INTERNATIONAL ENGINEERING AND PRODUCT DESIGN EDUCATION CONFERENCE
2-3 SEPTEMBER 2004 DELFT THE NETHERLANDS

EDUCATING AUTOMOTIVE DESIGN: A SCIENTIFIC APPROACH WITHOUT COMPROMISING TACIT KNOWLEDGE

Elmer D. van Grondelle and Matthijs B. van Dijk

ABSTRACT

The car has, more than any other, become a product with highly emotional properties and a significant impact on society. The automotive styling process as generally educated and practiced today has its foundation in the 1930's in the Detroit studios of General Motors and has not changed significantly since. The automotive industry and its market however have evolved dramatically. Car companies need to manage brand portfolios rather than a single brand and manage synergy between SBUs without compromising brand identities.

It is due to the very properties of the styling process that automotive styling departments have not acquired a position in the value chain that allows an active role in corporate strategy formulation. Cynically, the tacit skills and culture that allow stylists to design successful cars also appear to be the threshold in implementing methodologies that would allow a more influential power base. The myth of the profession is embraced passionately by those who are a part of it. Being part of a myth is even better than being a scientist. Styling strategy and competitive advantage fail to emerge and each new model generation puts a company at a larger risk than acceptable.

Styling is currently recognized as a main automotive design driver. However it is no longer sufficient to design the next generation without a strategic context that exceeds the level of the business unit. The resources that are invested in a new car, and the number of people that depend on it, are too high.

The challenge is to design and introduce a scientific business framework into the styling process without compromising or bounding tacit skills, which are so critical to the appeal of the final design.

Keywords: automotive design education, strategy models, tacit knowledge

1 INTRODUCTION

In this paper an assessment of the automotive design process and its context suggests that styling plays no identifiable role in corporate strategy formulation due to the changes the industry has undergone in recent decades.

Comparing the automotive design course and research at Technical University Delft to the automotive design practice in the field, indeed reveals a different, more scientific and business oriented approach.

An introduction of automotive styling research models, and the application thereof in a case study, seems to confirm that a revised approach of styling, through business models that build on tacit knowledge rather than conflict with it, improves

communication and the styling studio's power base, allowing participation in long-term strategy formulation at a corporate level rather than that of a business unit.

2 CONTEXT

2.1 Ancient history

The rise of mass production in the early decades of automobile history, largely the result of the pioneering efforts of Henry Ford and the automotive industry, undermined the meaning and identity many Americans found in their profession, their craft. Degrading, unskilled, heteronymous work on assembly lines no longer testified to the moral worth and integrity of the individual.

Americans looked elsewhere (outside work) for personal meaning and gratification. Not any domestic product would do. They demanded products offering individuality and variety to provide the distinction that their homogenous jobs no longer could. They demanded products with 'style' [1].

The automobile was increasingly a vital part of this quest for individuality. Consequently people were demanding that it should be as beautiful as everything else in their parlours, where they escaped their factory lives [2].

The structure of Fordism denied these needs in production ('any colour as long as it is black') and blocked the realization in consumption. Ford, considering the car to be commodity product, pursued a strategy of economies and offered a solid, simple car at a low, decreasing price. Americans who traded in their first cars were demanding comfort, convenience and style, all of which were lacking in Ford's car.

Direct rival General Motors was smaller and Sloan (Alfred P., President of General Motors) ruled out a price war because he knew he could never win. He decided to introduce a graded hierarchy of products blanketing all markets. And in each market a division (brand) would offer a better quality car for a bit more money [3]. Hence, a branding portfolio diversification strategy, triggered by social economical reasons, and managed by design!

The system and principle of car design as Harley Earl at General Motors invented it in the early 1930s, is still educated and practiced today [4]. This process, predominantly based on cognitive and tacit skills, has barely changed since and has initiated the studio culture in which cognition prevailed over debate [5],'I can see but I can't hear'.

When from 1923 on the different GM divisions reduced cost by sharing components [6] it was full circle.

2.2 Modern history

Recent decades in the automotive industry have been dominated by mergers, takeovers and partnerships, resulting in a limited number of car companies, each with a portfolio of brands to strategize, rather than a single one. Predictions on the remaining number of car companies vary from 5 to 7 [7].

For car companies this introduces a major new challenge introducing a corporate level above that of the strategic business unit (the brand). Rather than managing a sole brand identity they need to manage a brand portfolio. In doing so they are not only to compete with other brands; they must also create supplementing identities within their own portfolio so that they don't cannibalize amongst their own. Especially when former competitors are included in the company an identity diversification strategy is crucial. In addition the 'identities portfolio' must, arguably, correspond with that of identified competitors.

The novelty of brand portfolio management at this scale for most of these companies (including the Americans who have, in the mean time, replaced their brand design strategies by 'batch-branding') resulted in strategies that were often doubtful from the beginning and have already resulted in sales drops and panic strategies.
In the mean time the styling process and culture have barely changed. Changes that did occur such concerned with logistics (Kaizen [8]) or the reduction of cost and development lead times (simultaneous engineering, concurrent engineering and product data management) and were mainly IT driven. They contributed little to nothing to the intellectual contents of the profession.

3 AUTOMOTIVE DESIGN EDUCATION

At the Faculty of Industrial Design of Technical University Delft, Automotive Design is a popular elective. It builds on technology classes as well as developing tacit skills, from the vision that co-existence and fusion thereof are crucial to the final result. The common denominator being the understanding of why and how the relationship between automotive technology and styling are mutually dependent in the design of comprehensive successful cars.
The course addresses a wide range of aspects that are crucial to understanding automotive design. Subjects vary from history, automotive engineering, aesthetics, sustainability and branding to design processes and future cultural, social and technological developments. Students must become familiar with the effects that all of these aspects have on plastic expression in automotive design and they will develop the skills required to visualize them.

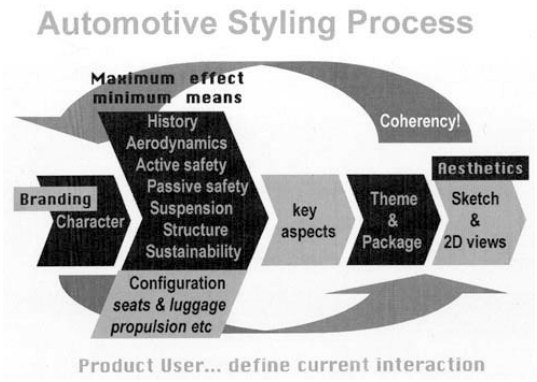

Figure 1: Delft Automotive Styling Process

The design process as educated is structured and involves application of all relevant subject, which if applied consistently back and forth, leads to a design that expresses the original intend.
Insight in general parameters such as vehicle dynamics, aerodynamics must be the bases for developing automotive concepts. The history of car styling and automotive engineering form a lexicon to which new design may be related. Next to that, due to development throughput times, a long-term strategic vision is essential. Vision should not be solely based on innovative technologies but should start from cultural and social developments as well as brand identity. Developing a long-term vision provides a leitmotiv and assessment criteria for qualitative requirements, reflected in the car's character and guiding quantitative requirements.

4 RESEARCH

Research plays a fundamental role in automotive design education. The development of a lightweight car, DutchEVO, has been chosen in 1999 as the research carrier in an extensive research program involving the faculties of Aerospace Engineering, Design Engineering and Manufacturing, Geosciences and Industrial Design. The car, being the most ubiquitous, and arguably the most dominant, visual form of the last century [9],

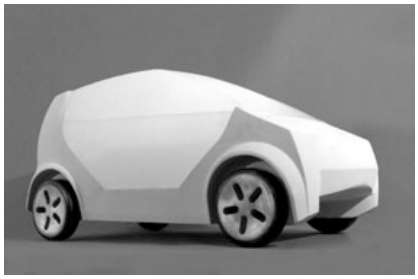

Figure 2: DutchEVO1:5 scale

allows combines a vast number of quantitative technologies with qualitative emotional values.
DutchEVO is a 400 kg. 4 seat car for urban regional use. The research addresses, amongst others, lightweight construction, new materials, life cycle analysis and recycling, new technologies and sustainability in the widest possible sense.
A wide range of research findings is being introduced into automotive design education.
The foundation of automotive styling research lies in an extensive research program in which, next to technology and form and automotive experience research, business models are being developed for automotive branding strategy analysis, competitive analysis and strategy formulation:

4.1 Branding analysis model

The Branding Model is being developed to be able to identify, analyze and design automotive branding strategies [10]. The model contains three dimensions in which, by cognitive analysis, on current and past cars, cars are positioned in the model. Strategic analysis of both the brand and its competitors allows to mark the direction in which a brand is moving and provides feedback for competitive strategy formulation.
The two dimensions in identifying individual brand analysis are time (vertical) and model range (horizontal). The weight of the branding by design factor is determined by the level to which a car shows 1) family resemblance to it's predecessor and 2) the level to which it disqualifies the predecessor in terms of visual ageing.
Horizontally (the model range) the branding factor is determined by family likeness between various models of a brand at one point in time. Four basic strategies may be identified. The third dimension of the model is the brand portfolio, which allows analyzing and strategizing the brands as complementary, allowing for a long-term diversification strategy.

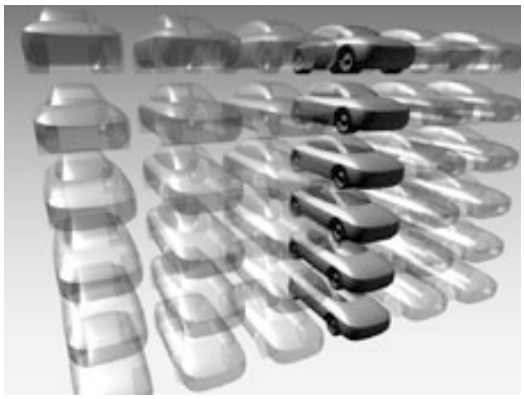

Figure 3: global view, vertical branding

4.2 Hierarchic styling analysis model

In order to assess automotive styling on its strategic merits it is important to understand how and where car styling links to strategy. A cognitive hierarchy identifies six levels in automotive form, which can be linked to the three strategy levels in an organisation [11]. The strategic level to which a styling level is linked is a strong indicator towards the opportunity to create a substantial differential advantage over competitors, and the effect on the long-term characteristics of the organization [12]. The hierarchy levels from high to low:

- Strategic level. This level is not merely based on cognitive research into a specific car, rather also includes other cars, and may affect the automotive environment in a larger context. Strategic choices concern sharing strategies (platform, parts), corporate branding strategies and global technology choices.
- Volume arrangement. This identifies not only the number of boxes (sedan, hatchback) but also the relation between global measures, e.g. overhang and visual features. The base for volume arrangement is the platform of a car (floor panel and firewall), the technical building blocks (propulsion, suspension) and furthermore defined by the package.
- Surface treatment. This is the global styling approach of body panels, the usage and the application of styling features and baroque elements. This level of the styling model is largely independent of the levels above. In practice this is at operational level but our case will show that communication at corporate level is mandatory.
- Detail design is concerned with the detailing and defines shape and appearance of small parts and features; body parts (air inlets) and materials (light units, grill).
- Colour and trim is the level most directly related to fashion. It is the level where the buyer has most influence in the appearance of his car and where for a large part the visual durability of an individual car is being determined.

Next to the hierarchy a range of analysis tools may be included dependent on the objective of the moment. An obvious example is analyzing the weight of a competitive sustainable advantage of e.g. technology choices, as our case example will show. The higher in the hierarchy a decision is made, the longer a sustainable advantage may be of benefit. In terms of risk assessment it will also give insight to the affect in case the wrong choices are made. In this way various models may be linked to the hierarchy depending on the objective at hand.

5 CASE STUDY

The Volkswagen group is one of those companies facing the brand portfolio situation, and currently facing sales problems for the Volkswagen brand. The portfolio contains four volume brands, which are subject to the study. Audi has been fully Volkswagen owned since 1971 and is positioned as the ‘higher’ brand, competing with BMW and Audi. In 1987 Volkswagen took a majority share in Seat and acquired full ownership in 1990. Since 1991 Seat has been slowly replacing its (Fiat based) model range by Volkswagen technology based models. Seat’s mission within the group is to be positioned as Volkswagen’s ‘Latin brand’ aimed to compete e.g. with Alfa Romeo [13]. Since 1999 Volkswagen owns a growing majority share of Skoda. Skoda’s mission is to compete with the ‘northern’ brands such as the four-wheel segment in Europe’s mountain countries (e.g. Subaru) and Volvo.

Both Seat and Skoda had a cheap and low quality image. The chosen strategy therefore allowed both brands to literally advertise ‘Volkswagen quality’. A strategy that, quite predictable, was very successful in placing both brands on the map.

However, equally predictable in author’s view, after a few years both brands began to cannibalize their mother. Potential Volkswagen buyers switched to Skoda or Seat, perceived to be equal in quality, no longer very different in style or status and most important, substantially cheaper.

Figure 4 clockwise: Volkswagen Golf, Audi A3, Seat Toledo and Skoda Octavia

Volkswagen succeeded in establishing the quality image but appears to have failed in creating complementing brand identities rather than competing ones. A brief overview of educated observations related to the hierarchic model:

- A corporate level decision is that of platform sharing. All the brands share the same platform and propulsion layout. The Volkswagen Golf, Audi A3, Skoda Octavia and the Seat Toledo are four of about nine cars built on the same 'Golf' platform. Therefore the cars are quite similar in terms of overhang and suspension. The latter being to crucial to how a car 'stands' on the street, which is an important factor in the appearance of a car. This is a corporate level choice and mandatory.
- The volume arrangement is largely dependent on the platform and the package. The cars mentioned above share platform, power train, suspension and interior technology, and the latter largely dictating the package. The front overhang is alike. The rear overhang is equal for hatchbacks or sedans. The cars also share the windscreen position. There is little room for differentiation between the brands in volume.
- All of the cars display a similar approach to surface treatment. Large 'clean' surfaces for all cars, few to none styling features and similar split lines between body panels e.g. door panels.
- At the detail design level, wheel arches and hipline are similar which amplifies the visual of the suspension as mentioned earlier.

We may conclude that at all levels of the hierarchical styling model; the similarity between the cars is visually being confirmed at the cost of their respective brand images. Opportunities for differentiation have not been missed. There is no consistency between vision at one end of the process and the product at the other end.

6 SCIENTIFIC AUTOMOTIVE STYLING

Branding is currently recognized as a main design driver in automotive while other properties seem to differ less and less between brands [14]. It is due to this and the tacit properties of the styling process, or rather the stylist, that styling departments have acquired their current valued position in the development process. Credit thus, compensates for the lack of strategic contribution.

However the styling department's focus remains at a single brand while the changing face of the industry demands a larger context to consider. An active role in corporate strategy formulation and risk management through repositioning styling in the value chain [15], [16], is blocked for lack of the ability to defend a case on other grounds than cognitive argumentation.

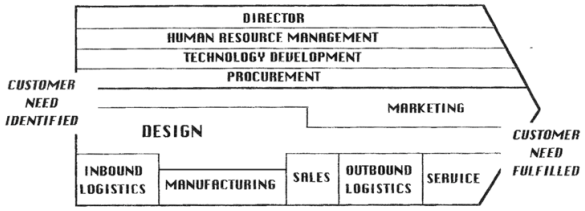

Figure 5: optimal position of design in the value chain

In the previous chapter we have touched on a case that links corporate strategy to styling. By use of the Hierarchic Model a preliminary analysis suggests a failing brand portfolio strategy. A styling diversification strategy designed by use of the Branding Model should have led to completing strategies at the surfacing and lower levels of the hierarchic model.

Introducing scientific business models in an environment that is driven by tacit skills suggests bounding these skills. On the contrary, having acknowledged earlier the value of this intangible quality, cognition is a valid method in collecting data in qualitative research [17]. The objective is to regard tacit skills as critical success factors in achieving strategic objectives [18].

By no means is it suggested that the observations made in the case study are unique. However the difference between observing as a human and as a researcher is the structured approach to the quality of observation [19]. The added value of the presented business models is the ability to place it in to context [20], the ability to objectively make it abstract and guide decisions.

7 CONCLUSIONS

The face of the automotive industry has changed and requires a broader approach in strategy formulation. Case studies imply that, in order to create a sustainable strategic advantage and allow adequate risk management, Styling must have a continuous role in strategy formulation. In order to achieve that Styling must critically assess its own principles and culture and embrace a new paradigm.

It is also strongly indicated that the use of scientific business models is valuable, if not necessary, in analysing and designing branding strategies. These models rely strongly on tacit and cognitive skills that are the merit of the styling profession.

Scientific research and design education are mutually dependent in linking quantitative to qualitative properties, and in linking research to practice, similar to the co-operation between education and the industry.

REFERENCES

[1] Doorman, Dennis P. (1995): *Design History, an anthology*, first edition, Massachusetts Institute of Technology:122-123, 133; Gartman, David (1994): *Auto Opium, A Social History of American Automobile Design*, first edition, New York, Routledge: 6

[2] Ibid: 133; Gartman
[3] Ibid: 76,125-126.
[4] Ibid: 122
[5] Armi, C. Edson (1988): The Art of American Car Design, The Profession and Personalities, first edition, The Pennsylvania State University Press: 17
[6] Doordan: 41-46; Armi
[7] Mantle, Jonathan (1996): *Car Wars, de strijd der autogiganten op weg naar de 21e eeuw (Battle of the car giants)*, first edition, Weert; van Buuren and Oude Weernink, W. (1998): *Old wine in new bottles*, Autovisie 22, 24, 1998: 21
[8] Imai, Masaaki (1995): *Kaizen: the philosophy behind Japanese succes,* Second edition, Deventer, Kluwer Bedrijfswetenschappen; Womack, James P., Jones, Daniel T. and Roos, Daniel (1991): *The machine that changed the world, the story of lean production*, first paperback edition, New York, HarperCollins Publishers
[9] Armi
[10] Author (2001): *I can see but I can't hear,* University of Westminster
[11] Mantle: 4-5, 9
[12] Ibid: 4-5
[13] Autovisie Yearbook (1995): 416
[14] Mantle
[15] Porter, Michael E. (1985): *Competitive advantage*, first free press edition, New York: 42-52
[16] Author (1999): *Design and corporate strategy,* University of Westminster
[17] Becker 1970, Miles and Huberman 1984, Strauss and Corbin 1990, cited by Ghauri, Pervez and Grønhaug, Kjell and Kristianslund, Ivar (1995), *research methods in business studies*, first edition, London, prentice Hall International Ltd
[18] Johnson, Gerry and Scholes, Kevan, (1997: Exploring Corporate Strategy, fourth edition, Hertfordshire, Prentice Hall: 419.
[19] Denzin K. and Lincoln, Yvonna S. (1998): *Collecting and Interpreting Qualitative Materials*, first edition. London, Sage Publications Ltd.: 80
[20] Solso, Robert L. (1994): *Cognition and the visual arts*, first edition, Massachusetts Institute of Technology: 75-78

Contact information:
Elmer D. van Grondelle MBA,
Faculty of industrial design,
Delft University of Technology,
Landbergstraat 15,
2628 CE Delft,
The Netherlands.
Phone: +31 152 786004 / +31 79 3313124
Email: elmer@arx.nl

Co-author information:
Prof. Ir. Matthijs B. van Dijk,
Faculty of industrial design,
Delft University of Technology.