how to best allocate, coordinate, plan, and track the resources involved in product development and production ramp-up. Design and process planning are two important phases in the product realization process. Decisions taken early will have an high influence on the possibility to influence the cost structure at a later stage. Done wrong, market windows are missed. Done right, more products come to market sooner, with revenue growth following right behind.

The product development process needs to be flexible in order to continuously adapt to new demands and to take new product related information into consideration. The product development process is also complex, and might be better viewed as networks than as chains. Horizontal and vertical integration is used in order to minimise costs, allocate resources and share risks. Horizontal integration tends to be used for complementary technology/knowledge, and vertical integration tends to be applied for cost reduction.

Successful product development, according to the PDMA-organization, can be defined as the development of a product that meets its goals and performance expectations. Product development success has four dimensions. Three dimensions at the project level: financial, customer-based, and product technical performance. The fourth dimension is new product contribution to overall firm success.

Much has been written about success factors for product realization, for example Balanchandra and Friar have made an extensive survey and mapped success factors in product development literature [1]. The major categories found were market, technology, environment and organization. The most critical factors were found in the organization category. Other authors have latter addressed critical factors of product realization that must be managed which are executive direction, project team, innovation strategies, internal factors, and external factors, etc [2].

Still, many companies have attempted to standardize on focused product development methodologies. However, an increasing number of leading edge companies are realizing that this is not enough. In fact, they need to manage their people, product portfolios and commitments with the same rigor and system support that they apply to the rest of their operation.

The engineering conceptual framework has for long time been described in development and design of new products in terms of problem solving. This is an analytical approach which is central to the professional identity of engineers and engineering research to the task of product development. The ultimate goal is to arrive with an economically produced product quickly to the market. The key to do so, for most of producers, have been to work through a chain of decisions by first establish clear objectives of the product, identifying the target market segment and trying to systematically determine the customers wants or needs. Coming steps are a target timeframe, a budget and to find available resources for the project.

This analytical and linear approach is not quite appropriate in terms of innovation and fast changing values of people and new expectations. Also, all product development must have a sustainable approach, which means energy saving materials and methods, recycling design, meaningful and developing work content and environment. The leadership and organization must adapt to new values in the society, especially in the young generation men and women, for creating a growing interest and motivation for their active part in the

future engineering industry and product development.

2.2. The innovation approach towards product development

Thus, technological and scientific excellence by itself is no guarantee for a dynamic and growing economy. On the open world market today with free access to new science and advanced technology, science must be linked to the development of new technology, which can improve productivity and create competitive advantages. The connecting links are innovation, design and information where creative and flexible thinking is essential [8]. In the knowledge and complex society of today we need to know how to use information in an appropriate way and create good communication methods to understand where to look, what and how to do and for whom. Furthermore, innovation is not just based on research, or science and technology. Innovation depends also on organizational, social, economic, marketing ant other knowledge. Of course even the nature of innovation is changing in the knowledge-based economy, or the innovation economy [7].

The reason why individuals and companies invest money, time, and effort in innovation is of course that they believe that it will be profitable, that it will result in improved competitiveness and that it will give opportunities to a better life. The fact is, however, that society, even more than the inventor or innovating company, is the very big winner in terms of growth and development [11].

Technological breakthroughs or innovations will sooner or later come into the stage of dominant design, where companies work successful with their products. However many of them fail in short or long term if they are not open – in time – to the changing needs and even latent expectations in market trends, as Christensen, Utterback and others have shown [3].

Another dimension in the innovative processing raises the question of how ´problems´ should be defined when consumers, customers or clients not yet have imagined a product they do not yet know, and engineers are not sure what they can build. At least in the early stages of product development, it is not possible to have a clear set of objectives for the project, no matter how carefully you listen to the customers or client's voice. You simply do not know for certain how the new technology would be used. The use of mobile phones was first expected to be used only as a car-mounted device.

The short definition of innovation is usually "a new idea that has been value-creating and successful", most often on a market. Innovations are not only related to a new product from a technological point of view but could also be a new process, a new service or a combination of these in technology, business, organization, work and even in sport, music and much more. The perceived change can be in small incremental steps – doing what we do, but better – or in a more radical way – new to the company or even new to the world - sometimes when an innovation transforms society, see figure 2.

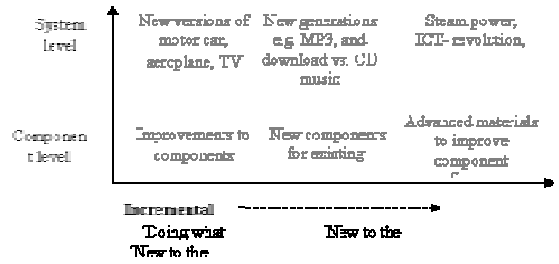

Figure 2: *Dimensions of innovation [12]*

The dimensions of innovation can be used as a theoretical model for explaining the use of different methods developed in the daily research work and for what purposes these methods can work. For an existing company the incremental approach on a component or even higher up closer to the system level could be appropriate. For a new company with a quite new product the horizontal approach could be more useful to think and work with the market. The dimensions could also be used in terms of organization or other aspects of innovation.

Innovation, whether in products or processes, or in organization or services to customers, is one of the main paths through which manufacturers can become more distinctive, satisfy customers, expand sales, reward workers and improve their bottom line. Companies that do not continuously innovate will find themselves under increasing pressure from low-wage producers globally. Offering innovative products gives companies a competitive edge that provides protection against outsourcing and allows them to charge a premium – which creates higher margins and allows higher wages. But innovation isn't limited to only products and processes. Companies can compete by using innovative marketing strategies and organizational approaches like meeting new demands in leadership including personal leadership, flexibility in many ways, individuality and team-work, especially for the young generation born in the late 70- and 80-ies, if they will have any interest in engineering and industrial product development for the future.

More and more innovation spring, not from particular industries or disciplines, but rather across them – the so called Medici Effect. "When you step into an intersection of fields, disciplines, or cultures, you can combine existing concepts into a large number of extraordinary new ideas" [6]. The intersection is a ´place´ where ideas from different fields and cultures meet, leading to an explosion of ideas and possibilities. It also explains the forces that are creating it and why it's growing in importance.

The so called ´Medici Effect´ alludes to what the Medici family accomplished in Florence during the 1500s: they sponsored people from lots of different

disciplines - architects, painters, sculptors, philosophers, scientists - from all over Europe, even actually as far away as China, and brought them all together in Florence. And it's through their interactions that Florence essentially became the epicenter of one of the most creative eras in Europe's history, the Renaissance. One of the most famous innovators in that time was, of course, Leonardo Da Vinci, sometimes called the first scientist, engineer, architect, artist and innovator in the same person. But there were many others in Florence who found connections between their various crafts, which ultimately allowed them to set off the creative explosion.

In summary, the most important source to innovation is people with their free opportunities to use their skills, express their ideas, develop inventions and create intra- and entrepreneurship for innovations and companies. But most ideas that generate innovations today are too complex for one person to accomplish individually. There must be a multidisciplinary team, which has different roles, some freedom in thinking different in ideas and a supporting learning and innovation climate. How technology, talents and tolerance for diversity (in cultures, attitudes, competence etc.) are close connected to each other, has in an obvious way been shown by the research of Richard Florida about ´the creative class, creative clusters, creative regions and cities´ [5]. Few – if any – are those innovators that have the ability create and launch innovations by their own. Usually today it is a cross-functional or interdisciplinary team behind successful innovations – in the research and in the company world.

Most innovations can not be identified from the beginning with a clear address to a particular need or problem. The problem and possibilities became apparent after a while or even after the product was in use. In this uncertainty, the innovation approach is more like a random process, ad hoc, a matter of trial and error and an open-ended process. This innovation approach in combination with the best of the engineering problem solving approach needs different approaches, both of technical problem solvers and other creative people in the product development project. There is a need for innovative product development skills with a multi-scientific approach.

3. THE NEED FOR INNOVATIVE PRODUCT DEVELOPMENT SKILLS WITH A MULTI-SCIENTIFIC APPROACH

It is vital that companies develop innovative product development skills. This is also concluded in the study of future challenges and trends within the manufacturing industry “Visionary Manufacturing Challenges for 2020” established by the National Research Council’s Board on Manufacturing and Engineering Design, USA [9]. It is concluded that the competitive climate, enhanced by communication and knowledge sharing, will require rapid responses to market forces. Sophisticated customers, many in newly developed countries, will demand products customized to meet their needs. Thus, the basis of competition will be creativity and innovation in all aspects of the manufacturing enterprise and the development of innovative process technologies will change both the scope and scale of manufacturing. The global distribution of highly competitive production resources, including skilled workforces, will be a critical factor in the organization of manufacturing enterprise.

Six goals are concluded in the study, which should be the basis for developing innovative product development skills:

- Concurrency in all operations
- Integration of human and technical resources
- Transformation of information into useful knowledge for effective decisions making
- Reduction of waste
- Reconfiguring manufacturing enterprises rapidly
- Developing innovative processes and products with a focus on decreasing dimensional scale.

To develop next generation products and services there is a need to support and improve product development skills within industry. There is a need to find and implement new innovative leadership and methods that will support industry to generate new ideas and realize these into successful products. There is also a need to support new ideas and to cultivate them into new businesses. This includes developing incubators including business support but also supporting with product development skills all the way to prototyping.

And again, it is not enough with only engineering or design or marketing or entrepreneurship skills. To compete successfully in the future it also requires a combination of leadership, organizational and different creative skills – competencies with their heart in psychology and human behavior. A team of people is necessary for creating ideas and realizing these ideas into innovative actions. Preferably the team will have different skills, energy levels and frames of reference as a result of their backgrounds, perspectives and experiences.

4. DISCUSSION

This paper has discussed and compared a “traditional” engineering approach with an “innovation” approach towards product development. To support the development of the next generation products and services within industry there is a need to develop and implement new innovative methods and models that will support and strengthen industry to generate new

ideas and realize these into successful products and improved processes. There is also a need to give support through incubators, including business advice as well as support with product and production development skills, and support from existing labs/workshops helping to build prototypes.

There is a need to establish teams of people, with different skills, energy levels and frames of reference on the innovation ideas as a result of the backgrounds, experiences and activities. Examples of possible competences are mechanical engineering, information-, product- and industrial design, busi-ness and marketing, innovation management, ergonomics and applied psychology. The goal is to eliminate traditional barriers and to foster good communication and cooperation.

Research should be directed towards development of efficient methods and models within the area of innovative product development supporting industry to realize and develop more ideas to competitive products. Possible research areas needed for this are:

- Innovation management and entrepreneurship, e.g. management of creativity and change as well as supporting an idea towards a business concept. The area includes technical, organizational as well as managerial aspects of innovation and entrepreneurship.
- Development models and methods, e.g. to support the development of new products and productions processes. The area is technically oriented towards engineering but also includes change management within industrial organizations as for example lean manufacturing.
- Information design and Communication management which is needed in every step for efficient product development processes as well as when bringing research and new ideas to the market. Includes design of communication processes, information management, environmental scanning, design and understanding of information as well as interaction design and tests.

An example of “innovation” approach towards product development is an ongoing implementation of a ´product realization centre´ with a multiscientific approach at Mälardalen University in Eskilstuna, Sweden. The objectives of this center are to support the development of the next generation products and services within industry and this center will develop and implement new innovative methods and models. The center will give support through incubators including business advice as well as support with product and production development skills, and support from our other existing labs/studios helping to build prototypes.

The profile of this product realization centre is engineering science within Product & Process Development in cooperation and knowledge exchange with Innnovation Science & Management and The Science of Information Design. These three “academic partners” and research groups are working together in an “intersection”, a place where ideas from different fields and cultures meet, leading to new forms of ideas and possibilities.

This academic intersection and product realization centre will work close with another ´inhouse-partner´, Idélab (Idealab), which is an open space arena for developing ideas, innovations and entrepreneurs out of students and researchers in the first place, but also for the surrounding industry and its´ development. One more new close ´partner´ in our concept is Munktell Science Park in Eskilstuna Sweden, which is developed out of Idélab as a following step for innovators and entrepreneurs to establish their product ideas on the market. At Idélab are creating about 30 new companies every year – in total in five years 180 new companies – with new products, some of them with patents.

The product realization centre at Mälardalen university is designed to give industry and entrepreneurs access to innovative product development techniques through talented students, world-class faculty and dedicated technical staff members. Different important knowledge areas, also displayed in figure 3, to be developed and utilized in the center are:

- Environmental scanning
- Scenario planning
- Innovation management
- Leadership of innovative product development projects
- Product-/Industrial design and Interaction design
- Information design and communication management
- Product- and Process development – models and working methods
- Rapid prototyping and reverse engineering
- Production and logistics management
- Business development and marketing

Figure 3*: Knowledge areas within the product realization centre at Mälardalen university*

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