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CREATIVE PROCESSES AS A MEDIUM FOR LEARNING DESIGN COMPETENCE

Dagfinn AKSNES
Wärtsilä Industrial Operations WIO, Fitjar, NORWAY

ABSTRACT
As design thinking and design competence become more sought after across society and globally, there appears to be a need to develop strategies and good practice in delivering learning and teaching in design to more diverse groups of learners. The current publicity and debate on Design Thinking has highlighted new opportunities and challenges in terms of the context and content of Design Competence and because the learners range from non design students to industry leaders and politicians. This paper discusses and disseminates a new teaching programme in Design and Innovation for year 3 (final year) students of Production Engineering at University College, Bergen, Norway and the development of a new framework for design practice within Wärtsilä Industrial Operations (WIO) at Fitjar, Norway. Lessons learned and possible directions for future development will also be discussed.

Keywords: Design thinking, creativity, design process, adding value, innovation, intuition, framework for product design

1 THE CHANGING GLOBAL LANDSCAPE OF DESIGN AND INNOVATION

Design has a long tradition in learning through creative practice and development of tacit knowledge as demonstrated by artisan practices in design and construction of artifacts over the millennia. In the UK this was followed by the establishment of the twenty Government Schools of Design, as exemplified by the Royal College of Art (1837) and the Glasgow School of Art (1845). In fact the word Art replaced Design at a later date as the scope of learning and teaching became wider. These higher education establishments had their root in design for manufacture, built as a consequence of the findings of the *House of Commons Select Committee on Arts and their connection with Manufactures (1835 – 1836)*. The need was for a more competitive industry internationally, the argument was strongly economic and Design Competence was the strategic tool for achieving commercial success through well designed products.

This practice in learning and teaching has since evolved significantly in style and content and spread wide both nationally and internationally. In many countries however, the tradition for design learning and teaching is still quite young and the uptake in industry is sometimes less than could be expected. The ability to innovate or to realize and put into practice new thinking, new ideas and new products is a key transferable skill in demand world wide and in all human pursuits. Design competence, design thinking and creative processes are at the core of any innovation effort. Although there is a growing recognition for the value of design competence it is seldom delivered as a component in other academic subjects. Creative processes are even less well understood academically and in many cases left untouched by the curricula, to be pursued individually by students on the basis of personal interest and intuition. Clearly there is significant scope for improving both the academic understanding of creativity and its delivery through learning and teaching. How can the experience of the past inspire good learning for the future? Earlier research has suggested a map for the general application of creative processes [6] and has provided a model for learning in creativity and design.

2 DESIGN THINKING, INNOVATION AND CREATIVITY

Recently there has been an upsurge of interest in the creative processes within design and the concept of *Design Thinking* [1], [2] and [3] has grown in prominence in a wider international community which extends well beyond the realms of design. Industry leaders, entrepreneurs, politicians and public administrators are beginning to realize that Design Thinking has a general value and potency as a tool

kit which can be applied and exploited in their own practice and organizations. *It is a tool for innovation and creating value.* This however is not new as the British Parliament and Government of 1836 reached the same conclusion and subsequently resulted in a long tradition in Design Education, as well as the Great Exhibition of 1851 and London's Crystal Palace in Hyde Park (long since moved and destroyed in a fire). So what is Design Thinking? Tim Brown offers the following definition: "A discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity." One might argue that it is not so much a discipline rather than a mode of working, but this is really a semantic argument. The matter of importance is that this mode of working is *strategic* and it may also be applied in a *business or organizational context*, where it can be used to develop not only new products but also services, processes, policies and strategies. In short it is a tool for innovation and creating value. This is helpful as a general description and a starting point. Many other attempts at defining Design Thinking exist, however the author would argue that the simple outline described above strikes a valid balance between those that question whether a definition is needed at all and those that want to define it in minute detail. Both of these would appear to be counter productive but awareness of the various arguments helps to provide insight.

3 DESIGN PROCESS – VISUAL, NON LINEAR, CONCURRENT/PARALLEL

One of the most difficult learning tasks for design students comes when they have to apply the theory of the design process to their own projects. Suddenly the theory and reality collide and they are facing a confusing and contradictory situation where it seems impossible to apply what they have learnt in a way that makes sense in practice. It takes a lot of determination and open mindedness to succeed because the design process is essentially a different way of thinking to nearly all they have learned in school. Hopefully the intuitive thinking they enjoyed during play as children is still latent and may help some to accept the uncertainty, risk and challenges inherent in working and thinking as designers.
It is probably true that there are as many design processes as there are designers and design theorists. This combined with a healthy debate about design processes is a good thing but it is also adding to the confusion felt by students initially. It seems to help if the students are able to accept the design process not as a strict methodology, but rather as a strategic tool that can be adapted and applied in different circumstances to provide a framework for a wide range of design related tasks in order to deliver the product on time, to specification and within the budget and resources available. Of course the students also need to combine their design process with reflection in practice, developing their tacit knowledge and intuition as well as their management skills, not an easy task.
Over many years of design teaching experience with diverse groups of learners, the IDEO 5 step Innovation Process and the Design Management Institute (DMI) 9 stage Product Development Process have been found to provide a clear set of descriptions and useful sequences for working. In addition to this material, the students have been given a schedule for *concept design* and *detail design* together with their associated presentations and delivery of work. The design process has thus been presented in lectures and supported through regular tutorials. This approach has consistently worked well in the design studio learning environment and has the benefit of a good balance between simplicity of structure and detailed knowledge.
Still the students find it difficult to grasp the non linear and concurrent nature of the design process. This is perhaps not surprising as they have been largely conditioned to sequential, serial processes of logic deductive thinking in school and suddenly they have to cope with parallel processing of design practice. The minute they have to retrace their steps in the design process, they appear to lose confidence and become confused as this mitigates against all their previous learning and sense of progress. Yet this concurrent and parallel processing is at the heart of design competence.
In an attempt at making concurrent and parallel processing easier to grasp and less confusing, a new design process is proposed as visualized in Figure 1. The organizing and division between concept design and detail design and the combined wisdom of IDEO and DMI is still retained. Elements, including the fuzzy front end of the product development process from Koen et al 2004 [4] are also incorporated. The content of concept design and detail design can be adapted to suit circumstances as indicated in Table 1 and is represented graphically as a wheel where each element of the process is a sector that can be accessed by turning the wheel in either direction. This presentation breaks the linearity and sequential structure of written or numeric presentation and gives the design process a more intuitive character where it is easy to move through the elements intuitively and non linearly as

the work demands, rather than working with a sequential written list which doesn't fit with the real world. This approach will also ensure an integration of the requirements capture and product definition within the concept stage.

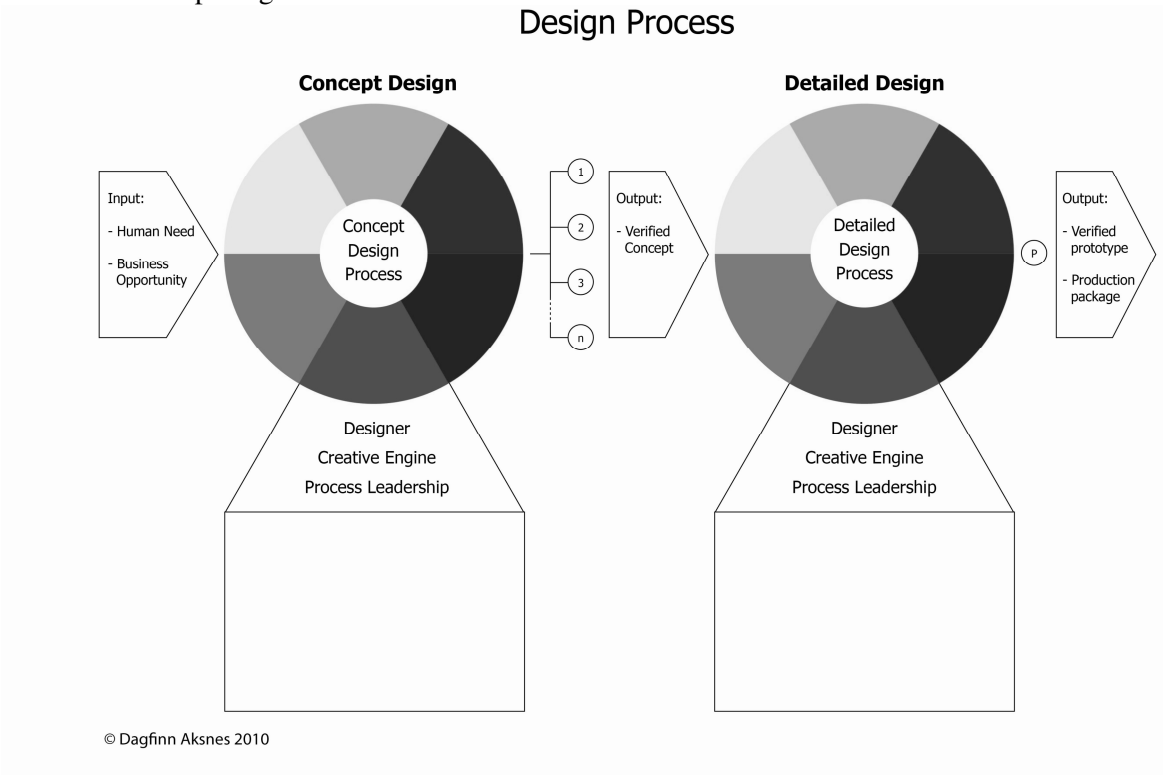

Figure 1. Intuitive, non linear and concurrent design process

Table 1. Design Process Elements (As represented by coloured sectors in figure 1.)

Concept Design	**Detail Design**
Inspiration and incubation	Inspiration and incubation
Creative Processes	Creative Processes
User and market investigation	User and market validation
Technology investigation	Technology application and development
Requirements capture	Prototype design and development
Concept design and development	Detail design and development

This mode of working also lends itself to working through the chaotic early stages, the front end strategies of Koen et al 2004[4], where possibilities may be explored freely, risks taken and all the explorative and experimental steps needed to avoid unforeseen issues at a later stage when they are difficult and expensive to rectify. The evaluation and verification steps are deliberately separated out of the 'creative zones' as these are largely logic deductive processes. Work in progress includes the development of an animated and interactive presentation of the described design process.

4 DESIGN AND INNOVATION AT UNIVERSITY COLLEGE BERGEN

For the autumn semester 2009, University College Bergen needed a teaching programme in innovation for their final year students in Production Engineering. The author was approached to develop and deliver this programme which was then given the title **TOM 104** *Design, product development, innovation and entrepreneurship.* The study took place over 12 weeks with 60 hours of classes split between lectures and practice, plus 40 hours of self study, thus achieving 10 ECTS study points. There is a near total absence of design as an academic subject in higher education in western Norway, consequently there is no possibility of collaborating with other institutions on delivery of such courses. In short, the challenge was to give 20 production engineers a real and valid introduction to design process and design thinking. They were introduced to the design process described above during lectures and tutorials and worked with it as a tool throughout. They were also given numerous

presentations to help them understand design and the value of design in peoples lives. These presentations included a historical background (with local Norwegian examples as well as from other cultures) and exemplars from students and designers practice. The material included mind mapping, brain storming, visualizing, modeling, prototyping and working out a graphic grid underlay for their work. It was attempted to provide the students with experience of all the major elements of Design Thinking and opportunities for design practice. The necessary background theory on innovation was provided in the textbook [5]. An introduction to creative processes was also provided as outlined in [6]. The students were required to produce a design portfolio supported by an executive summary, a short report and a video about their learning process.
Next they were give a design assignment very early on and they worked together in small groups on this throughout the term. The assignment was called Tempus Fugit and challenged them to create value from their own design of a product to mark and symbolize time in their own chosen context. They were encouraged to take risk in their choices and then to reduce risk during their design process, using all the design tools that were introduced to them to add value and innovation.

Table 2. Product scenarios chosen by the students

Suntime, a device for schoolchildren to predict sunrise and sunset in various Norwegian latitudes
Pictogram clock for teaching time to children with learning difficulties
Timeit, a device for calculating time differences between the worlds time zones, taking into account the variations in dates for summer time
Alcoreader, a device for calculating the time taken to become sober after a specified intake of alcohol
Sunish, a sundial based piece of jewelry
Extratime for determining extra time in football games
Automatic stirring device for making soups and stews.

The design brief was chosen deliberately to have a direction towards a graphic solution as the college didn't have available resources for production of models and prototypes. Some students had access to cad software and many used the freeware Google Sketch-up program.
It was clear from the beginning that the students gave priority to empathies with their user groups and social factors in their choices and all of them demonstrated a high degree of engagement throughout. They adapted and improvised, overcame difficulties and delivered a solid performance in their learning processes. In their final reflection on the Design and Innovation course, the students clearly felt that they had gained good knowledge about design and design thinking and that the material delivered in the curriculum, including the design process described in this paper, was directly applicable in their assignment and easy to use. They commented that the studio based learning style was new for them and that it had been a positive experience and a good learning process. The students regretted that the college had limited facilities for modeling and prototyping but they were grateful for the financial support given to them for and materials and product realization.

5 PRODUCT DESIGN AT WÄRTSILÄ INDUSTRIAL OPERATIONS (WIO)

Wärtsilä is a large global energy and power business with 17,500 employees. It has grown strongly through acquisitions and the group is active in marine and land based power generation and in renewable energy systems. Wärtsilä has decided to establish a new design facility at Fitjar, Norway in late 2010, with a mandate to redesign substantial elements of the company's product portfolio and also develop a framework for product design and establish this as a development tool across Wärtsilä's business centers. An international, diverse and multidisciplinary team of 5 design professionals have been established to tackle these challenges. The unit is housed within a Wärtsilä Ship Design facility and enjoys a modern working environment set on the edge of the beautiful Fitjar fjord with a small shipyard as a near neighbour. The size and diversity of Wärtsilä is a big challenge for the designers, however the development of a Graphic User Interface (GUI) which unites the functionality, Human Factors, appearance and branding of all Wärtsilä's control displays is an early effect of how Design Thinking can start to unify a diverse giant and contribute towards the creation of a stronger market brand. The design team has developed a consensus for the design and implementation of the GUI across Wärtsilä.

Work is progressing on design of a new Propulsion Control System (PCS) for ships bridges and a new range of Wärtsilä diesel engines, among others. Design Thinking principles are being applied in the design process and our user dialogues and user validation of design concepts in Propulsion Control are already providing positive and valuable feedback to the design team. The indications at this stage are that this has potential to strengthen Wärtsilä's market position through design and innovation, when the new PCS is launched.

The construction of a framework for Product Design is also progressing and steps are being taken to produce a clear visual overview of how Design Thinking can be applied across Wärtsilä's diverse businesses. This overview will link all relevant strategic statements with design process and design tools and make design competence available throughout Wärtsilä's product development processes. An example of one element in this work is shown in Figure 2 below. Here we can convey that the detailed content in requirements capture, creative processes and validation is directly linked with significant advantages in the design process: A clear understanding of the requirements through user and market needs, an innovation process that uncovers new opportunities and removes surprises and a user dialogue which confirms that the requirements are met trough design and innovation. In this scenario we can advocate the need for more time and space during the concept stage, reducing the gradient of the concept design slope. This will allow a more complete exploration of risks and opportunities for design in the early stage of development which reduces risk and maximizes value later. Another benefit of this strategic approach is the reduction of inertia at the front end by providing a clear overview of design tools, ensuring their application and progress at the appropriate time. Of course this is anathema to a conventional project management strategy which seeks to reduce

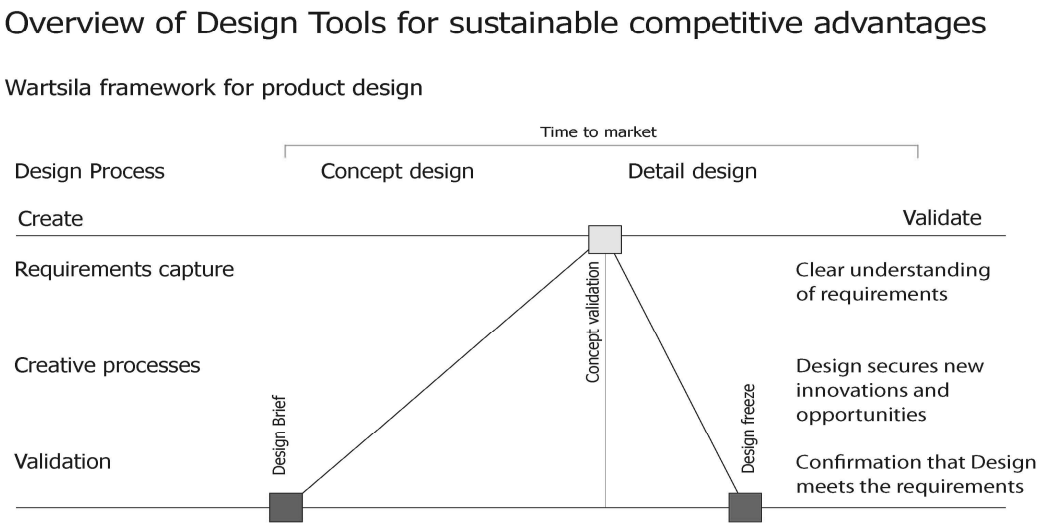

Figure 2. Overview of Design Tools for sustainable competitive advantages

risk and squeeze timelines all along. The argument for Design Thinking is that a better understanding of the process and appropriate adjustments to the disposition of resources and time will benefit the project significantly in the long run. A steeper gradient for concept design may ultimately extend the time to market through neglecting to 'turn every stone' in the early stages. The framework for product design will be communicated throughout Wärtsilä through the Wärtsilä Compass web portal and through web based interactive training sessions. The contents of design tools may begin to look like table 3 below.

Table 3. Design tools overview

Requirements capture	Creative processes	Validation
Wartsila Business Objectives	Brainstorming	User dialogues
Wartsila Branding Policy	Mind mapping	User validations
Wartsila Design Vision	Visualization	Questionnaires
Design Brief	Modeling	
Product Design Specification PDS	Prototyping	
User dialogues		
Human factors requirements		
Visual mapping of systems		
Market position mapping		
Standards and safety requirements		

6 POTENTIAL FUTURE DIRECTIONS FOR DESIGN THINKING

There can be little doubt that current global trends are helping to open a window of opportunity for design competence and Design Thinking. If we are going to make the most of this, then we have to deliver on content and style of new learning and teaching directed at more diverse groups of learners. There is a challenge to develop and deliver new teaching material which expounds visual thinking, creative processes and Design Thinking and which help people to apply these tools in their own practice.

At University College Bergen the introduction of Innovation and Design as a subject for students of Production Engineering was beginning to break new ground and was well received, however design education as a whole has been neglected in Western Norway and if the aims of sustainability and competitiveness are to be fulfilled, there remains a significant challenge to put in place programmes of design education across the region, both in its own right and as a component of other courses of study.

At Wärtsilä the process has only just begun, however there is every prospect for successful application of Design Thinking both in strategy development and in product design and branding. Progress in this respect should be available for presentation at the EPDE 2011 Conference.

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