CHAPTER 6

SUMMARY, MANAGERIAL IMPLICATIONS, RECOMMENDATIONS, LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

“He simply don’t have a vision of an alternative economic system that isn’t oriented toward unending material growth. Until we have an alternative vision, we won’t give up the one we have.” Homer-Dixon

The research summary, the managerial implications for the automobile industry and recommendations, the research limitations, and the suggestions for future research are discussed in this chapter.

6.1 INTRODUCTION

The developing world, including India is experiencing an unprecedented expansion of International Trade, with a concurrent growth in Industrialisation. The opening of trade and the liberal investment policies have helped ‘unbundle’ production across a range of countries. Thus, parts and components are manufactured in different locations around the globe. Many of these manufacturing plants are located in developing countries, which as a result, become increasingly integrated in global supply chains. As per the United Nations Environment Programme and the World Trade Organization (WTO-UNEP Report of 2009), the World Trade in 2008 - in volume terms - was nearly 32 times greater than it was in 1950, while the level of world Gross Domestic Product (GDP) increased by little more than eight times during the same period. Consequently, the share of international trade in world GDP increased from 5.5 per cent in 1950 to 21 per cent in 2007. The expansion in global trade is also due to the increased number of participating countries as the growth of trade in manufacturing has resulted in the relocation of production, from developed to developing countries – a process that has gradually accelerated. The developing countries in 2007 accounted for 34 per cent of world merchandise trade which is approximately double their share of this trade in the early 1960s.

The economic activities have a significant impact on the environment - extracting raw materials from the environment requires water and energy,
manufacturing processes including maintenance, transport and packaging create waste and consume energy, supplying and services generate waste pollution and emissions and the majority of products end up rapidly as waste after utilisation. The large variations in carbon emission between different industrial activities and between different technologies necessitate a prudent choice in selecting the right pattern of industrialization that can actually pave the way for sustainable development.

6.2 SUMMARY OF THE RESEARCH STUDY

The research project ‘Integration of Environment Management System (EMS) In the Value Chain: A Study of Select Automobile Companies in India’, examined the environmental impact mitigation and growth strategies of select companies in a highly regulated operating and marketing environment that places major carbon constraints on vehicles. Further, the study focused at the marketing end, i.e. on the attitudes and behaviours of car users regarding environment.

6.2.1 Need and Significance

The unique characteristics of the automobile industry lend themselves well to research. The industry by itself is considered an economic barometer for measuring countries’ performance on development indices. However, the manufactured product pollutes through its life cycle, and the industry, always a complex network of stakeholders, is currently facing its toughest challenge yet – that of restructuring its production and re-engineering its product - in an uncertain business environment. The study of the Automobile Industry is pertinent in view of the following:

1. Growth of Automobile Sector in India: India is home to the second largest population in the world, the economic boom is a natural corollary to India becoming a lucrative consumer market as well as an attractive manufacturing base.
2. Infrastructure Concerns – There are limited alternatives to personal vehicle ownership and use. The Indian public transport systems are congested and just cannot sustain the growing requirement for mobility.

3. Environmental Concerns: Although a symbol of progress, motor vehicles cause pollution throughout their life cycle. Approximately 75 percent of the environmental impact associated with motor vehicles occurs as they are being driven.

4. Energy Concerns: The energy used in transport (mainly from oil) accounts for more than a quarter of world demand. And given the population and the current economic growth, demand for energy is bound to increase.

5. Growing Regulations & Consumer Awareness: Under pressure from environmental groups and consumer lobbies, companies are now considering their role as members of the wider community and adopting measures to become good citizens.

6. Exhaustive Study: it is important to study the inclusion of environmental concerns in the vision and strategy of a business as well as the integration of these issues into the value chain to truly determine how ‘green’ a company has become.

7. Car Owners’ Attitude and Behaviour: Although it is in the domain of car manufacturer’s to introduce alternate fuel vehicles (AFV) or develop more efficient cars, a lot can be achieved at the level of car owner/user, through selection of right form of transport, checking tyre pressure, and right car maintenance and driving styles. However, there is hardly any focus on the car owner’s role in conservation.

6.2.2 Review of Literature

A comprehensive literature survey was conducted that included the most recent global thought and research on the subject. All aspects of the problem environment & industry established over the years as well as the ones that have most recently been propounded were referred. The research work and reports studied were classified under common areas pertaining to the problem under discussion. These were:
• Studies related to Sustainable Development - It is evident from the review of studies related to Sustainable Development, like those of Chen (2001), Hart (2005) and Waeraas and Ihlen (2009), and reports of International Organisations like the International Environmental Technology Centre Division of Technology, Industry and Economics, United Nations Environment Programme (Environmentally Sound Technologies for Sustainable Development, 2003; the Trade and Environment Review – Promoting poles of clean growth to foster the transition to a more sustainable economy, Global Gaps in Clean Energy Research, Development, and Demonstration (International Energy Agency, 2009) (UNCTAD, 2009/2010) and the World Resources Institute (WRI), (2010) that environment concerns wield an ever increasing influence on the way business is being done. The relationship between the firm and the environment is being critically reviewed in both professional and academic literature with research work that is immense in its depth and breadth of coverage. It is recognised that the imperative for inclusive and sustainable development can achieved only through comprehensive and collective social efforts.

• Studies related to Consumer Behaviour and Environment - The review of various papers by Chitturi & Ors (2008), Gupta and Ogden (2009), Creusen (2010) on consumer behaviour and environmental concerns highlighted the need for responsible choices that can be influenced through proper product information and awareness campaigns. Moreover, in certain cases the regulatory or top-down methods like taxes can show greater effectiveness in moulding consumer behaviour.

• Studies related to Corporate Strategies for integration of Environmental Concerns through the Value Chain- The review illustrated that the area was widely researched, with a consensus for a complete vision to value chain and closed loop inclusion of environment responsiveness. The researchers Gonzalez-Benito (2005), Giancarlo (2005) Pflieger et al (2005), Polonsky & Jevons (2009), Voola & O’Cass (2010) have written regarding the seriousness of incorporating environment concerns in product and process planning. The researchers namely Pun (2006),
Sambasivan & Fei (2008), Jorgensen (2008), Hacking & Guthrie (2008) who studied the Environmental Indicators and Evaluated the Environment Performance of Organisations found that it was easier for companies to quantify and address the facility level indicators that resulted in efficient resource use helping in improving their balance sheets. The review signified that companies have a long way to go in reaching the fully developed social consciousness level, wherein the companies would acknowledge their role as partners in the larger system. Further, Watson & Anthony (2004), Simpson & Power (2005), Fassoula (2006) Vachon & Klassen (2006), Stonebraker & Jianwen (2006), Shukla et al (2009), Alaez-Aller R. & Longas-Garcia (2010) established that the adoption of EMS helped the companies to identify measures for environment impact abatement and enabled streamlining of value chain activities; thus improving overall performance of companies.

- Studies pertaining to Environment Management System (EMS) & Value Chain Analysis In Automobile Industry - The studies pertaining to Environment Management System (EMS) & Value Chain Analysis in Automobile Industry, especially those of Corswant & Fredricksson (2002), Benko & McFarlan (2003), Saad & Patel (2006), Kumar & Yamaoka (2007), and Gonzalez P. Sarkis J. & Adenso-Diaz B. (2008) highlighted the unique characteristics of the automobile industry, the sourcing trends, challenges in integrating operations across the supply chain and adoption of closed loop systems to take care of the environmental regulations and concerns across markets.

### 6.2.3 Research Objectives

The objectives of the study were:

1. To study the extent of integration of environmental concerns in the Value Chain of select Automobile Companies.
2. To examine the current focus of the auto companies for environment impact mitigation of process and product.
3. To assess the car owners’ attitudes and behaviours regarding environmental impact of cars.
4. To study the role of attitudes towards environmental impact of cars in environment friendly behaviour.
5. To propose a framework for addressing the increasing environment concerns faced by the Automobile Industry.

6.2.4 Research Methodology

The research focus was to study the value chain of the automobile companies along with the attitudes and behaviours of the car owners. The sample size included 5 automobile companies, 97 experts and specialists, and 351 car owners (Table 6.1)

Table 6.1: Sample Size for Study

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<th>SAMPLE</th>
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<td>1 Automobile Companies</td>
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<td>2 Automobile &amp; Environment Experts</td>
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<td>97</td>
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<td>3 Car owners</td>
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The top five companies, namely Maruti Suzuki India Ltd., Hyundai Motor India Ltd., Tata Motors, Honda Siel Cars India Ltd and Ford India Pvt. Ltd., are selected on the basis of number of units of passenger vehicles sold, formed the sample for study. The research covers the ‘Strategy and Profile’, the ‘Management Approach’, and the generic ‘Environment and Product Responsibility indicators’ as well as the industry specific concerns as discussed in the Automotive Sector Supplement (Pilot Version 1.0, 2004), by the Global Reporting Initiative (GRI). The company analysis includes the inter-weaving of the above identified environmental concerns through the activities across the value chain and the linkages between the support and primary activities of a company. Further, the study analysed the significance and impact of these issues on companies’ choice of strategy, and the level of successful integration of environmental concerns in process and product. The evolution of corporate environment consciousness is determined on a
framework of five-level hierarchy of indicators (*Lowell Centre for Sustainable Production - LCSP*). The levels - **Level 1, Facility Compliance/Conformance Indicators**; **Level 2, Facility Material Use and Performance Indicators**; **Level 3, Facility Effect Indicators**; **Level 4, Supply Chain and Product Lifecycle Indicators**; and **Level 5, Sustainable Systems Indicators** - follow an evolutionary process of setting goals and measuring performance.

The schedule of questions framed for the automobile companies encompassed the value chain, listing out the environmental concerns at each stage. There are two parts to the schedule. The first part consists of 36 questions pertaining to the environmental elements in the ‘Support Activities’. The second part is composed of 29 questions regarding the value creation ‘Primary Activities’ of a company. The research covers company officials and industry experts, and the schedule of questions is the basis for interviews conducted across various functions. The experts consulted (97 in number), included the senior automobile company executives as well as independent consultants and specialists in the field of environment and mobility. The schedule of questions is analysed qualitatively, with a focus on the manufacturing process and the cars marketed. The secondary research had yielded studies carried out by independent organisations on the industry. The data collected through primary research is used for building upon the information gained through secondary research. The current competitive environment with the dominating macro elements in the form of government regulations and climate change concerns has brought the role of ‘Technology’ to the fore. Thus, of all the activities through the value chain, ‘Technology’ is the single most influential factor and differentiator at this juncture. The automobile companies are faced by a number of divergent paths for developing new technologies. Not only is a choice required to be made here, at the same time the decision has to translate into an organic innovation strategy that can sustain across multiple possible technology pathways. Consequently, the various questions of the schedule were evaluated keeping in mind that the environmental concerns are best manifested in the choice and application of environment friendly technology.
Further, a total of 351 car owners' behaviour and attitudes regarding environmental impact of cars and various issues that impact mobility - selection and purchase, maintenance, servicing and handling of cars were analysed. The selected locations viz. Chandigarh area, the Delhi area and other metros, reflect the car ownership and usage patterns in urban centres. The sample is non-probability; judgement sampling and the instrument designed in four parts comprised of a series of statements to evaluate the consumer's responsiveness towards environment. The first part has 27 attitudinal statements and the respondents rated each statement as per their level of agreement on a nine-point Likert-type scale. The second part of 15 statements required the respondents to delve into their own driving and car management practices of past one year. They recorded, based on their experiences on a nine-point scale from never to always, their level of engagement in environment friendly behaviour. The third part consists of the personal car details as well as driving, servicing particulars. The fourth and final part covers the personal information including academic, employment, and income and family particulars.

A multi-stage quantitative analysis is carried out on the questionnaire responses in MS Excel, and in statistical packages – SPSS and AMOS. The first stage consisted of calculating intercorrelations amongst the 27 attitude scale items measured in the study and carrying out factor analysis by the Principal Components Analysis. Cattell’s (1966) Scree Test criterion is utilized to identify the optimum number of factors that could be extracted. Further, Direct Oblimin (oblique) Method of rotation is employed to allow for the emergence of distinct, yet possibly correlated factors. The second stage comprises of computing intercorrelations amongst the 15 behaviours and the attitude dimensions that emerged from first stage. Subsequently, step-wise multiple regressions are carried out separately with each of the 15 car use behaviour items as the predicted variables and the attitudinal dimensions as the predictors. Further, the causal relationship between the behaviour items as dependent variables and attitudinal dimensions as predictors is analyzed by developing path models. Structural Equation Modelling is carried out in AMOS software using Maximum Likelihood Estimation (MLE). Path modelling is done independently.
for each behaviour item, for confirming the regression paths obtained through SPSS. Finally, the analysis of variance (ANOVA) is carried out for various car ownership and usage particulars declared by the respondents – car manufacturer, segment of car, year of car purchase, total kilometres run, average monthly running, city/highway running, car driver and number of cars owned. Additionally, certain demographics are also considered for identifying any significant differences – city of residence, gender, age, household size, income source and total annual income.

6.2.5 Findings of Analysis of Environmental Impact Mitigation in Process and Product by Select Automobile Companies

The automobile companies have to integrate environment concerns in the product as well as the manufacturing process. Thus on one hand is the increased involvement with the suppliers as well as the sales & service chain. And on the other, the automobile companies are adopting a comprehensive strategy that involves technical measures to reduce fuel consumption at the vehicle level through application of fuel efficient air conditioning systems, options to reduce vehicle and engine resistance factors, meeting CO₂ based emission targets, research on alternative fuels vehicles. Non-technical measures include community development and education programmes for training drivers and car owners on fuel efficient driving, as well as voluntary declaration of fuel efficiency.

The findings of the Indian Automobile Industry on the inter-weaving of environmental concerns are discussed through the activities across the value chain of a company.

6.2.5.1 Support Activities

1. There are dedicated personnel ensuring compliance to all environmental regulations and legislations, maintaining the Environment Management System (EMS) and liaison with the State Pollution Control Boards. The representative body Society of Indian Automobile Manufacturers (SIAM), ensures that all issues that impact a company’s operations are taken up with the relevant government bodies.
2. All companies monitor trends within the industry on product, service & process productivity and innovations, there is active participation in global meets on Research & Development (R&D), and environmental challenges being faced due to the automobiles on road and the future strategies to be adopted. The representing body SIAM, ensures that adequate platforms are available to all the stakeholders, including researchers to present their work and enable a healthy exchange of ideas. The current and proposed environmental regulations, legislations, consumer movements, work of NGOs is discussed and integrated into the larger framework of product and process evaluation and continuous improvement. Thus all efforts are being made to include various stakeholders in the planning for environment.

3. The companies have an EMS duly certified and applicable at their manufacturing units. EMS forms the main component of the company's registration plan for various auditable standards like the ISO 14000 series. Although the EMS can be maintained in sections of the company quality or operations manual, at the automobile manufacturing companies it’s documented in an environmental manual. The scope of EMS is location specific, and targets on environmental performance & efficiency and measurement of progress (periodicity) form an integral part of the ‘aspect and impact’ study. The companies have well established robust systems for good governance, transparency and disclosures.

4. The companies have put in place education and training programmes for creating awareness amongst the employees and developing competencies according to their roles and responsibilities for environmental impact mitigation. The training on EMS is undertaken as an integral part of equipping the employees. There is exchange of information across departments and business functions regarding environmental, performance and efficiency success stories. All companies have suggestion schemes with idea management centres for employee engagement on environment issues.

5. The R&D for powertrain technologies is an area of great challenge for automobile companies, mainly because of huge outlays required to explore the various alternatives to conventional engines. Today there is a
choice of fuel engines available eg. HSD, MS, LPG, CNG etc, however the car models marketed in India are either MS or HSD variants; there are only a handful of car variants that run on LPG. The average fuel consumption model-wise is being increased by making the conventional engines more efficient in burning fuel. Companies are partnering with other companies, suppliers for exploring technology development, considering the massive investment in R&D for Alternate Fuel Vehicles (AFVs). Meanwhile there is elimination of toxic and/or hazardous substances used in the production. This is a result of integration of resource, material & energy efficiency into product development – giving due consideration to ‘material reuse, recycle’ in both products & packaging. However, what is still lacking is an assessment of main environmental impacts and costs of products throughout the life cycle (use and disposal). The quest for competitive advantage in alternate fuel vehicles and innovative product developments has led the OEMs in developing strong linkages with businesses that provide components, products, and services.

6. All automobile companies collect information on compliance from their suppliers, additionally there are policies regarding active monitoring of supplier performance. There are formats in place used for regular reports and undertakings on regulatory compliance. There is active involvement of OEM engineers and specialists in providing education/assistance to suppliers on environmental matters in order to increase supply chain efficiency: value analysis including costing is carried out for selection of vendors. Moreover, companies are insisting upon environmental certification as a pre-condition for empanelment as a supplier. The environmental purchasing criteria/requirements are suitably communicated to marketing staff, employees, stakeholders, and customers. Additionally, the automobile companies are party to the International Material Data System (IMDS). Under the IMDS, all materials used for car manufacture are archived and maintained. In this way it’s possible to meet the obligations placed on car manufacturers, and thus on their suppliers, by national and international standards, laws and regulations.

7. The Indian automotive component segment has grown rapidly in recent years, adding capacity as well as modernizing its production processes to
meet international standards. In order to encourage the investment of international manufacturers and subsequent transfer of technology, the government granted automatic approval for equity investment of up to 100% in automotive component businesses. The component export market also reflects the growing acceptance of Indian parts on the global market. The data from the Automotive Component Manufacturers Association of India shows that in 2006, 36% of component exports were destined for Europe and 26% for the US.

6.2.5.2 Primary Activities / Value Creation

1. The three ‘R’s – Reduce, Reuse and Recycle result in savings for a manufacturing unit, especially automobiles where material cost itself is upwards of 65% of total costs of a company. All the companies visited practice the ISO 14001 – declaring all activities and monitoring the environmental impact at every stage. The aspects are quite comprehensive including not only the manufacturing activities, but also peripheral services like – canteens and employee transport.

2. The handling and disposal of toxic materials is being done as per the State Pollution Boards. The EMS documents various prevention programmes to identify and eliminate sources of pollution and reduce costs, as well as promote and track the reduction of waste, measuring the environmental costs associated with operations and processes (e.g., monitoring and abatement equipment, remediation, waste disposal, compliance costs). There is phasing out of materials and substances that are hazardous or toxic e.g.: hexavalent chromium, asbestos (used earlier in gaskets and brake lining), lead, mercury and cadmium.

3. An automobile company has anywhere between 110 (Honda) – 400 (Tata) Tier-1 suppliers. Use of reusable / recyclable shipping containers, pallets, skids, or packaging has become the de rigeur. The companies are using fleet management tools, techniques and technologies to optimize distribution and shipping efficiency. All of them use the most cost effective means of inbound material movement and outbound product distribution. Maruti and Honda are using Milk Run for ensuring full load efficiency by
combining inbound material from auto component manufacturers in the Pune zone.

4. The field of Automotive Logistics in India as well as globally is moving towards collaboration and ‘built-to-order’ set up. On the outbound side, currently trailers and to a minor scale – trains are being used for distribution of finished vehicles. However in near future, there will be greater intermodal transportation. Nearly thirteen private players have licenses to operate container trains and in future it is expected that majority of distribution will happen through rail. Although hinterland connectivity still remains a challenge for logistics players, yet over next few years this will be taken care through emergence of logistics parks in different parts of the country. Automotive logistics in future is poised to become a totally collaborative affair between the manufacturer and logistics player; there will be partnerships and alliances between the two. Hence the Environment Management System of most automobile manufacturers would have to factor in role of vendors and suppliers very clearly in future.

5. An interesting development is that most companies now manage the transportation/distribution system not just for materials and products but employees’ commuting & business travel. This includes modes of transport and follow-up on associated impact with the companies monitoring the fitness of the vehicles being used.

6. The Automobile industry with its decades of experience and current global challenges ensures that only the most efficient techniques of production are used. The companies are managing their production in the most sustainable manner; from constructing environmentally sound buildings, EMS Certification, benchmarking, continuous improvement, creating internal awareness and management commitment for going beyond resource efficiency and regulations. All possible measures are taken for reducing material, water and energy use in production. The process design itself integrates environmental and efficiency criteria. Waste management program is in place that minimizes handling costs and complies with all applicable regulations. The latest plants being established use futuristically designed state-of-the-art equipment with
environment concerns integrated at every step, e.g. there is facility for re-burning of the exhaust of the paint shop and the resultant heat and energy is reused. Energy efficient electrical, mechanical and lighting fixtures are selected. Grounds management plan that suits the natural landscape, local eco-system and reduces maintenance costs are in place.

7. Marketing, Sales & Services (Maintenance): An automobile marketing company offers a portfolio of brands, and the Total Cost of Ownership (TCO) is the measure used by companies to compare the brands in a segment. This includes – fuel efficiency, servicing, maintenance, insurance and cost of spares; environment costs do not constitute a part of this calculation. Although, the service manual offered along with the car contains comprehensive information on maintenance and best service practices, there is no mention of actual emission levels of the vehicle at the time of purchase, as all that the car manufacturer certifies is the compliance of a model/make with the prevailing Bharat Stage norms. Moreover, there is hardly any information available on the rate of deterioration that the vehicle undergoes once it is on the road. The companies are already offering extended warranties and incentives for attracting owners to avail service and repair facilities at authorized service stations, which can help maintain the car in better condition; however the benefits need to be quantified and communicated effectively to the car owner. Additionally, the consumers need to have greater access to data regarding car life cycle pollution and end of life issues. This will certainly enable a consumer to make an informed choice. Recently, the companies have agreed to share the mileage of cars in the product marketing and communications material. However, there is no information on the emissions or on the material constituents.

8. A major initiative from OEMs is their entrance into the pre-owned car business. All the major companies (with the exception of Ford India) are offering exchange programmes to accept old or used products, for purchase of a new car. Strict quality standards are maintained to ensure that the used cars sold are of a superior quality and the used car buyer gets complete peace of mind. The purchased car is put through a rigorous series of checks, which covers every aspect of the car's functioning.
Hence, each customer is assured of a certified pre-owned car in very good condition.

9. The companies have monthly returns and audits for monitoring of the dealer chain that includes compliance with environment legislations and availability of infrastructure. Honda has initiated moves to ensure that their dealers adopt EMS and receive certification on ISO 14001. Tata’s customer care teams are carrying out greening of company’s dealers, and the company is exploring opportunities of implementing SA8000 in the supply chain and dealer network.

The study of the ‘support and primary activities’ through the value chain reveals that the companies are at different levels of the LCSP framework. The study indicated that all 5 of the companies studied have achieved Level 3; having integrated the Facility Compliance/Conformance, Facility Material Use and Performance, and the Facility Environmental and Human Health Effect indicators within their systems. The adoption and certification of an organisation to ISO 14001 is considered part of Facility Compliance. It is at Levels 4 and 5 that differences creep in – Supply Chain and Product Life Cycle, as well as Sustainability indicators. The Level 4 indicators have been achieved with respect to ‘water’ by all plants achieving zero wastewater discharge; as well as limiting fresh water consumption. The companies are not tracking packaging, miles travelled for delivery of raw materials and products, employee commuting, etc. There is also no information gathered on the ‘ecological footprint’ of the company. Though the companies have a sound vision and policies on environment, there is scope on developing sustainable systems/carrying capacity indicators.

6.2.6 Findings of Analysis of Car Owners’ Responses regarding Attitude and Behaviour towards Environmental Concerns in Car Purchase and Use

Personal mobility is a human need, and a car is the medium for fulfilling it. At the most basic level owning/possessing a car defines accessibility to opportunities for work, health care and recreation. However, no product is
sold with only the elementary application in mind, and cars more than any other product symbolise status, power and a social mobility. Thus, exercising the decision to purchase a car goes beyond the basic idea of mobility or for that matter simple aesthetics: style, power and other car attributes denote an expression of self, a symbol of having arrived at a certain level in life. The aim of this part of the study was to understand customers’ perceptions about environmental impact of cars and various issues that impact mobility. The study highlights the attitudes and resultant behaviours concerning the selection, purchase, maintenance, servicing and handling of cars. The results are summarized as under:

1. The factor analysis of the attitude items resulted in six dimensions, namely, **Environmental Concerns in Purchase (AF1)** consisting of 4 items, with internal consistency reliability (Cronbach’s Alpha) of 0.84, the highest amongst all the six dimensions; **Careful v/s Nonchalant Driving (AF2)**, composed of 6 items regarding prudence in driving, with Alpha=0.77; **Quality v/s Economy of Car Maintenance (AF3)**, with only two items, concerning car service and repairs, with Alpha =0.59; **Infrastructure & Regulatory Policies (AF4)**, consisting of three items referring to road condition, car subsidy for environment friendly cars and recommended servicing, with Alpha=0.64; **Concerns on Car Size (AF5)**, composed of three items related to car size, higher taxes on bigger cars, and on number of cars, with Alpha=0.469 (the lowest amongst the 6 Attitude Dimensions); and **Environmental Compliance at Service Stations (AF6)**, formed of three items of which two were regarding the service station, with Alpha=0.67.

a. The attitude dimension Environmental Concerns in Purchase (AF1) emerged as the main attitude factor and showed significant positive correlations with the other attitude factors (exception being Quality v/s Economy of Car Maintenance i.e. AF3).

b. The attitude dimension AF3 exhibited distinctive properties: (i) It was composed of only two items - A24 i.e. one should select the most economical servicing centre for the car and A25 i.e. one
can take the car to any convenient place for denting and painting (ii) It correlated significantly only with one other attitude dimension, namely AF2, Careful v/s Nonchalant Driving (r=.108, p<.01). Thus, the car owners’ attitudes that determine servicing and repairs were quite independent of her/his decision on purchase and driving.

2. The analysis evidenced that pro-environment purchase attitude dimension in general contributes positively towards environment friendly car use behaviour. Currently, the automobile companies are trying to leverage this through innovative programmes for extended servicing that include cashless repairs too. The growth potential is immense, and requires a long term strategic application to derive full benefit.

3. The 15 behaviour items studied, had different set of significant correlates and attitudinal predictors, and there were differences to the extent that the models explained the variance of behaviours. Amongst the 15 behaviour items there were few unique behaviours - B7 (Sourcing of Spare parts), B8 (Car Pooling), B10 (Avoiding Public Transport), B11 (Idling with AC), and B12 (Idling at Traffic Lights). The behaviour item B7 (Sourcing Spare Parts) had for its major contributor the attitude dimension AF3 (Quality v/s Economy of Car Maintenance). The behaviours B8, B10 and B11 were the least explained by the attitude dimensions. These findings have implications for the automobile companies – pricing of spares to be made competitive, or actively support the pricing through creating ‘value’ as translated in genuineness and performance. The implications regarding public transport is for the government to establish and promote better means of mass transport systems.

4. The attitude dimension AF3, (Quality v/s Economy of Car Maintenance), showed up as a suppressor variable in predicting three behaviours, viz., B2 (Gear Shifting), B4 (Keeping Car Free of Clutter), B5 (Recommended Car Servicing), and B6 (Servicing at Authorized Centres), and emerged as the single predictor of the behaviour B7 (Sourcing of Spare Parts). The attitude ‘Economizing in car maintenance, i.e. AF3’ being correlated with other pro-environment attitudes appeared to suppress that portion of their variance which does not predict environment friendly behaviours. Thus
AF3 helped in improving the overall prediction. This attitude needs to be better understood for a better comprehension of pro environment car driving and use behaviour of the Indian car owner.

5. The analysis of variance, (ANOVA) was carried out for various car ownership and usage particulars declared by the respondents – car manufacturer, segment of car, year of car purchase, total kilometres run, average monthly running, city/highway running, car driver and number of cars owned. Additionally, certain demographics were also considered for identifying any significant differences – city of residence, gender, age, household size, income source and total annual income. It was found that there were significant differences observed on different attitude dimensions and behaviour items for every factor so analysed, with one exception - ‘city of residence’. Thus, it seemed that the car owners’ pro-environment attitude and behaviour was similar across the cities, urban centres sampled. The respondent groups formed on the basis of demographic and car usage particulars – total income, average monthly running of car, car driver, and age, showed significant differences across maximum number of attitude dimensions and behaviour items.

i. The respondents were grouped under two categories on the basis of OEM of the cars owned, viz. Maruti Suzuki India Limited (MSIL) and other manufacturers (other OEMs). The observation of the Means for the variables with significant F-ratios allowed the interpretation that the respondents who owned and used a Maruti vehicle, as compared to those who owned other cars, (i) showed a relatively greater concern for environment, as evident from their more favourable attitude for a smaller size vehicle, AF5, (Means= 15.34 and 14.69, respectively), which gets translated into a car from Maruti, leaders in the small car segment in India., (ii) exhibited a greater willingness to use public transport, B10, (Means= 5.11 and 4.90, respectively), (iii) were more predisposed to turn off the car AC while idling, B11, (Means= 5.15 and 4.86, respectively), and (iv) were more inclined to turn off the engine at traffic lights, B12, (Means 5.12 and 4.90).
ii. The respondents were grouped under 5 categories as per the segments of the cars owned (Segments Premium, A5, and Luxury, A6 owners were grouped together). The comparison across AF5 revealed that the group of segment A1 (Mini) car owners, (Mean=15.67), displayed a significantly stronger attitude than the group with A3 (Mid-size) cars, (Mean=14.33), and the group with cars belonging to segments A5 and higher. (Mean=14.57) The respondents whose cars belong to A2 (Compact) category (Mean=15.19) exhibited a significantly higher environmental friendly attitude than the respondents who use an A3 car (Mean=14.33). The group with segment A1 cars (Mean=4.60) displayed a behaviour less likely to use authorised service stations as compared to the group with segment A2 cars (Mean=5.03), and the group with segment A3 cars (Mean=5.22). The group of car users of segments A1, A2 and A3 cars (Means=4.71, 5.02 and 4.95 respectively) exhibited a higher willingness to source spares from an economical source as opposed to the group with segment A4 cars (Mean=5.64). Surprisingly, the group of car users of segment A4 cars (Mean=5.64) as compared to the group of car users of segment A5 & ors cars (Mean=5.01) were less likely to purchase economical spares. Thus, the group of segment A4 car owners (Mean=5.64) were least likely to compromise on quality for economic reasons. The group of car users of segment A1 cars (Mean=5.35) showed a higher propensity to switch off engine at traffic lights, as compared with the groups of car users of segment A2 and A4 cars (Means = 5.00 and 4.61 respectively). Thus, it is apparent that the respondents who own and use a car that belongs to the segments A1 & A2 are relatively disinclined towards frequenting the authorised service stations for servicing, and believe that spare parts can be purchased from an economical source, which again is the unorganised sector. However, these respondents are the ones who will turn off their cars at traffic lights.

iii. The respondents were grouped into 4 categories on the basis of year of car purchase, those who had bought the car in ‘2008-09’, ‘2005-07’, ‘2002-04’, and ‘2001 and earlier’. The group who owned cars
purchased within the years '2005-07', showed a higher predisposition for quality maintenance as compared to the group with cars bought in '2002-04' (Means=10.24 and 9.60 respectively). The groups with cars purchased during the period '2008-09' (Mean=5.22) and '2005-07' (Mean=5.08) frequent an authorized service station as compared to those who have purchased their vehicle '2001 and earlier' (Mean=4.70). The group with cars purchased in '2005-07' displayed a more quality conscious behaviour while purchasing spares as compared to those who have purchased their vehicle '2001 and earlier' (Means=5.14 and 4.75 respectively). The group of respondents with cars purchased during the period '2001 and earlier' (Mean=5.34) as compared with the group with cars bought between '2008-09' (Mean=4.95) and '2005-07' (Mean=4.86) demonstrated a higher propensity to switch off engines at traffic lights. Thus, the respondent groups with cars purchased within last 5 years were more likely to get their cars serviced at authorized service stations and purchase spare parts from an authorized centre.

iv. The respondents were categorized on the basis of the total kilometres that their cars had run, 'up to 25000', '25001-50000', '50001-80000', and '80001 and above'. It was found that respondents whose cars have run more than 50000 Kms are more amiable to car pooling than the ones whose car has run between '25001 – 50000' Kms. (Means=5.15, 4.85 respectively.

v. The respondents were categorised into three groups as per the average monthly running of the car – 'upto 600 Km'; '601-1200 Km'; and '1200 Km and above'. The group of respondents with average monthly running 'upto 600' Km displayed an attitude with greater concern for environment at the time of purchase of car, than the respondents who have a monthly running of '601 – 1200' Km, (Means=20.67 and 19.57 respectively). The group of respondents with average monthly running 'upto 600' Km (Mean=15.49) displayed a more positive attitude towards smaller cars, than the respondents who have a monthly running of '601 – 1200' Km (Mean=14.68). Moreover the respondents who have a monthly running of '601 – 1200' Km
exhibited a higher concern than the group having a monthly running of 'more than 1200' Km (Mean=14.92). The groups with monthly driving of ' upto 600' km (Mean=15.58) and 'more than 1200' km (Mean=15.12) as compared to the group averaging ' 601-1200' km monthly (Mean=14.42) displayed a greater awareness regarding environmental compliance at service stations. The groups averaging monthly driving of ' upto 600' Km (Mean=5.26), and '601-1200' Km (Mean=5.02) as compared with the group that averaged 'more than 1200' km (Mean=4.76), were found to be more amenable to car pooling. The group of respondents who averaged a monthly driving of ' upto 600' Km were more likely while idling to switch off Car ACs than the respondents who averaged a monthly running of 'more than 1200' km (Means=5.22 and 4.84 respectively). The groups of respondents who averaged a monthly driving of ' upto 600' Km (Mean=5.22) and '601-1200'Km (Mean=5.04) as compared with the group that averaged 'more than 1200' km (Mean=4.76) were less likely to idle their cars at traffic lights. Thus, it can be said that there was an inverse relationship working between average monthly car driving and level of environment concern on AF1, AF5, B8, B11 and B12. However, with more driving, the respondents displayed higher concern regarding the service station compliance issues (AF6).

vi. The respondents were categorised into three groups as per their driving routine – within city, or a combination of city and highway. Thus, three groups were made ' upto 50% city running', '51-99% city running' and '100% city running'. The group who drive '51 - 99%' in the city as compared with the group who drive'100%' within city, displayed a more careful driving attitude (Means=30.53 and 29.22 respectively). The group that consisted of ‘100% city’ drivers (Mean=4.66) as compared to the group of ‘ upto 50%’ City’ Running (Mean=5.06) and the group ‘ 51 - 99% city’ running (Mean=5.15) were least likely to shift gears properly. The ‘100% city’ drivers when compared with the group driving '51-99%' within city were relatively less likely to maintain the right tyre pressure (Means=4.78 and 5.09 respectively). The ‘100% city’ drivers were less
amiable to car pooling as compared with the group of respondents who drive ‘51-99%’ within city (Means=4.81 and 5.12 respectively). The ‘100% city’ drivers as compared to the group of ‘Upto 50% city’ drivers (Mean=5.17); and the group ‘51 -99% city’ drivers (Mean=5.06) were least likely to walk. Thus, it is concluded that the respondents whose driving experience is limited to cities were less likely to display environment friendly driving attitude, and driving behaviour.

vii. The respondents were grouped into two categories on the basis of who drove the car most - self or chauffeur. The self driving group as compared to the chauffeur driven group displayed a higher concern for environment on (i) the attitude dimension environmental concerns in car purchase AF1, (Means=20.20 and 19.21 respectively); and the behaviours (ii) driving at optimal speed, B1 (Means=5.06 and 4.78 respectively); (iii) proper shifting of gears, B2, (Means=5.09 and 4.64 respectively); (iv) maintaining the right tyre pressure, B3 (Means=5.08 and 4.68 respectively); (v) keeping car free of clutter, B4, (Means=5.06 and 4.77 respectively); and (vi) servicing car as recommended, B5, (Means=5.07 and 4.72 respectively). Thus it is evident that the group of respondents who drive themselves display a higher concern for environment in both their attitudes and behaviours regarding car purchase and usage.

viii. The respondents were categorized into two groups on the basis of total cars owned in the family - the respondents who owned one car formed one category and respondents who owned 2 or more cars constituted the other. The observation of the Means for the variables with significant F-ratios allowed the interpretation that the respondents who owned only one car in the family, as compared to those who owned more than one car, showed a relatively greater concern for environment, as evident from their more favourable (i) attitude for a smaller size vehicle, AF5, (Means= 15.28 and 14.73, respectively), and behaviours (ii) driving at an optimal speed, B1, (Means= 5.11 and 4.89, respectively), (iii) predisposition to car pooling, B8, (Means= 5.14 and 4.86, respectively), and (iv) inclination to walk when possible, B9, (Means 5.11 and 4.90).
ix. The comparison between the groups on the basis of gender yielded significant differences only on the behaviour, Tyre Pressure (B3), F(1,349)=4.481, p<.035, revealing that men as compared to women displayed a higher tendency to maintain the car tyres inflated at the recommended pressure by the car manufacturer. (Means =5.05, 4.75 respectively)

x. The respondents were grouped under three categories, 'Under 29' years, '30-49' years and '50 and more' years. The analysis illustrated that the respondents in the age group of '50 and more' years displayed significantly higher concern for environment while selecting a car as compared to the age group 'under 29 years'. (Means =20.89, 19.50 respectively). As per the comparisons of means the younger generation 'Under 29' years (Mean=4.77) as compared to the groups '30-49' years (Mean=5.09) and '50 and above' years (Mean=5.19) was found to be least concerned regarding Optimal Driving Speed (B1). Further, it was found that the group '50 and above' years as compared to the group 'under 29' years, (Means=5.36 and 4.80 respectively) was more likely to Keep Car Clutter Free (B4). The comparison among the three groups also showed that the group '50 and above' years (Mean=5.28) as compared to the group '30-49' years (Mean=5.06) and the group 'under 29' years (Mean=4.79) was most particular about Servicing Car as Recommended in Car Service Manual (B5). Thus, the older generation showed the greatest concern for timely servicing, with the age group consisting of the youngest respondents, exhibiting the least concern. Finally, the mean scores of the three groups exhibited that the group '30-49' years (Mean=5.05) when compared to the age group 'under 29' years (Mean=4.94) was more likely to carry out timely PUC checks (B14). In view of the results one can affirm that the older generations displayed the greatest concern for the environment.

xi. The respondents were grouped into three categories on the basis of household size - families with '2 or less members', families with '3-4 members', and families with '5 or more members'. The analyses allowed the interpretation that the respondents who belonged to families with '2 or less members' were more particular as compared to
the group composed of respondents with families of ‘3-4 members’ regarding maintaining the right tyre pressure (Means=5.25 and 4.91 respectively). Further, the respondents who belonged to families with ‘2 or less members’ as compared to those with ‘3-4 members’ were more inclined to get the car serviced as recommended (Means=5.25 and 4.87 respectively).

d. The respondents were categorised on the basis of single and multiple source of income and the comparison between the two groups elicited significant differences only on one Attitude Factor namely, Environmental Compliance at Service Stations (AF6), \(F(1,349)=6.697, p<.010\); and there was no significant difference on the behaviour items. The respondents with multiple income sources exhibited more environment consciousness than the group with single income source regarding the compliance issues at service stations. (Means 15.25 and 14.59 respectively).

e. The respondent groups on the basis of income groups (in Rs) - ‘Upto 3,00,000’; ‘3,00,001 - 5,00,000’; ‘5,00,000 – 10,00,000’; and ‘10,00,001 and above’, displayed significant differences on two attitude dimensions, Careful v/s Nonchalant Car Driving (AF2), \(F(3,347)=2.804, p<.040\); and Environmental Compliance at Service Stations (AF6), \(F(3,347)=4.924, p<.002\); and on five behaviour items Tyre Pressure (B3), \(F(3,347)=2.640, p<.049\); Sourcing Spare Parts (B7), \(F(3,347)=3.138, p<.026\); Car Pooling, (B8), \(F(3,347)=4.935, p<.002\); Idling at Traffic Lights (B12), \(F(3,347)=5.965, p<.001\); and Timely PUC (B14), \(F(3,347)=4.676, p<.003\). The multiple comparisons on the basis of income groups revealed that the lowest income group displayed the highest environmental concern on all variables found to have significant F-ratios, excepting one behaviour item – sourcing of spare parts (B7). The respondents belonging to the highest income group were most particular about the purchase of spare parts, while on the other behaviour items and attitude factors they performed poorly as compared to the other income groups. Evaluating this variation in context, it can be construed that the attitudes and behaviour displayed were more an expression of
economy than of environment consciousness, although economy
does result in a reduction of the environment footprint.

6. The ANOVA for all the 14 elements depicted that there was no significant
difference in the attitude of the respondents towards the attitude
dimension AF4 (Infrastructure & Regulatory Policies). Thus, the
sample drawn across various cities had a similar response profile on the
role of government in addressing environment issues with regard to
personal vehicle transport.

7. The other major attitude dimension AF3 (Quality v/s Economy of Car
Maintenance), was also addressed with relative consensus, with
significant differences arising only amongst the respondent grouping on
the basis of ‘Year of Purchase’. This analysis does support popular opinion,
and the experience of car manufacturers that the respondents frequent
the authorised service stations mainly during the period of free
services, tapering off after the warranty period.

8. The behaviours B13 (Gentle acceleration) and B15 (Checking fuel
efficiency) have response profiles that do not vary significantly across any
of the 14 car usage and demographic elements analysed. Therefore,
‘Checking fuel efficiency’ established itself as an environment
conscious behaviour displayed explicitly, obviating all demographic
categories.

9. The three behaviour items B3 (Tyre Pressure), B8 (Car Pooling) and B12
(Idling at Traffic Lights), were the behaviours most influenced by different
respondent groupings. The behaviour B3 showed different strength of
manifestation across total annual income, household size, gender, the car
driver (self / other), and the percentage driving on city / highway. The
behaviour item B8 was exhibited with relative differences across car usage
elements like total kilometres that the car has been run, the average
monthly running, the percentage driving of car in city / highway, and
number of cars in the family. The behaviour B12 was demonstrated with
significant variations across OEM of car, segment, and year of purchase,
average monthly car running and total income.
6.3 MANAGERIAL IMPLICATIONS

The findings from the study of car owners’ attitude and behaviours have implications for the automobile companies – pricing of spares and servicing of cars to be made competitive. It is apparent that the respondents who own and use a car that belongs to the segments A1 & A2 (small cars) are relatively disinclined towards frequenting the authorised service stations for servicing, and believe that spare parts can be purchased from an economical source, which again is the unorganised sector. Thus the car manufacturers need to actively support the pricing through creating ‘value’ as translated in genuineness and performance. Another important aspect that emerged is that the respondents whose driving experience is limited to cities were less likely to display environment friendly driving attitude, and driving behaviour. Currently, the companies offer driving skills training at a very limited scale – mainly to commercial vehicle drivers. However, given the rise of vehicles in cities as well as the worsening air quality, it is only prudent to offer such training to the car users so that they drive well on city roads. It is also clearly established that the attitudes and behaviour displayed by the respondents are more an expression of economy than of environment consciousness, although economy does result in a reduction of the environment footprint. Thus, better interventions through active involvement with the car users is required to ensure that environmental concerns get translated into pro-environment behaviour.

The automotive sector has with great alacrity reoriented its research and development towards the low cost and ultra-low cost cars, however in time this is bound to put greater burden on the already stretched infrastructure. The companies need to consider that the Government regulations can change, thus their efforts should be focused on the long term expectations and a commitment for the future, directing efforts towards technology upgradation surpassing environment norms and greater customer satisfaction. The automobile companies like any other manufacturing companies are driven by ‘techno-commercial’ decisions. However, the current trend of playing the scale game, and introducing new products and variants for maximising sales in the
volume market of small cars, may slow the companies down in introducing Alternate Fuel Vehicles (AFVs).

The selected companies have not done justice to the infrastructure available for AutoLPG – approximately 900 stations across 400 odd cities. The LPG variants are limited – Maruti (Wagon R, Omni and Maruti 800); Hyundai (Accent Eco and Santro Eco, Tata Motors (Indica V2 Xeta LPG). Honda and Ford currently are unrepresented in this segment – although Honda sells its Civic Hybrid (Gasoline Hybrid). The OEM models (including the automobile manufacturers not studied, comprise just 20 percent of the total autogas fleet currently; the mileage-per-litre conscious buyers are thus being driven to the retrofit market.

Although there is no recyclability & recoverability regulation or guideline in the country for the ‘End of Life vehicle’, yet these are certainly on the anvil. Therefore, the automobile companies need to make smart material choices, bringing in the ‘learning’ from Japan and the European Union to ensure environmentally sound ‘dismantleability’, ‘recycling’ and ‘final disposal’ of the vehicle at the ‘end of its life’.

6.4 CONCLUSION AND RECOMMENDATIONS

The various stakeholders need to collaborate and offer a comprehensive solution that translates into cleaner vehicles and increased fuel efficiency, including new technologies, better fuels, getting old polluting vehicles off the roads, government leadership and changes in driving behaviour. The government should create a regulatory environment that is on the one hand benign to green product innovation and on the other hand strict enough to ensure the overall environmental quality. The automobile manufacturing and marketing companies have to accept the current situation as an opportunity to innovate and develop new value streams.

Further, behavioural change is needed to encourage transition to low carbon transport, which can be brought about by a combination of top-down or bottom-up polices. The top-down methods include command and control
policies, such as regulation and incentive based policies, such as taxes and charges. The bottom-up methods or complementary polices fall into three broad categories: physical polices, soft polices and knowledge polices. There is a requirement to provide 360 degrees information regarding environment and personal mobility choices. The various sources that can be developed for imparting environment related information to car owners are - magazine reviews, dealer visits, ready access to ‘expert’ opinion, government enabled comparative websites, - offering product to product information.

6.4.1 Specific Recommendations for Companies

1. Foremost, the companies have to share greater information with the car owner. The only way to balance personal mobility demands with the increasing pressure on the environment is through empowering the car owner – and information is the first step. In addition to the physical process for sales transactions and dealer involvement, the marketing strategy should cover the communication of environmental issues.

2. Currently most cars are marketed with an accent on power and style. ‘Mileage’ is mentioned mainly from the angle of targeting the car owner on ‘cost of ownership’ rather than concern for the environment. However, there can be standards introduced to ensure that the ‘environment footprint’ of car production and use is made integral to advertisements.

3. There is scope for introducing AFVs into the market, and the companies through their own corporate use can set the ball rolling. All automobile companies should introduce environment friendly technology to address its own mobility demands.

4. At the organisational level, a company needs to make its support activities more eco-centric, and develop environment product stewardship so that environment concerns are integrated into sales, marketing and service. The Human Resources team has to ensure that all employees and business associates get adequately trained on environmental issues. Moreover, there is requirement for developing higher intensity of programmes and training for dealers, sales and service staff.
5. There is need for the OEMs to rethink the services provided to customers related to both vehicles and mobility, including the overall approach to customer relationship management. Considering that the government demands pollution under check certification on a half-yearly basis, and is also toying with a move on ‘vehicle fitness’ certification – it is prudent to offer these as value addition services to customers who exclusively frequent authorised service stations.

6. The OEMs, either on a regular basis or periodically offer free camps and driver training courses. The companies can collaborate to avoid duplication of efforts and specialised centres can be opened jointly for providing driver training (especially training related to safety and eco-driving).

7. Greater investment is required for the training of mechanics to support vehicle maintenance initiatives/schemes/programs and personnel policies for their retention.

8. There is a major price difference between the repair-work and parts replacement between the authorised centres and the market. It is well established that maintenance of vehicles can actually reduce the impact on the environment. The car owner thus needs to feel confident regarding both the price differential as well the quality of work being carried out.

9. Although most OEMs have launched their ‘pre-owned’ car businesses (other than Ford) yet the model hasn’t attracted the masses. Perhaps, the business model to be developed here is volume based, with a competitive advantage in line with ‘cost leadership’ - providing the best service backup at the least cost.

10. Recyclability & recoverability at the ‘End of Life’ of a vehicle is relatively new concept in India, yet the companies have wide experience from Europe and Japan. As most of the OEMs have already introduced their pre-owned car businesses, the requirement now is to explore take back systems for recovery, recycling, and proper disposal of vehicles (including components or parts).

Thus, of all the factors, technology, especially leadership in fuel efficient propulsion (powertrain) technologies, consequently differentiation
supported by effective customer communication and relationship development programmes will be the key success factors for the automobile industry.

6.4.2 Specific Recommendations for Car owners

1. The car owners have to comprehend their role and adopt choices that translate into ‘Green consumption’; in the consumer market it means buying cars to serve the most basic requirements rather than the enhanced psychological needs. Personal mobility is a genuine requirement especially in a country where public transport is not fully representative of the population pressure, however, the need has to be served responsibly,

2. Car purchase checklist for buyers including a shift in the consumer mindset is required from a ‘his’ and ‘her’ car to a transport based solution – for daily requirements, and for holidays and leisure.

3. All manufacturers offer a three-year warranty with a new car, with options available for extended warranties, cashless schemes etc. The car owner needs to understand what’s covered by the policy, and the service support available.

4. While buying a pre-owned car one should check the service history - a properly maintained used car will last longer, protect its value and minimise environmental impact. A car sold under a manufacturer’s pre-owned car scheme will surely ensure quality and customer service.

6.4.3 Specific Recommendations for Government & Regulatory Agencies

1. The government should initiate and support the investigation of new technologies and processes, leading to their application in the development of mobility products and services. A new car takes anywhere between 5-8 years from the drawing board to road. Thus it is essential to develop a time horizon for commercialisation of various technologies (short term, medium term, long term). This will ensure a smooth transition
from current 'incremental' technology improvements to an adoption of a 'disruptive' technology.

2. Travel demand reduction, a method that focuses on maximizing the movement of people, not vehicles, within the transportation system is an initiative which requires the support of the government. This can be ensured through 'differential' pricing --by increasing the number of persons in a vehicle, by influencing the time of travel, and the availability of parking. The other strategies that can be considered to reduce travel demand to employment centres at peak commute time are, working from home, carpooling, staggered work hours, and compressed work weeks.

3. The government can also introduce benefits for car owners or users of cleaner-technology vehicles in various ways like lower taxes as well as providing preferential road spaces (e.g. high occupancy lanes) and parking.

4. Currently there is no tax support for promoting hybrid cars. Moreover, there are no regulations regarding hybrids when it comes to testing and gaining approval from the Automotive Research Association of India, which has to be carried out for all new imported models. India is lagging its regional peers in terms of preparation for alternative fuelled vehicles. Thailand has its 'Eco car' programme aimed at encouraging investment in new plants by providing tax incentives for the production of fuel-efficient vehicles, while the Philippines has its Bio Fuels Bill, which has encouraged production of flex-fuel engines and vehicles.

Thus, this is a transition period for automobile companies, where the business model of automobile companies itself is being challenged. The pressure on automobile companies to integrate and partner will continue to increase, leading to greater influence over the economic, environmental, and social performance of its suppliers and business partners. The focus area for the select automobile companies is 'process', a greater emphasis on collaboration with suppliers, development of vendor base with active support in skills training, assisting the Tier1 and Tier2 suppliers to adopt environmentally sound practises and implement global standards. The
management of supply chain and enhancement of manufacturing capability by adopting better technologies for higher quality levels and maximising productivity helps the companies in reducing their environmental footprint. On the product side the companies are focusing on ‘smaller cars’ the mini and compact car segments, which succeeds in reducing the environmental life cycle footprint of a car, yet the increase in number of cars on the road, requires other initiative like take back systems for recovery, recycling, and proper disposal of vehicles (including components or parts).

There are areas that the companies have lot of potential, which is Alternate Fuel Vehicles (AFVs), and the ‘Pre Owned’ Car Business. Currently, India is lagging behind its regional peers in terms of alternative vehicles; however the joint ventures and partnerships on the anvil are paving way for development of more alternative fuel vehicles in the country.

Thus, climate change and other environmental issues are perhaps the most important strategic concern facing the various automobile companies today, and a shift from short term strategy of optimizing the conventional technologies, to the long term introduction of radical, disruptive technologies, is consequently imminent.

6.5 LIMITATIONS

The focus of the current study has been the car owners, and the automobile industry – with its linkages and control exercised over the component manufacturers and dealers and authorised service centres. The objective of the study is to make a comprehensive analysis of the integration of environmental concerns in the automobile value chain.

However, the industry is very vast with many stakeholders namely: Government (at all levels), manufacturers (including production of materials and parts), distributors (including new and used car dealers, maintenance, and repair), customers (vehicle and fuel purchasers) and last but not the least the fuel manufacturers and distributors. Thus, there are areas in the value chain analyses that can be comprehensively detailed out.
The study only considers the car owners, precluding two-wheeler owners, and commercial transport.

6.6 SUGGESTIONS FOR FUTURE RESEARCH

The study was vast and thus there are sections that can be selected for intensive research. The areas for future research can focus on the roles, responsibilities and performance of individual stakeholders in the automobile industry.

1. The major force shaping the future is the multilateral agreements and consequent national policies and regulatory framework. The alignment of different policies regarding sustainable growth that impact the industry can be researched e.g.: The Automotive Mission Plan, National Action Plan on Climate Change, the Jawaharlal Nehru National Urban Renewal Mission, National Urban Transport Policy as well as infrastructure development investment.

2. The study on car owners' attitude and behaviour is based on primary data from a non random sample survey of 351 car owners. The content is valuable to Companies, various Government Agencies and Non Government Organisations for addressing the paradox of translating positive environment attitude into environment friendly behaviour. The researchers in the same field can take the study further and generate hypotheses for future research.

3. The current study exclusively covers personal vehicle purchase, use and maintenance. There is scope to study the commercial transport sector.

4. The unorganized sector that is currently the major player in the vehicle servicing, resale market, and the recycling and disposal (end of life activities) is an area that can be studied in greater detail.

5. The impact of automobile company advertising on car owner’s selection of service centre, purchase of spares and repair work, and resale can be an area that can yield information that can help the automobile companies to reorient their demand chain.

6. The growing number of service centres places an increasing pressure on the local resources. Thus, their environmental performance can also be a rich research area.