Design Innovation Paradigm and Patterns of Family Cars

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Abstract

Innovation plays an important role in product design development that would respond to the user's needs. However, users' perspective on innovation is influenced by the values that grow in a society. The changes in society values have influenced the users' perspective towards the innovation of the car. This situation leads to gaps between how designers think about the innovation and what the users' needs of the car innovation design are. Thus, this study intends to compare the differences between the designers and users' perspective on the innovation of the Indonesian car industry. The study focused on the design of the four top-selling cars in Indonesia, namely: Toyota Innova, Toyota Avanza, Suzuki APV and Nissan Grand from the year 1998 to 2012. The survey was conducted by distributing 303 questionnaires from June 10 to June 16, 2013 to a virtual community at saft7.com, one of Indonesia's well known automotive websites. Then, questionnaires were distributed and interviews were conducted about the characteristics of product design innovation in several automotive industries, namely: Toyota, on December 1 and March 21, 2013; Daihatsu, on March 18, 2013, Suzuki on April 16, 2013; and Nissan, on May 1, 2013 and May 16, 2013. Furthermore, the data compiled from the industry and the public respondents were processed using the non-parametric Mann-Whitney test and Wilcoxon W. This nonparametric test was performed on two independent samples to determine similarities and differences in the values of certain variables between the two groups tested. The results show that the designers and users tend to perceive car innovation as being part of the incremental innovation category. The innovation gaps were found in the attributes of the orientation of innovation and the product's platform. However, the slight difference indicates that users tend to look at the design innovation as a differentiator and a novelty marker for cars they would purchase.

Keywords: incremental innovation, radical innovation, design driven innovation, designer perception, user perception, family car, design innovation.

1. Introduction

The car industry has seen a rapid change in innovation. In Indonesia, family cars have the highest sales rate for five consecutive years (see Table 1). However, there have been few studies that explore whether the perception of innovation between the designers and the users is similar or different. The study of the perception should be carried out because the industry needs to fulfill the users' needs, wants, demands, and preferences towards the family car innovation. The tight competition among car industries has become the triggering factor in the pursuit of different values to gain a competitive advantage (Brem, 2009). The more the industries know about the users' needs regarding the car, the better innovation could be developed to create better car designs.

Good design should ideally be an ongoing process in the context of aesthetic, functional and commercial to improve the quality of life of a community and to minimize the environmental impacts that may occur (Design Council, 2008). As a process, the ideal design is a system of thought, a mental reference, methods of skills, tools and technologies that are able to define the problem, followed by finding a solution and turning it into something real. The key to sustainable design innovation is the synergy between creativity and the designer's capability to read the development of a society. Creativity is crucial as it should be able to transform those items into practical and attractive products that can provide value which inspires the society / market as prospective users (Bennie, 2011). Innovation is the creative process of translating ideas or inventions into products, which can be realized and can provide novelty values and thoughts, or an early first-time action (Tellis and Sood, 2008). The components of innovation could vary from products, services, to processing the use of new modules or materials.

There are three types of innovation characteristics that could also resemble the phases of innovation. They are the incremental innovation, as the early phase; the radical innovation, as the mezzo phase; and, the design driven phase as the complete phase (Abetti, 2000; Tidd and Bessant, 2009; Verganti, 2009). The incremental innovation phase involves a short term orientation to fulfill the user' needs. It is also related to the market–pull innovation that changes gradually with a small innovation or added value to the products. The radical innovation responds to the long term orientation with a high technology based innovation. It has medium level changes in the product design development. The last phase is the design driven phase that emphasizes the meaning of the products (Verganti, 2009). It combines technology and users' understanding of its design.

From the three types of innovation, this research generates some attributes which could be compared by

the designers and the users. The attributes consist of the orientation, design lifetime tendency, product platform, objective, product operating procedures, production process orientation, users' characteristics, design focus, product/technology, and design management. These attributes were gathered by observation towards the family car design development. By understanding the comparison perception of the family car innovation, this research could describe the innovation paradigm of designing the family car for Indonesian people. Based on that situation, this research objective is to understand the designers' perspective on family car innovation; to understand the users' perspective on the family car innovation; and to compare whether there were any differences in the designers and users' perception towards the car innovation.

Table 1. Car sales in Indonesia year 2008 – 2010

Year	Mini PU & Pick-Up	Minibus & Microbus	MPV (Family Car)	SUV	Sedan	Truck & Bus
2008	90.672	19.755	**266.681**	74.769	32.655	83.622
2009	59.433	9.999	**237.191**	55.595	20.214	55.593
2010	116.358	15.225	**404.041**	89.658	34.86	104.568
2011	154.035	16.739	**459.511**	112.962	19.266	124.018
2012	185.397	20.775	**590.413**	137.033	34.887	47.719

(Source: Summary compilation of car sales data compilation from 'Association of Indonesian Automotive Industries' in 2008-2012)

2. Literature Review
2.1 Design Paradigm and Innovation Pattern
Innovation is a new creation that successfully develops significant economic values of a new product or process as a result of a new idea that enforces knowledge, skills, technology, and experience in creating a new product.

Table 1. Research and Development Pattern and Paradigm with its Innovation

Generation	Paradigm	Pattern	Characteristics of Innovation
First Generation 1950s	Inter group competition	Technology push based on the result of research and development. Developing product innovation using a process based on existing technological findings.	Radical and simple innovation done in sequence and private.
Second Generation 1960s – 1970s	People started to cooperate proactively.	Change in society, the development of consumers and market pushed the growth of a variety of new needs. Research and development of product innovation was done as a reactive action against the trend and market needs in sequential process.	Gradual, simple innovation; dependence between working units began to appear to anticipate changes in the market.
Third Generation 1970s – 1980s	Collaboration in society was more structured.	Production efficiency and market success requires merger between research and development with marketing. Research and development of product innovation was done in a sequential process using feedback between the two.	Radical innovation and gradual, simple innovation. Combination of market analysis and technology push.
Fourth Generation 1980s	Pressure of market needs and the strengthening of information technology	Ongoing development was parallel and integrated based on the integration between users and manufacturers. The process of innovation takes place collaboratively and non-sequential.	Radical and gradual innovation using strong parallel social interaction with potential users.
Fifth Generation 1995-now	Vast information stream and inter boundaries knowledge	Design management systems appeared to regulate network-based system integration. Collaboration in the innovation system conducted takes the form symbiotic networks of information.	Continuous innovation with the use of new technologies and interactions blend with existing social networks.

Source: adapted from Cagnazzo (2008); Savage (1996); Rothwell, R. (1992); Amidon (1996).

The innovation map in Table 1 above shows that the main challenge of innovation lies in the synergy and integration of design and technology development, and various dynamics of economy, social and culture in the society that take place in a sustainable manner. Technological development of such economy, social and culture is a system of mutual influence in the development of product innovation. The key to innovation is novelty and level of product commercial. The final product should be able to meet users' satisfaction when compared with other competitors'. All of this stems from the general paradigm that the success of a product design lies in the aspects of its simplicity and users' empowerment oriented in technological excellence and/or existence more than its formal aspects. The formal form of a product is more a result of the demands of the work function of the products related to the environment where they are used (Papanek, 1972).

The beginning of a new design paradigm initiated by the *Deutscher Werkbund* (1907-1935) and Bauhaus (1919-1933) movements have brought the industry's awareness of the importance of the artistic value of the product in line with technological advances applied to the product as a new method to improve the marketing success of the products (Luke, 2002). Since the Bauhaus era until 1970s (Bayley, 1985), the paradigm of 'good product' began to focus on the quality of formal / visual product forms with existing technology constraints. In this phase, the design orientation still relied on designer's decision (product oriented). The society was conditioned more as a group of common people who would be potential buyers of the products offered, while designers and the industry were considered as the party that understood their needs the most.

In the 80s decade, the design paradigm began to shift toward community-oriented design. Design played a role in the social and economic context, as well as giving more attention to the role of product users to the design process (Forty, 1993). This was a result of strong consumer demand for a more specific product design. The industry was conditioned to follow the shifting balance. According to Hilton (2001), it is a sign of the emergence of the era of consumerism. Products are increasingly becoming a means of establishing identity in the world of commodification, be it as a conscious act of the consumers themselves, manipulation of intentional desire done by marketing experts to the community, as well as the more specific variant of the interaction between a product and the consumer with a variety of functions.

In the 90's decade, consumers began to grow into a producer of meaning for cultural artifacts, including design (Walker, 1989). The trend of design innovation using Pierce's concept of semiotic in the anthropological understanding of myth and symbol started to develop (Hebdige, 1981). It enabled design to be more capable of expressing a new meaning to the object of consumption that is designed in the social and cultural context (including the sub-culture). The design had a greater capacity to build the myth into a tangible form and made it a reality. The key to the design's success rested on its ability to combine a variety of practices and activities of the community in generating meanings associated with the products they used. The end of this decade was marked by the start of the design development efforts that can meet a variety of different market segmentation by product and industrial designers.

The beginning of 2000 decade was marked with the development of innovative design concept that focuses on usability, emotional / likeability and user-centered as a new paradigm (McDonagh, 2000). Good design according to Barnum (2011: 1, 324), is a design that takes into account its cultural differences so that the products made are easy to learn how to use them, easy to use, intuitive and fun when used. This paradigm tends to make design evolved as a cultural artifact that can represent various stakeholders associated with it in a sustainable manner. The end of this decade is marked by the growing public demand for designs that can meet the users' physical and psychological needs. The development of the product design innovations was sharpened on a human scale that was inclusively referred to the users' preferences and experiences (Kälviäinen, 2000). The design exploitation of usable products has made them evolve into a cultural artifact entity with various other related aspects of life in them (Luna, 2001, 45-69). Design is increasingly becoming a medium of visual expression and representation of community and social classes that have left the initial aspects of technical function much further (Morello, 2000). In an increasingly mobile urban life, creative design challenge lies in optimizing the needs and aspirations of the product (Malhotra, 2005, 7-28). Therefore, as a matter of culture, the focus of design innovation needs to be addressed as a problem-solving effort in which there is the issue of value, meaning, behavior, reality, habits wherein everything will always be associated with visual imagery and expression of human life.

In its development, design has undergone a metamorphosis from a solution for function and safety - comfort of product operation problems to a vehicle for the modern human entity to actualize himself (Dinkgräfe, 2005: 173). In terms of engineering, superior quality products continue to be developed in the direction of increased efficiency, safety, and comfort of the product operation (Carlopio, 2010: 151). Technology plays an important role in presenting a variety of novelty products to satisfy users to the growing global issues. Technology is the key for everything ranging from the approaches of environment-friendly products with higher energy efficiency, the development of safety driving system, to attempts to improve its users' performance and operating skills on various features of the existing controls. The product along with all attributes associated with it has grown to become a part of self-representation symbol and become a part of people's social class identity

(Carlopio, 2010: 74). The increasing complexity of product variants offered carries the implications for the formation of character groups in the community. This has made people tend to adjust the various artifacts they own with their values or groups. The society has increasingly needed a distinction between themselves or their groups with others through the way of choosing a product and various markers and distinctions.

Design has continuously formed the growth of product users' community characters through the consumption of lifestyle and brand image, in addition to various added values with the optimization of engineering, physiological (usability), and psychological (likeability) needs. All of these tend to make the current product design shifted towards fashion (Ehrenfeld, 2008: 73, 103, 131). Fashion is the motor of novelty in product design through development pattern of design styling which is more thematic and focused on the exploitation of the visual character. The styling approach to design leads to the aesthetic side with emotional value, strengthens the visual imagery of the brand, and becomes a differentiator to other brands (Carlopio, 2010: 43, 63; Fletcher, 2008: 132, 133, 134, 136). Furthermore, imaging of the brand identity of a product becomes stronger in binding the characters of its community. Design is approaching each user's segment specifically by developing a number of variants of shapes, sizes, and product features.

2.2 Definition and Categories of Innovation

According to Luecke and Katz (2003), innovation is generally understood as the successful introduction of a new thing or method; innovation is the embodiment of combination, or synthesis of knowledge in original, relevant, and value of new products, processes, or services. Based on this definition, the innovation typology could be divided into four parts, such as product innovation, process innovation, organizational innovation, and the market innovation. Though the types are different, they work as interrelated components to build the innovation process effectively and efficiently (Avermatte et. al. 2003:10). Every typology of innovation would result in a certain novelty to the final product and ultimately will create a novelty for the prospective users or completely new users.

Innovation tends to cultivate the meaning of the product, process, organization, and market. To gain the innovation on product, process, organization, and market, car designers could use some resources in the socio-cultural environment, such as the economic conditions; demographic; and social changes (perception and perspective), as well as new science and technology (Drucker, 2002: 5 -10). Verganti (2009) argued that people do not buy products but meanings. Although technology and the market is the motor of innovation, the more innovative products can only be achieved by reading how society makes sense of a design to meet their various needs. Therefore, the car makers need to understand the various developmental meaning besides technological and socio-cultural developments in the society to support the improvement of their product innovation.

Innovation could be defined as incremental categories when it focuses on extending the product's life cycle by adding a variety of improvements or changing the characteristics of the existing products that can provide novelty (Rampino, 2011: 8); while radical innovation provides novelty product as a whole. This innovation is the result of the latest technological application to create a completely new product with major improvements. (Brem, 2009: 355). The next category is design-driven innovation that stresses the importance of radical innovation of meaning (Verganti, 2009). He explained that design-driven is a medium between radical and incremental innovations. Though there are some tangencies between radical and design-driven innovations, Singh (2011) explained that the radical innovations propose different and unexpected meanings that answer what people are actually waiting for. On the other hand, design-driven strategy emphasizes on realizing "proposals" and "putting forward a vision". He stated that design-driven is a push strategy which moves against the dominant aesthetic standards and the established product meaning in the industry.

2.3 Innovation in the Automotive Industry

The car industry's vision need to cover aesthetics (shape and color), visual trends, the environment, and the users' cultural background, as well as the marketing and engineering insights in the design and production development. The design development division should increasingly be aware of the importance of social perception facts in the market as a reference to develop new designs. Furthermore, design relates to cultural change and its ability to affect people's mental conceptualization. Therefore, the design development needs to explore the entire space preferences of the prospective customers to gain innovative ideas for the design.

Responding to this situation, Utterback (2006) stated that there are four strategies for designers to develop innovation. These include: 1) design exploration of the new territory, 2) learning something about everything related to the user, 3) finding the hidden connection between the product and the user, and 4) creating a prototype that can be operated responsively by the prospective users. In addition, Tidd and Bessant (2009) maintained that the innovation strategies could only be implemented by the industry if there were an integration process on the design development. The integration includes the engineering process, analysis, design development, manufacturing process, and development of the final product.

Moreover, the integration could also be found in the invention of technology and the changes in social

demographic factors that have pushed the automotive industry to develop car innovations, because cars have become a dominant influence in urban people's mobility and have made them become dependent on them (Graeme, 1995: 31, 32, 34). In incremental innovation, design comes as an attempt to create visual delights for the society as the design user. Some examples of design development are creating innovation on the simple components of the car by replacing the design of the bumper, grille, taillights, glass, extra console box at the car front interior, the model replacement of rearview mirror and so on. The incremental innovation is the cheapest cost of innovation. The product development strategy is focused on extending the product's life cycle by emphasizing the product's added value through various simple additional features.

Radical innovation creates innovative user-centered design. A designer is capable of approaching the user, understanding their needs, and then producing creative ideas which are supported by the massive technological advances. Here, the design evolves to facilitate the users' desires and expectations as the subject of design with various advanced utilities and simple features. This product development strategy is expansive and budget consuming, with the main emphasis on the penetration of new markets. The sophistication of the technology became the basis of product development. This strategy has a high competitive level and extreme point of failure or success in the market. The automotive industries push the innovation onto the market and assume that by using advertising and informational campaigns they could enhance the market's learning curve through their innovation (Lenfle and Midler, 2003: 146). Some examples of the radical innovation application on cars, for example: dual hybrid electric system developed by Volvo that integrates almost fifteen patents (Pohl, and Maria Elmquist, 2008) and carbon fiber reinforced plastic technology for lighter and stronger car parts developed by BMW (Price Waterhouse Cooper, 2003), and vehicle safety and driver assist technologies developed by Ford (Ford, 2013).

The design-driven innovation develops design to create novelty through meanings by means of predicting the society's future needs through in-depth research within demographic evolution from the technological, social, and cultural aspects (Verganti, 2009: 7, 9, 92, 107). If incremental innovation is market-based and radical innovation is technology-based, the design-driven innovation requires more closeness to the prospective users. In design-driven innovation strategy, there would be a situation that triggers the technology integration with the ongoing market orientation. To implement the integration, the car-makers need to have a strong social-culture orientation. It emphasizes product differentiation with various value-added elements and novelties that are capable of providing satisfaction to the users, and marketing it to the specific segment of potential customers.

3. Research methods

The method used was qualitative research and the automotive industry was the unit analysis of this research. The data sources are designers and users, which were gathered through observations, in-depth interviews, and surveys. Observation was carried out to understand the design of existing family cars commonly used by Indonesians. There were four top-selling MPV that were being observed, namely: Toyota Innova products (with 13 design variants), Toyota Avanza (with 5 design variants), Suzuki APV (with 6 design variants) and Nissan Grand Livina (with 11 design variants) from the year 1998 to 2012. Those cars are categorized as family cars as they have three-seat rows and are aimed to fulfill the family segment in Indonesia (Figure 1).
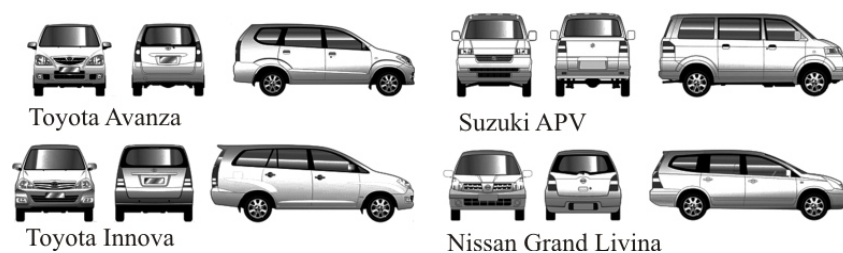

Figure 1. Exterior comparison of the four tested cars.

Furthermore, the in-depth interview was carried out to understand the designers' perspective on the innovation categories. The instruments used for the interview were extracted from the attributes of the design development. The survey was implemented to gather users' perception of the innovation categories. The same attributes used in the in-depth interview with the designers were also asked in the questionnaires for users. Because of this, the study could analyze the comparison between the designers and users' perspective towards the family car innovation. The questionnaires were distributed to 303 respondents in the virtual community gathered from saft7.com – a popular automotive website in Indonesia that has an average of 190,000 visits per day. Then, the results of the in-depth interview and survey were converted into ordinal scale to compare and analyze whether there were similarities or differences between the designers and users towards the innovation

categories.

To understand the comparison, this research would use the nonparametric tests for the two independent samples. This type of test is useful for determining whether or not the values of a particular variable differ between two groups. This is especially true when the assumptions of the *t* test are not met. Most importantly, the *t* test assumes that the sample mean is a valid measure of the center. While the mean is valid when the distance between all scale values is equal, it is a problem when the variable is ordinal; because in ordinal scales, the distances between the values are arbitrary. Furthermore, because the variance is calculated using squared distances from the mean, it will also become invalid if the distances are arbitrary. Finally, even if the mean is a valid measure of the center, the distribution of the test variable may be overly abnormal such that it causes suspicious of any test that assumes normality. To conclude whether there are any differences between designers and users, this study implemented Mann-Whitney and Wilcoxon statistical analysis. The statistics is used to test the null hypothesis where two independent samples come from the same population. Their advantage over the independent-samples of the *t* test is that Mann-Whitney and Wilcoxon do not assume normality and can be used to test ordinal variables. The hypotheses of the research are as follow: H_0 indicates that there are no differences between designers and users' perceptive regarding the innovation of the family car design. H_1 indicates that there are differences between designers and users' perceptive regarding the innovation of the family car design.

The design driven strategy has a tendency to support the producers' success. Hence, the strategies have now started to be used more frequently by the producers to improve user satisfaction. To compare the three categories of innovation on the car design development, this research has compiled some attributes such as orientation, design lifetime, product platform, objective, product operating procedures, production process orientation, users' characteristics, design focus, product/technology, and design management. The comparison among the three categories is given in table 2. The data shows the comparison in the stages of design development. The first attribute is design development orientation, which is a background perception that triggers innovation. The second attribute is the design lifetime. This attribute explains that the incremental innovation has a short design lifetime compared to radical and design-driven innovations. This situation occurred because the market trends easily change over time. The third attribute is design development objective. The incremental innovation objective emphasizes prolonging the product's life cycle; while the radical innovation puts an idea on building a new product's life cycle. In the mature stage of the products' life cycle, a producer needs to think about how to rejuvenate them. Thus, they put significant effort into technology adaptation to make a radical innovation. The last category is the design-driven innovation. The objective is to create a new market by strengthening the meaning of the products.

The fourth attribute is *product operating procedure*. This attribute explains how operational management synergizes within each category. The incremental innovation focuses on the existing operational management to solve particular problems within the systematic approach of the existing products. The radical innovation emphasizes the understanding of the socio-cultural context in the users' perspective. It also attempts to find a new way in operational management. The design-driven innovations emphasize the management operation on the deeper understanding of the users' socio-cultural background to find the meaning of the products. The fifth attribute is *production process orientation*. It concerns the production process and how to implement the technology on the production process. The sixth attribute is *production process development*. The seventh attribute is *the users' characteristics*. This attribute explains how the industry pays attention to the users' characteristics in their design. The eight attribute is *design focus;* it is how the industry focuses on their design. The ninth attribute is the *product/ technology involvement in design development*. Finally, the tenth attribute is *design management*.

The car industry is developing a wide range of specially designed features and variants. They seek to provide insights and added value with the purpose of indulging the potential users with the cars they produced, by sorting out the types based on the target market segmentation more specifically. This tendency evolves into a competition in the car industry and directly impacts on the more accelerated frequency and intensity of design changes. The tendency of design lifetime seems to be conditioned to be getting shorter. In this situation, the car design no longer attempts to solve the technical aspects and functions alone. It has increasingly evolved into a medium of visual expression and representation of urban social classes. Car design has increasingly left the technical aspects of the early car function as merely a means to move.

Table 2. Comparison of the innovation characteristics in design development

No.	Design Development	Incremental innovation	Radical innovation	Design-driven innovation
1	Orientation	Market-based	Technology-based	Meaning-based
2	Design lifetime tendency	Short	Long	Long
3	Product platform	Old	New	In-between
4	Objectives	Extending the product's life	Building a new product's life cycle	Creating new markets
5	Product operating procedures	• Patterns of formal stages of work the user in operating the product	• Following the user's pattern in socio-cultural and lifestyle emerging	• Developing a new perspective on the product
		• Focuses on the operation improvement	• Focuses on the new procedures operation	• Focuses on the new procedures operation
		• Systemic approach to particular modules	• Designing a system approach opens new technical opportunities	• The new design system approach to change the user perspective
6	Production process orientation	• Efficiency of the function	• Facilitate the collection of science-related	• Oriented in effectiveness
		• Reducing risks	• Supporting risk taking and experimentation	• Experimenting to reduce risks
7	Users' character	• Focuses on existing technology exploitation • Homogeneous users • Experienced user on similar products	• Focuses on new technological exploitation • Heterogeneous users • Deconstructing existing patterns operations and seek alternatives	• In-between and socio-cultural • Homogeneous users • Impressing the user at first sight
8	Design focus	• Production costs reduction by component efficiency	• Developing new technology and operational methods	• Developing new breakthroughs based on social, cultural, technology
		• Developing additional features	• Experimenting with new operational methods	• Developing new products meanings
		• Improving the efficiency of existing competitors	• Creating new ideas	• Proposing a new vision and meaning to the product
9	Product/ technology	• Majority using the existing technology	• Majority using the new technology	• Developing new breakthrough efficiently
10	Design management	• Exploiting product's details and interfaces	• Exploring users' characteristics and how design facilitates them	• Exploring the evolution of culture, technology and society

4. Findings

4.1 Designer's Perspective on Current Car Design

The car designers perceived incremental innovation categories in the design development. The designers argued that the innovation orientation in car design was intended to anticipate the market by keeping the product life cycle so that they could be sustainable and accepted by the market. Furthermore, designers confirmed that the existing design had complied with the needs, desires and satisfaction of the current car users. Hence, it could be concluded that they tend to use the market-based design development, and adapt it to the existing technology. From the perception of designers from Toyota, Daihatsu, and Nissan towards the lifetime of good design, they believed that good design innovation was a long-lived one. This implied that they have already considered the area of design-driven innovation categories; while Suzuki's designers believed that a good design life time is short. In this case, Suzuki used the concept of incremental innovation. Thus, the industry could continuously swap and plug in the various components of the car that were well accepted and appreciated by the market.
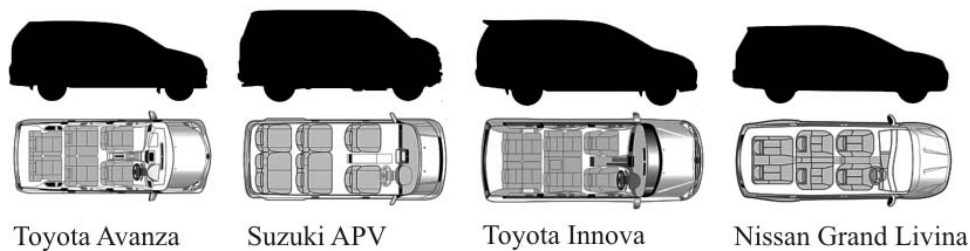
Figure 2. Interior layout comparison of the four tested cars.

Overall, these designers tend to choose design-driven innovation in developing their design. They often use the strategy of pairing the new product components with the old platform to give a new impression of the developed products. The example of modification of an old platform was the *Daihatsu Terios* which was modified from the original model from Japan. The modifications were made by extending the wheel base to fit the needs of Indonesian people who preferred 3-seat rows for the family cars, as shown in figure 2.

The product design development in Toyota and Daihatsu tend to choose incremental innovation to extend the cars' life cycle. Both of them preferred to enhance the users' workflow pattern in operating the product as a focus on improving the products' operation. Their operational procedures on the design development tend to follow the Kaizen system. This design approach did not directly follow the emerging trend of the people's lifestyles. Toyota and Daihatsu tended to develop new functions based on one platform with the aim of production efficiency. They used existing technology with various visual approaches on the same vehicle basis. They are not ready to compete on the side that changes the users' point of view. Daihatsu considered that Indonesian society were still in the early adoption of car technology. Thus, the sophistication of the technology would be seen as a new complexity for the users.

The designers also thought that early adopters were conservative in using the car and the technology. The users were also perceived as risk-averse users that purchased cars according to the common needs of the people in their lives. Toyota and Daihatsu had already in common in Indonesia that they were family cars' pioneers in this country. Indonesians preferred to purchase these cars in order to minimize the risk. However, Toyota and Daihatsu designers understand that the Indonesian market could be divided into two groups according to the economic levels of the users. The designers argued that Toyota is perceived as the medium-high car by the users, while Daihatsu was perceived as the medium-low car. The designers also assumed that some mature users have had experiences of the product and were well informed about them. Though designers had already understood the different users' behavior, they all agreed that good design should be able to impress the users at first sight. Designers agreed to create designs which were stylish and had the wow effect.

Different from Toyota and Daihatsu, Suzuki and Nissan tend to focus on the radical innovation category. The designers tend to think that radical innovation was needed to build a new life cycle of the product. They emphasized developing opportunities on new technology and product operating procedures. The design teams sought to develop design by observing all things that happen in the society. Nissan Juke with the unusual shape design was an example of a vehicle which took a market risk. The new vision and values of a product are preferred by the majority of designers in design development. This is accomplished when the engineering aspects of the car had been well-assessed and the car also had a saving-fuel system to improve the efficiency. This situation differentiated the car from the existing competitors. The car was also built in the new platform that the old mold had been discarded.

There are some challenges in the car innovation. The first was a challenge to avoid the market rejection or failure. To anticipate the challenge, the designers claimed that the company released a six-month test on the new products to the market. Then, the marketing divisions would gather responses from the users and communicate the results to the designers and production division. Another challenge was that the research and innovation would take a huge cost. To anticipate this, producers had different operating production strategies. For example, Nissan had more orientation towards the product functions mixed with production efficiency. Toyota and Suzuki facilitated the development of various science related to the design that was being developed. Meanwhile, Daihatsu was more oriented in the production effectiveness.

To be more efficient and productive, the car makers underwent three (3) production stages to prepare the technological readiness level of mass production. They should (1) match every car parts in order to join all parts with precision, (2) conduct a trial production by trying to assemble a vehicle with a variety of parts that have been matched in engineering, (3) prepare the new design to go into mass production stage after fulfilling various industrial criteria. The convenience of production processes was also a major concern. When entering the production flow, Daihatsu was targeting *"one minute one vehicle"*. The sequences of the flow were: parts matching, parts reviewing, production trial, production tooling, and finally entering mass production stages with a target of one car in one minute. Essentially, the new design should not slow down the mass production speed.

The industry strongly considers the elements of speed and accuracy associated with the cost of the production process.
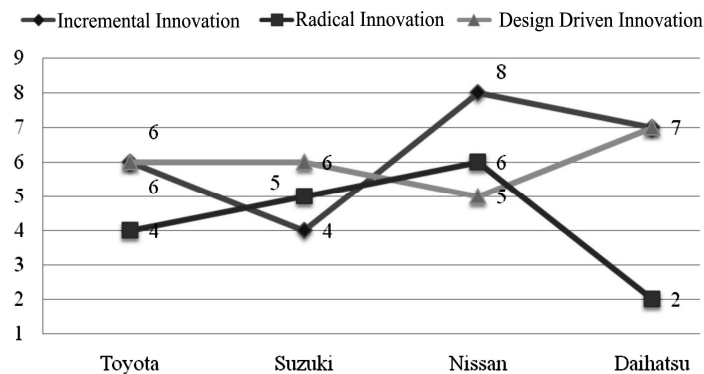

Figure 3. Characteristics of design innovation in the tested car industry.

Figure 3 is the result of the interview, explanation, and response to a list of questions to the six sources (informants) who hold the position of research and development related to the design of the four studies used by the automotive industry (Toyota, Daihatsu, Suzuki, and Nissan). Broadly speaking, the innovation process in the car design to anticipate market target is to keep the products' life cycle to continue the market's acceptance. Data collection was conducted to determine the extent to which the development of the design has been done to it and further confirm the extent of the existing designs in accordance with the needs, desires and satisfaction of current car users. This phase of research was carried out to find the hidden meaning in the design development of automotive industry in designing the vehicle model.

At the macro level, the pattern of the design innovations made by the majority of the automotive industry in Indonesia is associated with the focus of the operational procedures in the development of the product design, user faceted design considerations, the main focus and approach to the design of technology in the development orientation that vary between stages of innovation, radical innovation and design-based innovation (Figure 4). In each of the vehicle design development of family cars, they tend to do three (3) innovations as well. Innovation tends to run gradually to extend the life of the base design of cars sold. Innovation -based designs are preferred by the automotive industry in the context of producing a long design life, the development of base products used for the development of car design in the view of the users' character design, as well as the top priority in the design development. The pattern design approach is done through the development of radical innovations. The automotive industry sees radical innovation more as a tendency of the design development goal which is built on a completely new platform or marketed products to build their sophisticated image.

4.2 User's Perspective on Current Car Design in the Automotive Industry

The survey on the users' perception towards the car industry innovation was carried out through an internet survey. This study was assisted by saft7.com, a popular Indonesian website which holds a forum for virtual community to share experiences about automotive matters. 20 questions were posed to the community. Eighteen of the questions represented the attribute chosen for describing the innovation category. There were 303 respondents to the survey. From the total respondents, 94% of them were male and the rest were female. The respondents were mostly 31 – 40 years of age (58%), followed by those who were 45-55 years of age (28%). Thus, it represented that they were in their productive age with experience in using cars. The users tend to perceive the car industry innovation as an incremental innovation. Here are some opinions gathered from the questionnaire:

Table 3. Indicator of purchasing cars and preferences on existing platforms

No.	Attributes of Innovation	Indicator	Percentage	Cumulative Percentage
	DESIGN ORIENTATION			
1	*Opinion regarding car design nowadays*			
	Incremental	Adjusting new design to the market needs	39.60%	39.60%
	Radical	Developing new design according to the technology advances	23.45%	63.04%
	Design Driven	Following the updated trends	36.95%	100.00%
	DESIGN LIFETIME TENDENCY			
2	*Opinion regarding the cycle of new design in the market*			
	Incremental	No problem if new design comes so fast	68.49%	70.63%
	Radical	New design should not come too fast	17.48%	99.01%
	Design Driven	Previous design remains attractive	14.03%	100.00%
	PRODUCT PLATFORM			
3	*Opinion regarding to the expected design*			
	Incremental	The design should be long-life	66.34%	66.34%
	Radical	The design could just be an upgrade or facelift from the previous one	6.60%	72.94%
	Design Driven	The design should be unique	27.06%	100.00%
	OBJECTIVES			
4	*Opinion regarding ~~to~~ the new design compared to the previous one*			
	Incremental	Only has a few small changes	32.34%	32.34%
	Radical	Different than the previous one	29.70%	62.05%
	Design Driven	Combine both for the new market segment	37.95%	100.00%
	PRODUCT OPERATING PROCEDURES			
5	*Opinion regarding the most-desired car*			
	Incremental	Design could adjust the daily activities	56.77%	56.77%
	Radical	Design could meet the lifestyle	16.17%	72.94%
	Design Driven	Design should be cool and very surprising	27.06%	100.00%
6	*The trend of today's car according to user's observation*			
	Incremental	Only do the minor facelift for cosmetics	55.78%	55.78%
	Radical	New technology features on the cars	30.03%	85.81%
	Design Driven	New lifestyle features	14.19%	100.00%
7	*The car design emphasized in the society according to user's observation*			
	Incremental	Improving the previous car design performance	13.53%	13.53%
	Radical	Adding new interesting technological features	85.48%	99.01%
	Design Driven	Adding new interesting features	0.99%	100.00%
	PRODUCTION PROCESS			
8	*The trend of Indonesian car according to user's observation*			
	Incremental	Tend to develop low-price cars	22.11%	22.11%
	Radical	Tend to develop new technology cars	17.49%	39.60%
	Design Driven	Tend to give a facelift to the cars	60.40%	100.00%
9	*The manufacturers experiment for the new design according to user's observation*			
	Incremental	Ordinary experiment to fulfill the market needs	63.04%	63.04%
	Radical	Tend to do experiment and take the market risk	9.57%	72.61%
	Design Driven	Experimenting to decrease the market risk	27.39%	100.00%
	USER CHARACTERS			
10	*The manufacturer attention to the users' characteristics according to user's observation*			
	Incremental	Perceiving that users are all experienced drivers	33.66%	33.66%
	Radical	Requiring the users to study the new technological features of the cars	21.45%	55.12%
	Design Driven	Tend to make a high impression at first sight.	44.88%	100.00%
11	*The car that will be purchased if the users have limited budget*			
	Incremental	Popular/branded cars	26.07%	26.07%
	Radical	Car with the new technology	28.71%	54.79%

No.	Attributes of Innovation	Indicator	Percentage	Cumulative Percentage
	Design Driven	Attractively designed cars	45.21%	100.00%
	DESIGN FOCUS			
12	*The today's car character according to user's observation*			
	Incremental	Each brand tends to be similar to the other.	78.22%	78.22%
	Radical	Each brand has different technological advantages	20.79%	99.01%
	Design Driven	Each brand has different values and characters	0.99%	100.00%
13	*The Indonesian car design pattern according to user's observation*			
	Incremental	Tend to exploit the product detail and user's interface	50.17%	50.17%
	Radical	Tend to study the user characteristics for developing the design	33.33%	83.50%
	Design Driven	Tend to explore the cultural change, technology, and other environmental concern for the new design	16.50%	100.00%
14	*The car manufacturer priority of their design method according to user's observation*			
	Incremental	Developing new feature to the design	56.77%	56.77%
	Radical	Doing Experiment to the new product technology operational method to the new design	7.26%	64.03%
	Design Driven	Developing new added value to the car design	35.97%	100.00%
	PRODUCT TECHNOLOGY			
15	*The technology perception of the manufacturers according to user's observation*			
	Incremental	Mostly using the same technology	67.99%	67.99%
	Radical	Mostly using new technology	15.84%	83.83%
	Design Driven	Developing new breakthroughs efficiently	16.17%	100.00%
	DESIGN MANAGEMENT			
16	*The manufacturers way in developing new design according to user's observation*			
	Incremental	Exploiting the existing technology	28.38%	28.38%
	Radical	Focusing on the new technology exploration	3.63%	32.01%
	Design Driven	Combining both approaches (exploit the existing tech. And explore the new tech.)	67.99%	100.00%
17	*The Indonesian design development according to user's observation*			
	Incremental	Tend to be cost effective for the component	74.26%	74.26%
	Radical	Tend to develop new operating system	15.84%	90.10%
	Design Driven	Tend to design new breakthroughs based on social, culture, and technology variables	9.90%	100.00%
18	*The manufacturer's main consideration about their design development according to user's observation*			
	Incremental	Efficiency from the competitors	55.78%	55.78%
	Radical	Creating new ideas in the car activity	10.23%	66.01%
	Design Driven	Offering vision and added value in the car design	33.99%	100.00%

The above results indicate that respondents expect the profit-driven innovation as the design they are looking for, but the fact remains that the industry is in the category of gradual innovation. The trend in the industry that prefers exploitation of product details is are seen more as an optimization of interface design that compromises the development of economic production. The recapitulation of the respondents' answers to questions relating to the three categories of innovation (Table 3) shows that the automotive industry is facing fierce competition within the MPV segment prices for lower-middle class, which have forced them to always strive to become more effective and efficient in managing the design development.

4.3 The Comparison of Designers and Users' Perspective on the Design Innovation
To compare the perception between designers and users regarding family cars, this research used the non-parametric test from Mann Whitney and Wilcoxon W. The 2-talied Asymptotic Significant result shows that there were some differences between certain attributes. However, most of the attributes tend to have no differences.

Table 4. Non parametric test for user and designer perspective on car design

Design Development	Mann-Whitney U	Wilcoxon W	Z	Asymptotic significance (2-tailed)*	Conclusion
Orientation	**240**	**250**	**-2,262**	**0,024**	**Different**
Design lifetime tendency	344,5	49.172,5	-1,934	0,053	Not Different
Product platform	**168**	**48.996**	**-3,008**	**0,003**	**Different**
Objective	396	406	-1,334	0,182	Not Different
Product operating procedures	472	482	-,866	0,386	Not Different
Production process orientation	616,5	626,5	-0,045	0,964	Not Different
User's character	582,5	49.410,5	-0,234	0,815	Not Different
Design focus	623	633	-0,006	0,995	Not Different
Product/ technology	512	49.340	-0,747	0,455	Not Different
Design management	546	49.374	-0,470	0,638	Not Different

*Significant for α = 0,05

Cross-tabulation of the test results in Table 4 above shows the majority of perception between users and designers in developing the design of the same car. Differences in perceptions between users and designers lie in the orientation of the base product and design development. Both groups tend to assume that innovation is an additional category in car design. However, there are some differences which indicate the behavior of users who tend to seek the benefits of design innovation as a differentiator for the car they want.

Respondents prioritize on attractive interior design over exterior. This is due to the modification of the car; one part of which is not less important is the interior. No matter how good the exterior design of the car is, it would feel inadequate if not matched with a good interior design. The comfort in the car also greatly affects the quality of the driving. The interior design of a passenger car is one of the top priorities for manufacturers in offering a product to attract more buyers. These include: the selection of colors, types of material used for seat cover, dashboard shape, the color of the car ceiling and the selection of other accessories that support the appearance and beauty of its interior. This is done because the more comfortable the interior design of a car, the more comfortable users will feel driving it, and vice versa. The exterior design is the exterior appearance that may indicate or reflect the inside of the car. The exterior design featuring a certain impression of the exterior design of the car is one of the things that supports the aesthetic value of a car in order to look beautiful and attractive. The beauty of the exterior design can be reflected in the external appearance of the car.

The orientation of car design development for a family on the five surveyed automotive industries is market-based group. This is one of the characteristics of the gradual innovation, while the public's expectations of the design on the gradual innovations tend to spread out the distribution of the gradual innovation only 39.50 %, while the 23.49 % of radical innovation, and 37.01 % of design -based innovation. The consistency of this automotive industry is seen on its view of the life of good design. The survey showed that four out of the five industries tend to see that a good design is the one that is long-lived. Since the industry only needs to simply perform a one-time industrial design development and sell it as much as possible. Problems arise when the gap between industry and community perspectives occurs. The survey found that 71.17 % people think that good design is the one that tends to be short-lived. That is the preferences of the community on the level of novelty in design become critical in the design of the car.

Regarding the basis for developing design products, all industries tend to perform design-based innovation. The pattern of their design development is to combine the old product base with the addition of new components. Any changes are made on the basis of long established industry according to market needs. The market needs in question here is based on information compiled from various parts of marketing input from dealers in every area of car product sales concerned. Meanwhile, the distribution of public opinion looks pretty evenly split. Where 32.74% of respondents thought that the development of new designs were based on old products, 29.89% were product based, and 37.37% considered that the development of the new design is an amalgamation of old and new products, as needed.

Radical innovation is the goal of the design of automotive industry. From five automotive industries, three of them develop design to build a new life cycle of a product. While 64% of people thought that it was made to extend the life of the product, this is in line with the answers given by two out of the five industries. The development of design with the aim of creating a new market segmentation industry is not an option, even though 28% of people see it as an attractive option. This is because opening new market segmentation requires huge investment and also great risk. The overall approach exploits the technological advantages in the design development of automotive industry is not an option. Three out of five industries use existing technology, while 55.4% of the society has approached the former understanding. The use of new technologies was only chosen by

one of the industries and 15.56 % of the population. This suggests that the gradual innovations tend to be more of an option than radical innovation. For the society, the use of new technology industry tends to be seen as an expensive production costs and the problems of care complexity for its users. The trend applied in the development of the operating system of product design in the automotive industry tends to choose the sequence of radical innovation as an initial orientation development. Gradual innovation became their second choice. However, 86.38% of respondents preferred a new design system that is able to give the impression of a new operating procedure that changes the users' view.

The main focus in the design development of four out of the five industries is the reduction of production costs by the components' efficiency. As much as 73.99 % of people have the same thoughts as the industry. The society hopes that with the more efficient use of the components, the more affordable the selling price of the car and the more efficient the cost of maintenance. Regarding the top priority in the development of the design, one out of five industries chose to develop additional features and 56.78 % of them agreed with this view. However, there is no industry preferred to develop a new way of operation. Four out of five industries preferred to develop new values of the product. The production process is essential as a follow-up of the design development. Here, the industry preferred the combination of gradual innovation and design-based innovation. The automotive industry tended to be more oriented towards the efficiency and effectiveness of the functions when performing various experiments to reduce the risk of the products' rejection by the market. This is also in line with the perspective of the society.

The comparison results of the innovation elements from the survey conducted in the manufacturing industry and the users regarding family car showed the results of an industrial design development patterns associated with the users. Three out of five tended to perform design-based innovation by focusing on the users characteristics and facilitating them through design. This is close to 33.33% expectations of the community. Moreover, the other two industries tended to exploit the product details and system interface, which addressed the same by 50.00% of the respondents. Innovation-based design that explores the evolution of culture, technology and society was not an option for the industry and also only 16.67% of respondents agreed to this.

Within the fund limitations in buying new expensive cars, the new cheap ones that people preferred to buy, in order, are: new tech, 28.36%; famous brand, 26.49%; and attractive design, 45.15%. This suggests that although the car must be financially affordable, it still must be able to demonstrate excellence in its visual appearance. Then, regarding the design of the car, 57.86% of the people would rather to choose an attractive interior design rather than the exterior one when buying a new car. In connection with the car exterior, the most favored basic form of family cars people preferred is the vehicle that has a bonnet (engine hood), has sufficient headroom that gives a broad sense of the car interior and has three rows of seats for maximum passengers' capacity.

5. Discussion

From Table 3 it can be seen that the proportion of innovations is implemented between the automotive industries and judged by the public. In general, the greatest weight of innovation still relies on gradual innovation. The second position is a design-based innovation, while radical innovation occupies the last position. The similarities between the automotive industry's perspective and the community in the new design is a merger between the base of the old design (known to the public) with the addition of various body components for the exterior and interior design that can visually give a new impression. The main aspect in novelty made by utility is its ability in meeting the functional needs of the public. Aesthetically, it is capable of providing beautiful and attractive forms to the interior and exterior of family cars.

The novelty concept is crucial to the community in the decision to buy a new car. The desired novelty is not the one with brand new technology-based. Although people want design novelty and rapid change, if the technology requires them to change their habit pattern, then it tends to be considered as a problem. People want novelty, but not the one that forces them to change their habits. The society prefers novelty in design patterns that can adapt to their customs. The most preferred technology by the community is more on interface technology which is represented on the control panel in the car dashboard than what is installed on the suspension and propulsion system (which is not directly visible). Learning patterns to an operating system (technology) for a new car tends to be regarded as an obstacle by the community.

The results of the survey showed people's perception of the automotive industry users in designing a car. In general, there is a link in the understandings that the industry pay attention to the characteristics of users in the design of the car before it is marketed. Users also felt that a car has become one of the facilities that can support their daily activities. An in-depth exploration on various things that become a routine activity when people use a car: starting from single-handed use, with one's extended family to the nuclear family; in order to design a car to be well received by the car users in Indonesia. The results of the field research over medium groups represented a more pragmatic orientation related to lifestyle and utility products. The need for new technology is always there, but not a major one. The presence of the most desirable technology is the system that makes the user

interface of advanced realms, namely the processing of the control device on the dashboard and steering area. Users prefer a car with features that can support their daily activities (utilitarian) and the attractive appearance of the car to meet the lifestyle and various other hedonistic aspects.

The difference in perspective between designer and user lies in the orientation and product platform. Car industry does not orientate itself in applying its latest technology in cheap car segment in Indonesia since it will result in the increase of production costs and the price of product. The difference in cheap car price with the competitor from the same class has become a sensitive issue for customers in buying cars, while users tend to look at it from a different angle. The can see that the orientation of car design development in Indonesia now has been developed by car industry and that they have tried to satisfy the users' needs and wants from its technological and design sides. Meanwhile, the difference in perspective between designers and users in product platform lies in the novelty concept. If respondents hope that new car design, ideally, must be different visually from previous product, then the industry tends to look at its production economy. This means that respondents consider that in general, the innovation that has been applied by the automotive industry is still an effort to exploit old product basis to its maximum, perhaps by changing certain additional components to make them look new.

6. Conclusion

Considering the trend of car design that evolves through the medium of visual expression and representation of the society, then such difference in perspectives needs to be anticipated by designers as quickly as possible. The development of lifestyle has always been influencing the perspective of family car users. The society wants novelty in design that follows the pattern, socio-cultural characters, the trend and the growing lifestyle. They want operational system in impressive new design through new operating procedures that change their perspective. However, it should not add complexity in the learning process to learn those new operating system. Another similarity is in terms of component efficiency. From the industry's perspective, component efficiency means production economy. While from the society's perspective, component efficiency means cheaper cars and more efficient maintenance. As long as the design can functionally facilitate as much as its users' hopes and needs, then it can give added values in the public's considerations to own one. The difference between the automotive industry's perspectives with the community lies in the age of a good design. The industry has the opinion that a good design is long-lived, while the population considers otherwise. Then, the industry's assumption regarding the users' characters of the car design they make is heterogeneously at odds with the way people tend to view that every car design made by the automotive industry is principally the same.

The car industry tends to do three innovations in a family car design development. They prefer to run incremental innovation to prolong the basis design life cycle of the cars they sell. Design-driven innovation is done preferably in the context of producing a long life time design. They tend to compromise between developing a new variant of older cars basis and looking at the users' characters. The radical design innovation development approach is seen as a tendency goal in developing a completely new design or done to build the advanced product image. The car design development is a process of developing various interrelated aspects, ranging from technological, economic, social and cultural complexity aspects. It is not the result of styling form for the sake of beauty alone. In the development of innovative car product design, a very important thing to be observed is the fundamental building blocks of the car body (exterior and interior) itself. Since, the more number of components, the more precise length of production flow should be prepared. This means the cost of production of the car will be more expensive. From these ideas, then a design idea that seeks to maximize the compromise between the utilization of each component of body shapers and a range of the users' needs and desires was developed.

Most industry in finding inspiration for its product development does not derive from the approach that supposedly centers in human emotion as its main subject. Its main paradigm is in how to operate efficiently and effectively. Thus, its various thoughts are still in exclusive paradigm, since its innovation development stems from its own perspective as the producer of values and the society as the consumer of its products. This applies for both service and goods products. The industry creates a value and creates that value in its products, then, indoctrinates the society (market) massively as its consumers through those values. Broadly speaking, the process innovation in car design is required to face the competition among car companies. It is also required to fulfill the users' needs or their target market in order to sustain their production. The pattern of design innovations made by the majority of the Indonesian car makers is associated with a focus in developing the design usability with consideration of the user's character. Design-driven innovation is preferred to be performed by the car makers in context to produce a long life car design. Hence, it is important to look at the users' characters design and they are the top priority in car design development.

The car industry has broadened its spectrum. Initially only producing goods/cultural materials, now it is producing values as well. If the initial purpose of design innovation was to improve the utility of wearable products, then now design innovation must also increase empathy from any products it manufactures. A good

design innovation is the one that can create novelty to fulfill the users' physical and psychological hopes. As a means of meeting the novelty expectations and desires of human audience, any new design must be better than ever. The more often a product renews the quality of its 'novelty' the better all systems (especially economic) that relate to it. The design will continue to grow to fill the expectations of every segment of society who consumes them and will continue to evolve to renew itself in the long journey of human civilization.

The development of car design will be more ideal if the designers studies further to 'read' the development of socio-cultural phenomenon of the revolving and changes the attitudes from merely becoming an expert in appearance enhancement to becoming a cultural actor, so as not to get stuck repeatedly into rigidity of values therein. Furthermore, the designer can see the problem from outside the value boxes without having to destroy the boxes. From there, the designer is able to produce different concepts and / or ideas by learning to take everything that is growing in the community and to synthesize it into a cultural strategy to progress more dynamically. The process of design innovation will be more beneficial to civilization if it starts to really get to know people and the environment, have empathy for their situation, and let them be the experts who guide the innovation process itself. Currently, almost all dimensions of public life are increasingly guided by economic logic that offers openness, novelty, and changes in constant acceleration. In such situation, lifestyle, fashion and performance becomes a new value that replaces the traditional values associated with wisdom, discernment and simplicity.

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