INNOVATION MANAGEMENT IN DESIGN PROCESS

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Abstract: The paper focuses on applications of current trends in innovation management in design. After brief introduction, we describe how to use stage-gate process to reduce costs. Then we discuss basic concepts of disruptive innovation and open innovation and finally we try to deduce some implications for the new product development

1 Introduction

In the increasingly competitive global economy, innovation is critical to success. The product life cycle is getting shorter and shorter, new products must me introduced ever more frequently. The lead time between new product idea and its introduction to the market must be as short as possible (and sometimes even shorter). Moreover, the design-push approach, quite common for many designers – *if we have superior product, customers will come and buy it* – must be changed to market-pull: first, find what the market wants, and then fight to satisfy customers' needs. The excellent new product is the necessary condition for success, but it does not guarantee it. There are numerous examples of technically superior products failing in market competition.

The price of the product is one of the decisive factors of product success in the market. It must be taken into account from the very beginning of the new concept development. As mentioned in [5], *„Companies waste billion of dollars every year on new product enhancement that consumers do not want, cannot use, or will not pay for. The fact is that most new products ... are overengineered"*. The authors conclude that design-driven cost reduction for products in development can be as high as 10 to 30 percent. Overengineering is also the driving force of disruptive innovation – see e.g. Christensen [2],[3], Thommond and Lettice [7].

The results of the Accenture recent survey [6] among 350 CEOs suggest that innovation is considered key to competitive advantage. While there is no shortage of new ideas (more than 75% of respondents answered their people generate a sufficient number of worthwhile ideas), majority of businesses commercialize less than 20% of promising ideas. About a quarter of companies have no innovation stimulating programs and do not use any formal measurement of innovation (this percentage is probably much lower in transition economies of the CEE countries). For most, the biggest barrier is a

lack of people with adequate skills. Companies often assign responsibility for implementing new ideas to cross-functional teams whose members also continue to be responsible for existing "day jobs". What is very important – companies view their customers as the most valuable external resource of innovation impulses, followed by suppliers and alliance partners.

We will probably all agree that the technological excellence is necessary for the innovation's success. However, often it is not sufficient. Technical skills must be combined with business and managerial ones. As products are getting more complex, you need to combine many disciplines and efficiently work in teams. It means that the design process itself has to be innovated. Many technological developments, namely information and communication technologies, can support design process innovation. On the other hand, if you design a new machine, it can initiate substantial process innovations in companies where it will be used.

This all implies change of the design paradigm. Design process must incorporate such disciplines as innovation management, team work, and creativity. With advantage it can employ basic concepts of knowledge management. In the following, let us summarize some recommendations and experiences.

2 Design-driven cost reduction

As mentioned above, the price of the product is one of the decisive factors of product success in the market. Costs make up the substantial part of the price and the following text is focused on the cost reduction.

According to [5], there are four cornerstones of the design-driven cost reduction:

- Process discipline imposed at every stage: idea generation, evaluation and prioritization, and implementation through production. Each step has an expected duration, every idea is tracked. Increasing number of companies incorporate the Stage-Gate new product process [8] that divides the effort into distinct stages separated by decision gates (see Fig. 1). The team must successfully complete a prescribed set of tasks in each stage prior to obtaining approval (and financing) to proceed to the next stage.

Source: http://www.prod-dev.com/stage-gate.shtml

Fig. 1: Example of Stage-Gate process.

This approach results in higher success rate of new product development programs by 10-30%, shorter time from idea to market (by 30% and more) and improved adherence to time schedules and budgets (while the average

project in industry is 50% behind the schedule, the 20% of the top companies using proper processes complete most of their products as planned). And this all is reflected in more satisfied customers willing to pay a price premium.

- Target setting and transparent monitoring. Targets can be derived e.g. from benchmarking. They should be measurable to allow transparent monitoring ensuring that deviations from targets are quickly corrected.
- A cross-functional organization removing organizational barriers and fostering collaboration and creativity. This organization facilitates parallel processing (concurrent engineering), therefore shortening time to market.
- Management commitment, empowering design teams to make and implement difficult decisions, e.g. the decision to kill unsuccessful projects in early stages, before they waste significant resources.

3 Disruptive innovation

Based on his research in the industry of hard disk drives, Christensen in his book [3] introduced the concept of disruptive innovation and showed that even the best managed companies, focused on their best customers and most profitable markets, often fail in competition with far less technologically sophisticated products.

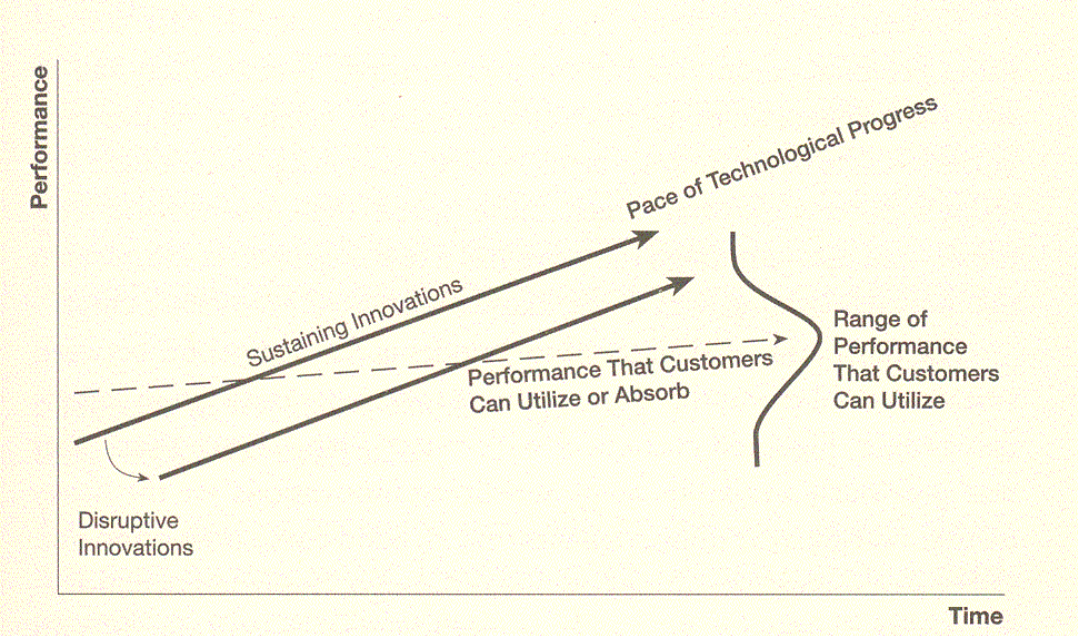
While sustaining innovation focus on better product that can be sold with greater margin, disruptive innovation brings to the market simpler, more convenient, cheaper product that at the beginning appeals to new or unattractive customers. But then the improvement cycle begins and the originally inferior technology improves enough to satisfy the needs of more demanding customers. Industry leaders, with their processes designed and tuned to satisfy the high-end customers, are often unable to respond to disruptive entrants and lose their positions.

This process is well illustrated in Figure 2.

The concept of disruptive innovation is closely linked to the market absorption capacity: at each market there is the speed of change that can be absorbed by the customers. The suppliers innovate their products to satisfy their best customers. However, the technological progress is usually faster than the capacity of customers to employ it.

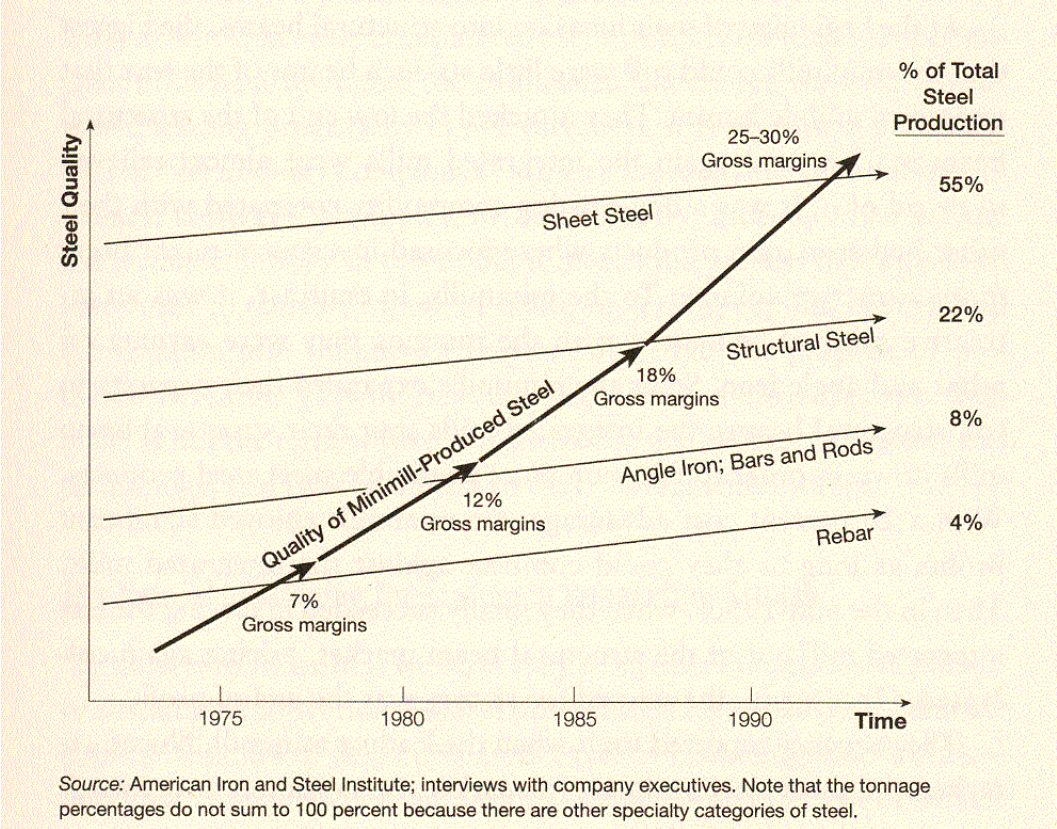
As industry leaders are motivated to succeed at the best, highly profitable markets, they too often welcome new entrants, serving low-end customers. However, due to the technological progress, trajectory of disruptive innovation in time intersects the trajectory of performance demanded by high-end customers. And then it is often too late for established companies; as they are not prepared to defend their markets, they lose customers and their market share rapidly decreases.

This process is excellently illustrated by the case of minimills – see Figure 3.



Source: [2], p.33

Figure 2: The disruptive innovation model



Source: [2], p.37

Figure 3: The Up-market Migration of Steel Minimills

Notice gross margins and market shares of individual types of steel products. At the successive steps of the process, integrated mills were quite happy that minimills took from them the burden of low profit, low market share business – until it was too late.

The story similar to that of hard disk drives industry and steel minimills was repeated in other industries: hydraulic excavators disrupted cable shovels, discount stores disrupted traditional retail chains.

As Christensen says, *„Moving up the trajectory into successively higher-margin tiers of the market and shedding less-profitable products at the low end is something that all good managers must do.“* [2], p. 43. And that is the innovator's dilemma – each company prepares its own disruption. However, it is also the start of the innovator's solution: the company has to be prepared to disrupt itself, before anybody else does it.

The theory distinguishes two types of disruption:

- New market disruption: products compete with non-consumption. They are more affordable and simpler to use by new users (PC, transistor radio, desk copiers). And, as has been shown beforehand, as their performance improves, they become good enough for the mainstream market with all the consequences.
- Low-end disruption focuses on the low end of the mainstream market (minimills, discount retail stores, Korean car makers).

Whenever you start thinking about a new product development, you should try to identify the disruptive potential of your new product.

To be disruptive at the new market, there has to be sufficient number of less skilled or less affluent people who can own and use the technology that was formerly available only to more skilled or more affluent people, possibly only in centralized, inconvenient location.

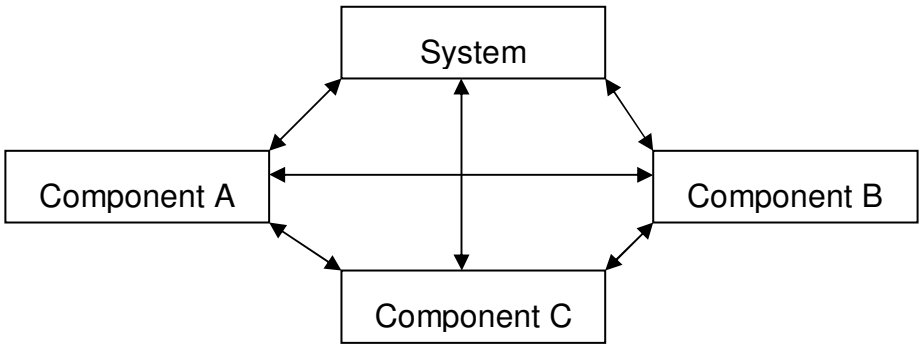
The product can be suitable for a low-end disruption, if there are customers happy to purchase a cheaper product with less (but good enough) performance and if it is possible to create a business model making money at lower price per unit sold.

4 Open innovation

As H.Chesbrough shows in [1], the paradigm of innovation has significantly changed in recent decades. The leading principle of the closed innovation, typical for the most of the twentieth century, says that successful innovation requires control. The company must hire the best and the most clever people to outsmart its competitors; it must generate its own ideas, bring them to market first and carefully control the intellectual property, so that the competitors can't profit from our ideas. For most of the twentieth century this model worked well.

However, this logic of innovation has been challenged by the growing mobility of highly experienced and skilled people. Growing number of new firms commercialize external research and successfully compete with large, established companies. Time to market is getting ever shorter and customers are more knowledgeable and more demanding. Open innovation assumes that companies use external as well as internal ideas and both external and internal ways to market, and that internal ideas can be taken to the market through external channels to generate additional value.

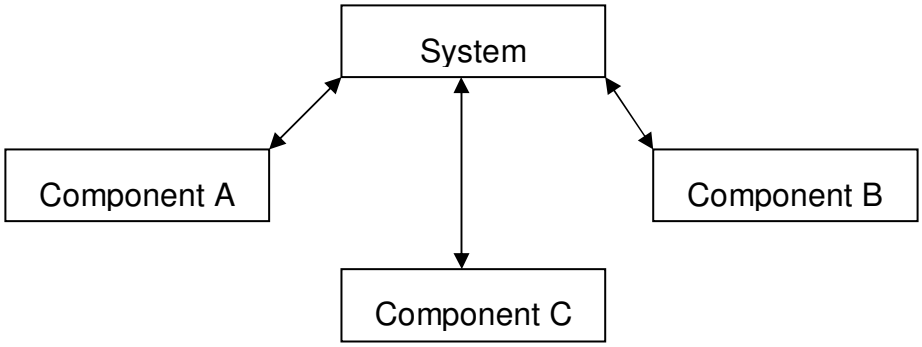
A critical role in the new product development plays the definition of the product architecture, i.e. a hierarchy of connections between disparate functions within a system. In an early stage of a product development, there are many possible ways how to combine components; the greater the number of components, the greater the number of their possible interconnections. Often there may be no obvious best way to proceed. To coordinate the complexities and resolve the ambiguities, it is necessary to develop deep expertise in many areas. Possible interdependencies between the system's parts are shown in Figure 4: components A, B, and C constitute the system and they all interrelate – changing one component requires changes in all other parts of the system, because the relationships between the parts are not clearly understood. Such architecture can be best managed through internal processes.



Source: [1], p. 60

Figure 4: An Interdependent Architecture

Over time, as the technology matures, interdependencies become clearer and better manageable. In a modular architecture (see Figure 5), components A, B, or C could change without causing any change in other components. The modular design enables to assemble system more easily, from "plug and play" components whose interfaces are well understood. The modular architecture makes it easy for many companies to innovate components without worrying about possible impact on other parts of the system. Open innovation firms must be prepared to shift their approach: deep vertical integration becomes a millstone around a company's neck. Company must open itself horizontally by participating in the complex supply chains. This approach often opens new markets and requires mastering of so-called co-opetion, combination of co-operation and competition.



Source: [1], p. 61

Figure 5: A Modular Architecture

5 Implications for new product development

The above mentioned paradigm shifts in innovation management have direct implications for new product development and design. Moreover, extended circle of company stakeholders, often including customers, NGOs, local and regional governments and many others, demand new products that are not only of superior quality, but also environmentally friendly, aesthetically appealing, etc. – briefly speaking designed for X, where X can be quite large and multi-faceted set. After-sale services play an increasing role – and bring increased turnover and profit.

All these requirements can be rarely met by even the most able, skilled designer working alone. Therefore designers must be trained to work in multidisciplinary teams covering many aspects of the new product. In [9] we summarized some requirements to new engineers, which are applicable also to new designers. We say that *"The engineers of tomorrow must be able to solve problems that have not been even formulated during their studies"*; life-long learning becomes necessary.

Paradigms of disruptive and open innovations imply that companies must look for unsatisfied needs, new ways of delivering value to their customers, create new business models for new products. Technological excellence of new products is the necessary, but not the sufficient condition for their market success. Technological and business intelligence becomes extremely important – you must know what is happening in relatively diverse disciplines, anticipate potential disruptions and use them as an opportunity, otherwise they can become threats. On the other hand, the company must competently work with its intellectual property and – if it cannot be used internally – to create spin-offs or to license it to external companies.

While advances in manufacturing in the past 25 years have been largely driven by information technology, computer tools, automation, and advanced work practices, unit processes that transform materials into products have advanced only incrementally. Mechanical or structural parts and products still require partitioning of processes by functions. New, emerging technologies, as

nanotechnology, biotechnology, and direct materials deposition present new challenges to research, development and design.

Concurrency can shorten the time between the conception of a product and its realization. However, current systems often lack flexibility and the ability to respond to rapid market change.

All above mentioned processes open new ways to cooperation between universities and industry that can be advantageous for both sides. In the open innovation mode, universities can bring to companies new innovation impulses and, with their good access to information resources, can play an important role as centres of knowledge networks and information and knowledge brokers. On the other hand, the feedback from companies and from the market can bring new impulses to universities.

Acknowledgements

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