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PRODUCT CONCEPT DEVELOPMENT AS A CONSCIOUS RESOURCE

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Abstract

Development of new products is a necessity due to turbulent markets, fast product cycles, and disruptive technologies. In order to remain competitive, companies have to be innovative and create new products as well as improve existing ones incrementally. Product concepts are considered to be proposals intended for commercialization within a standard product development cycle. Therefore, they may be seen as the central driver for downstream development. However, product concepts may serve a company in various means, suggesting that their use and value is not limited only for product development. In this paper, we will discuss the current view on concept development and communicate a broader view on concept development within a company context that acknowledges time as a variable. We suggest that product concept definition should not be treated as a phase that occurs at a moment in time for a given purpose, but as an on-going activity that acknowledges the elapse of time i.e. advancement and degree of completion. Also a new categorization model for product concepts is presented in this paper. The categorization model not only attempts to clarify the context, purpose, and nature of product concepts, but it may also serve as a basis for implementing a set of concept development activities within different levels of research and development. In addition, we discuss product concept development in general, for we believe that the benefits incorporated by systematically creating and managing product concepts is not well understood within the industry or the academia.

1 Introduction

Product concept development is one of the earliest tasks to be completed in the development of any product. Hence, product concept definition and selection is the fundamental driver for downstream development and commercialization. In addition, Orihata and Watanabe argued that in order to bring about product innovation, technological innovation must be preceded by concept innovation [Orihata&Watanabe00]. This is to say that product concepts may enhance

the relevancy of applied research through better focus on applications. Product concepts may serve a company in various means, suggesting that their use and value is not limited only for product development. In this paper, we will discuss the current view on concept development and communicate a broader view on concept development within a company context that acknowledges time as a variable.

When reaching for first-mover advantages, technological innovation must be supported by internal technology development or e.g. licensing. Technology itself has insignificant value to a company commercializing its own products, if that technology is not applicable to an existing or new product. So in order to bring about product innovation, customer needs must be met directly or indirectly by the specified functions enabled by a new available technology. Hence, the deliberate creation of product concepts may offer direction in a specific technological area. That is, by offering insight on functions that can be used to satisfy customer needs within a particular product concept. Therefore, product concept development should be aligned with technology development or acquisition in a consistent and proactive manner. Hence, the information that a product concept provides is not only limited to making decisions for downstream development, they may also offer direction for specific research areas.

Previous research into the matter of conceptual design is somewhat fragmented. Engineering research discusses conceptual design as the creation of solution principles for sub-functions. Pahl and Baitz [Pahl&Beitz97] propose the 'standard' guideline, however their considerations are only valid after the solution principle, in terms of functions, is agreed upon. Therefore, the methodology involves only a part of the conceptual design process. The current models on concept development hardly are able to integrate the market and technical oriented sides of a concept [Hansen&Andreasen03, Scmidt97]. On the other hand, methodologies have been created for transforming customer needs into functional requirements e.g. House of Quality [Hauser&Clausing88], "Mapping between domains" in Axiomatic Design (AD) [Suh01], and "establishing specifications" [Ulrich&Eppinger00]. Additionally, researchers have discussed product concepts as part of the so-called Fuzzy Front-End process of product development, but these considerations do not describe the actual development of product concepts. Therefore, we find lack of common understanding and holistic methodologies for concept development.

This paper attempts to clarify the art of product concept development. The proceeding section defines a product concept based on definitions found from literature, in order to clarify the often vaguely used term product concept. The following section discusses how product concept development is perceived in a company context; the implications are based on literature review and personal experience within the Finnish industry. Then the next sections present a new categorization model of product concepts, and discuss how it may be aligned within the framework of R&D. Finally, the paper ends with conclusions.

2 What is a product concept?

Product concepts are internal or external marketing material that should reflect the change within a product portfolio. They are crystallizations of applications that bring together customer needs and functions, or in other words, markets and technologies. Management sees product concepts as material for decision-making as they set objectives for short- and/or long-term development. A product concept has several descriptions:

- A product concept is an approximate description of the technology, working principles, and form of the product. It is a concise description of how the product will satisfy customer needs. [Eppinger&Ulrich00]
- A product concept has a well-defined form, including both a written and visual description that includes its primary features and customer benefits combined with a broad understanding of the technology needed. [Koen&al02]
- A product concept is a brief statement that explains the product a manufacturer intends to make and describes the product attribute, benefit, and value to customer. It takes a free format. [Ishino&al00]

As a result from the various descriptions, we are able to provide the consensus that a product concept is a visualization of a product that has a statement of customer needs and benefits, and a translation of those needs into functional features and requirements. Thus, product concepts have two sides: use context and design context [Hansen&Andreasen03] and technology can be seen as the enabling function between the customer and physical domain. It is essential to show integration during the creation of product concepts. Figure 2 shows a visualized presentation of the two sides of a product concept.

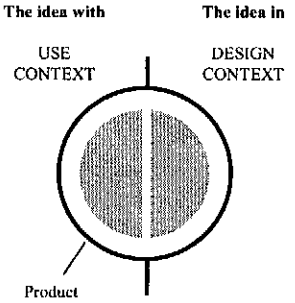

Figure 1 Two sides of a product concept: The idea-with (use context) and idea-in (design context) [adapted from Hansen&Andreasen03]

Product concepts should acknowledge key features and link them to existing or new market segments. Concepts may be generated from the combination of known concepts e.g. Nokia has successfully combined personal computers, game-consoles, radios, and cameras into a mobile terminals. However, new product concepts may also be based on e.g. new mechanisms such as the garden tools of Fiskars that are sold worldwide and have received appreciation for their ergonomics, performance, and award-winning industrial design. In addition, removing overwhelming constraints such as 'place' can lead to something commercially successful e.g. laptops, mobile phones, and Sony Walkmans. So basically concept innovation may come from a variety of sources. Still, the described product concepts have analogies, they all not only offer true customer benefits but also they are exposed to high-volume market segments. The latter comment is meant to emphasize that no matter how well a new product concept satisfies the needs of a customer; there must be a profitable market to which it is aimed. The second most important thing is that companies must possess or attain knowledge on the technologies needed to realize a new concept.

3 Product concept development in a company context

There are two distinctive concept development entities within a company: product concept creation and product concept realization (Figure 2). The first entity relates to the generation of product concepts and their definitions, whereas, the second entity – concept realization – refers to the commercialization of the generated product concepts that are perceived potential given the requirements of the company. Concept realization is conducted within the actual product development project and it may be perceived mainly as a process of engineering and industrial design [see e.g. Ulrich&Eppinger00].

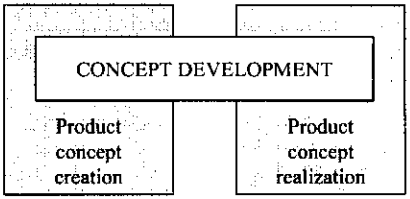

Figure 2 Concept development entities

The current approach is that, concept definition is included as the latest part of the fuzzy front-end processes, which in its totality is initiated by an identified product idea [e.g. Urban&Hauser93, Cooper01, Khurana&Rosenthal98, Koen&al01]. Hence, concept definition is usually perceived as the initiating part or activity prior of the actual product development (realization) project, with a mechanic linear flow between phases. Therefore, product concepts are treated as a part of a step-wise process of moving an idea through a sequence of steps to a commercial deliverable. However, it has been argued that: "concept definition should be treated as a separate and on-going part of the development process, operating as a continuous transition between research and development" [Casto94]. Additionally, a study showed that the concept definition phase was most important for research projects when compared with platform and incremental projects, also the time spent for definition was six times higher for research when compared to the incremental project [Nobelius&Trygg98]. Therefore, we believe that product concept definition should not be treated as a phase that occurs at a moment in time for a given purpose, but as an on-going activity that acknowledges the elapse of time i.e. advancement and degree of completion.

These considerations imply that if the concept definition on a given proposal is inaccurate or a product concept is considered somewhat unfamiliar, the particular proposal is not suitable for instant commercialization. However, this does not necessarily mean that the concept is not potential or desired when considering time i.e. advancement as a variable. For instance, concept projects can be technology driven, which do not have a market demand, thus being far from 'market-introduction' but nonetheless perceived as valuable. Additionally product concepts may also have other roles within a company, these roles include [adapted from Keinonen&Jääskö03]:

- Risk reduction: Well defined product concepts help to plan product development projects and risk management is easier if the concepts are tested prior to development;
- Extension of product (concept) portfolio: It is possible to discover radically new products by developing product concepts;
- Management support: Prepare for the future by concretisation of options – product concepts may support the strategic management of R&D;

- Source of new features: Some new features may be extracted from 'futuristic' product concepts and implemented into current products;
- External marketing material: Product concepts may be used e.g. to inure customers to new innovations or trends, new types of products;
- Testing material: By introducing product concepts to the customers it is possible to collect reactions before the decision to develop a product;
- Idea pool: Documented product concepts and ideas can be used later e.g. to support different development tasks;
- Reputation (public relations): State-of-the-art product concepts keep the company on the cutting edge of development – if concepts are communicated to the public, it gives an impression that a company is a first mover rather than a follower;
- Working method development: Concept development teaches creativity amongst the employees.

Based on these implications, we propose that product concepts should be treated and monitored as a portfolio of options, not narrowed by a single purpose and use i.e. decisionmaking material for instant commercialization. The concept portfolio should be managed and monitored according to the specified time-frame and purpose of product concepts. Additionally, product concepts that never become commercialized and launched into the market may serve a company in various means.

4 Management of product concepts

Figure 3 presents the product concept field and illustrates the time horizon of product concepts. Each new product concept can be placed into the product concept field (Figure 3(a)). The vertical-axis presents the ability for the company to realize a given product concept in terms of technologies and know-how, whereas, the horizontal-axis presents the knowledge on intended customers and markets. The further a concept is placed from the origin the more the concept makes the company face an unfamiliar terrain. This also applies for the understanding on the particular concept, that is, the degree of completion of the concept definition varies within the field. The surface of the product concept field includes all existing technologies and markets, which is the current operational ground for a company. The two-dimensional matrix presents the current options for a company to expand or reinforce their product portfolio, suggesting that options that are created anywhere in the field could be realized with current resources – internal or external. However, the development time for new products is relatively long, therefore, in order to be proactive and prepare for change as well as to discover emerging possibilities beyond current markets and technologies, considerations of time-to-market (Figure 3(b)) should be included e.g. a product concept may be highly potential but the enabling technologies and ought markets are still immature.

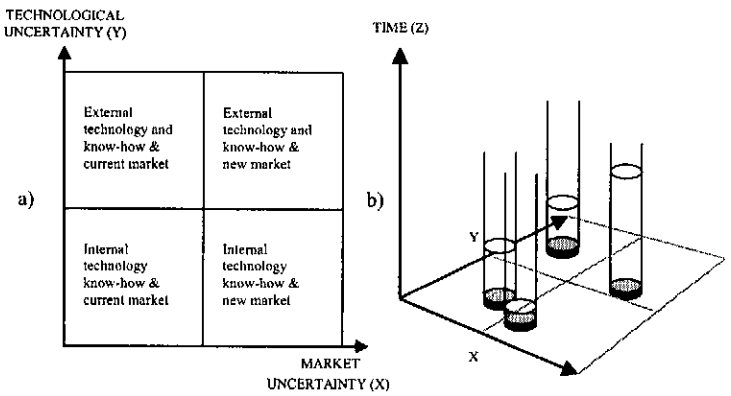

Figure 3 (a) Product concept field (b) Time horizon of product concepts

Concept 'pipelines' discuss the third variable of the product concept field – the time. In order to achieve full benefits incorporated by the systematic creation and management of product concepts, product concepts should be set into a specific context, referring to different levels of R&D. This is to say that each concept has a certain purpose and timeframe. In figure 3(b) product concepts are illustrated as 'pipelines', which have different positions and heights. Product concepts may be intentionally created to any given area of the concept field with a specific timeframe as to focus on relevant areas. This implication serves as a basis for the categorization of product concepts presented in the next section. The categorization model attempts to clarify the context, purpose, and nature of product concepts, and it may also serve as a basis for implementing a set of concept development activities within different levels of research and development.

5 Product concept categories

One of the basic strategic decisions for a company is whether to be reactive or proactive in its R&D [Urban&Hauser93]. This primary approach determines the tiers of innovation [Hauser98] in which the company is willing to operate. To the fullest, the activities range from the basic research level to the commercial implementation level. Hence, product concepts have supporting roles in each level and the nature and intent of product concepts should be understood and rationalized to support the objectives of each level. In order to clarify the possible use of product concepts, we have constructed a theoretical categorization model, which can be set into a company context by considering product concept development as a process that integrates marketing and engineering.

The clarification of product concept categories is presented in Figure 4. Product concepts are categorized in terms uncertainty of embedded technology and required availability i.e. maturity of ought markets. The categorization model is meant to emphasize the differing nature of product concepts. Technology is not always a bottleneck in the development of product concepts. It is also possible to have e.g. emerging product concepts that contain only available technologies – the maturity of the market, legislation, global infrastructure, environmental factors, or product strategy may not be favourable for the commercialization of the product concept for a long time.

Technological uncertainty	Required availability			
	> 10 years	5 - 10 years	2 - 5 years	0 - 2 years
Not proven	Visioning concepts			
Proven		Emerging concepts		
Well understood			Defining concepts	
Available				Solving concepts

Figure 4 Product concept categories

The categorization model is believed to present the spectrum of concept development activities performed in a company; it is constructed based on investigations on concept development among several Finnish manufacturing companies. The titles of the categories – visioning, emerging, defining, and solving - are meant to be descriptive rather than prescriptive. Each concept category may be aligned within the framework of R&D as described in figure 5. If simplified, R&D progresses from research to product planning to development. Additionally, companies engage in long range planning, which not only relates to R&D but also to the business of the company as a whole. Hence, product concept development may be used as a supporting or decisive process within these 'levels of R&D'. The first two categories – visioning and emerging – are rather tentative, whereas, the role as well as connection between the last two categories – defining and solving – is somewhat straightforward.

Technology approach	Concept development activity	Marketing approach	~Time
Basic research	Visioning concept development	Industry foresight	> 10
Technology development	Emerging concept development	Market analysis	5 - 10
Feasibility assessment	Defining concept development	Business case development	2 - 5
Engineering design	Solving concept development	Marketing plans	0 - 2

Figure 5 Product concept development activities within a company

The defining concept development phase occurs in the early stages of New Product Development and refers to the product concepts within a specific business context of a company. At the defining level, the efforts should be aimed at a realistic product concept and all the important features should be defined during the process prior to the actual development project. The product concept and its business case should be verified and planned prior to commercialization, including investigations on market acceptance, technical feasibility, life cycle, product architecture, logistics, manufacturing etc. These product concepts are evaluated for feasibility and given a verdict on the following actions - this is a Go/No-Go point regarding the NPD-process. This point also shifts the nature of concept development from defining to solving. Thus, the initiating factor for the concept development in the solving category is the mission statement and specifications derived from the concept definition of the

previous phase (level). The nature of solving concept development is to generate design solutions given the critical values of the specifications that ultimately would satisfy the needs of all parties concerned with the development effort. These two concept development activities are or at least should be considered 'standard' operations that relate to the development of any product.

Further on, concepts may also be used for visioning purposes and with aligning technology development with applications. The driver behind these categories is that companies must be proactive and prepare for changes in technologies and markets. Sticking to the way things are done simply is not enough. An industry usually evolves through a succession of technology cycles; technologies become obsolete as new superior technologies become available. Therefore, companies willing to be pioneers must prepare themselves for disruptions in current products. In addition, products based on new superior technologies may over-run current products or new technologies may enable the creation of a variety of new applications. Visioning concepts support the strategic management of R&D. Visioning product concepts may be generated based on scenarios and technology roadmaps [see e.g. Peltola&al03], and be used to guide product and technology strategies and even the company as a whole. At the next level there is emerging concept development, which probes e.g. emerging technologies and markets. Emerging concepts may be used to discover possibilities beyond current production based on e.g. internal technology development. One of the most important things for technological and market research is that findings should have commercial value, therefore, products concepts based on emerging possibilities may help to approve the relevancy of applied research. Also, effective technology transfer is supported by better communication of applications through the early use of product concepts. The time frame is still fairly long and for example the technology is not necessarily mature yet, but it still is possible to form concepts based on certain assumptions. Emerging concepts should be more reasonable than visioning, yet factors such as legislations, global infrastructure, immature technologies and markets may prevent the commercial introduction of these concepts.

6 Conclusions

The contribution of this paper as a whole is that it articulates the use of product concepts for a variety of purposes, suggesting that their use is not limited to making decisions concerning commercialization. Additionally, in order to clarify the art of concept development we introduce a new categorization model and discuss concept development activities in a company context. The categorization model attempts to clarify the context, purpose, and nature of product concepts. We believe, that the systematic creation and management of products concepts may offer direct and indirect benefits for a technology-intensive company. Therefore, product concept development should be acknowledged and treated as a conscious resource.

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