CHAPTER 3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

The case study method using quantitative analysis has been employed for the present study. It attempts to critically examine the factors contributing to logistics cost and optimising the logistics cost of the chosen product (automobile sector) in an organisation. It is longitudinal in nature since the logistics data are collected between two milestones of product development (Program Target Setting and Program Approval). There are number of studies conducted previous with regards to logistics costs in automobile supply chains with specific reference to a product’s multiple stages. However, there is little research conducted on examining logistics costs in the new product launch stage. This research attempts to explore various factors that influence logistics costs of an automotive product in its introduction stage. It also tests the relationship between key influencing factors affecting logistics cost. This work focuses on a new automobile product that is under development. More than 500 components’ cost data has been collated, and the relationships between six identified variables have been examined through Regression and Structural Equation Model.

JICK, T.D. [57], compiled the relative strengths of case study, Survey and experimentation in his study. Having gained knowledge and advantages of combining Qualitative and Quantitative research methods through cited literature, the methodology was applied to validate the model developed. (Figure 3.1), explains four stages of mixed Research Method adopted for this study. – namely (1) Case study conducted to build Least Cost Supply Chain Model (2) Model is iterated and validated using Structural Equation Model (3) Survey conducted using Questionnaire (4) Model experimented in the Industry for achieving Logistic cost reduction.
The next few chapters are dedicated to cover the above four methods in depth as per the sequence given below

- Case Study Research Method
- Model Building using Structural Equation Model (SEM)
- SEM Data Analysis and Results Discussion
- Model Validation/Generalization using Industrial Survey Method
- Experimentation – Model applied to Case study to achieve Logistics cost results

3.2 CASE-STUDY AS RESEARCH METHOD

Researcher has taken case study as research method to collect the data from the Case Firm and to validate the Hypothetical Least Cost Supply Chain model. This study follows the six Cast Study steps prescribed by Simons, H. [56]

3.2.1 Define the research questions

In case study research, the questions that usually begins with how or why is answered. These questions are specific to the events that are limited and are interrelated. In order to insist the process of targeting and formulating the questions, the researcher performed reviewed the literature. From the literature review, the research conducted so far has been understood followed by creation of insightful questions and its refining about the research
gap is rised. The questions were developed with utmost care in a defined path so that the evidence is matched and it also helped to finalize the analytical processes to be deployed in the study. The study is well designed and guided through proper literature review.

3.2.1.1 Hypotheses used for the study (Research Questions)

The following null hypotheses (Ho) have been established in order to reduce the logistics cost of the product, which is currently under development stage in the automobile sector:

1. There is a significant relationship between the logistics cost and the Supply Factors (Incoming components’ supplier location –distance and Part Volume).

2. Logistics factors (Cubic efficiency, Packaging Type and Handling cost) have a significant relationship on Inbound Logistics cost.

3.2.2 Case selection

After studying various characteristics in automobile profile such as sales figures, automobile components’ supplier location and automobile manufacturing plants, the Case Firm (CF) was carefully selected from India. Further, various factors were considered to select the Case Firm such as willingness to participate in the study, intensive inbound logistics (number of suppliers and number of components), new model launch phase opportunity, and multiple manufacturing location.
Figure 3.2. Automobile manufacturing units and sales mapping in India

The figure above (Figure 3.2) details the automobile profile of India with the automobile component suppliers and automobile manufacturing plants that are scattered across the southern and western regions of the country. So, the current study has chosen the automobile manufacturer which not only has multiple plants across these Indian regions but also has a product which is in its launch phase. As per Lehtimaki, T., Salo, J., and Karjaluoto, H. [58], this case would be the optimum characteristic in order to address the research gap and fits exactly in the scope of the study.

The firm chosen for the study i.e., Case Firm, being one of the India’s five top automobile manufacturers, it holds 4% market share in the passenger car segment. Being an
automobile manufacturer for more than a decade in India, it already launched six new models in a successfully manner. Further, the company is making new investments in India so as to meet the domestic and export demands. One of the investment ideas that this car manufacturer is to start the new start-of-the-art manufacturing plant in another region so that it can introduce more new models in Indian market. In an interesting note, the products of the Case Firm range from small family vehicle to Sport Utility Vehicles. The Case Firm procures the automobile components from more than 100 domestic suppliers across the country and imports components from all the continents. Adding to the above, the car maker exports vehicles to 50 countries.

It imports more than 60% of automobile components (also called as parts) and 40% from domestic suppliers to serve the assembly plant located in southern part of India. The distance between upcoming assembly plant and present assembly plant are more than 1500 km. Automobile components sourced from Indian suppliers flow through three logistics hubs located in northern, western and southern parts of India. Automobile components sourced from overseas suppliers flow through port located in southern India. The upcoming plant proximity to a western port presents a potential second automobile components import gateway. The case firm follows just-in-time philosophy and engages a third-party logistics firm for its line hauling operations. This scenario is illustrated in Figure 3.3.
The case firm’s management is considering a warehouse in an appropriate location to optimise total logistics cost in two assembly plant operations scenarios. The problem is broken into four parts:

1. Selection of component category for study
2. Identification of factors contributing to inbound logistics cost
3. Application of statistical tools
4. Optimisation of total logistics cost

3.2.3 Data collection

As per the suggestions made in the review of literature, when it comes to case study research, the researcher gets enormous amount of data from different sources and care
must be taken to systematically organize these data so that the researcher can get proper insights and can prevent themselves both from being overwhelmed with the huge data as well as losing the original research purpose and questions. It is better to approach case study research in a well-prepared advanced manner to handle huge data in a documented and systematic fashion. Usually databases are prepared by researchers in order to assist them in categorization, sorting, storing and data retrieval for analysis.

### 3.2.3.1 Data collection sheet for the case study

A format is created to capture the data elements such as Case Firm, Model name, Vehicle code being used by Case Firm and Launch Phase of the vehicle. Further, the researcher also captured the information about the data collection person so that they are accountable or they can be involved in a discussion in future if there are any clarifications sought in the data sheet. The format also collects information such as the file name or data base version which is used by the Case Firm to provide the data for traceability and verification purpose.

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<th>PartName</th>
<th>Supplier</th>
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The above said factors/variables are identified through comprehensive study, which is explained in Chapter 4.1.
The data are collected from Case Firm – Supply Chain and network department subject matter experts. Also some of the data are collected from third-party logistics provider. The data are collected over the period of one year for a chosen new product from the Case Firm. Thus the primary research data was collected from the Case Firm. Due care was taken to obtain accurate responses, and few data had to be derived from the primary data based on the interview with Case Firm subject matter experts.

### 3.3 DATA EVALUATION AND ANALYSIS

The researcher evaluated the raw data with various interpretations so that the linkages are found between the research objectives and outcomes with regards to the original research questions.

The methodology consisted of 7 steps as follows,

1. **Selection of variables through literature review, Causal factors and Expert interviews**
2. **Building Hypothetical Model “Least cost Supply Chain”**
3. **Convert the Hypothetical-Model into Structural Model in AMOS software**
4. **SEM Model iterations and Final Model**
5. **Improve the SEM Model**
6. **Validate the SEM model using the Case Firm Data**
7. **External Validation of Model using survey method**

This study focuses on examining relationships between selected variables. Since the research objective is focused on longitudinal study, in the case firm qualitative approach with case study method was selected. The integrated measurement validation approach to
research begins with development of a theoretical framework and then examines its validity with appropriate empirical framework Bhattachjee, A. [59].

The subsequent two chapters describe the methodology in detail.