The 'Build to Think' Orientation: When an Organization Uses Design for Concept Development

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Introduction

Design has attracted the attention of business academics and been a major subject of discussion in NPD literature in recent years. While various aspects of design have been discussed, this study focuses on the aspects of design defined as 'creative visualization of a concept etc.' (Walsh et al, 1992; Roy & Potter, 1993; Bruce & Cooper, 1997). This is because it is the aspect common to many types of design as a development activity (Walsh et al, 1991), and is related to concept development. Moreover, developing a concept attractive to the market and defining it as a protocol is one of the key success factors, as Cooper & Kleinschmidt (1987) have shown. As for it being the aspect of design related to concept development, Cagan & Vogel (2002), Kelley (2001), and some other design researchers and practitioners have claimed that design can help develop and improve the concept itself, resulting in a better NPD performance. This study aims to identify the factors that enable an NPD project team to adopt such a concept development model, and become oriented towards using design to improve concept ideas.

Cagan & Vogel (2002) and Kelley (2001) have claimed that design, including concept visualization and quick prototyping, can help improve a concept, which is the source of the visualization. Isono (2011) showed that this kind of development model was used by Suntory, a Japanese design-oriented firm, and is called 'Build to Think' in this study. On the other hand, NPD researchers such as Cooper (1994), Urban & Hauser (1993), and Crawford (1991) have traditionally claimed that product development, including visualization of a concept (e.g. prototyping), should be carried out after the concept is properly defined as a protocol. Additionally, it needs to be confirmed as attractive enough to the target customers, and therefore worth further development in the NPD process. This has been particularly discussed within the framework of stage-gate systems (Cooper, 1994 and 1986), and is a type of NPD management model adopted by many firms such as Procter & Gamble (Cooper, 1994). Isono (2011) also showed that this was the kind of development model used by Coca-Cola Japan, and it is called 'Build After Thought' in this study.

What this means is that there have been two distinct models of concept development in terms of how it relates to design, namely the 'Build to Think' model, where design helps improve the concept itself, and the 'Build After Thought' model, where design work begins only after a concept is defined, with no intention of

improving concept ideas using the design. They have been discussed separately in previous literature with no deliberate comparison and are essentially incompatible. 'Build to Think' means visualizing a concept idea before it is defined and either learning the potential of that concept idea through the outcome of the visualization or, derive some kind of stimulus from it to develop the idea or create a new one (Cagan & Vogel 2002; Kelley 2001). 'Build After Thought' involves design happening after concept definition. According to the 'Stage-Gate-System', a concept should initially be defined as a protocol, and then any development, including concept visualization (e.g. prototyping), should be carried out. It is regarded as a key factor for NPD success that the business potential of the concept should be confirmed before any major investment is made in it (Cooper, 1994; Cooper & Kleinschmidt, 1987).

While concept development is by nature a complex process (Cooper, 1986), some studies advocate adopting a 'Build to Think' oriented model, while others recommend a 'Build After Thought' oriented model. Both viewpoints demonstrate that using these models lead to positive effects on NPD performance. What can be assumed is that any conclusion as to which model is right would depend on the type of project organization or the type of product. Some firms may be convinced of the effectiveness of the 'Build to Think' model and want to adopt for it for their NPD process when the way they work has been based around the 'Build After Thought' model. They have to be told what enablers (or organizational or development conditions) exist for them to adopt the 'Build to Think' model. Without knowing the conditions that suit the 'Build to Think' model or the 'Build After Thought' model, an organization may be confused as to which model to adopt, and the benefits they could derive from them may turn out to be limited. However, no study has so far addressed the question of what factors enable an organization to adopt the 'Build to Think' model (i.e. design influencing concept development) or the 'Build After Thought' model (i.e. design occurring after concept definition).

Two kinds of view regarding the role of design in concept development

This chapter summarizes the main points of both arguments – 'Build to Think' (design influencing concept development), and 'Build After Thought' (design occurring after concept definition). In addition, the model of what this study calls 'Build While Thinking' (design happening during concept development), is discussed as an extension of the 'Build to Think' model.

1. The 'Build After Thought' model: design occurring after concept definition

Crawford (1991), Urban & Hauser (1993), and other NPD studies which explain more generic NPD processes, have traditionally concentrated on what this study calls the 'Build After Thought' model in terms of

the relationship between concept development and design (concept visualization), when compared with the model which this study calls the 'Build to Think' model (to be reviewed later).

Crawford (1991, 1984) explains that, as a generic NPD process, development, including prototyping, should be carried out based on what is called protocol - a defined concept and a statement of the benefits the product is to deliver to the target customers. Because a concept is to be the foundation of all subsequent development activities, it has to be confirmed as attractive enough to the market and therefore worth major investment (Crawford, 1991, pp210-211). Visualization materials, such as sketches in the concept research that take place before protocol definition, are described, but the actual visualization process is not mentioned. After a prototype is developed based on the defined protocol, it is then used for further concept testing (Crawford, 1991, p.215). However, as this prototype immediately follows major investment, the concept testing here should be more for confirmation of the its validity, rather than an exploration to find better concept ideas. This is because what matters is the basic premise, which is that the potential of the concept itself should be defined, and the potential of the concept visualization outcome (e.g. prototype) depends on the potential of the concept itself (Crawford, 1991; Shimaguchi & Ishii, 1987). Cooper & Kleinschmidt (1987) show empirically that setting a well-defined protocol prior to the product development stage is a critical factor for a NPD success.

Urban & Hauser (1993) introduce the concept of 'CBP: Core Benefit Statement', which is equivalent to the protocol used by Crawford (1991), and they essentially take the same view regarding the problem of concept visualization in concept development. They claim that an idea (equivalent to a concept in Crawford (1991)) is defined as a CBP, and it should be realized in the following development phase. They introduce examples of ideas (concepts) including some sketches in the ideation phase (preceding the CBP definition stage), but do not mention the visualization process. They state that a tangible representation of CBP (a function of the visualization process after CBP definition) can help people experience the concept, and that the process of the CBP visualization should be an iteration of the development, testing and improvement, which may lead to CBP improvement (Urban & Hauser, 1993, p.351). Yet, in reality, as long as CBP is based on a defined concept, revising it repeatedly during the improvement process, when it has already been defined, is hard to imagine and should be avoided in principle.

2. The 'Build While Thinking' model: design during concept development

Cooper (1994) first confirms the positive impact on NPD performance implementing stage-gate systems with the process. This basically consists of identifiable and discrete stages preceded by review points or 'gates'. The key features of this include sharper product definition prior to the beginning of the development phase,

which is what Crawford calls the protocol. Second, he foresees the need for the 'third generation' as an evolution of the stage-gate systems, given the review of feedback from the experiences of the implementation. He goes on to say that the 'third generation' should allow or encourage the overlapping of stages (i.e., phases in this study), as opposed to adhering strictly to the definition of what to do in which stage, so that it will contribute to speeding up the process.

Clark & Fujimoto (1991) also discuss the benefits of phase-integration in the development process. They argue that the nature of the integration of problem solving in NPD, which can contribute to reduced lead time and improved product quality, is determined by the following dimensions: timing of upstream/downstream activities (sequential or stage-overlapping), richness of information media (documents or face-to-face), frequency of information transmission (batch transmission or fragmented), direction of communication (unilateral or bilateral), and timing of upstream/downstream information flows (late release of complete information or early release of preliminary information)

Bhattacharya et al. (1998) discuss the significance of phase overlapping from a different angle. They show that early definition (i.e., having a sharp product definition (concept definition in this study) prior to beginning the development work (Cooper, 1993)) is optimal only in a limited set of situations. Instead of this, they present what they call real-time product definition, where the definition is refined in real-time using customer information, resulting in improvements in the product's attractiveness and sales potential. In this model, the optimal definition approach (definition timing and phase-overlapping period) is determined by the following: product integration needs, price/performance sensitivity, and team flexibility. When the team is flexible, it can begin the integration phase before definition is completed, and the additional time available for integration can be used to delay definition of specifications (and to improve the product's attractiveness using prototypes and customer input) with both high and low integration needs.

What it means is that there is room for modification in the 'Build After Thought' model advocated by Crawford (1991) and others. However, the point made by Cooper (1994) and Clark & Fujimoto (1991) are that phase-overlapping can contribute to speeding up the process and improving product quality. The emphasis made by Bhattacharya et al. (1998) is on showing that the optimum timing of concept definition/optimum phase-overlapping period for product demand maximization is affected by environmental uncertainty, level of project team flexibility, and other factors, and cannot be determined in one way.

This study calls the model of overlapping concept development with design (concept visualization) 'Build While Thinking' model. It bears similarity to the 'Build to Think' model, yet they are different, as 'Build While

Thinking' emphasizes phase overlap between concept development and design, while 'Build to Think' emphasizes how design (concept visualization) influences concept development. With the 'Build While Thinking' model, design and concept development overlap, although the former may not be influencing the latter.

3. The 'Build to Think' model: design influencing concept development (to improve concept ideas)

As cited earlier, some NPD studies addressing the problem of design for NPD claim that design can not only realize product-attractiveness as an outcome from the NPD process but also influence the concept itself, helping to identify a better concept idea. Kotler & Rath (1984) claim that effective design management contributes to the development of a product that is high in customer satisfaction. They believe that a project team should have designers involved in upstream process, and should proactively consider idea proposals from these designers in the idea/concept development phase. Bruce & Cooper (1997) claim that designers play an important role in transferring market information into a concept (allowing customers to experience and comment) because they use visual materials representing targeted customer profiles, existing products, metaphors, etc. for concept development. Jevnaker (2000), through multiple case-studies, addresses the research question of how small-medium size firms, which have no a-priori design expertise or experience of interacting with designers, become able to acquire design capability. She shows that one of the key activities needed in the process of design capability acquisition is when designers get involved in the upstream NPD process, generate/propose ideas, and influence the product strategy development. Kelley (2001), general manager of IDEO, a world-class industrial design studio famous for their innovation capability, introduces the concept 'Build to Learn' as a key activity they have practiced for product innovation. Here, 'Build to Learn' is about the quick development of prototypes for concept idea development/refinement. Here, concept visualization (e.g. prototyping) is regarded as part of the whole unit of concept development, which is a creative process. Cagan & Vogel (2002) advocate an NPD process for the development of a product establishing product superiority in style, function, and customer value. As soon as a concept idea has been developed, this NPD process is claimed to develop and test a prototype, improve the concept idea, and iterate the cycle. Concept definition should be carried out only after all aspects, including style, technology, and value, have been confirmed as right for customers. Based on multiple case studies dealing with mid to large scale firms in the UK, Perks et al. (2005) establishes a typology of the role of design in NPD. This includes 'Design as functional specialist', 'Design as a multi-function project team member', 'Design as the project leader'. The latter is a type of design role that includes idea generation for concept definition through direct contacts with the market. Veryzer & Mozota

(2005) argue that design based on deep customer understanding is effective for the establishment of product differentiation, calling it 'User-Oriented Design'. They hypothesize that applying such 'User-Oriented Design' contributes to the development of better product ideas.

There are studies dealing with the problem of design in NPD that describe how design can influence the development of the concept itself. Some of them, such as Walsh et al (1991), explain it as an extension of the discussion on phase-overlapping as argued by Clark & Fujimoto (1991), yet no study, as far as this author knows, discusses it in comparison to a more generic concept development model such as the ones explained by Crawford (1991) or Urban & Hauser (1993). The 'Build After Thought' model, and the 'Build to Think' model are by nature incompatible; Isono (2011) pointed out the differences between them through multiple case studies. However, no study has addressed the question of what factors enable an organization to adopt either the 'Build to Think' or 'Build After Thought' model.

Table 1 Typology of the relationship between concept development and design

Types of concept development model	Literatures
Build After Thought (Design after concept definition)	Crawford (1991), Urban & Hauser (1993) Perks et al,(2005) 'Design as Functional'
Build While Thinking (Design during the concept development)	Clark & Fujimoto, (1991), Cooper (1994), Bhattacharya, et al, (1998)
Build to Think (Design influencing concept development)	Isono (2011), Perks et al, (2005) 'Design as NPD Leader' Veryzer & Mozota, (2005), Cagan & Vogel (2002); Kelley, (2001), Bruce & Cooper (1997), Kotler & Rath (1984)

Hypotheses on factors that facilitate the 'Build to Think' orientation

What are the factors that enable an organization to take the 'Build to Think' model, i.e. design (creative concept visualization) influencing concept development? In this chapter, hypotheses are drawn based on the discussions in previous literature.

1. 'Design Leadership' and 'Build to Think'

Past studies addressing the problem of design in the context of NPD, especially ones that discuss how design as a development capability or a development process can contribute to NPD, have claimed that 'basic' design capability alone (visualization, prototyping, creativity, aesthetic judgment etc.) can make a limited contribution to businesses. This requires a different type of capability which facilitates a 'basic' design capability to be fully utilized for NPD, and the afore-mentioned studies have attempted to identify this capability. It is called 'Design Leadership' in this study. It can be said that the past studies have discussed and identified the following aspects of 'Design Leadership' in the context of concept development: 1. Teamwork, including designers in concept development ('Teamwork' in the following part), 2. Designers' customer/market orientation ('Customer-orientation' in the following part), and 3. Designers' creativity orientation ('Creativity

orientation' in the following part).

On 'Build to Think', although it is included in 'Design Leadership' from a general perspective, a detailed examination of past studies suggests that it is dependent on 'Teamwork', 'Customer-orientation', and 'Creativity-orientation'. Literature review is extended in the following, where the description parts marked with (Tw) are about 'Teamwork', the parts with (Co) are about 'Customer-orientation', the parts with (Cr) are about 'Creativity-orientation', and the parts with (B2T) are about 'Build to Think'.

Kotler & Rath (1984), as reviewed earlier, pointed out that in a firm where effective design management is practiced, the project team has designers involved in upstream processes and who proactively consider idea proposals from designers in the idea/concept development phase. In addition, the kind of design management they believe a firm should have is one with the following characteristics: designers have a close working relationship with people in marketing etc. (Tw), designers aim for solutions that start with awareness of consumer needs/preferences and add a creative touch (Co), designers have creative freedom within the limits of the project parameters (Cr). This means that design management with these characteristics allows designers to be involved in upstream processes and influence concept development with their idea proposals.

Walsh et al. (1991, pp.50-51), through their UK cross-industry survey on design activities in businesses conducted from 1980 to 1990, point out that designers' visualization capability (Cr) facilitates the project team (Tw) to generate product ideas in the phase before concept definition (B2T).

Through a survey dealing with CEOs in high-performing firms, Dickson et al. (1995) identified characteristics of design management which the CEOs believed was necessary. These characteristics are represented as variables, and include getting different functions to work together (Tw), involving and getting new ideas from customers, quickly becoming aware of competitor's innovations and imitations (Co), finding new design ideas - not just me-too imitations (Cr), and replacing sequential with concurrent design (B2T).

Jevnaker (2000), reviewed earlier, showed the necessary key steps which small-to-mid-scale firms with no a priori knowledge on design must take in order to transform themselves into being design-oriented. The final step in the transformation process is what she calls 'Strategic anchoring and stretching', i.e. becoming strategic (taking part in NPD strategy formulation), where new product design ideas were adopted or co-developed through designers' initiatives, some of them becoming new platforms affecting product strategies. This is regarded as consistent with 'Build to Think' in this study. Prior to this, the process is initiated with step 1 (Tw) - accessing and starting the new approach, where a small set of managers and designers are key to introducing and adopting a new design approach, followed by step 2 (Tw) - connecting and coordinating

design/business. Industrial design, if fully integrated early on, results in new, successful solutions, which are co-created by the industrial designer. Step 3 (Co) - Communicating design-fostering learning - involves taking advantage of a live experience of the products in use (through visualization), while in step 4 (Cr) and (Tw) - creative absorbing, supporting, testing, and interfering – both designer and researchers collaborate in exploring development issues.

Kelley (2001), as reviewed earlier, advocates 'Build to Learn' (B2T), where quick prototyping for idea generation/improvement, leads to innovation. In addition, he advocates deep, emphatic customer observation, along with understanding and gaining ideas (Co), conducting the right kind of brainstorming (Cr), with a project team consisting of people with diverse knowledge, backgrounds, expertise, etc. (TW). These are regarded as effective activities for creating innovation.

Cagan & Vogel (2002), reviewed earlier, advocate what they call 'iNPD' (Integrated NPD), characterized by the use of quick prototypes and/or sketches (i.e. concept visualization) for idea/concept generation and improvement before the concept is frozen (B2T). Furthermore, they claim that this should be carried out by an NPD team consisting of members who have diverse expertise and backgrounds, yet who are fully integrated (Tw) and fully committed to delivering customer value in the development (Co).

Perks et al. (2005), reviewed earlier, establish a typology for the role of design in NPD. It included 'Process Leader', the most applied role type in the typology, whose activities include direct interaction with the marketplace to glean insight (Co). This insight supports initial ideas and refines design concepts (B2T), and is driven by project leadership and relationship management (Tw). Furthermore, other types of role include 'Design as Multifunction Team', the second applied role type, whose activities are centered around relationship management (Tw), and 'Design as functional specialist', the most basic role type, whose activities tend to take place after the concept is frozen and include idea generation, design prototype, aesthetics, visualization, and creativity (Cr). In this argument, 'Design as Process Leader', the most applied role, which includes 'Build to Think' activity, is based around activities included in 'Design as Functional Specialist', the most basic role.

Veryzer & Mozota (2005), reviewed earlier, define the concept of 'User-Oriented Design' and propose the following hypothesis: *integration or inclusion of user-oriented design in NPD* (Co) *will have a positive effect on idea generation* (B2T). Here, 'design' in 'User-Oriented Design' is based on the view of design as a creative activity (Cr), which is part of the definition of design by ICSID (International Council Societies of Industrial Design).

In summary, 'Design Leadership', an organizational capability that facilitates the 'basic' design

capability to become fully utilized for NPD, can be regarded as consisting of 'Teamwork', 'Customer-Orientation', 'Creativity-Orientation', and 'Build to Think'. 'Build to Think' is supported by the other aspects of 'Design Leadership'. The following hypotheses are drawn from the discussion:

'Build to Think' (design (concept visualization) influencing concept development) is facilitated when:

H1-1: Project team exerts teamwork, including designers as team members.

H1-2: Designers are more customer-oriented.

H1-3: Designers are more creativity-oriented.

2. Types of concept and 'Build to Think'

When a product concept to be developed is by nature directly linked with the product appearance and cannot be developed only in a narrative format, it makes sense to assume that concept development would involve concept visualization. Ulrich & Eppinger (2000) and Ullman (2003), who explain an engineering-focused NPD such as the development of machine tooling, bicycles, etc., deal with the kind of concept development wherein a concept is represented in both descriptive and illustrative formats. Alternatively, even if a product concept is not directly linked to the product appearance, such as those of engineering products, customers may be sensitive to product appearance, and therefore the concept development emphasizes product appearance. In this case, it makes sense to assume that the concept development would involve visualization, i.e. a simulation and testing of the product appearance. Cagan & Vogel (2002) advocate the use of prototyping in concept development in order to achieve a product that is superior in both product style and product technology. Kelley (2001) also advocates a 'Build to Think' type development, but this is more in the context of design-oriented product development. Isono (2011) identified the 'Build to Think' approach applied in the NPD case where customers are more sensitive to the product appearance.

On the other hand, it may be the case that firms are more concerned with the technology factors of a product in development, and less with its style or appearance, as they believe customers are more sensitive to the product technology, such as a hard-disk's storage volume, a detergent's washing efficacy, or product weight/size, as Cagan & Vogel (2002) discuss. In such cases, the firm would focus more on the technology factor in the concept development, keeping it separate from the design (concept visualization) in the development process so that they can minimize the complexity caused by the overlapping of concept idea development and design. Isono (2011) identified the 'Build After Thought' approach applied in an NPD case where customers were more sensitive to the product efficacy. The following hypotheses are drawn from the discussion:

'Build to Think' (design (concept visualization) influencing concept development) is facilitated when:

H2-1: The product concept to be developed is more closely linked to product appearance.

'Build to Think' (design (concept visualization) influencing concept development) is inhibited when:

H2-2: The product technology factor is more emphasized in the product concept to be developed.

Methods

1. Data Collection

To test the hypotheses, data was gathered using questionnaires mailed to people at management level in marketing or design functions involved in NPD during the period from September until November 2010. Names and addresses were obtained from the information file on the directors and the managers of listed and unlisted leading firms in the Diamond Inc. data-file service. The sampling frame included 460 names. 93 completed questionnaires were received, yielding a 20% response rate. Recipients of the questionnaire were instructed to pass it to those who were highly involved in the concept development and/or design of a major NPD project of the firms if they themselves were not. Respondents were asked to focus on a single project in the last five years. Pre-testing for questionnaire development was conducted prior to the data collection, from July to August 2010. Three sets of questionnaires for development, testing and improvement were iterated with a total 12 designers/marketers, each testing accompanied by a 1.5-2 hour follow-up interview in order to check the clarity of each question, whether each question was taken as intended, and the relevance of each question to actual development reality.

2. Measures

After data collection, each measure was purified by deleting items that were judged to be less relevant for testing the hypotheses based on their correlations to the total. Descriptive statics and reliabilities for each scale are presented in Table 2. A 7-point Likert-type scale was applied to each item. Originally, 'Build to Think' - Design influencing concept development - was defined as 1. the extent to which design influences concept development, and 2. the extent to which the concept is defined before design development. As discussed, it is assumed that 'Design Leadership' would consist of 'Teamwork', 'Customer-orientation' and 'Creativity-orientation'. The exploratory factor analysis that included the items regarding 'Design Leadership' confirmed the three factors representing each measure ('Teamwork', 'Customer-orientation' and 'Creativity-orientation') (Table 3).

'Teamwork' was defined as 1. the extent to which marketers and designers collaborate in concept

development, based on the discussions by Perks et al. (2005), Cagan & Vogel (2002), Jevnaker (2002), and Kotler & Rath (1984), 2. the extent to which designers are involved in concept development related decision making, based on the discussion by Jevnaker (2002). Coefficient alpha for the measure was .80.

'Customer-orientation' was defined as the extent to which the project team referred to data on target customers (secondary data, quantitative data, qualitative data), based on the discussion with Veryzer & Mozota (2005), and Cagan & Vogel (2002). Coefficient alpha for the measure was .84. The definition of 'Creativity-orientation' was based on the discussions by Sternberg et al (1997), Csikszentmihalyi (1996), Altier (1988), and Geschka (1986). They argue that the key characteristic of a creative process is that it involves trialing seemingly irrelevant associations of ideas in order to gain an idea that is eventually evaluated as creative. Based on this explanation, 'Creativity-orientation' as the creative process oriented by designers is defined as: 1. the extent to which the project team trialed seemingly irrelevant things, ideas, etc. in idea generation, 2. the extent to which the project team trialed product ideas in the different categories in the idea generation. Coefficient alpha for the measure was below .60, which means that the internal consistency of the two items was not high enough (Nunnaly, 1978). Therefore, for further analysis, item 1 (the extent to which the project team trialed seemingly irrelevant things, ideas, etc. in the idea generation) was selected as it had a higher loading on 'Creativity-orientation' in the factor analysis. As discussed, in terms of the concept types, two aspects - 'Concept/product appearance proximity' and 'Product technology emphasis in the concept' can determine the 'Build to Think' level. 'Concept/product appearance proximity' was defined as the extent to which the concept to be developed is linked to the product's appearance, based on the discussion by Cagan & Vogel (2002) and Isono (2011). 'Product technology emphasis in the concept' was defined as the extent to which the concept to be developed emphasized the product technology, based on the discussions by Cagan & Vogel (2002) and Isono (2011).

Table 2 Descriptive statistics and reliabilities for the purified measures

Measures	Items	Mean	SD	Alpha
'Build to Think'	1	4.44	1.65	na
'Build After Thought'	1	4.89	1.69	na
Teamwork	2	5.09	1.42	.80
Customer-orientation	3	4.79	1.59	.84
Creativity-orientation	2	4.22	1.72	.54
Concept-appearance proximity	1	5.80	0.90	na
Technology emphasis in concept	1	5.86	0.97	na

Table 3 Factor Structure for 'Design Leadership'

n = 93; principal factor method with varimax rotation

Items	Factor 1 Customer-orientation	Factor 2 Teamwork	Factor 3 Creativity-orientation	Communality
Designer's involvement in decision making on concept development	0.034	**0.818**	0.200	0.710
Marketer-designer collaboration on concept development	0.054	**0.813**	0.101	0.674
Reference to secondary customer data	**0.669**	0.122	0.157	0.487
Qualitative customer research	**0.955**	0.038	-0.012	0.914
Quantitative customer research	**0.790**	-0.040	0.112	0.638
Reference to seemingly irrelevant things, ideas, etc	0.199	0.103	**0.659**	0.484
Reference to design ideas in different categories	-0.001	0.126	**0.554**	0.323
Eigenvalue	2.028	1.374	0.829	
Variance explained (%)	28.967	19.634	11.838	
Total variance explained (%)			60.439	

Analysis

1. Differences in responses to each measure among functional backgrounds (marketers, design managers and designers)

This questionnaire was given to those heavily involved in the concept development and/or design of a major NPD project at the firms. As a result, the functional roles of the respondents turned out to be either marketer (28 (30.1%)), design manager (29 (31.2%)), or designer (36 (38.7%)). To check whether difference in functional role of the respondents had a significant impact on their responses to each item, and to understand what it would look like if this was the case, a one-way ANOVA was conducted. As presented in Table 4, the result indicates that there are no significant differences in the patterns of responses caused by the functional role of the respondents for any of the items/measures except for 'Product performance emphasis in the concept' ($p < 5\%$). On 'Product technology emphasis in the concept', Tukey post-hoc comparisons of the three groups (marketer, design manager, designer) indicate that marketers ($M = 6.18$, 95% CI [5.83, 6.53]) gave significantly higher ratings than the designers ($M = 5.56$, 95%[5.16, 5.95]), $p < .05$. Comparisons between the design managers ($M = 5.93$, 95% [5.68, 6.18]) and the other two groups (marketers and designers) were not statistically significant at $p < .05$. It makes sense that different functional roles create differences in emphasis according to which part of the product concept was being developed. Taking this into account, the following analysis includes these two measures.

Table 4 One-way ANOVA on each measure

Measures	
'Build to Think'	F(2, 90) = 1.489
'Build After Thought'	F(2, 90) = 0.569
Teamwork	F(2, 90) = 1.098
Customer-orientation	F(2, 90) = 1.142
Creativity-orientation	F(2, 90) = 1.252
Concept-appearance proximity	F(2, 90) = 1.693
Technology emphasis in concept	F(2, 90) = 3.520 *

* $p < 0.05$ ** $p < 0.01$

2. The relationships between 'Build to Think' and 'Build After Thought'

A review of the literature suggested that 'Build After Thought' - design (concept visualization) after the concept definition - keeps design from influencing concept development, and that 'Build to Think' - design influencing concept development - requires a concept be undefined before the design process begins. This is because the aim of 'Build After Thought' is to confirm a concept to be visualized as attractive enough to the target customers before investment can be made in the design, while 'Build to Think' focuses on design contributing towards the concept development/improvement before the concept is defined. A cross tabulation on 'Build After Thought' and 'Build to Think' was conducted in order to understand the relationships as shown in Table 5.

This indicates that, while there are cases that apply the 'Build After Thought' model (concept defined before design, 5 – 7 (Strongly agree); 63 cases, 67.7%) and cases that apply the 'Build to Think' model (design influencing the concept development, 5 – 7 (Strongly agree); 54 cases, 58.1%), there are substantial cases which apply both 'Build After Thought' and 'Build to Think' (31 cases, 33.3%). This means that applying 'Build to Think' can be separated from applying 'Build After Thought', although they are certainly closely related.

When are 'Build to Think' and 'Build After Thought' applied at the same time? Insights from the interviews conducted as part of the pre-testing reveal that some of the designers/design managers involved in and influencing the concept development were working on projects where the concept development and design were being run in an integrated way. Others were working for projects where (1) the concept was defined before the full design work yet they were involved in the concept development prior to the full design work, or (2) the concept was defined before the full design work, yet afterwards, the team revisited the concept and revised it based on the learning from the design work.

"We are asked to join the concept development even before design work starts. We prefer to do so for our design idea generation, and also to make sure that the concept we have to visualize is something we can make."

- Designer for consumer-goods company A

"Even before we work on the design, we often take part in the concept development, as the team may refer to our previous design work."

- Designer for consumer-goods company B

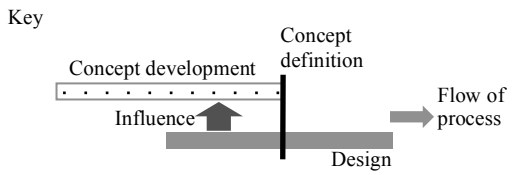
"We do design work based on a defined concept, yet after all the exploration of design ideas, we tend to come back to the concept and revise it so that it fits the design outcome."

- Designer for a cosmetics product company

These kinds of cases are regarded as applying both 'Build After Thought' and 'Build to Think' at the same time. In the following analysis, 'Build to Think' is the primary focus, and the potential factors that affect it will be explored, while 'Build After Thought' is dealt with as one of the main potential effect candidates.

Table 5 Cross-tabulation on 'Build to Think' and 'Build After Thought'

n = 93		'Build After Thought' Design after the concept definition		
		5 - 7(Strongly agree)	1(Strongly disagree) - 4	Total
'Build to Think' Design influencing concept development	1(Strongly disagree) - 4	32	7	39
	5 - 7(Strongly agree)	31	23	54
	Total	63	30	93



3. The effects of factors on 'Build to Think'

With all the above pre-analysis results, a multiple regression analysis was conducted to test the hypotheses. Table 6 presents correlations among variables, and Table 7 presents regression coefficients. An examination of the correlations among interaction terms indicates that multicollinearity was not a major concern. All the correlations fell between 0.011 and 0.276 and VIF fell between 1.092 and 1.184. The adjusted R^2 for the model was .421 ($p < .000$).

'Build After Thought' is negatively related to 'Build to Think' ($\beta = -.381$, $p < .001$).

Main effects of 'Design Leadership' on 'Build to Think' (H1-1, H1-2, H1-3): In H1-1, H1-2 and H1-3,

'Teamwork', 'Customer-orientation' and 'Creativity-orientation' were expected to have a positive effect on 'Build to Think'. 'Teamwork' has a significant coefficient on 'Build to Think' (β = .317, p < .001), so H1-1 is supported. The coefficient for 'Customer-orientation' is not significant, so H1-2 is not supported. 'Creativity-orientation' has a significant coefficient on 'Build to Think' (β = .160, p < .10), so H1-3 is supported.

Main effects of 'Types of concept' on 'Build to Think' (H2-1, H2-2): In H2-1, 'Concept-product appearance proximity' was expected to have a positive effect on 'Build to Think'. It had a significant coefficient on 'Build to Think' (β = .251, p < .01) so H2-1 is supported. In H2-2, 'Product technology emphasis in concept' was expected to have a negative effect on 'Build to Think'. It had a significant negative coefficient on 'Build to Think' (β = -.190, p < .05) so H2-2 is supported.

Table 6 Correlations among measures

	'Build to Think'	'Build After Thought'	Teamwork	Customer-orientation	Creativity-orientation	Concept-appearance proximity
'Build After Thought'	-0.431**	1				
Teamwork	0.531**	-0.255*	1			
Customer-orientation	0.015	0.181	0.089	1		
Creativity-orientation	.245*	0.042	0.208*	0.247*	1	
Concept-appearance proximity	0.221*	0.085	0.137	0.032	0.07	1
Technology emphasis in the concept	-0.157	0.011	-0.081	0.094	-0.06	0.276**

* p < 0.05 ** p < 0.01

Table 7 Main effects of measures on 'Build to Think'

Dependent variable: 'Build to Think'
n = 93

		Main effect	Standard coefficient		VIF
		'Build After Thought' (−)	- 0.381	*** (a)	1.145
Design Leadership	H1-1	Teamwork including designers	0.317	***	1.184
	H1-2	Designers' customer-orientation			1.128
	H1-3	Designers' creativity-orientation	0.160	+	1.118
Types of concept	H2-1	Concept-appearance proximity	0.251	**	1.139
	H2-2	Technology emphasis in the concept (−)	- 0.190	*	1.124
R^2			0.446		
Adjusted R^2			0.408		
F			11.562	***	

+ p < 0.1 * p < 0.05 ** p < 0.01 *** p < 0.001
(a) Two-tailed test of significance

Discussion

1. The ‘Build to Think’ model and the ‘Build After Thought’ model

The results of the survey show that, as far as the relationship between concept development and design (concept visualization) is concerned, a substantial percentage of NPD projects already apply the concept development model of ‘Build to Think’ (design influencing concept development) advocated by Kelley (2001) or Cagan & Vogel (2002) etc.. There are also many NPD projects applying ‘Build After Thought’ (design after concept definition, where design is separated from, and therefore has no influence on, concept development) advocated by Crawford (1991), Urban & Hauser (1993) or Copper (1986). In addition, there are cases which apparently conform to ‘Build After Thought’ yet apply ‘Build to Think’ as well. In these cases, it can be considered that, although a concept is defined before the full design work starts, 1) even before the concept definition, designers are involved in and influence the concept development, 2) even after the concept definition, designers influence the defined concept by virtue of their design work, as confirmed through the pre-testing.

2. Factors that facilitate ‘Build to Think’ orientation

It was found that ‘Build to Think’ is facilitated when (1) teamwork including designers plays a more active role in concept development, (i.e. designers and marketers collaborate and are involved in decision making surrounding concept development), (2) designers are more creativity-oriented in the idea generation, such as by trialing seemingly irrelevant things, ideas etc., (3) the concept to be developed is more closely linked to the product appearance, and/or the concept places less emphasis on the product technology, and (4) the concept is less firmly defined before the design work starts, as opposed to a ‘Build After Thought’ orientation. This means that in order to apply the ‘Build to Think’ model, an organization needs to achieve these conditions by investing in resources for (1) and (2). The type of concept being developed can also affect whether an organization decides to apply the ‘Build to Think’ model. The concept development process should allow design to be involved before a final concept is defined.

The factors on ‘Build to Think’ this study has identified contribute to what Veryzer & Mozota (2005), Perks et al. (2005), Cagan & Vogel (2002), Kelley (2001), Jevnaker (2000) argued. In particular, the ‘Teamwork including designers’ as a factor in ‘Build to Think’ is consistent with what Cagan & Vogel (2002) argued from their experience. The ‘Creativity-orientation’ of designers, or designers’ trialing of idea associations in the design/concept development, as a factor in ‘Build to Think’ is consistent with the insights gained from Isono (2011), and supports the argument by Kelley (2001).

On the other hand, the ‘Customer-orientation’ of designers was confirmed as a factor comprising

'Design-Leadership' in this study, which supports the argument by Veryzer & Mozota (2005), Craig & Vogel (2002). The relationship between 'Customer-orientation' and 'Build to Think', however, did not appear. This can be interpreted as follows: while marketers, who lead the concept development, are the ones who advocate customer-orientation in the organization, the reason why designers go ahead and are involved in the concept development is not because of their 'Customer-orientation', but their 'Creativity-orientation'. What designers can contribute to the concept development is not their customer-orientation, but their creativity-orientation (or creative skill especially, for concept visualization), as it is the unique orientation (or skill) designers have.

Conclusion and Implications

First, from previous literature, this study points out that there are two types of view regarding how concept development in NPD should be related to design: 'Build to Think' (design influencing concept development), and 'Build After Thought' (design after concept definition). This study then demonstrates through the survey that these two types of concept development models exist in practice. Second, on the research question of what leads an organization to adopt the 'Build to Think' model, this study shows that the factors surrounding 'Build to Think' are as follows: 'Build After Thought' (design after the concept definition) (negative impact), 'Teamwork including designers' and 'Creativity-orientation' in 'Design Leadership', 'Concept-product appearance proximity', and 'Product performance emphasis in concept' (negative impact). This means that whether an organization can effectively implement 'Build to Think', which some NPD studies addressing design problems have claimed as a major influence on NPD success, depends on the above factors. Without them, an organization would find it difficult to implement 'Build to Think'.

The managerial implication drawn from the study is twofold. First, it is suggested that in order for a project organization to apply the 'Build to Think' model, which the literature on design in NPD have pointed out as effective for NPD performance improvement, its NPD processes should involve the above factors. When an organization intends to gain a certain development effect, it needs to make an investment in certain types of resources. In previous literature, it was not clear what resources are needed for applying the 'Build to Think' model to gain an development effect from it, as opposed to adopting the 'Build After Thought' model. Second, 'Build to Think' is inhibited when an organization is more 'Build After Thought' oriented, i.e. it defines a concept before any design work. Therefore, an organization needs to decide which models to adopt for their project development by taking the resources they have and/or their types of concept into account. In this study, it was observed that a substantial number of cases applied 'Build After Thought' and 'Build to Think' at the

same time, but based on the findings from this study, they would do well to reexamine the types of resources regarding concept/design development they have, the types of the product they deal with, and decide whether they fit either the 'Build to Think' or the 'Build After Thought' model. They should choose either one of them unless they have a clear rationale for applying both.

For future research subjects, there is a need for clarification on how NPD performance is affected when the 'Build to Think' model is applied and when it is not. It may also be worthwhile, in relation to the use of the 'Build to Think' model, performing a similar examination when the 'Build After Thought' model is and is not applied. In previous literature, the effect on NPD performance when applying the 'Build After Thought' model was empirically shown by Cooper & Kleinschmidt (1987), etc., while the effect on NPD performance when applying the 'Build to Think' model was shown by Cagan & Vogel (2002). It is recommended, however, that a comprehensive study be provided to explain how these two models differ in terms of their effects.

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