NordDesign 2014
August 27 – 29, 2014
Espoo, Finland / Melbourne, Australia

Adding To Product Development Theory - A Language Perspective

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Abstract
The paper explores the effect that the languages associated with the applied methods have on product development processes. Product development does increasingly involve more diverse disciplines and expanded cross-disciplinary views. Most importantly, the new disciplines: *Design Thinking*, and, *Innovation Management* have introduced new cross-disciplinary methods and approaches. Some of the most important cognitive processes involved in product development: perceiving, meaning making, conceptualizing, communicating, and learning have been reframed and expanded as new disciplines have been introduced. An important aspect of the diversity is the introduction of the different languages that are introduced along with the new disciplines. Language is here defined as a combination of the vocabulary and the methodological approaches that are introduced by the new disciplines. The experience of the application of these new languages reveals that the traditional methods applied in product development are highly influenced and limited by the languages that are traditionally associated with the application of these methods. Though language plays an important part in these essential processes it is rarely addressed in the product development literature. This paper aims at exploring this language perspective in product development processes.

Keywords: Product Development Methods, Teaching Product Development, Language and Product Development

1 Introduction

Today, more students are exposed to design and product development disciplines. The trend is sustained by the expansion of 'Design Thinking' as a generally accepted approach to problem solving [1]. Also, the discipline 'Innovation Management' has a significant influence on the framing of design and product development [2,3]. Generally, we find that the meeting between, and merging of different cross-disciplinary fields enrich the product development discipline. In particular, we find that the influence from liberal arts, performing arts, and psychology have been fruitful. Language and language development occurs frequently at the intersections of different disciplinary fields. The development appears as new ways of

articulating user experiences, various phenomena, and approaches. In this respect the language developments become essential in the processes of perceiving, meaning making, conceptualizing, communicating, and learning that individuals and groups in cross-disciplinary teams undergo. These processes are also essential in the initial phases of any design task. Despite these facts, language and language development are not a part of traditional product development theory. The purpose of this paper is to introduce language and language development as relevant elements in product development theory.

2 Language elements in Product Development

As mentioned in the introductory part of this paper the processes of perceiving, meaning making, conceptualizing, communicating, and learning are cross-disciplinary fields that are informed by liberal arts, performing art, and psychology and are having a significant influence on design and engineering design. In the following we will unfold important elements of this cross-disciplinary influence and elaborate on some important aspects of language influence. In this paper we will restrict our focus to perceiving, meaning making, and conceptualizing.

2.1 Perceiving and language influence

All perception involves signals from the nervous system (vision, smell, sound, touch, taste) [4]. However, it is not a passive receipt of these inputs but is highly shaped by prior learning, memory, expectation, and attention [5]. Cognition is the organization, identification, and interpretation of sensory information in order to represent and understand the environment [4].

Cognition is highly dependent on the language that a person knows. Although an observer may be confronted with the same physical evidence in the form of experimental data and although he may be capable of seemingly similar acts of observation his resulting view and meaning making differs as a function of the particular languages that he knows [6].

Individuals are sensitive to various types of sensory input. The sensory preferences can overall be divided into visual (seeing), auditory (listening), and kinesthetic (feeling) types of input. When a person has a specific preference for sensing, the associated language most often reflect the same preference in respect to the words that used, e.g., “It looks good!”, “It sounds good!”, or “It feels good” [7].

In a design context perception is an essential part of the front-end exploration of a problem or an opportunity. The ability to train critical perception is therefore a core competence for anyone involved in design processes. Design Thinking has played a significant role in the acknowledgement of the importance of this critical aspect [8]. In particular, Design Thinking has brought the anthropology field into design processes. Anthropology has brought new methods that are focused on observing human behavior when interacting physically and emotionally with products, services, and spaces.

Critical perception is the foundation for a deep understanding of a particular problem in any design process. Empirical research emphasize that adopting a questioning approach can stimulate training of the critical perception ability [9]. A corresponding approach is to develop the critical perception ability by loops of hypotheses [10]. Both methods recognize that the languages that are needed to address a particular problem have to be developed in parallel with the critical observation of the problem and its surroundings. The richness of the languages influences the depth of the understanding of the problem [9].

2.2 Meaning making and language influence

Perception is an essential process in order to transform the sensory input. We observe, inquire, mirror, name, question, challenge, and reframe information and experience in order to make it useful – to make meaning. Meaning making is the process in which individuals construct mental models that ground their understanding in a deeply personal and unique fashion. These mental models are based on a combination of the sensory inputs and the prior knowledge and in order to make meaning we frame it or often reframe it by using languages.

In a product development context meaning making is closely associated with getting the "good idea". This is often the outcome of creative processes. The Lateral Thinking techniques developed by Edward de Bono emphasizes various ways of reframing in order to develop new ideas from existing ideas [11]. Reframing is to change the conceptual and/or emotional setting or viewpoint in relation to which a situation or an artifact is experienced and to place it in another frame. The reframing thereby changes the entire meaning of the original situation or artifact. Our languages are important features of our framing of a given situation and the reframing can therefore be seen as a merge or adaptation between different languages [12].

Many practitioners will refer to intuition as the source of the good idea. They can hardly explain how the idea emerged and intuition is therefore in popular science often seen as a magical phenomenon. Recent advances in psychology and neuroscience de-mystify intuition by concluding that "Intuition is nothing more and nothing less than recognition" [13]. These new findings emphasize the importance of accessing prior knowledge and the process of recombination of this prior knowledge with new sensory inputs [8]. Recombination can in this context be seen as the merging between known languages representing prior knowledge and new elements of languages provided by or inspired by sensory inputs. A simple example of this is the use of metaphors. When using metaphors the sensory input can be of any kind. Metaphors achieve their effects via associations, comparisons or resemblances and the important effect is that they provide an understanding supported by the richness of the languages that are normally associated with the specific metaphor [14].

This is also closely related to constructivism theory that argues that humans generate knowledge and meaning from an interaction between their experiences and their ideas [15]. One of the founders of the constructivism theory, Jean Piaget, saw play as an essential element of the cognitive development of children. He provided scientific evidence for his views and his followers has extended central elements of his ideas to adults as well as children [16].

2.3 Conceptualizing and language influence

The meaning making process will produce a number of loosely coupled insights and the conceptualization process is meant to combine these inputs to a more comprehensive description and understanding.

In engineering design the concept has a well-defined function as an approximate description of the technology, working principles, and form of the product [17]. Seen in a language perspective the concept will determine the main product language.

Roberto Verganti emphasizes the limitations this can have on the development of innovative solutions [18]. The language element is here seen in multiple perspectives. The customers have languages that reflect their use, demands, and meaning of the product. When addressing

the customers the richness of such a conversation will be limited by the richness of the language. There is a risk that the limitation of the product language will define the limits of the degree of innovation [18].

The vast majority of engineering design literature emphasizes specifications as the most important element of the product concept [19]. However, there is a risk that such an approach can lead to a language that reflect the development engineers' understanding of the product more than it reflect the needs of the customers. This can lead to a limitation of the language that could hamper involvement of anyone else than the development engineers [18].

The systematic use of prototypes is an essential competence in conceptualizing. In his book, Serious Play, Michael Schrage praises many aspects of physical prototypes and models for speeding up processes, and he mentions examples of great breakthroughs supported thereby [20]. Schrage argues against the common assumption that "great teams make prototypes" and suggests that instead one should realize that "prototypes make great teams." The making of great teams goes beyond the individual team, but helps create teams out of people with different backgrounds by creating "shared space". Shared space is the common ground where people can meet on even terms and objectively discuss matters. This is essentially the role of a language, and the prototype can therefore be seen as an important element in the emergence of the product language.

3 Innovation Management and Language

The simple definition of innovation: "the successful exploitation of new ideas" [21]. Successful innovation requires that the applicants are able to challenge the degree and the character of newness. Per definition this is unknown and has to be explored. The exploration requires one or more languages in order to facilitate the process and communicate the gained insight.

As the innovation dimensions are very different in nature it will likely involve a number of cross-organizational viewpoints and often external viewpoints. The cross-organizational and the inter-organizational perspectives require communication skills and languages (or methods as most authors today prefer to call it).

The combination of 1) cross-organizational involvement, 2) exploration of the unknown, and 3) communication, posses serious challenges. We have chosen to interpret these challenges as a request for a set of different languages that can facilitate the exploration of the relevant innovation viewpoints. An important reason for choosing a language approach (compared to the traditional method approach) is that it emphasizes communication and that it is based on the assumption that when a language emerge it needs to be shaped, trained, and, refined in order to suit its purpose. If not trained and refined there is a risk that the language can develop into stereotypes that are not able to capture the fine nuances of a relevant subject.

3.1 Innovation management and multiple views

An important aspect of managing innovation is the ability to assess, review, and challenge a number of relevant parameters and viewpoints associated with the characteristics or competitiveness of the product or service. Several empirical studies emphasize that successful innovation is more likely to happen when multiple innovation viewpoints are applied simultaneously and are specifically impacting the final solution [22]. The ability to apply multiple viewpoints is one of the most important Innovation Management requirements, and is seen as an essential part of the innovation capability of the organization [21].

The important challenge is: How can an organization be supported in assessing, reviewing, and challenging the relevant competitive features of the current state of a given product or service?

In order to respond to this challenge most organizations apply some kind of innovation management model or framework. Every organization has to choose its own model or framework and make it an integral part of their overall management system. There are basically two approaches, 1) To develop a company specific model that fits the particular requirements within the relevant industry, or, 2) To choose a generic model that can be adapted according to the particular requirements within the relevant industry. The second option has several advantages. By choosing a generic innovation model it is easier to benchmark with other industries and organizations; and due to the broader external documentation of the model it is easier to communicate internally within the organization.

3.2 Innovation Management models with multiple innovation viewpoints

There are several generic innovation models available that operate with multiple viewpoints [2, 22, 23]. The different models have many similarities. However, the most important shared conclusion is that innovation is not a matter of technical product innovation in an isolated way. The research behind the models document that isolated technical product innovation is not likely to be successful compared to an innovation effort that involves several viewpoints of innovation.

The application of the mutiple viewpoint innovation models will be illustrated and discussed based on one of the existing models: The 4P Model [2].

3.2.1 The 4P Innovation Model

The 4P model is named after the four innovation viewpoints that are represented in the model: Product, Process, Paradigm, and Position [2]. According to the 4P model innovation can be targeted in four main ways:

1. Product – innovation to introduce or improve products (often pure technical features)
2. Processes – innovation to introduce or improve processes (often manufacturing and logistic processes)
3. Position – innovation to define or re-define the positioning of the organization or products (delivering to new customers or challenging the existing perception of the product)
4. Paradigm – innovation to define or re-define the dominant paradigm of the organization or the industry (re-writing the rules of the product category)

The four innovation viewpoints are not tight categories and they have fuzzy boundaries. Nor are they alternatives: organizations can pursue all four at the same time.

The graphical version of the 4P model is seen in figure 1. In this model four independent axes represent the innovation viewpoints and each axis indicate an incremental innovation effort near the centre versus a radical innovation effort far from the centre.

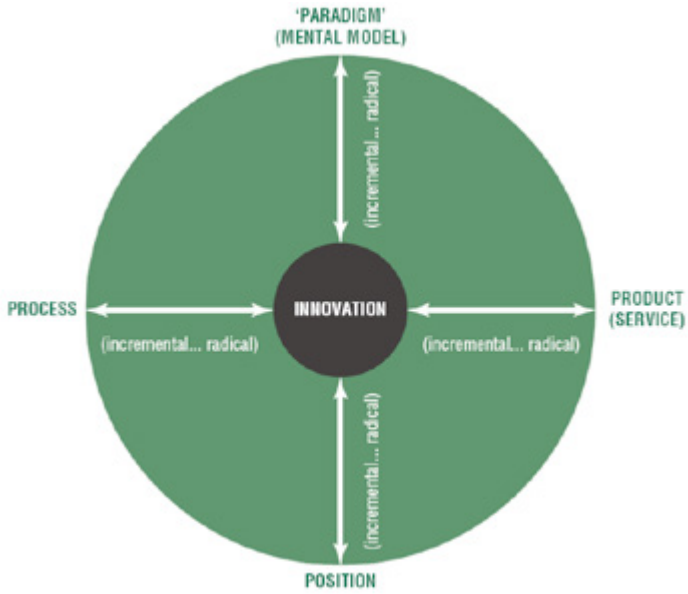

Figure 1 The 4P Innovation Model

The 4P Model can support a discussion about as well the potential configuration (to-be) as the existing (as-is) configuration of a comprehensive innovation effort. The 4P model can support the development team or the management in: 1) identifying the choice of alternatives, 2) creating focus at critical areas (impacting competition or risk), and, 3) identifying critical interdependencies between the various innovation efforts.

However, the systematic exploration of a given innovation challenge requires facilitation and support of appropriate methods. The premise and hypothesis of this paper is that the needed methods can be interpreted as languages, that either exist or emerge and mature during the systematic exploration or reviewing processes. The verification of this hypothesis and the consequence of the premise have a significant influence on the ways that the exploration processes are facilitated. We will illustrate this in the following.

3.3 Innovation as a questioning approach

It is generally challenging to questioning into the unknown. The dimensions of the 4P model do, however, support in such a process. Examples of relevant questions to the four dimensions are:

- Product Innovation
  - What are the key technologies?
  - How mature are these technologies?
  - What is the key offering provided by the product?
- Process Innovation
  - What is the manufacturing/operational setup?
  - What is the logistic setup?
  - What is the competitive strength of these?
- Paradigm Innovation
  - What is the current assumption of a given product category?
  - How do people expect to benefit from the offering?
  - What are the current business models?

- Position Innovation
  - Can the products vary according to different customers?
  - Can the products be supplemented with complimentary products?
  - What are the known and unknown market spaces?

If there is an immediate answer to the questions it does indicate that a language exists. This language can be utilized or expanded in order to support the further research of the question. Furthermore, it often indicates that the specific innovation effort is more likely to be incremental than radical.

If there is no immediate answer it indicates an innovation challenge and a need to find an approach to support the research. The research has to be articulated and, thereby, languages emerge.

In the following the questioning approach will be illustrated with extracts from one specific empirical case.

3.3.1 Case – LEGO Board Game

After a severe financial crisis from 2000 to 2005 LEGO Company has regained competitiveness and have for the last 7 years experience two digits growth rates in both turnover and earnings. A recent expansion of the product portfolio is board games [24].

The questioning approach revealed that the rules of the board game industry were well known both to LEGO Company and its competitors. The languages needed to understand the board game category did exist. Most importantly is the dynamics of board games. The existing languages revolve around drawing cards or rolling a dice to generate the dynamics of the game. By adding a dice where the sides could be replaced the development team at LEGO expanded the existing languages specifying the dynamics and the design of board games.

In 2009 LEGO launched the product series with 10 parallel product set. All of the sets make use of the distinctive LEGO Dice - a solid plastic, LEGO-compatible cube with soft rubber rimming on each edge to give the dice a particularly strong bounce. Depending on the game, the dice can be built with different LEGO tiles on its faces, which will affect game play in different ways.

The new game setup does challenge most radically the product and paradigm dimensions but all four dimensions support the comprehensive innovation setup:

- Product Innovation
  - The Game Dice with replaceable sides.
  - Patenting the Game Dice [25].
  - The possibilities of making dynamic rules.
  - The combination of existing product themes and games.
  - Introduction of mini-mini-figures.
- Process Innovation
  - The Game Dice molded in one piece.
  - Use of existing sub-supplier setup.
- Paradigm Innovation
  - Mothers can play LEGO with their sons and daughters.
  - The new play experience of being able to change the sides.
  - The mixture of game and construction process.

- Position Innovation
  - The widespread use of common LEGO bricks.
  - Games based on existing LEGO themes, e.g. Harry Potter,

The listed innovation parameters don't tell the whole innovation story, but they represent what the product management and the initial product development team chose as the main focus areas.

It is not possible to define general guidelines for a competitive innovation profile. This will differ from industry to industry. But it is possible to identify some patterns that should attract management attention and it is possible to identify approaches that facilitate the exploration of specific challenges. The last part is what we refer to as "languages".

4 Reflection

In reference to the 4P innovation model the most important step is to explore, design and decide on each of the four dimensions of the model. Due to the limitations of this paper we will restict our discussion to the paradigm dimension.

The individual case of an organization will determine how a product development or innovation challenge is framed. If the challenge is incremental there will generally be a good and comprehensive understanding of the context. This indicate that the appropriate languages to address the challenge is in place.

In the LEGO case the challenge was more radical. There was a need to identify growth potentials outside the traditional LEGO market (construction toys mainly for boys). Three external consultancy companies were invited to submit ideas on what new markets LEGO could approach. Based on this input it was decided to focus on board games. In this case the appropriate languages were yet not in place.

Board game is a large industry with big competitors and there are tough requirements to enter this market successfully. A paradigm break is the most powerful way of creating a competitive advantage. However, a paradigm break is difficult because is doesn't yet have appropriate languages. Through perceiving and meaning making iterative processes ideas will emerge. The initial ideas can be viewed as rather abstract impulses but they remain abstract until more details are added. When more details are added nuances emerge and facilitate dialogue and conceptualization.

The phase is best described as being complex. Complexity is referring to the fact that the relationship between cause and effect can only be perceived in retrospect. This means participants have to probe in order to gradually make meaning and conceptualize [26]. Several authors refer to the challenge of paradigm break as a process of reframing [12, 13, 18].

A powerful language approach to explore this further is prototyping. Prototypes create the space for innovation by providing the language that enables engagement. Prototypes engage the organization's thinking in the explicit. They externalize thoughts and spark involvement and dialogue [20, 27]. Furthermore, they support the reframing process. By being forced to express abstract ideas in concrete modells the involved parties can perceive more broadly (see, touch, hear) and thereby stimulate their meaning making processes [28].

The combination of constructing with LEGO and gaming was the initial bid on a paradigm break in the LEGO Board Game project. The further exploration was done by a number of prototypes. However, some of the first prototypes tested on potential customers revealed another potential paradigm break. The test group reported an unforeseen feature of the LEGO Board Game. Mothers could now play LEGO with their sons. LEGO's traditionally male appealing construction theme has to a large extent excluded mothers to take part of the play. The board game approach changed this limitation and proved also to be less gender biased than the existing product portfolio.

The prototypes also support and allow for a gradual clarification of specifications. Case descriptions in the literature are always made in retrospect and therefore the specifications appear to be clarified initially. This is generally not the case [29]. As described by March: "Alternatives are not given but have to be discovered or created. Expectations are not known but have to be developed. That development introduces uncertainty and errors. Desires are neither clear, nor unified, nor stable, nor exogenous to the process of choice" [30].

As can be seen through the LEGO case the whole development process from impulse to the final concept involves several different languages that facilitate the the dialogue between the involved parties and support in changing the abstract initial ideas to concrete concepts that can be communicated.

5 Conclusion

The purpose of this paper is to illustrate how the emergence or refinement of appropriate languages do support product development. Our intention is to reframe the thinking about both professional engineering design and the thinking about teaching engineering design.

Using the language term is rather unusual within engineering design. To some extend the language approach is overlapping the more traditional methodology approach. However, by introducing the language approach we find it easier to engage in a cross-disciplinary discussions of the whole design discipline.

The language approach emphasize communication and the problems about being accurate in communication. This connection makes it easier and more obvious to tap into the rich insights from liberal arts and psychology. Languages also need to be trained and refined. If not trained and refined a language will develop into stereotypes that are not able to capture the fine nuances of a relevant subject.

The introduction of the language thinking can be done incrementally and without much extra effort. Any existing methodology will per definition have several languages that are used in the application hereof. Simply by questioning the appropriateness and sufficiency of these languages will start a reflection process. And this reflection process will most likely lead to changes.

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