CHAPTER 3
RESEARCH METHODOLOGY

3.1 DEFINING THE RESEARCH PROJECT

The research project is ‘Integration of Environment Management System (EMS) In the Value Chain: A Study of Select Automobile Companies in India’. The study examines 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.

An established fact is that the major environmental impact of a vehicle happens during the product use stage. This makes the car owner and user an important player whose involvement is essential in reducing the environmental impact of a vehicle. She/he has a responsible and constructive role in exercising her/his choice in selection and purchase, maintenance, servicing and handling of cars. Thus, the study takes into account:

1. Automobile Marketing Companies (Original Equipment Manufacturers)
2. Car Owners

3.2 OBJECTIVES OF THE STUDY

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.
3.3 SCOPE OF THE STUDY

The study covered the Automobile Marketing (Manufacturing, Importing and Assembling) Companies in India and concentrated on the holistic approach of the companies in integrating environment concerns (emissions, reclaim, recycle, remanufacture, reuse, take-back, and disposal) in the value chain. The focus of the study was on the marketing end of the value chain activities including the dealer chain. The scope of environment friendly vehicles was also explored especially with regard to availability of alternate fuels. The study also covered the car owners' attitudes and behaviours concerning the selection, purchase, maintenance, servicing and handling of cars.

3.3.1 PERIOD OF THE STUDY

The study was confined to the period 2006-2010.

3.4 SAMPLE SIZE AND SELECTION

The sample size included 5 automobile companies, 97 experts and specialists, and 351 car owners (Table 3.1)

Table 3.1: Sample Size for the Study

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>Planned</th>
<th>Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Automobile Companies</td>
<td>5</td>
<td>5*</td>
</tr>
<tr>
<td>2 Automobile &amp; Environment Experts</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>3 Car owners</td>
<td></td>
<td>351</td>
</tr>
<tr>
<td>• Chandigarh</td>
<td>200</td>
<td>180</td>
</tr>
<tr>
<td>• Delhi Area</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>• Other Metros</td>
<td>100</td>
<td>91</td>
</tr>
</tbody>
</table>

*The additional automobile companies visited included: Mercedes Benz, Hindustan Motors (Mitsubishi) plant; component manufacturers: Bharat Forge Ltd., Kalyani Carpenter Steels Ltd., Tata Green Battery, International Auto Ltd., Bosch Chasis Systems, Bosch India Ltd., Beck India Ltd. and SKF India Ltd.
The sampling frame for the study of value chain activities consisted of the Automobile Marketing (Manufacturing, Importing and Assembling) Companies in India. The sample of companies was selected on the basis of sales in the year 2006-07 (Table 3.2). The top five companies in India on the basis of number of units of passenger vehicles sold in the domestic market formed the sample for study.

The top 5 companies with their percentage share of market were – Maruti Suzuki India Ltd. (51%), Hyundai Motor India Ltd. (18%), Tata Motors (16.6%), Honda Siel Cars India Ltd (5.5%) and Ford India Pvt. Ltd. (3.7%).

Table 3.2: Market Share Passenger Cars (2006-07, %age Share of Domestic Sales)

<table>
<thead>
<tr>
<th>SNo.</th>
<th>COMPANY</th>
<th>A</th>
<th>A+B+C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Daimler Chrysler India Pvt. Ltd.</td>
<td>0.19</td>
<td>0.15</td>
</tr>
<tr>
<td>2</td>
<td>Fiat India Pvt. Ltd.</td>
<td>0.20</td>
<td>0.16</td>
</tr>
<tr>
<td>3</td>
<td>Force Motors Ltd.</td>
<td>0.00</td>
<td>0.62</td>
</tr>
<tr>
<td>4</td>
<td>Ford India Pvt. Ltd.</td>
<td>3.70</td>
<td>3.03</td>
</tr>
<tr>
<td>5</td>
<td>General Motors India Pvt. Ltd.</td>
<td>1.58</td>
<td>2.82</td>
</tr>
<tr>
<td>6</td>
<td>Hindustan Motors Ltd.</td>
<td>1.16</td>
<td>0.99</td>
</tr>
<tr>
<td>7</td>
<td>Honda Siel Cars India Ltd.</td>
<td>5.52</td>
<td>4.44</td>
</tr>
<tr>
<td>8</td>
<td>Hyundai Motor India Ltd.</td>
<td>18.10</td>
<td>14.15</td>
</tr>
<tr>
<td>9</td>
<td>Mahindra &amp; Mahindra Ltd.</td>
<td>0.00</td>
<td>6.50</td>
</tr>
<tr>
<td>10</td>
<td>Maruti Suzuki India Ltd.</td>
<td>51.03</td>
<td>46.07</td>
</tr>
<tr>
<td>11</td>
<td>Skoda Auto India Pvt Ltd.</td>
<td>1.16</td>
<td>0.90</td>
</tr>
<tr>
<td>12</td>
<td>Tata Motors Ltd.</td>
<td>16.63</td>
<td>16.45</td>
</tr>
<tr>
<td>13</td>
<td>Toyota Kirloskar Motor Pvt. Ltd.</td>
<td>0.72</td>
<td>3.72</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

A: Passenger Cars
B: Utility Vehicles (Uvs)
C: Multi Purpose Vehicles (MPVs)

Source: Society of Indian Automobile Manufacturers

Further, the respondents for the car owners study on attitudes and behaviour were the educated car owners from the tri-city of Chandigarh, Panchkula and Mohali, Delhi NCR, and other metro cities. The locations were selected to reflect the car ownership and usage patterns in urban centres.

The Chandigarh area has the highest automobile density - for a population of just over one million; there are over 550,000 registered vehicles. The Delhi area was selected because it is the focus market for alternate fuel
vehicles, with a developed supporting infrastructure. Finally, the other metros were also taken into consideration as these are the most densely inhabited and fast growing urban areas; showing the impact of worsening environment with growing air pollution. The quality of air has steadily declined in the metros.

The sample was non-probability, judgement sampling, the questionnaire was personally administered in the tri-city. However, the respondents selected in Delhi area and other metros were referred to a website for submitting their responses. The form displayed on the website accepted only those responses that were complete in every respect. A return email was sent to those respondents who had successfully completed the form. This served the twin purpose of providing a record of the responses to the respondent, while enabling the researcher to confirm the validity of the form received.

3.5 RESEARCH FRAMEWORK

3.5.1 Framework for Analysing Environmental Impact Mitigation in Process and Product by Select Automobile Companies

The research framework for studying the Indian Automobile Companies was constructed in context of the climate change challenge, and other environmental issues as ‘the structural determinant’ of the intensity of competition in the automobile industry. The issues were identified as per the guidelines, standards, and disclosures, established by the Global Reporting Initiative (GRI) for reporting on sustainability.

The GRI Reporting standards have been developed around three categories of ‘Standard Disclosures’ viz. (i) **Strategy and Profile** - the overall context for understanding organizational performance and governance; (ii) **Management Approach** - how an organization addresses a given set of topics in order to provide context for understanding performance in a specific area; and (iii) **Performance Indicators** - comparable information on the economic, environmental, and social performance of the organization activities (GRI Sustainability Reporting Guidelines, Version 3, Pg 5). The GRI
indices cover six areas, namely Economic, Environment, Human Rights, Labour Practices and Decent Work, Product Responsibility, and Society. However, for the purposes of the study only the Environment and Product Responsibility Indicators were utilized.

Thus, the research study covered the Strategy and Profile, the Management Approach, and Environment and Product Responsibility indicators. Additionally, the GRI Automotive Sector Supplement (Pilot Version 1.0, 2004) was also referred, to comprehend the industry specific concerns. The company analysis included 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 value chain activities, the competitive forces shaping the company and the macro environment with its influencing elements on the automobile industry are depicted in Figure 3.1.

Figure 3.1: A Company’s Industry and Competitive Environment

![Diagram of a Company's Industry and Competitive Environment]

Source: Adapted from various studies on Corporate Strategy
### 3.5.2 Framework for Analysing Car Owners’ Concern for Environment

A car is the most desired and chosen medium for fulfilling personal mobility needs and at the most basic level owning/possessing a car defines accessibility to opportunities for work, health care and recreation. However, no product is bought with only the elementary application in mind; exercising the decision to purchase a car goes beyond the basic idea of mobility or for that matter simple aesthetics. The style, power and other car attributes denote an expression of self, a symbol of having arrived at a certain level in life.

The main factors (Figure 3.3) that determine choice of personal mobility can be grouped under three main categories, product attributes, service criteria and car cost (total cost of ownership). Amongst these elements, the car attributes – engine power, accessories (especially the air conditioner), mileage and maintenance, majorly define the impact that the car will have during its use.

**Figure 3.2: The Elements considered in Personal Vehicle Selection**

![Diagram showing the elements considered in personal vehicle selection](image-url)

Source: Adapted from various studies on Personal Vehicle Purchase and Use
The changing socio-economic conditions in the country and limited public transport options have resulted in a growing demand for personal vehicles. This demand, and need for mobility resulted in design and development of new low cost cars. However, the increasing number of cars on Indian roads has raised up many issues, the challenge of pollution, resource depletion, and strain on infrastructure (the carrying capacity).

The climate change issues of transport have required a concerted effort that involves the technological issues as well as the behavioural changes and commitments at the institutional level (ACEA & UNEP, 2002, pg.7, 32 and 37). The report stated, “...a driver’s behaviour contributes significantly to fuel consumption and related emissions...requiring responsible use of advanced technical products such as cars”.

Therefore, at the centre of the research is the Indian Car Owner, her attitude and behaviour towards personal mobility, and towards selection and purchase, maintenance, servicing and handling of cars. Thus a comprehensive questionnaire was developed and administered to study the car owners’ attitudes and behaviours about environmental impact of cars. The aim of the study was to explore the links between attitudes and behaviour; and identify any factors that influence environment friendly behaviour.

3.6 DESIGN OF RESEARCH TOOLS AND DATA COLLECTION

3.6.1 Schedule of Questions for Analysis of Automobile Marketing Companies

The automobile industry over the past century has developed into a complex and large industry, giving rise to a number of complimentory industries. Thus, the industry has deep forward and backward linkages; however, it is also the focus of climate change debate. Thus, an exhaustive study of literature was undertaken to understand the industry, covering a number of sources including peer reviewed journal papers, Government white papers and international reports. The report used both proprietary and public
domain secondary sources. It also included extensive first hand interviews with some of India's senior decision makers in the automotive industry.

The researcher received organisational support from Society of Indian Automobile Manufacturers (SIAM) for data collection; including sponsorship to attend few international level seminars and interact with international experts in the sector. Thus, access was available to learn and comprehend the issues through the latest research papers presented at Technex - 08 (2nd Global Automotive Technology Conference), Environmentally Friendly Vehicle (EFV) Conference - 09 (4th International Conference), Recycling of Vehicles Seminar (2010) and the SAFE Convention (2010).

The schedule of questions framed for the automobile companies encompassed the value chain activities, and listed out the environmental concerns at each stage. An affirmative corporate agenda as stated in the vision and strategy of the automobile companies, lays the foundation, and directs the integration of these issues into the complete value chain from suppliers to dealers and after sales service centres. The environmental concerns were identified on the basis of the automotive supplement (pilot) from the GRI, and the Product Responsibility and Environment Reporting Indices.

The schedule consisted of two parts: the first part consisted of 36 questions pertaining to the environmental elements in the 'Support Activities'; the second part was composed of 29 questions regarding the value creation 'Primary Activities' of a company. The schedule of questions is attached as Annexure-I and the GRI Product Responsibility and Environment Reporting Indices covering various aspects is attached as Annexure-II.

The 5 identified companies were researched and officials across various functions were interviewed. In addition to the 5 companies selected as per their market share, Mercedes Benz and Hindustan Motors (Mitsubishi) plant were also visited. Moreover, to gain a better understanding of the automobile industry dynamics, automobile component manufacturers were also visited, namely, Bharat Forge Ltd., Kalyani Carpenter Steels Ltd, Tata
Green Battery, International Auto Ltd., Bosch Chasis Systems, Bosch India Ltd., Beck India Ltd, and SKF India Ltd. The automobile dealerships in Delhi and Chandigarh were also visited, and discussions held with the service and sales staff.

The experts consulted, included the senior most automobile company executives as well as independent consultants and specialists in the field of environment and mobility. The list of organisations covered, along with the designations of experts interviewed, is attached as Annexure-III.

3.6.2 Design of Questionnaire for Car Owners’ Study

India, home to the second largest population in the world, has become a lucrative consumer market as well as an attractive manufacturing base for automobiles. Although it is in the domain of car manufacturer’s to introduce alternate fuel vehicles or develop more efficient cars, a lot can be achieved at the consumer level, through selection of right form of transport, checking tyre pressure, and right car maintenance and driving styles.

In India, due to various economic considerations there is greater demand for small vehicles that are high on mileage. The identified need is for convenient mobility at least cost; which has been the focused segment for various automobile companies. Moreover, the high cost of fuel does necessitate an investment in mobility that maximizes mileage. However, there is hardly any focus on the car user’s role in conservation. Do car owners hold an attitude that shows concern for environment? And does this concern translate into environment friendly behaviour?

An attitude may be viewed as an association between a given item and corresponding evaluation, with possible variations in the strength of this relationship (Fazio et al, 1983). Thus attitudes can be employed as predictor variables to better understand various dimensions of consumer behaviour. Cleveland et al (2005) examined the impact of various attitudes and personality characteristics on environmentally-friendly behaviour. The researchers found that it is important to consider the specificity of pro-
environmental behaviours, when assessing the roles of pro-environmental attitudes/dispositions. They have suggested that the research should be directed less at whether attitudes are predictive of behaviour, more on the question of when and how they are predictive of behaviour. Fraj & Martinez (2006) in their study have identified values and lifestyles that best explain environmentally friendly behaviours.

The questionnaire was developed – emphasising the car attitudes and behaviours, after extensive interaction with executives of SIAM, various Automobile Companies, the Oil Industry and other experts. The questionnaire covered car owners’ attitudes and behaviours regarding environmental impact of cars and various issues that impact mobility - selection, and purchase, maintenance, servicing and handling of cars, with an aim to explore the links between attitudes and behaviour. The instrument designed in four parts comprised of a series of statements to evaluate the consumer’s responsiveness towards environment. as depicted in the Table 3.3.

Table 3.3: The Format of Car Owners Questionnaire

<table>
<thead>
<tr>
<th>Part I</th>
<th>Part II</th>
<th>Part III</th>
<th>Part IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude Items</td>
<td>Behaviour Items</td>
<td>Car Details &amp; Owners Displayed Behaviour</td>
<td>Car Owners Personal Information</td>
</tr>
</tbody>
</table>

The first part had 27 attitudinal statements and the respondents had to rate each statement as per their level of agreement on a nine-point Likert-type scale. The second part had 15 statements that required the respondents to delve into their own driving and car management practices of past one year. They had to record, based on their experiences on a nine-point scale from never to always, their level of engagement in environment friendly behaviour. The third part consisted of the personal car details as well as driving, servicing particulars. The fourth and final part consisted of personal information including academic, employment, and income and family particulars. The questionnaire is attached as Annexure-4.
3.6.3 Pilot Study

The questionnaire for car owners and the schedule of questions was developed after an extensive review of literature and discussions with automobile industry experts. Initially, the consumer questionnaire was prepared with 30 attitude items and 17 behaviour items.

The first version of the questionnaire was administered to 40 select car owners in Chandigarh and Delhi areas. The resultant questionnaires were analysed and interpreted for results. Thus, the questionnaire was made shorter and the formulation of certain statements was changed, eliminating ambiguity.

3.7 ANALYSIS OF DATA

3.7.1 Automobile Marketing Companies

The schedule of questions was analysed qualitatively, with a focus on the manufacturing process (Figure 3.3) and the cars marketed; through an in-depth study of the ‘Strategy and Profile’, the ‘Management Approach’, and inter-weaving of ‘Environment’ concerns through the activities across the value chain.

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.
3.7.2 Analysis of Consumer Data

A multi-stage quantitative analysis was carried out on the 351 questionnaire responses found complete in all respects. The data was handled in MS Excel, and in statistical packages – SPSS and AMOS.

**Stage I** – The intercorrelations amongst the 27 attitude scale items measured in the study were factor analyzed by the Principal Components Analysis. Cattell’s (1966) Scree Test criterion was utilized to identify the optimum number of factors that could be extracted. Further, Direct Oblimin (oblique) method of rotation was employed to allow for the emergence of distinct, yet possibly correlated factors.

**Stage II** – The intercorrelations were computed amongst the 15 behaviours and the attitude dimensions that had emerged from Stage I. Subsequently, step-wise multiple regressions were carried out separately with each of the fifteen car use behaviour items as the predicted variables and the attitudinal dimensions as the predictors.
Stage III – The causal relationship between the behaviour items as dependent variables and attitudinal dimensions as predictors was further analyzed by developing path models. Structural Equation Modelling (SEM) was carried out in AMOS software using Maximum Likelihood Estimation (MLE). Path modelling was done independently for each behaviour item, for confirming the regression paths obtained through SPSS.

Stage IV - Further, 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.

3.8 LIMITATIONS

The focus of the research study was to examine the environment friendly attitudes and behaviours of the car owners and the integration of environmental concerns in the automobile industry – with its linkages and control exercised over the component manufacturers and dealers and authorised service centres.

Thus the objective of the study was to make a comprehensive analysis of the integration of environmental concerns in the automobile value chain. However, there have been some limitations to the study as enumerated below:

1. The automobile 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), car owners and users (vehicle and fuel purchasers) and last but not the least the fuel manufacturers and distributors. Thus, there are areas that could have been researched in greater detail.
2. The value chain study of an automobile company is an enormous task, even though care was given to cover the views of company personnel in all departments, yet there is some classified / trade related information that was not shared by the companies. The automobile companies would not share the auditing system in place at dealerships, nor was the benchmark profitability of servicing and spares at dealerships.

3. The study considers the car users, while precluding two-wheeler owners, and commercial transport.