

Techniques and Sequence of Sketching in the Conceptual Phase of Automotive Design

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To Link this Article: <http://dx.doi.org/10.6007/IJARBS/v8-i14/5032>

DOI:10.6007/IJARBS/v8-i14/5032

Published Date: 23 December 2018

Abstract

This paper evaluates the techniques of sketching in the conceptual phase of automotive design among automotive designers. The research identifies sketch types used in conceptual stage and a distinction is made between Thumbnail Sketch, Rough Sketch and Concept Sketch and they portray different stages of sketching process in the conceptual phase. An investigation (sketching task evaluation) with 9 automotive professional designers was conducted to evaluate the sketching approaches. Video Observational Analysis was carried out concerning 9 aspects identified such as Medium Used, Left/Right Hand, Line Thickness, Sequence of Activity, Size and Types of Sketch Produced with the results documented and discussed. An early finding shows that 5 types of sketching approaches portray 5 different sequence techniques for early automotive design conceptual phase.

Keywords: Sketching, Conceptual Design, Automotive Design, Design Process

Introduction

Can one imagine how designers develop their ideas without transforming it onto papers? How does one communicate a concept? Perhaps, these are the questions that one might need to explore if someone wants to know whether idea transformation is part of an important stage in the design process. Based on Evans and Aldoy (2016), digital sketching continues to emerge as an alternative to paper-based techniques. Undoubtedly, sketching is noted as part of a thinking process, communication and discussion of designers' ideas either among designers themselves. According to Yannou et al. (2013), "finding a new shape and style for an object can be seen as a profound human and sometimes artistic refinement process. Indeed, starting from an initial idea, the style designers continuously refine it through multiple sketches and

drawings using their intuition and perception of their own production in a reflexive manner". Sketching helps designers communicate ideas within themselves by stimulating their own thinking processes. Sketching can also be communicated to other people. In design domains, there is no better way to express someone's thought than through sketching.

Undoubtedly, sketching plays a key role in automotive design, particularly in the early concept stages of the design process. Yang and Chen (2016), highlight that sketching is one of the most important processes in the conceptual stage of design. In industry, the industry's design teams (automotive designers) are responsible for the appearance of the vehicle, therefore the creation of initial concept sketches maybe seen as the earliest stage of the design process. Sketching is used to stimulate the thinking process, for communication and discussion of designers' ideas and as a means of recording ideas for future development.

Additionally, the importance of sketching (which also has been addressed as drawing) has been recognised by most literature in different design domains. The academic literature and publications concerning sketching can be found from different authors such as Goldschmidt (1991), Anderson (1995), Kavakli (1998), Mc. Gown et al. (1998), Do *et al.* (2000), Powell (1998), Garner (2001, 2003), Wu and Wang (2015) and Yang and Chen (2016). On the other hand, the publications concerning automotive sketching can be found from Yannou et al. (2013), Tovey (1984, 2003). Even though they are from different design backgrounds, all publications concerning these activities were found to have the same opinion on the role and importance of sketching within the design process.

In this research, the word 'sketching' is referring specifically to automotive freehand sketching. In every part of the world, automotive freehand sketching is the conventional means of producing sketches which traditionally are often closely related with pen and pencil. In contrast, the new technology which is available worldwide nowadays, automotive digital sketching uses technology which is computer sketching i.e. the use of graphics tablet and digital pen (as pioneered by Wacom) to produce a sketch. Therefore, the objective of this paper is to evaluate approaches of sketching in the early conceptual phase of automotive design by studying the approaches practiced by nine professional automotive designers.

Materials and Methods

In order to externalise the implicit processes of sketching used by professional automotive designers, 9 professional designers were selected. Each of them was given a paper and a pencil to conduct their sketching activity. A table and chair was set up with an angled video to record the design activity. Just before the activity began, the designers were given a project brief similar to a designer daily job. The time frame given for the designers to perform their sketching activity was maximum 5 minutes. After the 5 minutes was completed, the designers had to stop sketching. The data collection process is depicted in a form of flowchart as shown in Figure 1: Stages of Approaches to Sketching. Data observed from participants were analysed using Protocol Analysis (PA). Observations with professional designers have been simplified in the form of a table (See Table 1).

Results and Discussions

Table 1 shows the sketching activities that were analyzed using Protocol Analysis (PA) method. Data analysed with the nine designers, shows that eight designers used the right hand to sketch. Only one designer is left handed. All the right handed designers observed had the front position of their car drawings on their left hand side. Left handed designers observed, had the front position of the car drawing on the right hand side. The constant relationship between the orientation of the car and the handedness of the designer can be explained by considering the motion of the hand in the production of a line and in particular, the production of lines that suggest movement and direction.

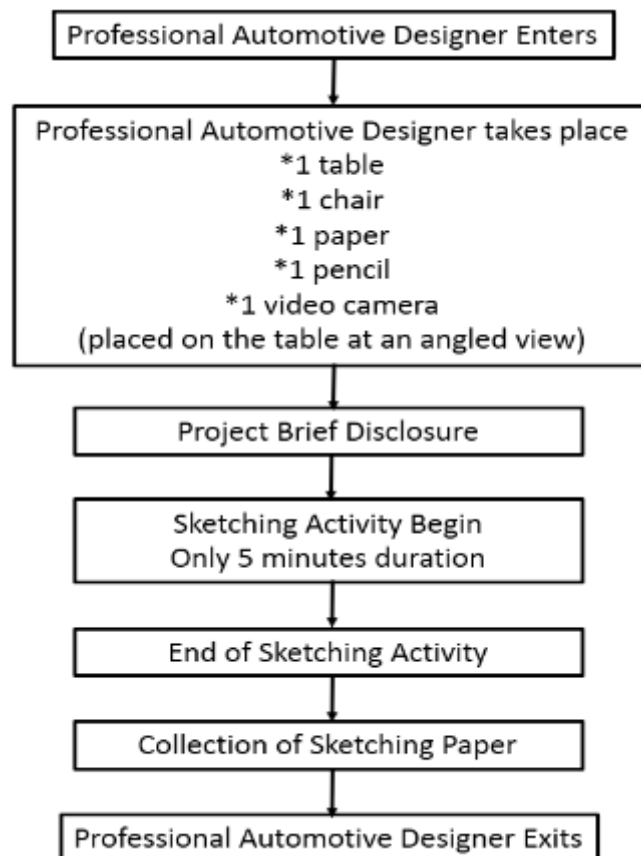


Figure 1: Stages of Approaches to Sketching

Table 1
Sketching Activities of Nine Designers

Aspect Measured	Designer 1	Designer 2	Designer 3	Designer 4	Designer 5	Designer 6	Designer 7	Designer 8
Lef/Right Hand	Right	Right	Right	Left	Right	Right	Right	Right
Medium used	Ballpoint Pen	Ballpoint Pen	Ballpoint Pen	Ballpoint Pen	Ballpoint Pen	Ballpoint Pen	Pencil	Pencil
Type of Sketch	Rough	Thumbnail	Thumbnail/Idea	Thumbnail	Rough	Rough	Rough	Thumbnail
Angle of Sketching	Side	Side	Perspective Front	Side	Perspective Front	Side	Side	Perspective Front
Line Thickness	Vehicle Layout, Glass Section, Headlight, Front Bumper	Vehicle Layout, Wheels, Door Cutting Lines	Vehicle Form Lines	Vehicle Layout, Bottom Rocker, Panel Line, Wheels, Glass Section	A-Pillar, Headlight, Wheel Arches, Shoulder Line, Lower Front Bumper	Vehicle Layout, Shoulder Line, Wheels	Vehicle Layout, Wheels, Shoulder Line, Character Line	Vehicle Layout, Headlight, Wheels, Wheel Spokes
Sequence of Activity	Bottom Rocker Panel Line, Shoulder Line, Overhangs, Roof Line, Headlight	Bottom Rocker Panel Line, Shoulder Line, Roof Line, Door Cutting Line, Glass Section	Bottom Rocker Panel Line, Wheels, Centre Line, Symmetrical Lines based on Center Line, Pillars, Headlight	Wheels, Bottom Rocker Panel Line, Overhangs, Roof Line, Glass Section, Wheels, Spokes, Shadow	Shoulder Line, Glass Section, Overall layout, Wheels, A-Pillar, Side Mirror, Headlight, Wheels, Bottom Rocker Panel	Wheels, Vehicle Layout, Shoulder Line, Headlight and Taillight, Door Cutting Line	Wheels, Vehicle Layout, Shoulder Line, Character Line, Headlight and Taillight	Wheels, Shoulder Line, Side Mirror, Wheel Spokes, Grille and Headlight
Component Detailing	-	Side Scoop	-	Wheels	Headlight, Side Mirror	-	-	Wheels, Headlight, Side Mirror
Shadow Line	-	Glass Section	Glass Section	Glass Section	Glass Section	-	-	Glass Section
Perspective	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Duration of Activity	-	< 3 Minutes	< 5 Minutes	< 5 Minutes	< 5 Minutes	< 5 Minutes	< 5 Minutes	< 5 Minutes

The variation in line thickness suggests a direction of motion for the car being depicted. The result of this effect is a suggestion of a car moving towards the right (for a left-handed person), with the line following a conventional depiction of motion or speed.

Table 1 shows that a ballpoint pen is the common medium for designers to use when sketching a car (medium used). A marker pen for example is normally used during the rendering process. However, designers may also use a marker pen at the initial conceptual stage. On the other hand, the use of a pencil helps designers to erase any unnecessary lines or mistakes.

Type of sketch based on these analysis shows that the majority of designers (five of them) created thumbnail sketches and three designers produced rough sketches. Thumbnail sketches produced from the five designers appeared to be of smaller size compared to rough sketches made by the other three designers. This finding validated the theory from the literature which stated that the 'thumbnail sketch' is a small representative sketch produced

by designers in the first instance. It is found that this thumbnail sketch is the quickest sketch to produce in order for designers to translate their ideas onto paper. For example, based on the session conducted with the Designers 2 and 9, they were able to produce few sketches within 3 and 5 minutes respectively. In contrast with the thumbnail sketch, 3 sketches produced by the other three designers in the session have been categorized as rough sketches due to the size of sketches produced by designers. It also appeared that designers took more time to produce their rough sketches compared to designers who created their thumbnail sketches. This reflects the outcome from idea generating stage as it is important to get as many ideas as possible in short period of time and sketching a bigger picture of cars will take up more time.

The investigation shows that 2 angles of sketching were produced by designers in this analysis. They were side angle and front $\frac{3}{4}$ angle with the majority of designers favouring side angles for their sketches, as shown in Figure 2. This highlights the need for speed in the idea generating stage as it is important to get out as many ideas as possible in the sketching activity within the early conceptual phase of automotive design process. From this analysis, it appeared that the most effective method to produce a sketch as quickly as possible was by creating a side angle sketch. Designer 7 commented about his side angle sketch; according to him by producing side angle sketch, he was able to project the car profile and the engine position quickly. With regards to the front $\frac{3}{4}$ angle, it was found that producing this angle was time consuming among the designers in this study. For example, Designer 3, Designer 5 and Designer 8 took more time to finish their sketch compared to other designers. It appeared that producing a front $\frac{3}{4}$ angle as an early sketch was not 'time efficient'.

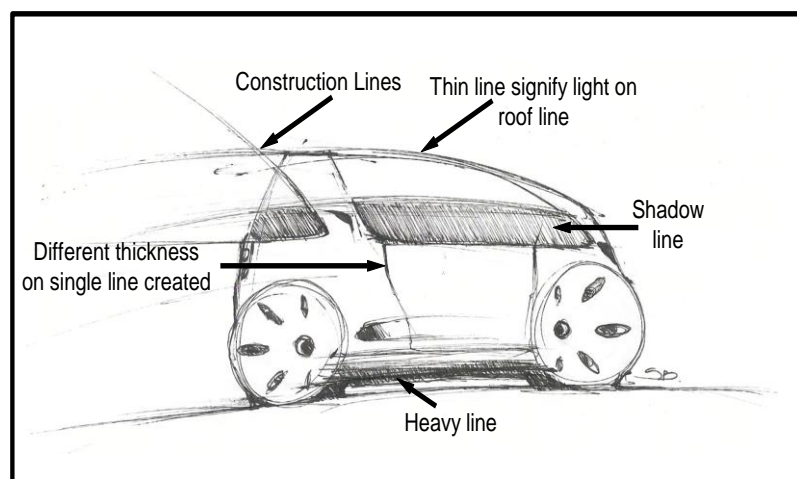


Figure 2: Representative Sketch (Illustrating Key Findings) on Different Line Thickness

The analysis shows that all designers applied a range of line thicknesses for their automotive sketches. Based on Figure 2, as a basic element of drawing, line thickness was taken into consideration by all designers. It appeared that the application of the line thicknesses varied among each of the designers. Line thickness seemed to help designers to improve the quality of line in their sketch. For example, they produced a single line with varying width. Line thickness is used in several ways: fine lines are used as construction lines and when left in place are ignored, as attention is given to the bolder lines that follow as the sketch develops.

A gradation in line thickness from one end to the other suggests movement and direction of movement. A variation of line thickness in the depiction of the car form is used to give three dimensional qualities: a light roof line suggests reflected light on the top surface whereas a heavy line defining the lower 'rocker panel' line. The designers were able to establish the line quality and therefore made their sketches more outstanding. Using different kinds of lines in sketching can help make the sketch more interesting and designers are able to avoid drawings being flat as all lines is similar in thickness.

The results also show that there were varieties of sequence produced by designers. However, the majority of the designers started their sketches with the wheels of the vehicle. It appeared that by creating the wheels, designers were able to determine the 'limit' space, wheelbase and the length of the overall vehicle. It was also found that by creating the wheels, it became a guide for designers to progress to other components and lines for sketching such as creating a ground clearance, shoulder line and the vehicle layout.

The analysis showed that the majority of the designers applied component detailing in their sketches. However, only a few components were sketched in detail by designers: this varied amongst the components created in their sketches. The type of components that were concentrated on by these designers were the head light, wheels (with spokes) and side mirror. It was found that designers only concentrated the maximum of 3 components at a time in the early sketches.

As shown in 'representative sketch' in Figure 2 and Figure 3, majority of designers have created shadow line for their sketches. It was found that two areas of mostly shaded parts were the wheels and glass section of the vehicle. This finding reflects the element of drawing that has been considered in designers' sketches. The purpose of the shadow line created by these designers also helped them to represent cars being depicted as two-dimensional. A sketch without shadow lines might be described as 'flat'.

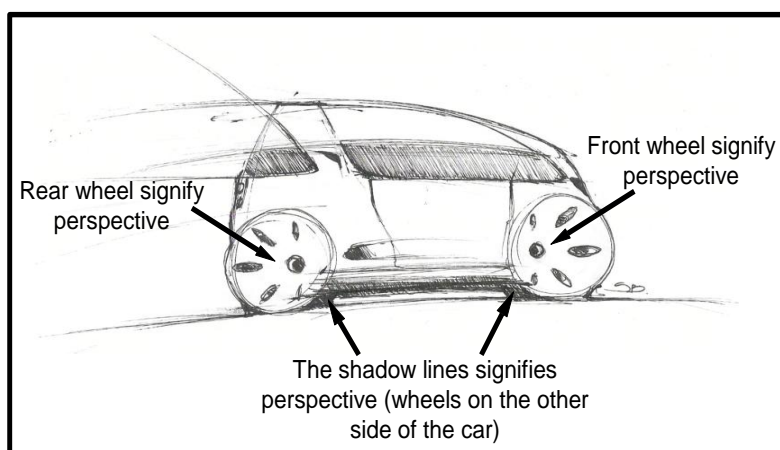


Figure 3: Representative Sketch (Illustrating Key Findings) on Perspective

In addition, as in 'representative sketch' as shown in Figure 3, all professional designers considered the perspective rules of the sketches even though they have produced side angle sketches. The method of showing the side angle of perspective sketches were signified by the

shadow at the inner side in between both wheel of the vehicles that all designers have drawn as well as at the centre point on front and rear wheel. In terms of duration of activity, the analysis shows that all designers produced their sketches within 5 minutes.

Conclusion

It has been found that it is important to identify sketch types exist in the conceptual phase of automotive design process. The range of sketch types that is apparent in design practice suggests that different categories of sketch may be sequential and related to stages of concept development within the design process.

The value of sketching confirmed the importance of sketching in the conceptual stage of the automotive design process and it is regarded as a predominant activity. In the design process, concepts are externalised before design decision is made, and through sketching, the designer was able to reflect on his sketch and make any modification from the comments received from others. The findings managed to reveal techniques of sketching in the early conceptual phase of automotive design by identification of several sketching classifications found to exist in the design process. They are thumbnail sketch, rough sketch, idea sketch and concept sketch. These sketches are used to produce an early idea of sketch. The research reveals the sequence do exist in the automotive sketching process. Firstly, it started with Thumbnail Sketch, secondly, it will continue with Rough Sketch and thirdly it will be refined with Idea Sketch. Finally, the Concept Sketch is proposed for better sketch presentation from designer. The finding techniques of sketching in the early conceptual phase of automotive design introduce a more systematic flow of sketching process of automotive design. Students, academicians and designers are able to use the new approaches as their guidelines in producing quality sketches of automotive design.

Acknowledgement

The authors would like to acknowledge the assistance of Universiti Malaysia Sarawak on the continuous support throughout this research project. This paper is derived from research conducted under UNIMAS Research Innovation Fund No: DI/11/2009(01).

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