CONNECTED 2007 INTERNATIONAL CONFERENCE ON DESIGN EDUCATION
9 – 12 JULY 2007, UNIVERSITY OF NEW SOUTH WALES, SYDNEY, AUSTRALIA

Strategies for Creative Connections: Fomenting Technological Change

Vasilije Kokotovich

University of Technology Sydney, Sydney, New South Wales, 2007, Australia

ABSTRACT

The pace of technological change in the world within which we live and work is increasing at an exponential rate. This in turn causes turbulent change within society, and indeed within social relationships. In a real sense it is the design teams who act as change agents. In the future these teams will need to alter their strategies for introducing even more change. As the artefacts' designers and design teams develop, which fulfil societal wants needs and desires, become more technologically advanced and complex, there is an increasing need to make creative connections between diverse design issues and diverse resources. From both a technical and human perspective these creative connections will require new creative strategies. This paper will propose some strategies for developing novel non-deterministic relationships between issues and people in order to develop creative connections. These in turn may lead to creative artefacts for the benefit of society. Further, this paper will propose possible empirical methodologies for testing these suggested strategies. The utility of randomness and our ability/inability to cope with it is seen as a central theme for developing creative connections. Moreover, it will be argued that as higher and higher levels of complexity occur greater creative opportunities will occur as well. While the proposed strategies remain untested, the central focus of this paper will discuss the need for this research and the implications for both design practice and, more importantly, design education.

INTRODUCTION

The world in which we live is becoming increasingly complex. It can be argued that while recent technological advances, such as mobile communication devices, personal digital assistants, home computers, the internet, and electronic banking offer great benefits, they also demand an increased and often sophisticated level of understanding of technologies. Most notably this holds true for the designers of those products and services. The industrial designers and design engineers who develop these sophisticated products are often very creative, intelligent, highly trained specialist designers. As they are specialists, with very specific core competencies, these designers are often brought together into teams. Moreover, corporations who bring together these leading-edge product development teams understand that they have the capacity to act as agents of technological change when they develop innovative technologies, products, and services which benefit society. Additionally, the general view is that groups of top designers are best able to act as the developers of the products, as they are conceived of as being expert problems solvers.

The design literature which concerns itself with design methodology and design processes holds the view that more often than not design is a problems solving activity [see Lawson (2000); Savransky (2000); Otto and Wood (2001)]. Additionally, as noted in his recent study relating to an investigation of the challenge of thinking together in global design teams, Larsson (2003) argued a key need of globalised industries is to have more effective globally-distributed teams. However, his focus related specifically to design teams working together. He contends these teams use a shared vocabulary or common language, and a common reference frame of thinking, in reference to problem solving in product design. Further, he argued that designers and design teams must negotiate and share common perspectives, agree on most significant issues, and shape a consensus in concept formation. He does, however, hold that design collaboration is framed by a social world. His observational study in relation to an international collaborative design exercise of virtually-designed pedals for the Volvo Car Corporation confirmed previous findings. These findings highlight the importance of viewing design as a social activity rather than as merely a systematic process. Additionally, his findings imply the need to rethink ways to support global design teams. In essence there exists a strong need to alter the strategies we use in order to foment innovation in increasingly distributed globalised design teams generally made up of professional designers and design groups.

II. GROUPS OF PROBLEMS SOLVERS

As suggested earlier, the world in which we live is becoming increasingly complex technically. Therefore, it can be argued that there is an ever-increasing need to put together specialist design teams who have a sharp, and consequently limited, focus on very specific aspects of technology. Superficially, it makes sense to draw together design teams who share common languages common back grounds and some common thought processes. A strong case can be made that shared previous patterns of experiences would allow global design teams to more quickly develop working synergies. This in turn would hasten the development of innovative designs. This shared pattern of experience may be a two-edged sword for design teams. On the one hand, while groups of designers share a great deal with respect to detailed design issues often focusing on localised design problems developing local optima solutions within their respective thinking frameworks. This may occur at the expense of the emergence of overall optimum solutions.

It can be argued that design teams using a shared vocabulary or common language, and a common reference frame of thinking, develop what is termed "Group Think". When problem solving in product design, this may lead to problematic issues within the team which are often associated with "Group Think" in organisations. The term "Group Think" as defined by Janis (1982:9) is conceived of as being 'a mode of thinking that peoples engage in when they are deeply involved in a cohesive in-group, when members' striving for unanimity override their motivation to realistically appraise the alternative courses of action'. As the antecedent to 'Group Think' is 'cohesiveness' this may generate possible problematic symptoms of 'Group Think'. A few of these are :

1.) The illusion of invulnerability
2.) Collective efforts to rationalise
3.) Unquestioned belief in the group's inherent morality
4.) Stereotyped views
5.) Direct pressure on members who argue against the group's stereotypes
6.) Self-censorship of deviations from group consensus
7.) Shared illusion of unanimity
8.) Emergence of self appointed mind guards

It is possible to argue these substantive issues may, at various times during the design process, be present in homogeneous groups made up solely of design specialist team members. In contrast, 'Group Think' problems may be less of an issue if design teams were made up of non-homogeneous groups from various personnel within a corporate environment. That is to say if members of the design team included not only design specialists, but also random selections of other intelligent yet design-naive staff that normally perform other functions for the corporation, divergent solutions to design problems may occur. Recent research goes some way to support this view.

In their recent research relating to developing a framework for modelling functionally diverse problem solving agents, Hong and Page (2001 & 2004) argued that groups of diverse problem solvers can outperform groups of high-ability problem solvers. They built and articulated their case using mathematical modelling. Their work has implications for global corporate cultures and our understanding/make up of design teams. At first glance, their research appears discordant with current practices of grouping team members typically found in current corporate cultures. These corporate cultures often hold the view design teams should consist of homogenous members who share common languages, common back grounds, and some common thought processes.

Essentially the work of Hong and Page (2001 & 2004) investigated the balance of diversity vs. optimality with respect to intelligent agents acting as members of problem solving teams. More often than not design team members are made up of specialist designers operating at a technically advanced level. Therefore, they may be considered to be a diverse group of intelligent agents operating on a problem or set of problems. However, design teams consisting solely of designers, in general, have very similar perspectives and heuristics. As suggested earlier design teams made solely of specialist designers may be considered best problem solvers. Conversely, an eclectic team comprising designers plus randomly selected non-designers may be considered a group of randomly chosen problem solvers. While they did not specifically investigate designers and non-designers, at the core of their research Hong and Page (2001 & 2004) sought to compare teams of the best problem solvers with teams of randomly chosen problems solvers.

The findings of Hong and Page (2001 & 2004) revealed that on average teams of randomly selected problem solvers out perform teams of the best problem solvers. They argue that this is due to the fact the best problem solvers often have very similar approaches or strategies. Further, they argue the best problem solvers 'get stuck' at the same local optima which may prevent them from finding the overall optimum solutions. Conversely, the random groups of problem solvers contain a mix of perspectives and heuristics. It is argued they tend to compare a wider set of local optima, and have a high probability of finding an overall optimum solution. Further, they are of the view that the benefit of adding a new problem solver to the team does not always decline the number of problem solvers. Alternatively, the number of team members depends on the composition of the team and the concomitant perspective and heuristics brought to the team by the new problem solver. They find this to be in sharp relief to the usual notion of returns-to-scale in economics. In brief, the central focus of their analysis was on the tension between the individual abilities in a group and their functional diversity. They contend that diversity trumps ability. This suggests that randomly grouping designers and non-designers together to form design teams offers a great opportunity for *creative connections among corporate human resources in order to foment technological change and innovation.*

III. Randomness

It was suggested above that an eclectic mix of randomly selected and diverse group of people, working on a design problem, should out perform a completely homogenous group of 'best' designers. For all that, while the group may be randomly selected, there is a probability the random group may develop a more optimum solution. Other useful aspects of randomness may have utility in the design process. For example, as discussed by Pritchett (1993), within the creative area music John Cage, an influential composer, generated some musical compositions by using chance via dice and Chinese I-Ching. Further, in the creative area of prose as discussed in Drew and Haahr (2002), Samuel Beckett wrote a piece of prose using random permutations of sentence order. However, it is essentially the observer of these artistic works who creates meaning. The recent work of Leong et.al (2006) investigated the use of randomness with respect to interface design and music-listening experiences [i.e. random selections of music in technologies such as I-pods]. The focus of the investigation by Leong et.al (2006) was squarely on the user and the user experience. Their focus was not on the use of randomness to generate product ideas.

In contrast with the above the work of Kokotovich (2004) discussed aspects of a three-phase process in recommends that during the exploration phase of the design process randomness has utility for product designers. In essence this work suggests that using randomness as part of the design process provides the designers with altered perspectives and heuristics in developing a wide search space for creative solutions. This paper discussed design strategies introduced to a group of 1st year industrial design students. The students were introduced to a three-phase design process which sought to mimic the design process/framework of expert designers. The students were introduced to non-hierarchical mind mapping as a way of developing and structuring the salient issues in a design problem area. Subsequently, they were introduced to what the author termed intuitive leapfrogging. Next they were guided in the use of linkography and Matrix techniques for the convergence/validation phase of the design process. This notwithstanding, it is the notion of using randomness and the strategy of intuitive leapfrogging during the exploration phase that is of importance in this discussion.

Prior to the explanation of leapfrogging it is appropriate that the exploration phase be contextualised. The creative mental synthesis experiments of Kokotovich (2002) found that greater numbers of creative responses were generated when the subjects were forced to develop ideas mentally and forestall the embodiment of ideas and drawing. Additionally, Mathias (1993) found that novice designers tended to rush towards embodiments with undue haste and they tend to 'justify' their designs. This suggests they limit their creative search space.

In order to explore a large number of divergent ideas the students discussed in Kokotovich (2004) would need a strategy that forced them to explore ideas that are **'unexpected' or "Random"**. In explaining the methodology of intuitive leapfrogging to the students they were first exposed to an exercise in class. For example, the first five students sitting in the first row in the lecture theatre were asked, what was the first object/product that came to mind? These were sequentially noted on the board in front of the room. For example, the first student could have said Motorcycle helmet, the second student surfboard, the third student mobile phone, the fourth wine cooler and fifth student Television set. Next the topics were leapfrogged in that every other topic was connected. The student who thought of the motorcycle helmet was to develop a concept for a helmet and a mobile telephone. The second student had to leapfrog and conceptualise a surfboard with a wine cooler. The diagram in Fig. 1 below illustrates that each topic is leapfrogged in order to force unexpected and random combinations resulting in unexpected ideas.

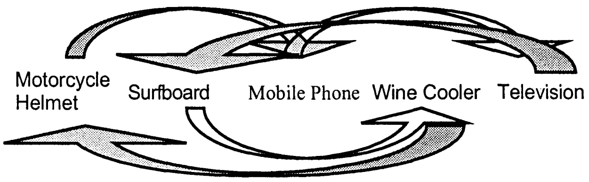

Fig. 1. Intuitive Leapfrogging.

It can be argued that design teams should be able to advance their creative output if they embraced the use of randomness as part of their exploratory design process. As an example, if a problem solving team was given the task of designing a new artefact to help people in their working lives, one way the team may be able to use randomness, is to begin by mapping the issues concerning the concept of work using non-hierarchical mind mapping and start with the main core themes of **WHO, WHAT, WHERE, WHEN, WHY, AND HOW.** The team members, either as individuals or as groups, would subsequently be encouraged collectively to develop lists of topics that should be randomised. For example they could devolp a list which related to various work environments, a list of various types of work, various demograhics of people who work, etc. Afterwards, they could divide the lists, placing each item from the list on a card and into a hat labeled with the respective themes. They would randomise all their lists and 'pick them out of a hat' one card from each hat. Accordingly, they could end up trying to conceptualise products for a businessman [***who***] using a hand held device [***what***] at a bustop [***where***], in the morning [***when***] communicating the advertising poster in the bus shelter electrronically [***how***], to book a resturnat for a busines lunch [***why***]. Subsequently, they could again pick one card from each hat and try to conceptualise another context. The leapfrog effect forces unexpected and **random** ideas and concepts thereby offering opportunities for developing creative insights within both designers and/or non-designers in the new product development process. Using his randomisation and exploration technique offers the opportunity for *creative connections to occur among design issues and concepts.*

IV. Experiment

As yet the working hypothesis of Hong & Page (2001 & 2004), with respect to design, and using designers solving a real design problem, remains untested using empirical methodologies. We can see how an experiment may be developed in order to test some of the issues raised in the discussions above. This experiment would consist of two design/problem-solving tasks given to two different cohorts of subjects. It is envisaged that twenty professional volunteer subjects and five professional designers, who have volunteered to act as judges, would participate in this study. One cohort of subjects would consist of 10 specialist professional industrial designers / design engineers. Another cohort of subjects would consist of 10 subjects who are a random selection of persons drawn from the corporate environment which would includes some randomly selected professional industrial designers / design engineers. Consequently, this would be a mixed group of designers and non designers, not unlike the diverse group of problem solvers discussed in the work of Hong and Page (2001 & 2004).

Given the discussions in earlier sections relating to groups of problem solvers, the 10 specialist industrial designers / design engineers may be characterised as high-ability problem solvers as they often share common perspectives and heuristics. Conversely, the other team of 10 problem solvers consisting of randomly selected yet intelligent persons drawn from a corporate environment when mixed with some designers could be considered diverse problem solvers, as discussed in the work of Hong and Page (2001 & 2004). In a real sense creative connections may be made in this group as the group is not predetermined but a random cohort of people with diverse perspectives and diverse heuristics.

Following the reasoning of Hong and Page (2001 & 2004), both cohorts of problem solving teams would be given a design task of developing as many innovative next-generation technologies and product / system concepts as they were able in the space of a 4 hour time frame of exploration. Further, the innovative next-generation technologies and product / system concepts must help and advance societies around the globe.

In theory the diverse group should develop 'better' innovative solutions for society. In contrast, the specialist design team would theoretically focus more on generating optimal solutions for local problems, as opposed to overall optimum creative solutions. There should be a statistically significant difference between the outputs of the two groups, in favour of the diverse group.

Consequently, creative connections made between these subjects should foment interesting and innovative potential technological changes for society. Conversely, the former team of specialist designers who share common perspectives and heuristics should create more pedestrian technological changes for society.

A subsequent task identical to the first would be given to both problem solving teams. In this second task they would again be given 4 hours to develop their concepts. However, in order to complete this task both cohorts would be required to use intuitive leapfrogging in order to make random connections between the issues they raise and map, with a view to develop innovative next generation technologies which would advance our society. As this second task requires all participants to operate with a new perspective and new heuristic, utilising randomness, there should be no statistically significant difference between the outputs of the groups of subjects.

V. Concluding Remarks

This paper has suggested that as our world gets more and more technologically advanced, technologically diverse, and operating within changing global dynamics, new strategies with respect to design team formation should be considered. It is suggested this is necessary in order to foment new innovative technological advances generated by new divergent combinations of perspectives and heuristics. It was suggested these divergent combinations of perspectives and heuristics would most likely occur when design teams are made up of people drawn from both within the design area and outside the design area. However, this has yet to be empirically tested. This paper has proposed an empirical study which could move the discussion forward and validate some of the assumptions made based on the current literature.

If some of the assumptions discussed in this paper are empirically validated, as design educators, we will need to rethink our education pedagogies, methods, and modalities of design education. For example, we would need to develop ways in which to bring together diverse student populations in order to provide opportunities for our design students to experience multiple perspectives and multiple heuristics. At the same time if some of the assumptions discussed in this paper are validated, this has implications for professional practice. In addition, new conceptualisations relating to the makeup of the design teams in a corporate environment will need to be reconceptualised at both a strategic level, and an operational level. As suggested earlier this work has implications for global corporate cultures, education cultures and our understanding of the makeup of professional design teams. The results of the proposed study should prove interesting, provocative, and challenging.

REFERENCES

Drew, E., and Haahr, M., 2002. Lessness: Randomness, Consciousness and Meaning", In *Proc. 4th InternationalCAiiA-STAR Research Conference 'Consciousness Reframed'*

Hong, L., and Page, S., 2001. Problem solving by heterogeneous agents. *Journal of Economic Theory*, 97: 123-163.

Hong, L., and Page, S., 2004. Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proceedings of the national Academy of science*, 101: 16385-16389.

Janis, I.L., 1982. *Groupthink: Psychological studies of policy decisions and fiascos.* (2nd edition), Boston, Massachusetts, Houghton Muffin.

Kokotovich, V. 2002. *Creative Mental Synthesis in Designers and Non-designers: Experimental Examinations.* Thesis (PhD). University of Sydney, Sydney, Australia

Kokotovich, V., 2004. Non-hierarchical mind mapping, Intuitive Leapfrogging, and the Matrix: Tools for a three phase process of problems solving in industrial design. In Proceedings of *The Changing Face of Design education, 2nd International engineering and Product Design conference, P. Lloyd, N. Roozenburg, C. McMahon, L. Brodhurst (Eds.),* Delft, Netherlands, 2004 September 2-3, pp. 213- 221.

Larsson, A., 2003. Making Sense of Collaboration: The Challenge of Thinking Together in Global Design Teams. *Group 03* November 9-12, 2003, Sanibel, Florida, USA, pp. 153-160.

Lawson, B, 2000. *How Designers think*, Oxford, Architectural Press.

Leong, T.W., Vetere, F., and Howard, S. 2006. Randomness as a resource for Design. *DIS' 06 June26-28, 2006* University Park, Pennsylvania, USA, pp. 132-139.

Mathias, J. R., 1993. *A Study of the Problem Solving Strategies used by Expert and Novice Designers.* Thesis (PhD). University of Aston, Birmingham, UK.

Otto, K.N., and Woods, K.L., 2001. *Product Design Techniques in Reverse Engineering and New Product development*, New Jersey, Prentice Hall.

Pritchett, J., 1993. *The Music of John Cage.* Cambridge, Cambridge, University Press.

Savransky, S.D., 2000. *Engineering Creativity Introduction to TRIZ Methodology of Inventive Problem Solving*, Boca Raton, CRC Press.