Design for industry: a practical framework of form development in automotive design based on design thinking

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Abstract
Automotive design is a profession involved in the development of road vehicles. Designer led in creating products and bringing together features of aesthetics, ergonomics, materials, manufacturability, and environmental consideration to the vehicle. Design is intuitive, holistic and requires higher order thinking. My PhD research, which I will present in this contribution, has the objectives to develop guidelines and establish criteria to facilitate designers with a practical framework of form development in automotive design based on design thinking. The main questions are: What is the process of design thinking in form development for individual designer in automotive design? How can form development contribute with aesthetical appearance in automotive design based on design thinking? My study will be based on descriptive and empirical research through design activities including methodologies of 'thinking aloud' protocol studies. The process of investigation is expected to be iterative since there is a continuous need to re-look at the research questions and sources of data and to refine them after verification with new findings.

Keywords: automotive design, form development, design thinking

Introduction
The design and development of a modern motor vehicle is typically done by a large team including various disciplines. Design involves interdisciplinary input to make sure that the product can become competitive. In automotive design all phases of the product development cycle are of concern to the designer, from the initial concept, through its development and manufacture, and finally, the marketing of the product. Therefore, designer needs to adapt a holistic approach toward designing, and form development is one of the areas which can improve the end product.

Definitions: automotive design, form development, design thinking
In this paper *Automotive design* is defined as a profession involved in the development of road vehicles; *Form development* is identified as a process of creation surface/appearance of form by a designer through a process of generation, transformation of intuition idea to reality, and by the manipulation of aesthetics characteristics through the interpretation of design appearances. The latter approach aims to certify the end product will fit the requirement of designer, client, user and legislator. *Design thinking* is characterized as a way how a designer generates, transforms and manipulates a holistic visual idea into reality.

What is the process of design thinking in form development for individual designer in automotive design
A designer responsibility starts with the initial design idea and moves to conceptual development. From there, it moves to stage where surfaces are detailed, after which, the engineering department takes over to fully realize the project. Valtonen (2005) has identified

six different roles for the designer in current challenging market such as the designer as the creator, the designer in a team with mechanics and marketing, the designer as an end-user expert, the designer as a co-ordinator, the designer creating experiences, and the designer pushing innovation. The automotive design process goes through a problem solving and design process of analysis, synthesis and evaluation. Generally, the process involves assimilation, general study, development and communication. Designers must able to generate, transform and manipulate the visual form using intuition toward form development and explore new form during evolution and resolution processes. Tovey (1997) has noted that designers employ visual, creative and intuitive techniques in making the special contribution to the design process.

Thinking processes for designers vary. Tovey (1986) has identified in the division of preferred thinking modes between the two hemispheres of the brain, designer tends to emphasize right hemisphere process. The classic division is between a left hemisphere focus on the verbal, analytic and linear mode and a right hemisphere focus employing synthetic, concrete and holistic modes. Cross (1982) characterizes five aspects of the thinking process: 1) Designers tackle ill-defined problem; 2) Their mode of problem solving is solution-focused; 3) Their mode of thinking is constructive; 4) They use codes which translate abstract requirements into concrete objects; and 5) They use these codes to both read and write in object languages. All design involves higher order thinking to optimise the design, including analytical, logical, critical, objective, systematic, pragmatic, positive, negative, constructive, proactive, projective, creative, perspective, lateral, value, emotive, reactive, histories, mathematical, and intuitive skills (Mohd et al 2005). In automotive design, form development is integrated with other aspects of design. The designer will manage to translate the idea effectively using metaphor, analogies and associations from other domains (Lerdahl 1999).

In design many problems are fluid and vague and imply tacit knowledge (Schön 1983, Lawson 1997). Therefore they need to be interpreted. Lawson (1997) claims that before we can study properly how designers think, we need to develop a better understanding of the nature of design and the characteristics of design problems and their solutions.
A combination of quantitative and qualitative research methodologies can contribute to significant insights in design thinking. One can think of for example psychological and physical approaches, descriptive research, and empirical research through design activities with the various methodologies of 'thinking aloud' protocol studies techniques.

The designing process is holistic; it concerns an understanding of the overall design solution as a visual entity. In moving from an initial unfocused concept to a detailed design proposal designers are required to display visual flair within a controlled yet changing formal vocabulary. Intellectual skill is equally important Bloom (1956), this includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellect abilities and skills.

How can form development contribute with aesthetical appearance in automotive design based on design thinking

Aesthetics is a broad disciplinary subject. The original Greek word 'aisthetika' means ´that which is perceptible through the senses´. The process of sensory perception of humans is complex and can provoke powerful responses in the enormous store of experiences, memories and behavioural pattern within each of us. Aesthetics is a very important element in design. Based on Lawson (1997), the designer must understand our aesthetic experience, particularly of the visual world. According to Vihma (1995), aesthetic experience can be characterized as

a sense impression, a subjective appreciation of the object in which, however also interpretations of references take part. All bodily faculties through sensation are aroused, sight, touch, taste, and smell, hearing, balance, movement and muscular effort, help to form an aesthetics appreciation of an object or environment. Knoop (1998) stated that design for aesthetics plays a significant role in the automotive product development process. Very few people buy a car based on technical performance and cost only. Design for aesthetics, together with design for ergonomics, intelligence, user friendliness, adaptability, etc are the fields which will surely be in the focus of the research and development in the near future due to their role in enhancing product acceptance (Knoop 1998).

The characteristic of aesthetical appearance will make design marketable because it can capture the human interest for the end product. Knoop (1998) has distinguished the basic characteristics that express the aesthetics of a product: shape, composition and physical attributes. High-level characteristics such as style or fashion may be dealt with by expressing them in terms of the three basic characteristics (Knoop 1998, Chen and Owen 1997).
A proper understanding of the designers work includes the ability to process a rich and diverse language of aesthetics, linguistic and graphic elements; Methods for design for aesthetics are; Alternative (non-geometric entity oriented) natural input mechanisms of shape; Flexible representation of the initial shape; powerful image manipulation techniques; and free-form physical prototyping techniques.

Conclusion and further research

This paper is presented as an overview of my literature research, which I started in January 2006. My next steps include a study of the various methods and the identification of a research methodology for automotive design, reflections about the thinking process and the practical process in design, and literature studies which contribute to shed light on the question of how to design a practical framework of form development in automotive design based on design thinking.

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