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Future Car Technology and Design: Perspectives and Directions

Topic and Purpose

This paper is to see some plausible scenario of vehicles suitable for the future society. We can say that the international car market is experiencing a hard time these days because of the economic situation. However, we should also know that manufacturers are not just thinking that they are totally losing this time. We can actually see some movements for better competition; GM, once the biggest car manufacturer in the world had to file for bankruptcy with its failure in the market. Companies with better technology and lower price are instead replacing the place in the US market where GM the giant once dominated as one of the Big Three. Not only consumers, but governments require more from the manufacturers. They set more strict regulations on emission and safety. For some companies those regulations could be a new guideline, instead of regulations, for technological development and opportunities in the market. Of course, it is true that powerful but fuel efficient engine has the biggest importance in car technology. However, there are much more things which could bring the difference in the market. Throughout this paper, we will look at some of those aspects and see what are the plausible and desirable directions in the future changes.

Introduction

It is always very fascinating to see the concept cars with revolutionary and futuristic design which we have seen only in Sci-fi films. Audi Shark concept model and Peugeot Capsule concept model could be good examples. However, we need to notice that they have more than striking body designs; not only the aesthetic and futuristic exterior design of the cars, but the technological features that they have are what actually make them special. Some might say that Audi Shark's flying ability still looks too unrealistic, but its video camera substituting the rear mirrors and energy saving LED lights could be readily applicable to the cars already



Figure 1 Audi Shark Concept



Figure 2 Peugeot Capsule Concept

in the market. Moreover, the unrealistic technologies could also be available in the market in the far future; we should not deny the fact that the cars that we have been dreaming could be real vehicles running on the street and we could be the ones who could possibly purchase and drive them.

However, the car market situation could be even more complicated than these days: deep economy recession time when people are not readily putting big investments including cars. Manufacturers will have to think not only about consumers' taste and the technological progress of the company, but should also think more about environmental effects, market power to survive in the infinite competition, and collaborations with various technology and fashion which could satisfy the diverse taste of consumers; other than core vehicle engine and driving technology, there will be more and more new technologies to help drivers. Manufacturers will have to think more about which new options to use for their cars, not unrealistically increasing the price of vehicles but maximizing revenue and minimizing cost. These new optional technology even could be the very reasons to attract consumers.

Not only from those concept cars or cars with unconventional designs, but from the cars in the existing market, we can read the trend of sustainability, energy efficiency, safety, and adaptation of new

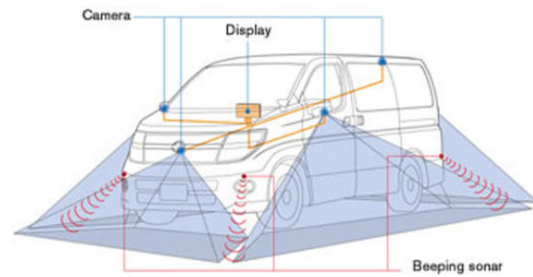


Figure 1 Nissan Parking Camera Technology

technology. Hybrid cars are becoming more and more prevalent every day. At the 2009 IIT Bombay Techfest, Nissan presented its new safety belt and parking camera technologies. The safety belt is to reduce further collision injury from inertia; when a driver puts sudden pressure on the break, the safety belt pulls the driver backwards, so that he will not get further injury from hitting on the handle or windshield. It can also prevent children's injury or death from air bag. The Cameras fitted to the car will generate a computer-simulated bird's-eye view of the surrounding area displayed on a central screen. Therefore, a driver can perfectly park his car even at a really small area. The parking camera technology could be comparable to the Audi Shark's rear view camera technology; they let drivers to see the unprotected areas from the traditional rear mirrors.

We will have to see both fictional and realistic scenarios when it comes to seeing the trend in car technologies and designs in the future market.

Perspectives and Directions

In the near future, we will be able to see the pre-ordered Aptera 2 series cars running on the street in California, USA. This model totally looks like one of those unconventional concept cars, but the difference is that residents of California could actually make an online pre-order at Aptera Motor's webpage, www.aptera.com. These three-wheeler two-



Figure 2 Aptera 2e

seater cars will be one of the very fuel efficient cars in the world. The manufacturer says that Aptera 2 series will reach up to 100 mpg of fuel efficiency. 2e, all-electric model, will be released in 2009 and 2h, plug-in electric hybrid model, will be in the market

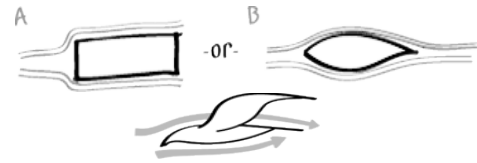


Figure 3 Aptera aerodynamics schematics

from 2010. One more thing we need to see from the Aptera cars is that designers are trying to maximize the fuel efficiency, not only by its engine technology, but also by adapting several more, such as LED lightening system, solar assisted climate control, and aerodynamics based car body design. Moreover, Aptera not only emphasizes the fuel efficiency, but safety; the manufacturer says that the car can stand the weight of two elephants. We can see that Aptera 2 could also be a good example of the designers' concern for environmental sustainability, energy efficiency, and safety, which are the main interest both for future car manufacturers and consumers.

Not only consumers want more fuel efficient vehicles, but governments actually require changes from the manufacturers. With the increasing concern about climate change, many countries are making new regulations regarding car emission. Of course, imported and exported cars cannot be excluded from those emission regulations. From 2016, all vehicles to be sold in the US should have 40% or more increased fuel efficiency. It is not a sudden change, considering President Obama's speech in Detroit during his presidential campaign; he said American automobile industry has shown too little effort to reduce the nation's dependence on foreign oil and improve their vehicle's efficiency. Moreover, in 2006, as a United States senator, he co-sponsored bills to raise fuel economy standards and encourage the use of alternative fuel. It is true that American cars has mostly targeted domestic consumers and roads; big cars are less tiring for long distance driving and the oil price had been stayed pretty low in the US. However, with the soaring oil price and competition with foreign car manufacturers in cities, US manufactures had to find a new way, which they failed to do, to survive in the market. Since the biggest car market in the world, the United States brings a big change regardless of domestic companies' inadequacy to it, it would

be inevitable for most of foreign car manufacturers to concentrate more on emission reducing technology; the environment friendly car market will invite even more competition.

Especially, Japanese cars could have better chances in this situation, since they have had overall competitive technology and price, along with the history of environmental friendly cars. While their competitors are still developing new technologies, Japanese car companies can actually release their new environmental friendly models and get feedback from the existing market.

Toyota and Honda are leading the hybrid electronic vehicle technology. Toyota released its first hybrid car in the market in 1997 and since then Japan has been developing more than five hybrid models.

Toyota has its own hybrid technology HSD(Hybrid Synergy Drive)¹. This technology is used both for Toyota and Lexus hybrid models, such as Prius, Camry Hybrid and Lexus HS 250h. What makes the technology even more competitive is that it is the refinement of original THS, Toyota Hybrid System, which had used for 1997-2003 Prius and some Lexus models as LHD (Lexus Hybrid Drive).



Figure 4 Toyota Prius Hybrid

Honda also has its own hybrid technology called IMA(Integrated Motor Assist)². Even though Honda released its first hybrid car two years later than Toyota, it is also one of



Figure 5 Honda Insight Hybrid

¹ A set of hybrid car technologies developed by Toyota and used in the company's Prius, Highlander Hybrid, Camry Hybrid, Lexus RX 400h, Lexus GS 450h, and Lexus LS 600h/LS 600hL automobiles. It is also used in the Nissan Altima Hybrid. HSD technology produces a 'full hybrid' vehicle and allows the car to perform on the electric motor only as opposed to other brand hybrids which cannot and are considered 'mild hybrids'; it also combines an electric drive and a continuously variable transmission.

² Honda's hybrid car technology, introduced in 1999 on the Insight. It uses an electric motor mounted between the engine and transmission to act as a starter motor, engine balancer, and assist traction motor. In its first generation, IMA could not power the car on electricity alone, and could only use the motor to assist or start the engine. The 2006 Civic Hybrid, however, can activate the electric motor while the vehicle is coasting without turning the Internal Combustion Engine on.

the leading hybrid manufacturer in the market, getting competitiveness with its comparatively low price.

Honda Insight's base price in the US is \$19,800, whereas the base price of Prius is \$22,000.



Figure 6 Kia Forte Hybrid

Korean manufactures, Hyundai and Kia, are also welcoming this change too; they have been mostly concentrating on manufacturing and exporting small and compact cars and now they are also very willing to compete in the hybrid car markets with their new models.



Figure 7 Hyundai Avante Hybrid

Even though they can already meet the emission regulations with their small cars, they invest more money on hybrid technology for future competition on bigger and heavier classes of vehicles. Hyundai and Kia release Avante LPI³ hybrid and Forte LPI to Korean market in July, 2009. One distinctive feature of them is that their engine is the hybrid technology of LPG engine along with electric engine.

Comparatively cheap price of LPG with the high fuel efficiency of hybrid cars are definitely the biggest reasons for savings. Even though some people still can say that it will take up to 100,000 miles for the saving from a hybrid car to catch up the saving from purchasing same model with cheaper traditional engine, comparing high hybrid car purchasing price and fuel consumptions with those of traditional cars, but finally it would be inevitable that both consumer and manufacturer would choose more environment friendly cars.

³ Hyundai hybrid technology. It is world's first LPG hybrid system. LPG is the cheapest fuel for vehicles and helps reducing the emission of harmful gas. For the first time in the world, Hyundai Avante meets the standards of SULEV (Super Ultra Low Emission Vehicle.)

Japanese, the US and Korean governments already announced that they will also give tax cut or discount for hybrid or fuel efficient vehicle owners. Moreover, the trend of environmental friendly cars will continue until the final goal of zero-emission vehicle⁴ eventually achieved; people generally



Figure 8 BMW Hydrogen 7

see that hybrid cars are the transit to the hydrogen cars or other types of ZEV. While Japanese manufacturers are concentrating mostly on hybrid cars, German manufacturer BMW has been working on its exemplary hydrogen model, Hydrogen 7. BMW leased only hundred Hydrogen 7 to selected people. BMW says that its Hydrogen 7 is “world’s first production ready hydrogen vehicle.” Those lucky selected people who could drive the car by leasing consist of famous public figures and celebrities. BMW carefully chose them since it believes that those people have the power to show the importance of environmental friendly technology in the world.

It is evident that environmental friendly policies are beneficial and for some companies, especially Asian manufacturers mainly selling highly efficient cars, small or hybrid models, are welcoming this change, but companies mainly selling big cars and trucks, including Big Three, Chrysler, Ford, and GM, who are already experiencing hard time nowadays, could face more difficulties in the future, unless they could develop better and newer technologies which could successfully compete with the Asian manufacturers.

⁴ A zero-emission vehicle, also called a ZEV, is an automobile that does not create pollutants. Zero-emission vehicles can be powered by two different sources: electricity or hydrogen. Some forms of both electric and hydrogen cars, those that are powered by fossil fuel plants, however, also pollute. The true types of zero-emission vehicles run on solar or wind power. Vehicles such as hybrids are not true zero-emission vehicles. Hybrids are cars that operate both by gas and environment friendly means, such as electricity. These are called partial zero-emission vehicles because, though they produce far less pollution than traditional fuel-powered vehicles, they still emit pollutants.



Figure 9 Chevrolet Corvair



Figure 11 Pontiac Aztec



Figure 10 Hummer H2



Figure 12 Saturn Ion

It was reported that with the high oil price, more consumers chose small and compact cars. However, US car manufacturers could actually still concentrate on their specialties. Actually they tried to build heavy vehicles and trucks with hybrid engines. In May 2004, GM released 0.5 ton Silverado/Sierra, world's first full sized hybrid pickups. However, overall uncompetitive of technology in the market could not be solved and it eventually led the company to failure. This story has been not only for GM, but for all big 3 companies.

June 1, 2009, once it has been the symbol of giant US economy, GM, filed for bankruptcy. Los Angeles Times made a list of five cars that have been contributed to the bankruptcy of GM; Chevrolet Corvair, Cadillac Cimarron, Pontiac Aztec, and Hummer H2, and Saturn Ion thoroughly represent some important aspects of GM failure.

Corvair, which was launched to compete with European sports cars, had technical failure and consumer advocate Ralph Nader said "it is unsafe at any speed." Pontiac Aztec case is rather regarding body design. The designers' goal was to build an easy to drive sport utility model. However, the result was not very successful. Only 115,000 consumers chose

to purchase this vehicle since 2001. Compared to the number of Honda Civic sold in Canada only in 2008, 72,463 units, we can see the rejection from consumers. Hummer 1, 2, 3 has been infamous for their fuel consumption. It also has design failure that it has small cargo space compared to the huge body size

and maximum six people can seat in the car. Moreover, it's placement of rear view mirror cause much larger blind spot, which can be a big issue when it comes to safety problems. Moreover, those Hummer cars do not have standard safety features. Saturn, the brand originally intended to represent "the reinvented GM" failed to achieve its ultimate goal. It did not have any things to impress people. People say that "it is just like those mediocre GM small cars, such as Pontiac Grand AM and Chevy Cavalier."

Even though it was not listed on the list above, Chevrolet's fuel economic car, Vega, to compete with Asian manufactures during the Oil Shock period, could be a good example, too. The mission in Vega were achieved, however, it had critical technical and safety problems. The designers concentrated only on minimizing the weight of the car and decided to use very thin aluminum for the engine. Therefore, the heat from engine ignited the engine oil. It is true that fuel efficiency is one of the most important factors, but not at the cost of safety features.



Figure 13 Chevrolet Vega



Figure 14 Elbilnorge Classic Buddy, Extremely small Norwegian electric car

There arises a question, "Will cars be smaller in the future?" The biggest concern for small cars would be safety and if people can be free from the safety concern, we can say that there would be much more small cars on the street. People generally think that when it comes to collision accident, passengers in small cars could be injured or killed by more than those traveling with big cars. However, Public Transportation Users Association of Victoria, Australia says "some (but not all) small cars increase your chances of being injured if you're in a crash. But they don't make you any more likely to crash, and might even make you less likely. The best way to minimize your risk of being injured is to drive

less.” It is true that historically small cars have had low crashworthiness scores. However, it also means that manufacturers actually have put lots of money to develop more safe cars; some recent models even have five star ratings when it comes to collision.



Figure 15 RX-3

Since there is prediction that 70% of people will live in city, more people will need cars to travel inside the cities instead of huge cars for long distance drive. Since many people know the importance of public transportation, it is probable that governments will encourage the public transportation.



Figure 17 Auto rickshaw

Moreover, we can also see the trend that three wheelers could be very popular along with small four wheelers. XR-3, Aptera 2 series, and Airpod are all three wheelers. In developing countries, three wheeler rickshaws are very popular because of its comparatively cheap price.

Moreover, they are not for very high speed driving, people do not need to think about the stability problem from three wheelers. However, smoke from auto rickshaw is harmful to health. People have been trying to decrease the emission by using proper fuel and regular maintenance, but still more people do not really care about the environmental effect from those three wheelers.

However, Luxembourgish compressed air car company MDI- Motor Development International- has plans to release two of its cars in 2009 and 2010. MDI’s small cars do not have good enough maximum speed to travel outside of cities, but their competitive price and zero pollution could be good reasons to choose them for inside city transportation. Moreover, its MultiFlowAIR is public transportation concept



Figure 16 MDI AirPOD and MultiFlowAIR

vehicle. If companies can bring more of these changes, we could predict that more environmental friendly vehicles will be running in the world, including developing countries with severe air pollution.

One more question is “will more people own vehicles in the future?” The answer is “More cars would be available.” With the decrease in price along with size, it is very probable that more people will own cars, even when they can expect only occasional use with better public transportation system. People can do this because those small cars suitable for city life will not be very costly or hard to manage and suit for cities.

Even we can see the movement these days. Tata Nano, city car primarily targeted India, could be a good example. As the chairman of Tata, Mr. Ratan Tata, desired, this less-than-100,000 Rupees car could substitute two wheelers for Indian families. With its revolutionary price, Nano’s preorder had reached 200,000 and total 60,000 of them will be produced in 2009. At Cornell University’s Global Forum lecture, Mr. Tata addressed how he set this goal; while traveling in Bangalore, he saw a scooter with a family of four under the rain. It slid on a drizzle-slicked road, just missing Mr. Tata’s car. "At that time I figured, if we want to make a contribution we should find out what we could do to make safer



Figure 18 Mr. Ratan Tata and Nano

transport available at an affordable price," said Mr. Tata. During the lecture, Mr. Tata emphasized the social responsibility of the corporations. Tata will bring greener change in Indian market, too. Tata has been developing Indica Electric, which will be launched firstly in Norway in 2009 and in India in 2010. Moreover, Tata will launch Nano in USA, too. Some might think that launching super small car in USA could be a too big adventure. Japanese and Korean manufacturers have been reluctant to introduce their smallest model even though their small and compact cars have been very competitive in US market.

However, with its increased safety features for US market and incentives from low emission, it could be worth taking the challenge.



Figure 19 Fiat 500 Barbie Edition



It is also true that the car has been more than just transportation. It has been the symbol of consumption culture and dream for young men. With the Barbie car, girls start to dream to have her own pretty car, too. Moreover, it has been representing the economic power of people in our society.

Therefore, the market for luxurious car would not be discouraged because of the change in society and lifestyle. Moreover, with the new technologies, better options could make cars even more luxurious. Cadillac once released a less expensive model, Cimarron. The result said it was a total failure and Cimarron actually even harmed Cadillac's image as luxurious brand. Therefore, we can see that luxurious big sedans would be more luxurious and expensive and companies would still concentrate on the luxurious side of the market. With this economic



Figure 20 Cadillac Cimarron

situation, it is true that overall luxury car market has been also affected. It is because people cannot just decided to purchase expensive cars just because they have enough money to purchase them.

For 2009 Tokyo Motor Show, all German car manufacturers decided not to attend. Earlier last year, all of Big Three already informed that they will not be able to participate in the event for the cost reduction purpose. It is true that car companies are facing hard time with the international recession. Moreover, Tokyo Motor Show is famous for having large number of concept cars and it could be burdensome for some companies to prepare for the huge event, where people come to see the future



Figure 21 Paris Hilton and her customized Bentley

trends of the industry and to predict the images of the companies. However, we should not just assume that car companies stopped developing new technologies and design. It does not mean that luxury brands should totally change their direction, since there will be more people who want very unique car only for them, as Paris Hilton did lots of design alternation for her Bentley.

Application: Car design direction for young women

Still there exists the myth that women are bad drivers and should avoid driving. However, we cannot deny the fact that the number of women drivers are increasing. Myth is myth, and we should find a better way to make them to run away from the notorious name of bad drivers. More and more women drivers are on the street all over the world and this trend will continue in the future with the increasing social participation of females. Even Muslim world, where womens' social activities has been significantly limited than other part of the world, started to see the importance of the increasing number of women drivers. Iranian manufacturer, Iran Khodro unveiled its new model totally targeting female drivers. It has automatic transmission and parking and navigation aid. The colors and interior design, of course, would be totally based on women's taste. This car is more for women as mothers; the

manufacturer mentioned that women need cars for some purposes such as “doing the family shopping or taking their children to school.” We can see that there are some factors which young generation women will also welcome and some features which cannot represent their lifestyle and preferences. According to Forbes, the most popular cars for women are Mitsubishi Eclipse two-door, Audi TT two-door, Volkswagen New Beetle two-door, Mitsubishi Endeavor SUV and Saturn Sky convertible. Another list shows some different result with Volkswagen New Beetle Convertible, Honda CRV, Hyundai Tucson, Saturn Vue, Honda Element. We can see the trend that women prefer light two-door car, when it comes to small cars, and small SUVs are also welcomed when they have good design and technical features. Interesting thing is that 60% of women choose red or similar colored cars. It is true that a red sports car is also very attractive for a man, but more than half of women consumers choosing a certain group of color could be a good hint; there exists feminine color group when it comes to cars.

For short women, the position of driver’s seat could be a big dilemma; if it is too low the rear mirror will hinder their sights. However, they cannot set it to be too high since they will not be able to reach the pedals at that position. Therefore, we need to design a car with high driver’s seat with long enough pedals. This goal could be achieved only when we can design a car exclusively targeting women; since these features could be very uncomfortable for tall male drivers, we actually need to target only women consumers. Other features of this car and advertisement should also be good enough to attract enough number of women.

We can easily find some videos on the internet, which are basically laughing at women drivers failing parking. Of course, it is not impossible for them to become more skillful in parking with practice and experience, but some tools can be actually helpful regarding the fact that women actually have different brain figure, which makes the basic difference in parking ability. Iran Khodro’s new car actually has this navigation and parking aid feature. Regarding the brain difference is actually about understanding the space and direction, low priced GPS could be very useful and attractive option for women, too.

We should also understand that women tend to drive safer than men. However, when it comes to instant decision making, men are better. Therefore, there should be some difference in safety features, too. It will be more advisable to have protection for the collision from the sides or back; women are less likely to cause accidents running into other cars, but their hesitance in decision making could invite other cars to collide.

Also, there are some miscellaneous features which could actually help women drivers. There are some items that only women are using: mini-skirt and high heels. However, they can be very annoying when it comes to driving. Even though the



revolutionary high hills can be helpful, they cannot satisfy women's desire for brand new high heels. Therefore, we can put a shoes storing place either around gear shift or under the driver's seat so that they can easily change and store the shoes. Moreover, we can put a wider and lower door for female drivers who love to wear mini-skirts.

Conclusion

In the future, customers' taste will not be the only factor when it comes to manufacturers' decision. With globalization and environmental and energy problem, we will face more uncertainty and more diverse taste of future customers will vary even more than nowadays. However, we can still see some common desirable factors for the future vehicles.

Fuel for future cars would be something new that would possibly and totally substitute traditional fossil fuel. Therefore, we may be able to expect that even though cars will be more available, the overall emission from cars would be decreasing. Since many governments have started to regulate the emission, giving tax incentives for environmental friendly cars and regulating cars that cannot meet their standards,

the change in fuel could be even more accelerated in the future. Moreover, the competition in the environmental friendly car market has been already started. With Japanese companies leading the market, companies all around world started to develop hybrid engine systems. Of course, the goal is ZEV, Zero Emission Vehicle, even some small and adventurous manufactures, such as MDI already developed the technology and ready for selling. Even though we need to wait a little more to see those ZEV vehicles running on the street, the path to ZEV would be finally paved starting from partial ZEV and very environmental friendly hybrid vehicles.

The trend of small and safe cars is quite evident. Even in the US, where big cars have been preferred base on the geographic traits and low fuel price, many people living in cities would readily choose small cars imported from Asia. Moreover, some of those small and compact cars can already meet new emission regulations standards since they are usually light in weight and their engines do not consume much fuel. Therefore, some manufacturers could concentrate more on the sales of cars in those classes while developing new and better low emission technologies.

The trend of decreased car size would accompany with decreased in car price, which will eventually contribute to the increase in the number of cars. It is also probable that too many cars can cause problems in cities, such as traffic jam and more frequent accidents. The problems could be solved with more public transportations and smaller but safer personal cars. India's Tata starts to release the cheapest car in the world in 2009. Mr. Ratan Tata's original goal was providing affordable and safe vehicle for Indian people. However, his plan is bigger now; at Cornell University, he revealed his plan of importing Tata Nano to US. Even though some people say that Nano is too small and simple to target the US market, it would be interesting to see its story in the US market with enhanced safety features.

We also need to see the luxury market side. With the new technology, more and better options would be available. Those new technologies could contribute to increasing in the price of luxurious cars, satisfying rich consumers' taste. Of course, since people who can afford those cars would choose better

designs, the body design would be also very critical part of those luxurious cars along with technical features. We can also expect that more customized cars would be running on the future street. Therefore, there could be more number of small sized manufactures, which are developing unique and revolutionary cars, whereas giant companies with mass production will face even more efficiency problems in the future. The GM bankruptcy in June 2009 case could be a good example. It would be inevitable for luxurious cars to have worse fuel efficiency than small and simple cars, but technological development tells us a different story. Toyota's hybrid technology, which is also used in Lexus cars, proved that new generation Prius consumes less fuel while having higher horse power. BMW also introduced its hydrogen car to selected people consist of famous figures such as celebrities and politicians, expecting that they would show the importance of environmental friendly technology in the world.

To get the market power, future cars should have not only increased fuel efficiency and safety, but affordable high technology options to help driving and design. We can see the movement among manufacturers all over the places. Both big companies with history and small revolutionary manufacturers are presenting their perspectives in the future market with own technology. It would be worth watching the competition. Of course, only those can meet governments' regulations and consumers' taste will survive.

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