INTERNATIONAL CONFERENCE ON ENGINEERING AND PRODUCT DESIGN EDUCATION
8 & 9 SEPTEMBER 2011, CITY UNIVERSITY LONDON, UK

CHALLENGING INNOVATIVE THINKING AMONG DESIGN STUDENTS THROUGH "CULTURAL" GOAL FINDING IN THE FUZZY-FRONT-END

André LIEM
Norwegian University of Science and Technology, Department of Product Design

ABSTRACT
Within the context of integrated product development, the level of innovative success in formulating an effective product strategy and a design goal is highly dependent on how thorough "Product Planning and Goal Finding" processes were carried out. The conventional approach of conducting external analysis focuses mainly on market, competitor's and stakeholder's analyses and has seldom led to radical innovation / diversification. To achieve diversification, which is the highest level of innovation leading to breakthrough products, requires a more comprehensive and exploratory strategic design approach.
This paper discusses the outcomes and challenges ahead for *1st year MSc. design students* who collaborated in pairs to comprehend an "External Analysis Assignment" (EAA) driven by social, political and economic perspectives and supported by a cultural understanding of societies and regions. Results have shown that students were not so sensitive yet in identifying social, economical and political trends, which has caused or can potentially cause frustrations and tensions within certain environments, but create opportunities for design improvement. Besides this, students do not have the experience in identifying suitable cultural models and accompanying dimensions with respect to their assignment topic. This provides valid grounds for an update in teaching "Product Planning and Goal finding", whereby students are to be made aware of the importance of understanding social, economic and political complexities to arrive at radical innovations in the Fuzzy-Front-End search and goal finding processes.

Keywords: External analysis, cultural dimensions, goal finding, fuzzy-front-end of innovation

1 PARADIGMS AND PERSPECTIVES ON INNOVATION

The changing global environment is compelling organizations and businesses to permanently seek the most efficient models to maximize their innovation management efforts through new methods and paradigms, which efficiently serve existing and new markets with new and/or modified products as well as services [1, 2]. Within the context of integrated product development, the level of innovative success in formulating an effective product strategy and a design goal is highly dependent on how thorough "Product Planning and Goal Finding" processes were carried out in the front-end of Innovation (FEI) [3]. The term '(fuzzy) front end' describes the earliest stage of an idea's development and is one of the greatest areas of weakness of the innovation process, but effective management of the front end may result in a sustainable competitive advantage [4].
Many authors have written about the different perspectives that firms have on innovation to determine their level of "radicalness". Utterback and Abernathy claim that the relative focus of innovation changes as the firm matures, underscoring its fluid nature with respect the firm and the environment in which it operates [5]. Crawford discussed three levels of innovation, pioneering adaptation and imitation [6]. Likewise, it is suggested that the degree of technological change represented by a product is the most useful way to classify development projects [7]. Lee and Na distinguished between "incrementally improving innovativeness" and "radical innovativeness, while explicitly excluding commercial performance as a basis for classifying innovations [8] Christensen distinguishes between two fundamental types of innovation, *sustaining* innovation, which continues to improve existing product functionality for existing customers and markets, and *disruptive* innovation, which provides a different set of functions which are likely to appeal to a very different segment of the market [9].

Existing firms and their customers are likely to undervalue or ignore disruptive innovations, as these are likely to appear inferior to existing technologies in terms of measures of benefit and performance [10].
As the (Fuzzy) Front-End (FFE) of innovation stages are consisting of unknown and uncontrollable factors, its focus is mainly one of opportunity identification and analysis [11]. Hereby, both internal and external sources are important for idea development and goal finding, but, the designer's approach towards the execution of the external analysis determines the level of innovation targeted [12]. In practice, external analysis focuses mainly on market, competitor's and stakeholder's analysis, which has led to incremental innovation, where new products were created for existing markets or new markets for existing products confining itself to the current product or service portfolio of the respective company [13].
In order to achieve diversification, synonymous to radical innovation, a broader approach is needed to obtain a maximum number of innovative product and process ideas. The cornerstones for embarking on a broader approach towards goal finding lies within a more comprehensive external analysis, which embraces social, political and economic perspectives supported by a cultural understanding of societies and regions.

2 A CULTURAL PERSPECTIVE ON GLOBALISATION AND INNOVATION

Within the context of globalisation, solving complex design problems within an environment where technologies become more advanced and complex, as well as user needs more diverse, is becoming more and more relevant in aiming for competitive advantage. Besides encouraging companies to rely more upon supply chain relationships to deliver high quality and value for money products [14], a broader approach towards value creation should be adopted, which incorporates a cultural perspective in the development of innovative products, services and systems.
When considering cultural driven innovation, strategists and designers should acknowledge that numerous societies believed that their habits, ideas and customs were what determined the shape of their political and economic arrangements, and were the source of their uniqueness. From a business perspective, growth in emerging markets with a high level of heterogeneity is even stronger because of the cultural differences in these markets, which can be exploited [15]. Complementary to this, several studies suggested that adopting a global focus when developing new products might result in higher market share and financial performance in comparison with having a domestic focus [16]. Users' culture and the relationship between global and local trends are among the characteristics that can influence the New Product Development (NPD) process as companies adopt a global focus [17].

3 CULTURE AND ITS CULTURAL DIMENSIONS

Culture has been defined in a number of different ways because of its multi-dimensional characteristics. For example, Kroeber and Parsons arrived at a cross-disciplinary definition of culture as "transmitted and created content and patterns of value, ideas, and other symbolic-meaningful systems as factors in the shaping of human behaviour and the artefacts produced through behaviour." [18]. For Hofstede, culture is "the collective programming of the mind that distinguishes the members of one group or category of people from another." The cultural characteristics thus comprise a constellation of psychological traits, attributes, and characteristics [19]. Identifying cultural characteristics is difficult because it lacks a robust measure that can identify the implicit levels of culture [20]. In an effort to address this issue, researchers have dissected culture as a set of 'dimensions' that provide a framework for cross-cultural comparisons of user behaviour [21]. Important work in defining cultural dimensions has been undertaken by Parsons and Shils [21], Hall [22], Hofstede [23] and Trompenaars [24]. Hofstede [23] conducted a survey of IBM employees in 40 different countries and proposed a model, describing national cultures that entailed four dimensions: *uncertainty avoidance*, *individualism* vs. *collectivism*, *masculinity* vs. *femininity*, and *power distance*. Hofstede and Bond [25] subsequently added the fifth dimension to their model, *long-term* vs. *short-term orientation*.
The author has conscientiously selected Hofstede´s five dimensions [19] to link cultural parameters to cultural behaviour. The main reason is that these dimensions are most suited for identifying, understanding and analysing cultural differences among nations and regions. More specifically, the feeding ground for radical innovation is the understanding of the status quo of a nation's cultural, political, economic and social atmosphere, followed by the acknowledgement that drastic

improvements in quality of life, service quality or minimizing inequalities within societies, are almost impossible to be achieved through political governance overnight. Hereby, one should also take note that the potential for radical innovation is neither biggest in leading nor developing countries.
A designing approach, whereby service-oriented, strategic design concepts are proposed to solve cultural extremes at the bi-polar scale of Hofstede´s dimensions is worth exploring [19]. Proper concept development within specific cultural contexts can positively influence life and service quality and solve inequalities in both upcoming and advanced economies.

4 EXTERNAL ANALYSIS ASSIGNMENT

According to Hofstede's five cultural dimensions, extreme trends and developments in nations´ political, economical and social situation were taken as a source of reference for the External Analysis Assignment.
Twenty-two *1st year MSc. design students* were asked to work in pairs on a social-economic topic of their choice. To accentuate the cultural aspect of the assignment, each pair comprised of a Norwegian and foreign exchange student. The assignment was to develop a short essay to illustrate the connectivity between "Context" (which describes the choice of topic), "Cultural Explanation" and "Cultural Dimensions" on one hand, and how this connectivity leads to the formulation of a design problem and concept on the other hand.
The "Cultural Explanation" is intended to share more in-depth knowledge on how these cultural differences affects society and human interaction from an economic and political perspective.
Prior to the commencement of the assignment, students were briefed on the different cultural models, embodying their own set of characteristic cultural dimensions.
The main motivation for initiating these assignments was based on the following two (2) hypotheses:

- Social, political and economical developments in a society are difficult to change overnight
- Extreme trends and developments in nations´ political, economical and social situation are a source for innovative thinking and radical concept development.

Design problems were formulated and design concepts generated as a response to the above hypotheses. An example of an EAA is shown below.

Public Transportation: Netherlands versus USA:

Context

The Netherlands is small and densely populated, where public transportation is highly developed and available. Although culture, levels of area and population density, infra structure and purchase accessibility factors are not homogeneous across the US, cars are still considered the main mode of transportation Comparatively, car usage is almost double in the US, while public transport is twice as much used in the Netherlands.

Cultural Explanation

Both the Netherlands and the USA are described as individualistic cultures. This individualism, however, is expressed very differently when it comes to transportation. In the US people are often driving their own car, while in the Netherlands, more people use bicycles and trains to overcome distances. In comparison to the US, The Netherlands focuses more on using taxes as a political means to reduce the amount of traffic on roads and C02-emissions from cars. In addition, fewer economic sanctions and relatively low car prices encourage the purchase and use of cars in the USA.

(Dominant) Cultural Dimensions

Regarding "Public Transportation" cultural differences pertaining ""individualism" and "power distance" between the Netherlands and the USA is shown in figure 1. The figure is also complementary illustrated by adding India's and Norway's positions. A car is more regarded as a social symbol of power and status within the context of the latter.

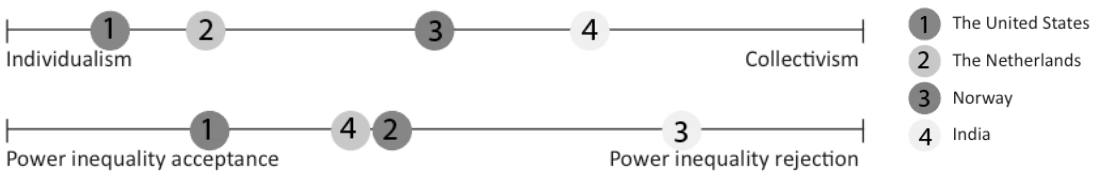

Figure 1. Mapping nations of cultural dimension on spectra

Design Problem

How to reduce the level of C02-emissions caused by private cars in the USA by substituting the benefits and privileges experienced by car owners with other enticing products and services, which can provide the same level of user experience.

Product-Service / Design Concept

The proposed Product-Service concept is "the Coffee Bus." The purpose of "The Coffee Bus" is not only to provide transportation, but also to act as an interaction hub where commuters can buy their favourite cup of coffee on their way to work. Buying the coffee on the bus would also mean that the time spent on making or waiting in line for a coffee is merged with the time spent on commuting to work.

5 SUMMARY AND ANALYSIS OF EXTERNAL ANALYSIS ASSIGNMENTS

11 External Analysis Assignments (EAA's) were summarised and analysed. On the basis of "Context", all case studies illustrate clear contradictions based on cultural differences. However, the selection of topics and context building activities differ significantly among the 11 pairs. In 6 of the 11 assignments, the context description and cultural explanation was too general and not topic specific.

Students were able to identify the cultural issues, which are prevalent in their assignments, but have difficulties in connecting these issues to selected cultural models and their accompanying dimensions, which are relevant to their investigation. All student pairs adopted Hofstede's cultural model, which may not always be suited for their choice of topic. Besides this, forced attempts were made by most of the student pairs to analyse and assess the topics on all Hofstede's cultural dimensions. This analysis has distorted the actual cultural assessment and revealed the mismatch between some of the assignments and the choice of cultural model with its specific set of cultural dimensions.

The topics of investigation and design problem formulation can be categorised into 3 areas: "Transportation", "Lifestyle" and "Social Development". In comparison with earlier case studies conducted by graduate research assistants [26], these assignments mainly addresses issues related to food preparation and consumption, as well as different modes of transportation. More urgent and crucial themes, such as "Healthcare", "Elderly Care", "Working and Living" and "Manpower Development" were hardly addressed in the selection of topics *(see table 1)*. This observation provides an initial indication that students are not so sensitive yet in identifying social, economical and political trends, which has caused or can potentially cause frustrations and tensions within certain environments, but create opportunities for design improvement.

All "Design Problems" described a need for improvement from one nation's referenced to the opposing nation's contextual perspective on the selected topics. Although the accompanying "Design Concepts" were culturally initiated from a natural progression of the design problem, not all could be classified as radical. Reasons for a lack of "radical innovativeness" were because of:

- A mismatch among context, cultural explanation and selection of relevant cultural models and dimensions.
- A lack of experience in identifying crucial social, economical and political trends

On a more positive note, a bottom-up analysis of the case studies and EAA's has resulted in six (6) preliminary categories, which can function as a guide for a broader approach for future external analysis and goal finding activities. Table 1 classifies the 14 case studies and 11 assignments according to the 6 categories.

Table 1. Classification and comparison of case studies according to categories

Categories	Case studies conducted by graduate research assistants	Assignments conducted by 1st year Industrial Design M.Sc. students
• Healthcare and elderly care	1. *Health Care, Denmark versus USA* 2. *Physical Activity, Norway versus USA* 3. *Elderly Care, Norway versus India* 4. *Health Care System: Norway – India*	1. *Sitting Style: United Kingdom vs. Japan (Lifestyle)*
•	1. *Construction Industry, Singapore*	

	versus Norway 2. *Waste Collection: Norway versus Singapore*	
• Education and manpower development	1. *Education - India versus Norway*	1. *Game to facilitate collaboration and cohesive learning in an educational context (Social)*
• Purchase / preparation of food, products and services	1. *Home Decoration and Interior Design* 2. *Food retail Shopping Experience, India versus Norway* 3. *Postal Services in rural regions*	1. *Food preparation and consumption: Norway versus France (Lifestyle)* 2. *Accessibility of cheap, quick and healthy food in China vs. Norway (Lifestyle)* 3. *(Hydro-) Energy generation: Norway versus Scotland*
• Mobility /Transportation of goods and people	1. *Mobility of women, Jeddah versus London* 2. *Public Transportation, India versus Norway*	1 *Public Transportation: The Netherlands vs. the USA (Transportation)* 2 *Taxi: Norway versus Uganda (Transportation)* 3. *Bicycle Sharing: Norway vs. Australia (Transportation)* 4. *Car usage: Norway versus The Netherlands (Transportation)*
• Interaction and Communication	1. *Making Contact, France versus Norway* 2. *Having Lunch – France versus USA*	1 *Interaction through sharing within society: Germany versus Norway (Social)* 2 *A business guide to bridge cultural differences in negotiations: USA versus China (Social)*

Referenced to Maslow's hierarchy of needs [27], the six categories can be classified under the first three level of needs of the pyramid; *Physiological, Safety, Love / Belonging*. This indicates that a cultural approach towards External Analysis and Goal Finding in the Fuzzy-Front-End of innovation can be instrumental in the generation of innovative system and concepts to improve quality of life and service in developing as well as developed nation.

6 IMPLICATIONS FOR TEACHING AND DISCUSSION

The diversity of topics as investigated in the EAA´s, each leading to a proposed design concept, has demonstrated that a cultural and contextual approach towards strategic design should be further explored in the development of Product Service Systems (PPS) in the Front-End of Innovation (FEI).
Extreme trends and developments in nations´ political, economical and social situation are a source for innovation. As social, political and economical developments in certain societies are difficult to change overnight; the intention of the EAA´s was to illustrate the potential role of design in improving the negative aspects of these developments, usually represented by extreme cultural trends, through innovative design concepts. On an implementation level, potential areas for innovation can be identified by mapping events and developments on a bi-polar scale, supported by a carefully selected cultural model and its cultural dimensions, illustrating extreme trends and developments
However, not all student pairs were critical in identifying topics as well as suitable accompanying cultural models, where design can leverage a strong impact from a social, economic or political perspective. Students tend to select topics, which are not implicated by social, economic and political trends. This calls for an update in teaching "Product Planning and Goal finding", whereby students are to be made aware of the importance of understanding social, economic and political complexities to arrive at radical innovations in the Fuzzy-Front-End search and goal finding processes.
Once these fundamental knowledge and attitudes are properly conveyed through design thinking, a bottom-up approach for developing a methodology for strategic goal finding based on social, cultural and political differences on a bi-polar scale can be aimed for. This bottom-up approach entails that from time to time future cultural case studies are to be developed to refine, update and validate the present six categories (see table 1). However future case study development needs to be more diverse from a nation-to-nation perspective to be able to ascertain that a categorical top-down approach can be applied as a source for external analysis in the generation of innovative system / product ideas, while considering prevalent economic, social and political status quo of their cultural contexts.

At this moment, it is early to determine whether design concepts are more innovative by addressing the potential gap of extremities on the cultural bi-polar scale as source for innovation.

REFERENCES

[1] Christiansen, J.A. *Building the Innovative Organization.* MacMillan Press, London (2000).
[2] Ansoff, H.I. *Corporate Strategy*, McGraw-Hill, New York. (1965)
[3] Buijs, J.A. and Valkenburg, R. *Integrale Produktontwikkeling*. LEMMA BV. Utrecht. (1996).
[4] Koen, P. A., Ajamian, G., Burkart, R., Clamen, A., Davidson, J., D'Amoe, R., Elkins, C., Herald, K., Incorvia, M., Johnson, A., Karol, R., Seibert, R., Slavejkov, A,. and Wagner, K. "New Concept Development Model: Providing Clarity and a Common Language to the 'Fuzzy Front End' of Innovation." *Research Technology Management 44*, 2, pp. 46–55. (2001)
[5] Utterback, J.M. and Abernathy, W.J. A dynamic model of process and product innovation. *Omega* 3: pp.639-656. (1975)
[6] Crawford, C.M. *New Product Management*, 4th Edition. Boston. Richard D. Irwin, Inc. (1994)
[7] Wheelwright, S.C. and Clark, K.B. *Revolutioning Product Development*. New York: The Free Press, (1992)
[8] Lee, M. and Na, D. Determinants of technical success in product development when innovative radicalness is considered. *Journal of Product Innovation Management*, 11: pp 62-68 (1994)
[9] Christensen, C. *Innovators Dilemma*. Boston, MA: Harvard Business School Press (1997)
[10] Tidd, J. Innovation management in context: environment, organization and performance. *Int. Journal of Management Reviews*. Vol. 3 Issue 3 pp. 169–183. Blackwell Publishers Ltd (2001)
[11] Belliveau, P., A. Griffin, A. and Somermeyer, S.M. *The PDMA Toolbook for New Product Development*, Wiley, Hoboken (2004)
[12] Hippel, E. von. *The Sources of Innovation*, Oxford Univ. Press, New York. (1988)
[13] Ansoff, H.I. *Corporate Strategy: An Analytic Approach to Business Policy for Growth and Expansion*. Harmondsworth: Penguin (1968).
[14] Bruce, M. and Moger, S. Dangerous Liaisons: An Application of Supply Chain Modeling for Studying Innovation within The UK Clothing Industry. *Technology Analysis and Strategic Management*, Vol. 11, No 1 (1997).
[15] Burton, D. *Cross-Cultural Marketing: Theory, Practice and Relevance*. New York: Routledge. (2009)
[16] Wills, J., Samli, A. C., and Jacobs, L., Developing global products and marketing strategies: A construct and a research agenda. *J. of the Academy of Marketing Science*, *19*, pp. 1-10. (2007)
[17] Perks, H., and Wong, V. Guest editorial: research in international new product development: current understanding and future imperatives. *International Marketing Review*, *20*(4), pp. 333-337 (2003).
[18] Kroeber, A.L. and Parsons, T. The Concept of Culture and of Social System. *American Sociological Review*, 23, 5, (14, p. 583). (1958)
[19] Hofstede, G.; Hofstede, G.J. *Cultures and organizations: software of the mind* (Revised and expanded 2nd ed.) New York: McGraw-Hill. (2005)
[20] Straub, D.W., Loch, W., Aristo, R., Karahanna, E., and Strite, M. Toward a Theory-Based Measurement of Culture. *Journal of Global Information Management*, 10, 1, pp.13-23. (2002).
[21] Parsons, T. and Shils, E.A. *Toward a General Theory of Action*. Harvard University Press, Cambridge, MA. (1951)
[22] Hall, E.T. *Beyond Culture*. Anchor Doubleday Press,Garden City, NY, (1976).
[23] Hofstede, G. Culture's Consequences: Comparing Values,Behaviors, Institutions and Organizations across Nations. Sage Publications, Thousand Oaks, CA, (2001).
[24] Trompenaars, F. *Riding the Waves of Culture:Understanding Diversity in Global Business.* EconomistBooks, London, UK, (1993).
[25] Hofstede, G. and Bond, M.H.. The Confucius Connection: from Cultural Roots to Economic Growth. *OrganizationalDynamics*, 16, 4, 5-24. (1988).
[26] Liem, A, Lind, A L., Gadaria, D, (2010) Towards a Culturally Driven Approach for the Development of Strategic Design Concepts. I: Proceedings of Norddesign 2010; International Conference on Methods and Tools for Product and Production Development, Gothenburg, Sweden. The Design Society. pp. 97-108 (2010)
[27] Maslow, A.H. *A Theory of Human Motivation*, Psychological Review 50(4) 370-96. (1943)