A

DISSERTATION REPORT

ON

An Integrated Approach to Improve Customer Satisfaction and Utilities of Key Attributes of a Product in the Design Phase of Product Development Process

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF

MASTER OF TECHNOLOGY
IN
INDUSTRIAL ENGINEERING

BY

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(2014PIE5379)

UNDER THE GUIDANCE OF
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JUNE 2016

CERTIFICATE

This is to certify that the dissertation entitled **"An Integrated Approach to Improve Customer Satisfaction and Utilities of Key Attributes of a Product in the Design Phase of Product Development Process"** being submitted by **Rakesh Kumar (2014PIE5379)** is a bonafide work carried out by him under my supervision and guidance, and hence approved for submission to the **Department of Mechanical Engineering, Malaviya National Institute of Technology Jaipur** in partial fulfillment of the requirements for the award of the degree of **Master of Technology (M.Tech.)** in **Industrial Engineering**. The matter embodied in this dissertation report has not been submitted anywhere else for award of any other degree or diploma.

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CANDIDATE'S DECLARATION

I hereby declare that the work which is being presented in this dissertation entitled **"An Integrated Approach to Improve Customer Satisfaction and Utilities of Key Attributes of a Product in the Design Phase of Product Development Process"** in partial fulfilment of the requirements for the award of the degree of **Master of Technology (M.Tech.)** in **Industrial Engineering**, and submitted to the **Department of Mechanical Engineering, Malaviya National Institute of Technology Jaipur** is an authentic record of my own work carried out by me during a period of one year from July 2015 to June 2016 under the guidance and supervision of **Prof. (Dr.) A. P. S. Rathore** of the Department of Mechanical Engineering, Malaviya National Institute of Technology Jaipur.

The matter presented in this dissertation embodies the results of my own work and has not been submitted anywhere else for award of any other degree or diploma.

Rakesh Kumar
(2014PIE5379)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Prof. (Dr.) A. P. S. Rathore
Supervisor

Place: Jaipur
Dated: __ June 2016

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- Rakesh Kumar

ABSTRACT

Competitive and dynamic business environment forces organizations to evolve according to changing consumer requirements and rapid technology changes. Organizations need to come up with new products, which fulfill ever-evolving customer requirements, to survive in highly competitive global market. Product Development and Management Association revealed in one of its study that new product development initiatives account for more than 50% of sales profit in most of the brands. Despite all efforts to introduce new products, many product development initiatives fail to develop a salable and profitable consumer product that might fulfill customers' expectations. The firms are unable to achieve a high level of satisfaction rate from the customers. In many new product development projects, the development process is carried out independently without taking due consideration of exact consumer desires, leading to wastage of resources and result in failed products. Decision makers need to establish structured approach for capturing the customers' needs in a better manner.

The present research proposes an integrated approach to integrate customer perceptions and customer preferences into the design phase of product development process. In particular, customer utilities of multi-level attributes are extracted with the help of Conjoint analysis and Kano model is utilized to elicit customer perceptions of dichotomous attributes. Two different questionnaires are developed; the first questionnaire is multiple-choice to find which of the attributes are preferred, while the second is more specific by rating product profiles made by combinations of various attributes and levels. The data gathered from the first-stage questionnaire is used to perform Kano model analysis to categorize the attributes of the product based on how well each particular attribute could satisfy the customer. Kano model categorizes each attribute into 'Must Be', 'One-Dimensional' and 'Attractive' categories. The output from the Kano model provides a better understanding of customer perceptions about various attributes which helps in designing a better product. The data from second-stage questionnaire is used for conjoint analysis to find the right composition of different levels of various attributes for the product. The results of conjoint analysis provides utility values of each level of different product attributes. These utility values

are useful in deciding the best feasible product profile. An overall preferred product profile is suggested based on the combined approach of Kano model and conjoint analysis which has the potential to satisfy consumers and generate profits.

Keywords: Conjoint analysis; Customer Satisfaction; Kano model; New Product Development.

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ABBREVIATIONS

NPD	New Product Development
VoC	Voice of Customer
VoD	Voice of the Designer
R&D	Research and Development
PD	Product Development
QFD	Quality Function Deployment
EAs	Engineering Attributes
CAs	Customer Attributes
JVs	Joint Ventures
QR	Quantitative Restrictions
CAR	Core team on Automobile
DOE	Design of Experiment
CA	Conjoint Analysis
KM	Kano Model

CHAPTER 1

INTRODUCTION

New product development (NPD) is identified as one of the important growth strategies of companies (Grunert and Trijp, 2014). The short- and long-term business strategic goals mainly of growth, continuity, and profitability are fulfilled with the introduction of successful new products or services. Ulrich and Eppinger (2011) in their study highlighted the contribution of NPD to the progress of the companies, its impact on profit making, in business planning. When a new product is introduced in the market it undergoes a sequence of stages, starting with product concept generation, concept evaluation, concept development, concept testing, and finally launch of the product (Booz et al., 1982).

Development of new product helps a company to stay competitive in the market, but for being competitive a company have to develop its product with the help of new technologies, new concepts and some innovations which is costly and risky. As technology is changing at very high pace, it is a tough task for the company to become success and in some cases a successful company to maintain its success rate for a long time. A lot of new products fail to satisfy the customer or even make significant impact on the market. It is difficult to find exact figures of failure rates as the market is divided not only on the market-nature but also on product-variation. However, failure rates have continued high over the previous decades, averaging 40% (Barczak at al., 2009; Burkitt and Bruno, 2010). The NPD performance in the past was also below par. As per to Crawford (1987), the average failure rate was around 35%. Later, Cooper (1994), a prominent NPD researcher, estimated a failure rate in the order of 25-45%. He devised the Stage-Gate process to bring out a structured and disciplined NPD process (Cooper, 2008). A more recent study by Nielsen (2010) showed that out of 24,000 new products only half survived their first year in the market. It is evident that the governance of NPD, its associated processes, and the methods are also key to ensuring a successful development.

1.1 Motivation for the Research

Incorporating the 'voice of the consumer' (VoC) in the early stages of a New Product Development (NPD) process has been identified as a critical success factor for a new product launch to satisfy a customer (Bjork and Magnusson, 2009). This step is often either overlooked or, poorly executed. There is enough literature on 'why' new products fail (Henard and Szymanski, 2001) and also 'How' NPD could be made successful (Dubiel and Ernst, 2012), but the NPD performance continues to be poor, which perhaps points to an ineffective execution of the entire product development process. As a result, much money is lost, and companies lose their competitive edge. This leaves them behind in the race for growth and prosperity.

Therefore, there was a strong motivation to develop an effective but simple methodology to capture the VoC and translate it into the early design stage. The thesis attempts to demonstrate this using a live case study in the Indian motorcycle industry, by using Kano Analysis and Conjoint Analysis to transform the captured VoC, into the Voice of the designer (VoD), right at the early design phase for a successful product development. Using this methodology, every product could be built with customer-determined features and launched to record sales and market share. This would help the companies to generate profit and help the customers' achieve total satisfaction.

Therefore, this research is carried out to improve customer satisfaction and utilities of key attributes of a motorcycle in the design phase of Product Development Process that can largely affect the success of NPD projects. Also, the Kano Model is used with the aim to improve customer satisfaction of Dichotomous Attributes, and Conjoint Analysis is utilized to improve customer utilities of Multi-level Attributes.

1.2 Objectives of the Dissertation:

The key objectives of this dissertation are as follows:

- Survey of available literature for identification of best practices for understanding customer requirements in the NPD process;

- Analyze and categorise the Dichotomous attributes of a product using Kano Analysis;
- Develop most-preferred combination of multi-level attributes using Conjoint Analysis;
- Selection of the best concept of a product which improves customer satisfaction and utilities.

1.3 Structure of the Dissertation:

This dissertation report is organized into six chapters as shown in the Figure 1-1.

Chapter 1 discusses the topic of the study, its motivation and need of study. It outlays the objectives of the research. Finally, the layout and content of the chapters are described.

Chapter 2 provides a literature review on NPD process, NPD in Indian automotive segment, best practices for understanding customer requirements in the NPD process, customer-satisfaction as a source to be competitive, automotive industry background.

Chapter 3 consists of the description of the research methodology. The design and organization of survey are explained in this chapter, along with the methods and tools used to analyze the data. The Kano Model and Conjoint Analysis are also discussed in the third chapter.

In Chapter 4, the responses of the empirical study (survey) are analyzed, and results are generated about the ranking of the attributes according to their importance levels. The analysis of interactions among the attributes is undertaken using Kano and Conjoint Analysis. The data analysis and results of the study are documented in this chapter.

Chapter 5 deliberates the implications of the study and reports the conclusions drawn from the study. An improved product profile of a Motorcycle is prepared which satisfies customer satisfaction and their utilities.

Chapter 6 lists the limitations of this research study, and recommendations are made to show the path for future research scope.

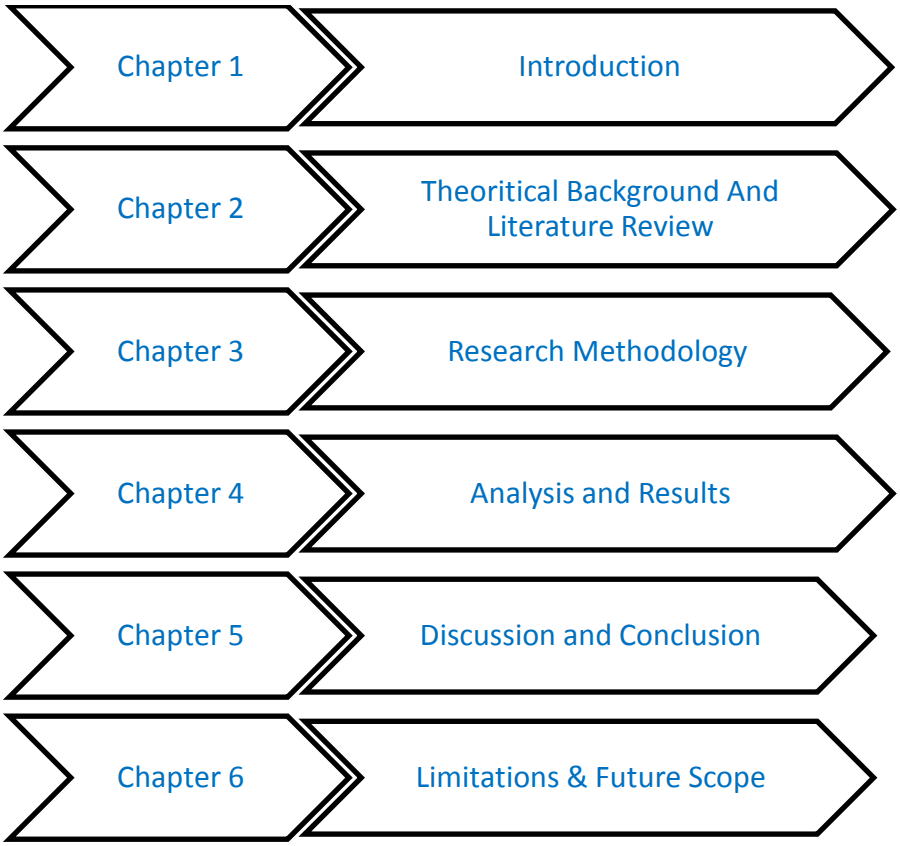

Figure 1-1 Outline of the Dissertation

CHAPTER 2

THEORETICAL BACKGROUND AND LITERATURE REVIEW

Literature review plays an important role in the collection of detailed information, which helps the researcher in understanding the problem in an elaborated way and hence gives an edge in preparing a solution to a research problem (Cooper and Schindler, 2008).

Literature of the product development is never-ending, ranging from generic explorations to detailed case studies and across numerous varieties of products, firms, and industries. Here, the literature review is organized into four sections, each providing a theoretical background and addressing the literature on the following four areas-product development process and new product development (NPD); importance of NPD; customer satisfaction as a source of competitive advantage; best practices for understanding customer needs in the NPD process and automotive industry background.

2.1 Product Development Process & New Product Development

Transforming the market opportunity along with the product technology assumptions into a product available for sale is the objective of a product development process (Krishnan and Ulrich, 2001). Though firms had executed numerous new methods & techniques, to improve the new product development process but the success rate of the product is around 60%, which is still stable (Poolton and Ismail, 2000; Barczak et al., 2009). Performing researches in NPD by developing new practices plays the role of key motivation in NPD process.There is very less number of NPD review is available. Page and Schirr (2008) have given emphasis to the necessity and significance of a systematic multi-journal literature review on NPD research.

Since the 1960s, the high rate of failure of new products stressed the researcher to examine different aspects of success and failure. Poolton and Barclay (1998) in their research stated that combination of new technologies and effort made by the committed research and development (R&D) team regualte the success of new products. Later on, it became obvious that apart form these two factors some more factors were responsible. The first analysis on NPDs revealed that key role in

encouraging the requirement for new and improved products was played by the marketplace. Since the impressive studies of Booz, Allen, and Hamilton (1968), not only the success but also failure of new products has been investigated thoroughly. Other factors such as extent to which the customer's requirements are addressed and its competitiveness are responsible for the success of a product. In spite of higher attention had been paid, but still the success rate of the product has not increased significantly (Wind and Mahajan, 1997).

Guo's (2008) review on NPD involved a total of 544 articles published in Journal of Product Innovation Management (JPIM) spread over a time span of 22 years. Page and Schirr (2008) in his review of NPD considered 815 articles and gave a comprehensive review. The main focus of this review was growth of NPD researches and different analytical techniques. He also focused on variety of topics covered in NPD, a broad systematic multi-journal review of NPD literature

2.1.1 Generic Product Development Process

It can be defined as an organisation of different stapes and activities, employed to conceptualize, design, and commercialize a product in a product development process (Ulrich, 2009). It considers redefining an existing product either completely or partially to fulfil the need of customer or to make a competitive advantage in the market. Many of these PD steps and activities are organizational and intellectual rather than physical. It is an inter-disciplinary process in which all the departments viz. strategic planning, marketing, product design, manufacturing and financial planning & budgeting have to cooperate. Apart from intra organisation, stakeholders are also brought into the process of product development.

According to Ulrich (2009), a generic product development process can be divided into six stages:

- Product Planning
- Concept Development
- System-Level Design
- Detail Design
- Testing and Refinement
- Production Ramp-Up

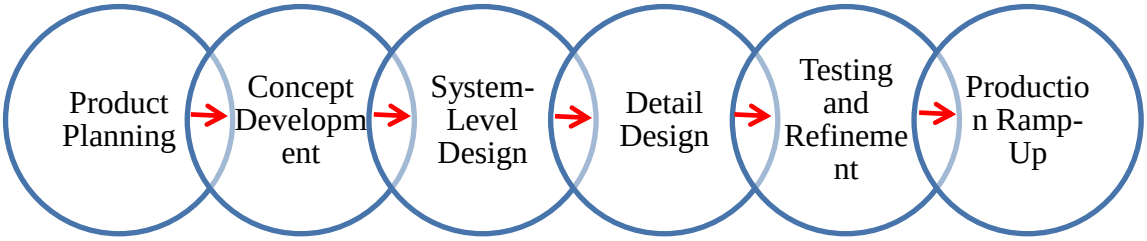

Figure 2-1Generic product development process (Adapted from Ulrich, 2009)

Stage 0: "Stage zero" comprises of planning about the product and here approval as well as beginning of the process of product development also considered. Corporate strategy, technology development, and market objectives are defined at this stage.

Stage 1: Concept development stage consists of origination and evaluation of alternative product concepts addressing the needs of the target market. The concept can be defined as the combination of explanation of different aspects of form, function, and features of a product supplemented by a set of specifications and competitive and financial analysis.

Stage 2: In this stage architecture and decomposition of the product is done. The product is decomposed into sub-systems and components. In this stage, final assembly performa is prepared.

Stage 3: Detail specifications of the shape, dimension, geometry, and tolerances of all the unique components of the product and the identification of standard components to be purchased from suppliers are considered in this stage. The critical issues of production cost are considered in this stage.

Stage 4: Testing and refinement stage involves the construction and testing of multiple prototypes of the product. The prototypes are tested, and refinements are done to make better quality product best suited for consumer needs.

Stage 5: This stage is the final stage of product manufacturing where the actual product is prepared using the planned production system. The goal of the ramp-up is

to give training to the workers and to solve any remaining problems in the production process.

2.1.2 Importance of NPD

New products that convey extra customer esteem contribute fundamentally to the accomplishment of organizations. NPD is perceived as the premise for benefit and development of most organizations.The creativity of organizations positively affects financial development (Capon et al, 1990). In their report, Eliashberg, Lilien, and Rao (1997) among 156 senior marketing-officers of US organizations, the new product will give, out of 61% of the participants believed that at least 30% or more of their sales. This finding is reliable with the survey of 700 firms (60% industrial, 20% consumer durables, and 20% consumer nondurables) of Booz, Allen and Hamilton (1982) who found that over a five-year span new products accounted for 28% of these companies' growth. Approximately 41% of company's sales and 39% of company's profits were generated from a new product in the last five-year span (Hultink and Robben, 1995). Apart from these benefits, the positive impact on company reputation, the opening up of new-fangled markets and the endowment of a platform for further new products are also some of the benefits (Storey and Easingwood, 1999). The need to establish new products is progressively felt in light of volatility in the surroundings.

The reasons of such volatility are numerous and mutually dependent and include:

- increasing competition (for the same market-segment)
- gradually demanding and learned consumers whose requirements, prospects and perception rapidly change (Dougherty, 1990)
- highly fluctuating developments in science and technology (Capon and Glazer, 1987), and
- Globalization of businesses, comprising improved international competitiveness (Wind and Mahajan, 1997).

2.2 Customer Satisfaction as a Source of Competitive Advantage

Many prominent firms are now concerning about satisfaction of the customer, in the entire world. A large number of companies use customer satisfaction ratings as a tool to indicate the performance of their products & services for their future growth.

According to Business Week, 1990, many of the consultation companies use customer satisfaction strategies despite few of the market-share strategy. This change in strategic level thinking is completely based on satisfaction of the customer, which is considered as company's future best indicator as higher is the satisfaction, higher is the customer's loyalty level. A constant stream of flow of future cash; decrease in transaction cost; and lower costs associated with the attraction of new customer are some of the advantages, can be obtained with higher customer satisfaction and their loyalty. The frequency and volume of buying goods of a particular company increases with the increased satisfaction of customer (Reichheld and Sasser, 1990). Hanan and Karp (1989) stated that: "Customer satisfaction is the ultimate objective of every business: not to supply, not to sell, not to service, but to satisfy the requirements that drive customers to do business."

2.2.1 Customer satisfaction and market share

Traditionally, each market strategy has a market share as its key objective. Its maximization leads to increase in return on investment (ROI) (Fornell, 1992). A large number of empirical studies and outcome of economies of scale are assumed to confirm the increase in market share in terms of profitability (Buzzel and Gale, 1987). Acquiring new and more customers is seen as prime objective in increasing the market share. Offensive strategies results in increased level of competition, decreased rate of market growth, and market saturation. Maintaining older customer is cheaper as compared to attract new customers when level of loyalty has increased. Its approximately five to six times costlier to attract new customer than to continue with existing one as per to the American Marketing Association. However, ironically, both strategies—customer satisfaction strategy and market share—are repeatedly considered under the same market scenario (Fornell, 1992).

With increasing level of competition, customer withholding or customer satisfaction strategies are considered as more important. The main goal of an organization is to gain sustainable competitive edge with certain market sectors where the basic competencies of the company can be used to create increased level of satisfaction and loyalty of customer.

Table 2-1 Market share versus customer satisfaction (Hinterhuber et al., 1997b; Fornell, 1992)

	Market Share	Customer Satisfaction
Typically in…	Low growth or saturated markets	Low growth or saturated markets
Strategy type	Offense	Defense
Focal point	Competitor	Customers
A measure of Success…	Share of market about competition	Customer retention rate
Behavioral Objective	Buyer switching	Buyer loyalty
Nature of Market share	Rather quantitative	Rather qualitative

2.3 Best practices for understanding customer needs in the NPD process

Comparing various methods involving customer requirements in the NPD process requires a scheme in which different methods can be interrelated. Kaulio (1998) proposes a scheme mainly based on two dimensions.

1) The longitudinal dimension, including the interaction between customers and the design practice.
2) The lateral dimension, capturing in-depth involvement of customer in the design practice. This dimension is further categorised into three categories:
    a. design for: based on the customer-research, the product is designed but without their involvement.
    b. design with: along with first, the customer is presented with various concepts
    c. design by: customer's active participation is considered (Lagrosen,2005).

Transactional, facilitative and integrative are three different customer's involvement in NPD, proposed by Lagrosen, 2009. Table 2-2 explains it.

Table 2-2 Proposed scheme for customer involvement in different levels of relationship (Lagrosen, 2005)

Level of Relationship	Longitudinal customer involvement	Lateral customer involvement	Suitable methods
Transactional	Only in the early phase	Design for the customer	Surveys, focus group, interviews, observation
Facilitative	In the early phases, in the testing phase and occasionally in the other phases	Design with the customer	QFD, Delphi method, conjoint analysis, prototype testing, beta testing, team customer visits
Integrative	In all phases	Design by the customer	Integrated product development teams including representatives of both the supplier and customer

2.3.1 Kano model

Kano model explains customer-satisfaction regarding various attributes of products. Customer satisfaction or dissatisfaction is represented with this model. Attributes of a product are categorised with the help of this model. Kano model has been selected for this thesis because it helps to understand and categories customer requirements. However, this does not the exact answers but offers an organised information about attributes of a product (Yesim et al., 2007). Figure 2-2 shows the categories requirements with the help of Kano's model.

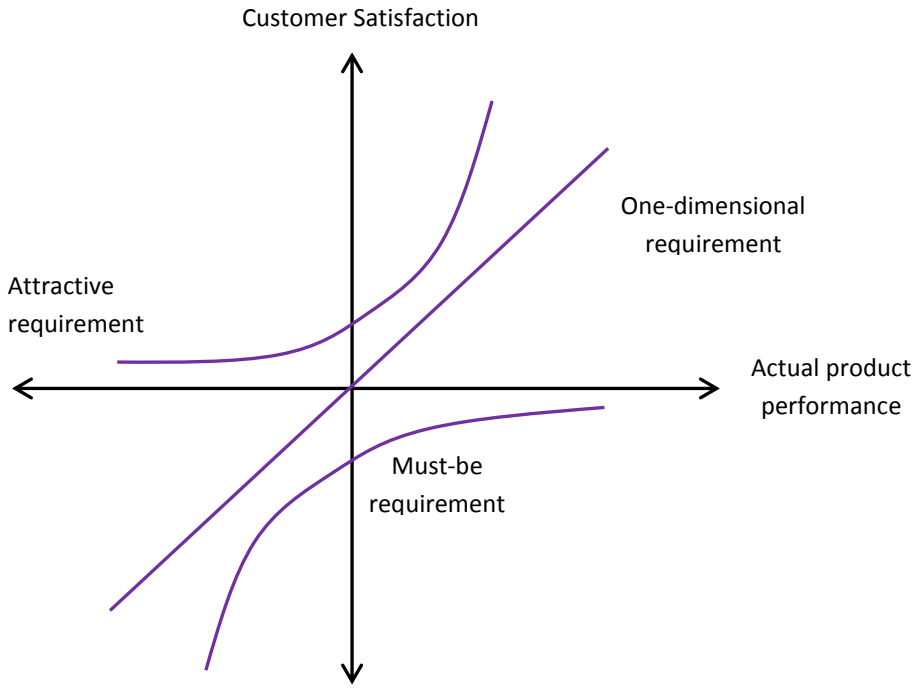

Figure 2- 2 Kano's model of customer satisfaction (Yesim et al., 2007)

The illustration shows three categories:

- One-dimensional requirement (O)
- Must-be requirement (M)
- Attractive requirement (A)

The *one-dimensional* requirement means that the customer is satisfied when it is provided and unsatisfied when it is not provided. A higher level of fulfillment means a greater level of satisfaction. This type of requirement builds customer loyalty.

A *must-be requirement* is a basic criterion of a product, since if it is not provided, the customer will be extremely unsatisfied. However, its fulfillment does not increase satisfaction, since the customer takes it for granted. If must-be requirements are not provided, customers are not attracted to the product.

An *attractive requirement* is the highest criterion of the product or service, which affects customer satisfaction. This can be something that customers do not even

know about before they use it. On the other hand, if this requirement is not provided, there is no dissatisfaction.

Kano model can further divided into three more categories:

- Indifferent requirements (I)
- Reverse requirements (R)
- Questionable requirements (Q)

Indifferent requirements: the customer is indifferent to this particular attribute of the product.

Reverse requirement: the customers are not interested but they expect reverse of the given attribute.

Questionable requirements: either the question was expressed inexactly or responder had misunderstood it.

Data collection for the Kano Analysis differs from traditional customer surveys. It is attained through a questionnaire, comprising pairs of questions. One product attribute has one set of questions, functional & dysfunctional.

With the help of Evaluation Table, the category of the attribute is obtained. All questionnaires were considered independently with the table. An attribute belongs to the category where the percentage is highest. For example, if 55% of answers are in the one-dimensional requirement category and 20% are the in the must-be category, then that specific attribute belongs to the one-dimensional requirements.

Table 2-3 Kano's Model Evaluation Table

		DYSFUNCTIONAL				
FUNCTIONAL		Like it	Must be present	Neutral	Can live with it	Dislike it
	Like it	Q	A	A	A	O
	Must be present	R	I	I	I	M
	Neutral	R	I	I	I	M
	Can live with it	R	I	I	I	M
	Dislike it	R	R	R	R	Q

To calculate the absolute importance values, these two formulas are used:

$$\text{Enhanced Satisfaction Coefficient} = \frac{A+O}{A+O+M+I}$$

$$\text{Reduced Dissatisfaction Coefficient} = \frac{O+M}{A+O+M+I}$$

A_i, O_i, M_i, and I_i denote the percentages of total replies from Table 2-3, for i=1,..., n, and n is the number of customer needs. Impact on customer satisfaction (S_i) and customer dissatisfaction (D_i) helps to determine the importance of a product attribute. Customer satisfaction (S_i), indicates the influence of satisfaction if an attribute is provided while customer dissatisfaction (D_i) indicates the influence of dissatisfaction if the attribute is not provided. This model helps the researcher to analyse the attributes because some attributes enhances the satisfaction while some increases dissatisfaction. Some of them are attractive in nature, which when provided attracts the customer. Some of the attributes are one-dimensional means increasing the level of attributes, increases the desire to buy the product. For indifferent attributes, the customers are not highly concerned (Erol et al., 2007).

Complexity in decision-making process is one of the complexities of the Kano Model Analysis. Actually, this happens when a number of counts of one-dimensional attributes is 42 and for indifference attributes it is 40, then it is a complex problem to state directly the category of the attributes (Erol et al., 2007).

According to Lagrosen's proposed scheme, Kano model is a transactional level of interrelationship because with the help of survey, data are collected and this should be done at the initial stage of the NPD process if we consider from the Longitudinal viewpoint of customer's involvement.

2.3.2 Service business approach

By changing the way of thinking in higher service business-way, we can increase our understanding on customer's needs. By this way of thinking, it cannot be meant that all the firms consider service and loss. It can also be understood from this approach

that the particular companies like manufacturing should support the customer processes as a supplier.

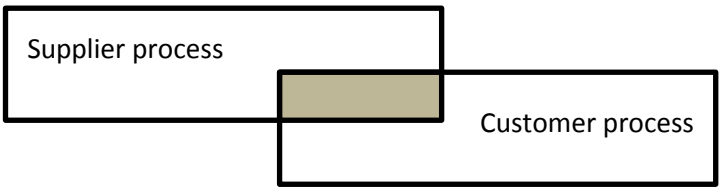

Figure 2-3 Process in the service business approach

The principle which helps to understand the relationship of processes of customer and supplier can be inferred from figure 2-3. Above figure shows a very small segment of the process and this happens for a small part of complete process (John Wiley & Sons Ltd, 2007).

By changing the methodology towards a service mode is long term process, and various principles must be considered in mind. Figure 2-4 represents three different ways, that an organisation develops its processes and information towards more of a service business approach.

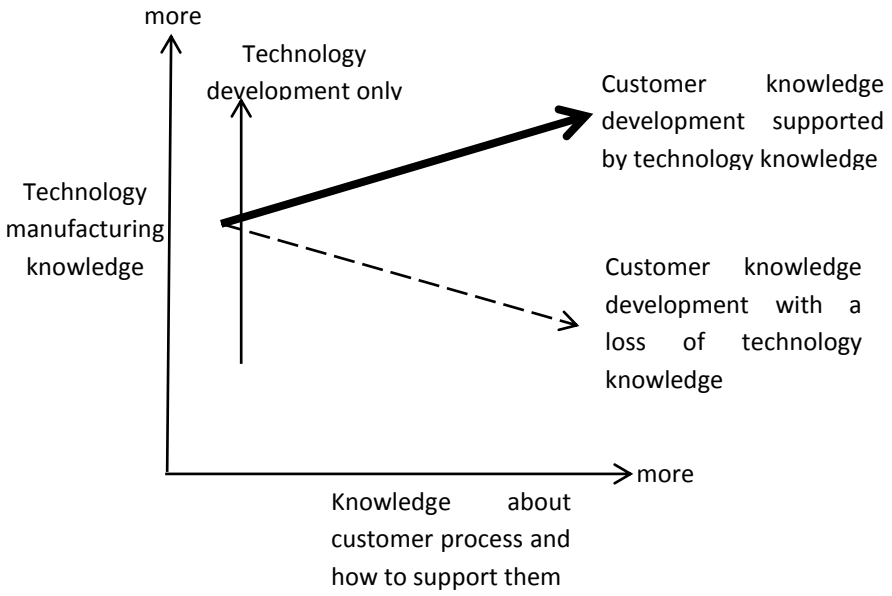

Figure 2- 4 Moving towards service business knowledge base in manufacturing

In the above diagram, thin line indicates the conventional method which a manufacturing company utilises to create the competitive advantage based on the information-base inclined towards the processes comprising technological and manufacturing. This particular development process, emphases only on the technological process and develops an understanding of it, but the customer process-understanding remains unchanged.

The worst progress that can take place is expressed with the help of dotted line. The firm emphases a lot on endorsing the customer processes and loses its ability to provide technical support in the form of products or services to its customers.

How a business becomes a service business, is indicated with the help of thick line. The value in the business process can be created and supported by gathering the information of the customer processes.

As Figure 2-4 represents, selection of different methods of developing their business to the companies. By supporting the development of customer knowledge and knowledge technology, a company can grow efficiently.

2.3.3 The QFD model

Quality function deployment (QFD) is a very popular set of methods for integrating customer needs into NPD. Engineering attributes (EAs) are prepared with the help of the desired customer attributes (CAs) obtained from market research. The engineers then utilise these attributes to prepare products. One of the notable aspects of utilising QFD is that it enhances communication among marketers, engineers and manufacturing staff (Philip and Keller, 2006)

House of Quality is one of the fundamental principles in the QFD model. Customer's inputs are used in the following stages like as design, production and marketing stages in QFD (Rodríguez et al., 2008). A matrix consisting of Customer requirements, Customer importance, Customer rating, , Relationship matrix, Technical design, Competence technical evaluation, , Specification values, Organisation difficulty, Technical correlation matrix, Importance rating are prepared to analyse different aspects to improve customer satisfaction. Figure 2-5 demonstrates the general structure of the House of Quality.

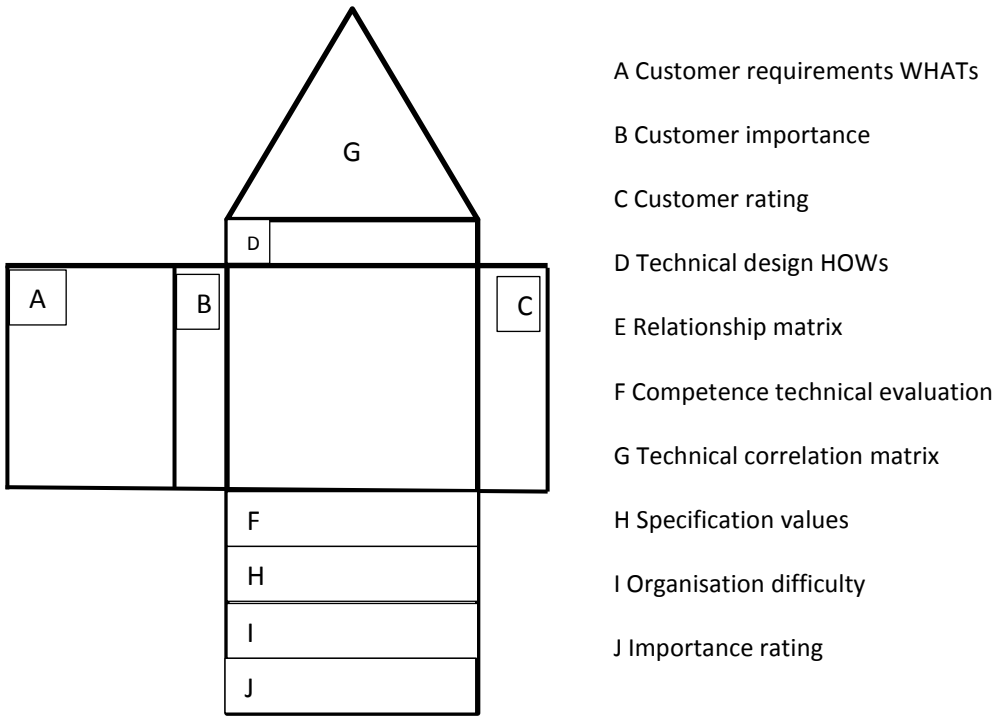

Figure 2- 5 The House of Quality: general structure

The execution of QFD and House of Quality is difficult job, and the literature represents numerous means to do this. Various researchers represent the procedure sequentially, but actually it is iterative. Quality Function Deployment (QFD) is an all-inclusive product development tool and generally employed for ideas-generation for the development of a system to develop a product of the company itself.

This System of QFD can also be employed to make it for the company in its own way. The company can let's consider an example, it can execute the QFD system in one of its NPD processes and meanwhile prepare its own observation into a note and evaluate the system. Then after, it can be altered to obtain the complete goal to meet the customers demand.

If we consider the QFD model from the perspective of the involvement of the longitudinal customer, then it appears to be much useful in the early stage of the design. Also, it represents the facilitative level of relationships in Lagrosen's framework proposal (Lagrosen, 2005).

2.3.4 Ethnographic market research

It is one of the methods to be used in the market research. Customer's known environment existence is the prime knowledge of the ethnographic market research. The level of information from an interviewee depends on the environment familiar to them. Apart from the expose of the issues with an existing service or product, ethnographic market research also helps in understanding few more facts associated with the customers like their attitude, perceptions, and requirements, both rational and emotional (Keith et al., 2012).

Video-recording can also be used for conducting the ethnographic research. While an NPD team visits the customer, if the team understands the customer requirements in a better way, then ethnographic market research can also be executed. A good experience of Fluke presents the above method of implementing the ethnographic market research. To design a superior product to meet the customers demand, a great success was achieved by Fluke's Documenting Process Calibrator product line. "camping out," "fly on the wall "or "day-in-the-life-of" are some of the common names of Ethnographic market research. Association of the customer with the company plays a critical role in this type of market research. Interacting with the most valuable customers is a better step in this method. One of the biggest challenges in this method is to interact with the smaller customers (Cooper et al., 2002).

An integrated level of the relationship using customer involvement and their perception in Lagrosen's framework proposal is related to the ethnographic market research (Lagrosen, 2005). For improving understandings, Ethnographic market research is considered as an excellent tool. Some health cares technology firms and others like this use this method.

2.3.5 Conjoint analysis

Conjoint analysis is considered as a well-known tool utilised to select product features in NPD. Basically this model is a mathematical model, which is used to find the solution by ranking different product profile according to their importance.

For example, a product is available with three different brands A, B, C and at three different price Rs. 50, 100, 150. Following table represents these attributes and their levels

Table 2- 4 Example of conjoint analysis matrix

Attributes	Levels		
Brand	A	B	C
Price (Rs)	50	100	150

From the above table, for example, it can be concluded that a product from brand A and price Rs. 100 is the optimal product, but the manufacturing cost associated with this product is high. But next optimum product made from brand C with price 150 is manufactured in less cost. Thus, it can be concluded from this analysis that the gap between the optimal product and the cheapest one gives the best product. The conjoint analysis offers a long-lasting, high-quality product to meet the customer requirements and gives a large number of options to choose one of them a choice (Philip and Keller, 2006). Answers of the customer vary widely from one customer to another as per their needs. Customer 1 might go for a product from brand B with price Rs. 100, while other customer chooses a product from brand A with price Rs 50. Not only the brand but also price play an important role in the selection of a product.

As it is an impossible task for a company to produce a single product to meet the demand of the individual customer, the product development team must produce a product which outfits for all customers to meet their demand. This is the basic concept of using conjoint analysis. The start-up cost associated with the conjoint analysis is not so high. Practically, templates or some computer-based programs can be used to take a large amount of data to simplify the calculation made in this. All the measurable features have to be identified in advance in NPD process is an obstruction to conjoint analysis. At this point of time, it works efficiently if various features are known to us as prior information. If the given product has a lot of confusing features, then it will not give a good solution.

As conjoint analysis helps the researcher in the choice making of various product features, that is why it has been chosen in this thesis. Practically, it needs higher

concentration, and it is the short description of the elementary knowledge of conjoint analysis (Lagrosen, 2005).

2.4 Automotive Industry Background

The Indian Automotive Industry is now working regarding the dynamics of the open market. Several JVs (joint ventures) have been set up in India with the foreign association. India stands at the second place as it is world's second largest populous country. Among Southeast Asia, India has least population approximately less than one percentage of its population, who owns automobiles.Many U.S. organization see India as a possibly attractive business sector, as India is a fastest developing economies. The economic development process of India will certainly improve by the development of automotive sector. Indian Automotive Industry development began in the 1970s. Somewhere around 1970 and 1984 automobile industries were viewed as an extravagance item; assembling was approved, development was confined; there were Quantitative Restriction (QR) on imports and levy structure intended to constrain the business sector, however, beginning in 2000, a few historical point arrangement changes like QR and 100% FDI through car course were presented.To distinguish requirement ranges for car R&D in India, a Core team on Automotive R&D (C.A.R) was established in 2003. India is at the second position in Two Wheelers, third in Small Cars and fifth in Commercial Vehicles among the foremost 10 in World.

The beginning of the industries of the automotive component results into the growth of the industries of the automobile. As local manufacturer of trucks, cars and two-wheelers started in the early 1950s, various allied manufacturer of the components specially from Europe, started their manufacturing in India. Over a long span of time, many of the lead producers had recognised plants for automotive component manufacture and assembly. Lucas (auto electricals), Champion (spark plugs), Girling (brakes), Armstrong (shock absorbers), Bosch (fuel injection systems and spark plugs), Lockheed (clutches), Mahle (pistons), and Union Carbide-Exide (batteries) were the leading companies who started manufacturing in India.

These firms were mainly proposed to support the substitution of import from Indian perception. Technology transfer took place in this process from their parent company. There was a gradual growth at a CAGR of 8.5 percent from 4.2 million in 2001 to

7.43 million in 2010 took place in the industry like a two-wheeler. The motorcycle sector continues to lead the market. Entry-level bikes are having engine power less than 125cc and price in the range of US$ 850–1,000 occupied almost 80 percent of the sales. The key purchase standard was economics of operations and ownership rate. The bike-segment mainly comprising premium bikes having engine power more than 150cc and price range US$ 1,200–2,000 is the highest growing bike-sector as compared to entry-level vehicles.

Latest inclinations specify that 100cc bikes are being desired over 125cc bikes by the market. Fig. 000 shows the Segment Wise Market Share.

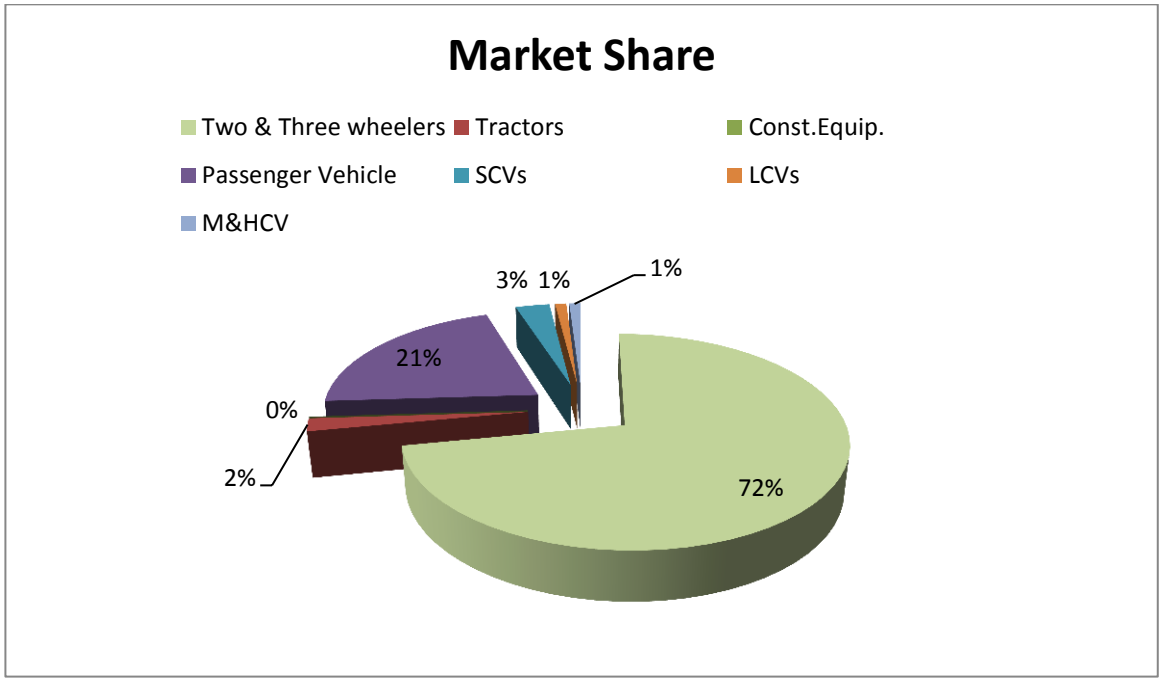

Figure 2-6 Segment Wise Market Share

Chapter 3

RESEARCH METHODOLOGY

3.1. **Purpose of Research**

As per Babie (2009), three different types of studies according to their purpose were discovered: the first one is exploratory, the second one is descriptive and third, and the last one is explanatory. The first one is utilised to explain some concepts, discover descriptions, determine phenomena or explore for new perceptions. Developing a theory is the prime goal of such research. This type of research is recognised as highly flexible one. Describing situations, people, and events is a descriptive type of research and is the second type. An elaborated image of the complete phenomenon should be available to the researcher in advance to conduct the research.

Hence, all changes required to conduct the research must be completed before the researcher start the research. The cause and relationships between different variables are analysed with the help of critical research, which is the last type of research (Babie, 2009).

3.2 Collection of Literature

An organized literature review helps to find the research objectives with the help of appropriate articles. Appropriate literatures were collected by using a wide range of sources. Some of the online databases of technical & management publishers like Taylor and Francis, Science Direct, IEEE online, Google Scholar, Emerald Insight, etc were used. Utilising prior information from preparatory readings and discussion, some of the keywords were used to discovering appropriate literature. As the research framework was explained, the key concepts are NPD, an attribute of a product, types of attributes, customer satisfaction, customer utilities and NPD stages, Kano Analysis, Conjoint Analysis. Using above mentioned parameters a list of the keywords that are correlated to the leading concepts was prepared. Following are the keywords which were utilised. In the preliminary stage of searching, the articles were filtered depending on the relevancy of title and abstract of different articles. In the next stage,

most appropriate articles were separated after further study. The keywords used for finding relevant articles were:

- New product development
- Attributes of a Product
- Customer Satisfaction
- Product Utilities
- Kano Analysis
- Conjoint Analysis

3.3 Selection of Analysis methods

A number of methods are available in marketing research to capture and understand the voice of customer, e.g. quality function deployment (QFD), kano model, conjoint analysis, ethnographic market research, service business approach, etc. These methods have been applied in various disciplines to understand customer needs and develop the product according to customers' desires.

Quality function deployment (QFD) is a set of methods for integrating customer needs into NPD (Bech et al., 1997; Shahin, 2005; Hwarng and Teo, 2001; Barad and Gien, 2001; Cohen, 1995; Besterfield, 1999; Cristiano et al, 2000; Adams and Gavoor 1990; Carpinetti et al. 2000; Piszczalski, 2003; etc.). It helps in converting the customer needs into product features.

Kano Model has been used extensively to elicit customer perceptions about dichotomous attributes (Rivie`re et al., 2006; Bilgili et al.; 2011, Chen and Chuang, 2008; Avikal et al., 2014; Lin et al., 2010; Tang et al., 2009; Sireli et el., 2007; Tan and Shen, 2000; Matzler and Hinterhuber, 1998; Pawitra and Tan, 2003; Bartikowski and Llosa, 2004; Nilsson-Witell and Fundin, 2005; etc.). Kano model finds its utility in identifying the important must-be and attractive product attributes which customers would like in the product. It is a widely accepted approach to capture the characteristics of dichotomous attributes of a product, and include them in the product design and development.

Conjoint Analysis is a popular approach for deciding the most preferred combination of different levels of various multi-level attributes (Krieger et al, 2003; Green, 2001;

Green, 1978; Green,1981; Srinivasan, 1988; Green and Srinivasan, 1990; Orme, 2005; Abernethy et al. 2008; Magidson and Vermunt, 2005; Wittink et al. 1994; Batsell and Louviere,1991; Louviere, 1994; Gustafsson, 1999).

Few researchers have worked on utilizing a combination of these methods for better analysis of customer perception about the product and its features. Researchers used conjoint and QFD (Gustafsson, 1996; Wang and Shih, 2013; Chaudhuri and Bhattacharyya, 2005; Baier and Brusch, 2005) for generating best product profile by conjoint analysis and incorporate the customer needs depicted by that profile into the product using QFD. Kano and QFD are also utilized in integration for eliciting customer perception about the attributes and use them in developing the product features (Tontini, 2007; Hashim and Dawal, 2012; Shen et al. 2000; Lai et al. 2004; Sireli et al. 2007).

Kano and conjoint analyses can be used in combination for getting a comprehensive understanding of both dichotomous as well as multi-level attributes of a product, and develop a complete product profile with maximum chances of being successful in market. Some studies (Wang and Chu 2014; Kim et al. 2008) have explored this integrated approach partially in understanding the consumer perceptions. This approach has been chosen for current study because of its merits in identifying and analysing both dichotomous as well as multi-level attributes of a product, leading to a comprehensive study of overall product requirements.

3.4 Variables and Design of Survey

A two-staged questionnaire was given to 12 respondents selected including 8 academicians, 4industry professional. The first questionnaire is multiple- to find the choice of the attributes to be preferred; while the second is more specific by rating attributes- combinations and their levels. A Likert scale from 1 to 5 was used to rate the second-stage questionnaire. After brainstorming, the attributes and their levels for the survey are recognized. Delphi survey method was seleted for this research as responses from lead users were obtained and analysed. It was assumed that all the respondents were known to the product in prior because of daily use.

By using the data collected from the first-stage questionnaire, a Kano model is used to group the attributes of services and products based on how well each specific

service or product could satisfy each customer (Widiawan and Irianty, 2004). The output from the Kano model demonstrates how customers reply and how their response affects them. This Kano model clusters each of the attribute into 'Must Be', 'One-Dimensional' and 'Attractive' categories. The 'Must Be' category shows the basic needs of the customer which must be fulfilled. The 'One-Dimensional' or performance requirements category, is where the performance of this attribute is parallel to customer's satisfaction. The 'Attractive' or excitement requirements category is when an attribute could significantly increase customer's satisfaction, but if that attribute is not present, then it would not reduce customer satisfaction.

The outcomes from the second-stage questionnaire use conjoint analysis to find the right composition for the product or service. Conjoint analysis computes the accurate market segmentation based on the likeness of consumer preferences, based on product/service attributes (Green and Krieger, 1991). The results of the analysis show the utility value of each attribute, the part-worth utility to generate the preference score for each attribute.

3.5 Questionnaire Design

The draft of the questionnaire is organized depending on the customer perception with the help of literature review and discussion with the expert from NPD field considering previous researches.

The questionnaire consists of two parts:

A. Basic information such as name, email-id, age and profession were asked in first part.
B. Each attribute was presented to the participants in the second part for their importance. A 5-point Likert scale (where 1 being "least likely"; and 5 being "most likely") was used.

3.6 Organization of the Survey

The final questionnaire was sent to customers by Google-doc. Online survey was utilised to collect responses from the customers. As online survey helps the researcher to collect data in large number within limited time and money conveniently, this was

selected for this research. The intended participants were lead users of the motorcycle. For Kano Analysis, a total of 125 responses were received in a time span of four weeks from the participants. Out of these, 112 responses were further considered for analysis purpose. While for Conjoint Analysis, a total of 61 responses were received in six weeks duration from the participants. Out of these, 52 responses were further considered for analysis purpose.

3.7 Kano Analysis

The various steps involved in the Kano Analysis are given below

Step 1: Construction of the Kano questionnaire

Using a questionnaire, product requirements are classified into three types viz. Must-be, one-dimensional and attractive requirements. For each product attributes, a pair of questions is from the customer's perspective. By combining the two responses in the Kano evaluation table (Table 2-3), the product features can be classified.

Step 2: Surveying Target Customers

It comprises surveying target customers (through questionnaires) about each feature with the help of a pair of questions (functional and dysfunctional). Functional are asked in a positive manner, and dysfunctional questions are asked in a negative manner or with alternate features. The participants are asked to select from among five choices for each question

Step 3: - Use the Evaluation Table and summarize the results

Once the surveys have been accomplished, the results are obtained and analyzed. For each feature, the results of the functional and dysfunctional for of questions are paired to determine the categories the attributes, is assigned to, and based on that customer's responses.

Step 4: - Determining the category of the evaluated product features

Once all the surveys have been investigated and the attributes assigned to categories based on each survey-takers replies, the development team then aggregates the survey responses and tracks the overall results for each feature.

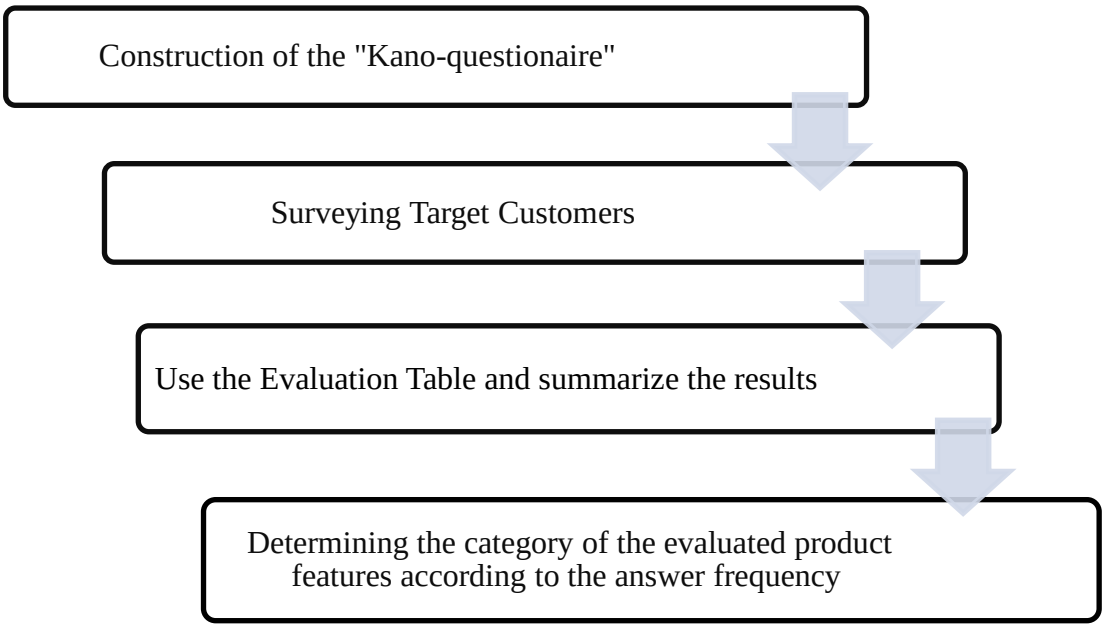

Figure 3-1 Steps of the Kano-Analysis

3.8 Conjoint Analysis

The following section will explain how customer utilities can be measured.

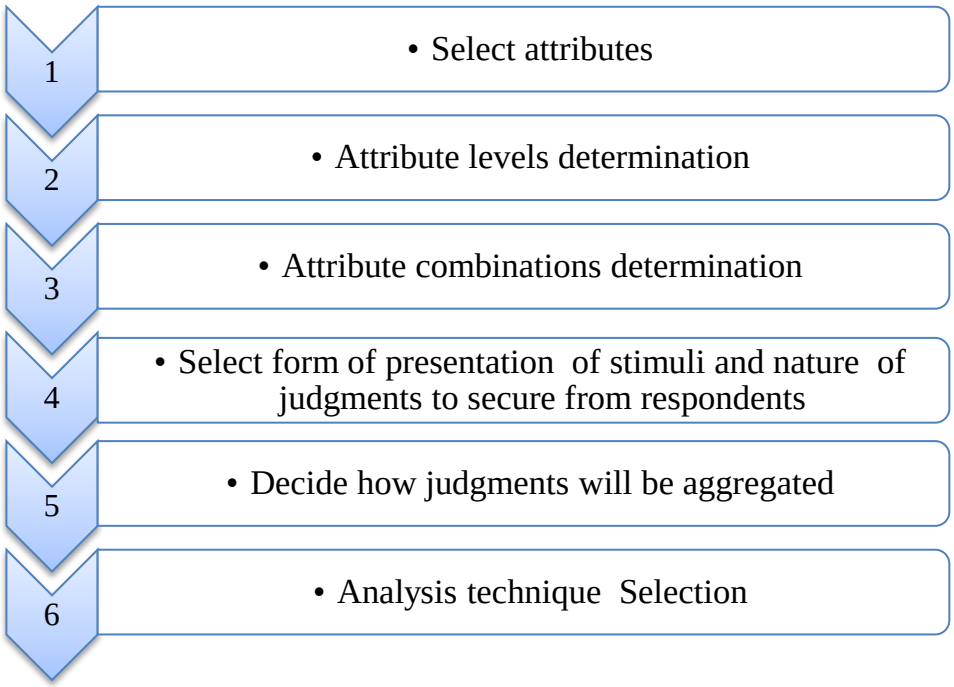

Figure 3-2 Designing a conjoint analysis experiment: (Churchill and Iacobucci, 2002)

Select attributes – The objective of the research will be considered for the selection of the attributes because attributes specify the product. Attributes will help the company to develop the product "… That is, it has the technology to make changes that might be indicated by consumer preferences".

Determine attribute levels – The number of profiles will be decided with the help of attribute levels. Higher the attribute, higher will be product profiles and larger the data for analysis.

Determine attribute combinations – The product will be decided from different attribute combinations. The respondents will be presented these combination and they have to prioritise these combinations.

Select form of presentation of stimuli and nature of judgments – paragraph description, verbal description and pictorial representation can be used for presentation of stimuli. Rating scales are provided to the respondents to rank the stimuli as per to their buying intention.

Decide on aggregation of judgments – Summarization of the responses from the respondents will be done in this step. According to Churchill and Iacobucci (2002), "this highlights an attractive feature of conjoint analysis because it allows market share predictions for selected product alternatives".

Select analysis technique – Selection of analysis technique is done in this final step. This decision depends highly on efficiency of the technique to analyse the data.

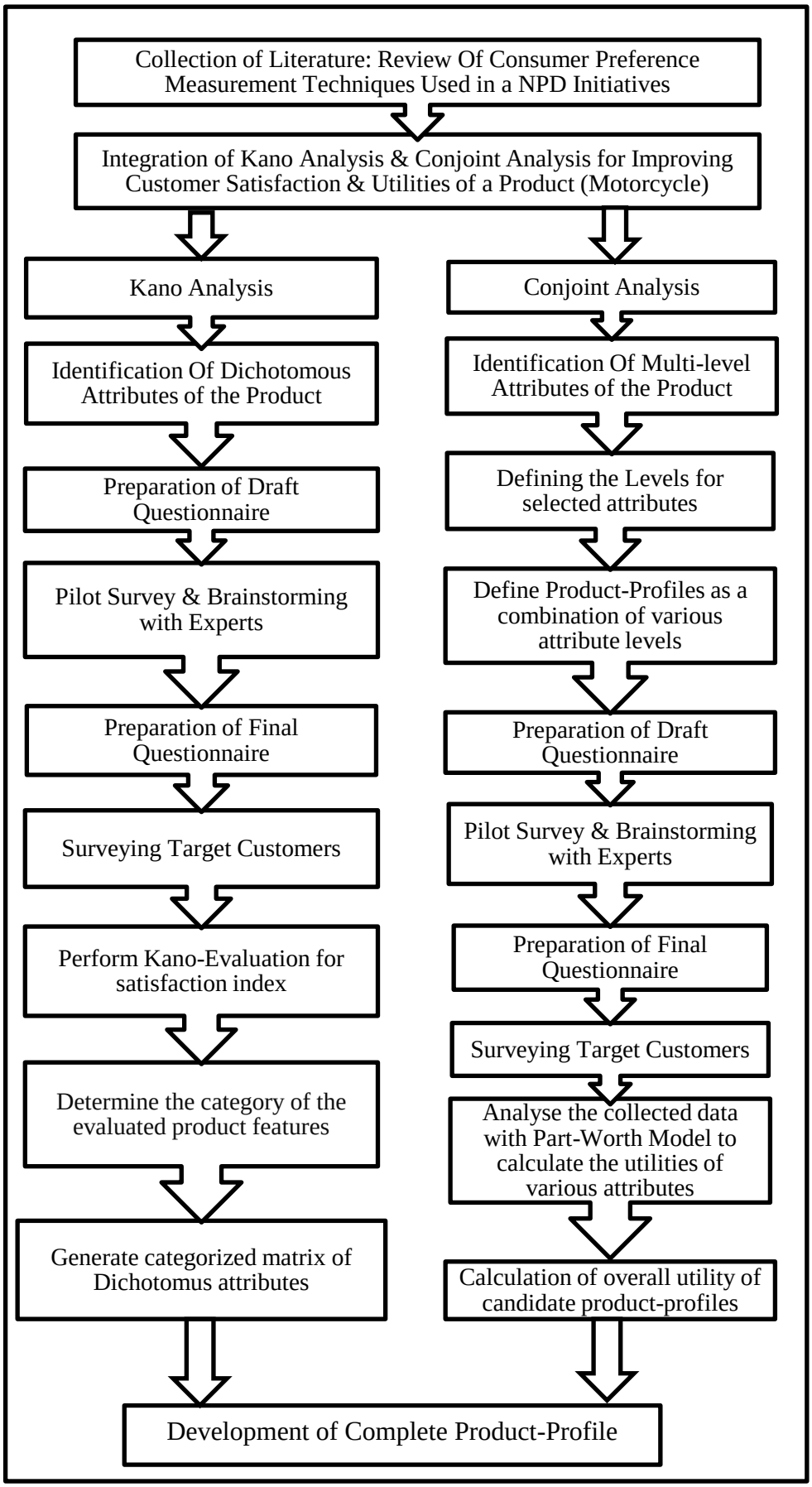

Figure 3-3 Research Methodology

Chapter 4

ANALYSIS AND RESULTS

The quantitative analysis of the collected data for the research is done using Microsoft-Excel and SPSS software packages. The detailed analysis is discussed in following sections:

4.1 Kano Analysis

Kano model is used to explain customer satisfaction regarding different dichotomous attributes of products. Kano model shows how customers are satisfied or dissatisfied about certain attributes, categorizing attributes into three different categories. Kano model has been chosen for this thesis because it helps the researchers to understand customer needs about dichotomous attributes.

Step 1: Construction of the Kano questionnaire

Using a questionnaire, product requirements are classified into three types viz. Must-be, one-dimensional and attractive requirements. For each product attributes, a pair of questions is prepared from the customer's perspective. By combining the two responses in the Kano evaluation table (Table 4-2), the product features can be classified. An example of a Kano-model question used in the questionnaire is presented below.

Step 2: Surveying Target Customers

It comprises surveying target customers (through questionnaires) about each feature with the help of a pair of questions (functional and dysfunctional). Functional questions are asked in a positive manner, while dysfunctional questions are asked in a negative manner or with alternate features. The participants are asked to select from among five choices for each question. In the case product, a total of 24 questions were asked to 112 respondents. A survey questionnaire for Kano Analysis is present in Appendix A.

Table 4-1 List of Dichotomous Attributes

	Functional Form (If the following feature is provided)	**Dysfunctional Form (If the following feature is provided)**
A1	Alloy Wheels	Spoke Wheels
A2	Disc Brake on One Wheel Only	Disc Brake on Both Wheels
A3	LED Head Lamp	Halogen Head Lamp
A4	Five Gears	Four Gears
A5	Tube less Tyres	Tube tyres
A6	Hazard Light	No Hazard Light
A7	Digital Console	Analog Console
A8	Ignition with Self Start Plus Kick Start	Ignition with Self Start Only
A9	Split Seats	Flat Seat
A10	Liquid Cooled Engine	Air Cooled Engine
A11	Mono Shock Absorber	Twin Shock Absorber
A12	Vertical Cylinder Position	Horizontal Cylinder Position

Step 3: Use the Evaluation Table and summarize the results

For counting and summarising the results of the survey, evaluation table is used. Acronyms used in the given table are attractive requirements(A), one-dimensional requirements(O), indifferent requirements(I), must-be requirements(M), reverse requirements (R) and questionable requirements (Q). For example, if one of the participant select "I like it" for the functional form of question and responded "I can live with it" for the dysfunctional form of the question, the particular product or service attribute would be categorized as an attractive requirement (A). When the participant is neither satisfied nor dissatisfied if the product, service or process is dysfunctional or fully functional about that particular attribute then such type of

requirement will be indifferent requirement.Questionable requirements (Q) represent outcomes that show conflicting answers. Reverse requirements (R) indicate that customers do not want the product or service feature and that they intensely expect the reverse (Elmar Sauerwein, 1996).

Table 4-2 Kano's Evaluation Table

		DYSFUNCTIONAL				
		Like it	Must be present	Neutral	Can live with it	Dislike it
FUNCTIONAL	Like it	Q	A	A	A	O
	Must be present	R	I	I	I	M
	Neutral	R	I	I	I	M
	Can live with it	R	I	I	I	M
	Dislike it	R	R	R	R	Q

Customer Requirements: A:attractive, O:one-dimensional, M:must-be, Q:questionable result, R:reverse, and I:indifferent.

Step 4: Determining the category of the evaluated product features

As per the answer frequency, the evaluated product or service attributes are categorised in this step.The results are calculated and taken according to the reply frequency. Though, if the questions are comprehensive, the outcomes might be distributed. Hence, it is recommended that if (O+A+M)>(I+R+Q), the highest value of (O, A, M) should be accepted. Else, the highest value of (I, R, Q) should be utilised. And when two attributes have the same frequency, then the requirement that influences high on the product or service should be selected. The priority order should follow M>O>A>I.

4.1.1 Analysis of Questionnaire Results

Table 4-3 Analysis of Questionnaire Results

Assessed Characteristics (If following features are provided then)	**A**	**O**	**M**	**I**	**R**	**Q**	**Total**	**Category**
Alloyed Wheels	6	11	57	27	7	4	112	M
Five Gears	38	2	12	48	8	4	112	I
Tubeless Tyres	47	11	9	34	6	5	112	A
Digital Console	16	34	14	35	9	4	112	O
LED Headlamp	10	36	17	22	13	14	112	O
Ignition with Self Start plus Kick Start	13	16	33	26	17	7	112	M
Liquid Cooled Engine	26	39	14	29	2	2	112	O
Split Seats	25	3	6	40	21	17	112	I
Vertical Cylinder Position	25	2	12	49	18	6	112	I
Mono Shock Absorber	21	2	3	46	22	18	112	I
Hazard Light	56	11	7	20	11	7	112	A
Disc Brake on both wheels	36	48	11	10	2	5	112	O

4.1.2 Customer satisfaction coefficient

The presence of particular attribute of a product enhances the satisfaction, or it only prevents from customer dissatisfaction, is explained with the help of the customer satisfaction (CS) coefficient (Matzler et al., 1998). The CS coefficient is suggestive of how intensely a product attribute may affect satisfaction or, in the case of its absence, customer's dissatisfaction. To estimate the average influence on satisfaction, it is mandatory to add the A and O columns and division by the sum of a total number of A, O, M and I responses. For the calculating the average dissatisfaction impact, add the M and O columns and divide by the same normalising factor.

$$\text{Enhanced Satisfaction Coefficient} = \frac{A+O}{A+O+M+I}$$

$$\text{Reduced Dissatisfaction Coefficient} = \frac{O+M}{A+O+M+I}$$

A positive value of CS coefficient ranges from zero to one; the value, closer to one, the greater the impact on customer satisfaction. A similar role is played by the negative value of CS coefficient. If this attribute is not provided then it will not not result in dissatisfaction when the CS coefficient value is zero. A visual representation of the evaluated characteristics is shown by a diagram. It is helpful to know their impact on CS and set primacies when designing products or services. For a motorcycle, the customer satisfaction coefficients are shown in Table 4-4.

Table 4-4 Calculation of ESC and RDC

	Assessed Features	Category	ESC=(A+O) /(A+O+M+I)	RDC=(O+M) /(A+O+M+I)
A1	Alloyed Wheels	M	0.168317	-0.67327
A2	Five Gears	I	0.40000	-0.14000
A3	Tubeless Tyres	A	0.574257	-0.19802
A4	Digital Console	O	0.505051	-0.48485
A5	LED Headlamp	O	0.541176	-0.62353
A6	Ignition with Self Start Plus Kick Start	M	0.329545	-0.55682
A7	Liquid Cooled Engine	O	0.601852	-0.49074
A8	Split Seats	I	0.378378	-0.12162
A9	Vertical Cylinder Position	I	0.306818	-0.15909
A10	Mono Shock Absorber	I	0.319444	-0.06944
A11	Hazard Light	A	0.712766	-0.19149
A12	Disc Brake on both wheels	O	0.800000	-0.56190

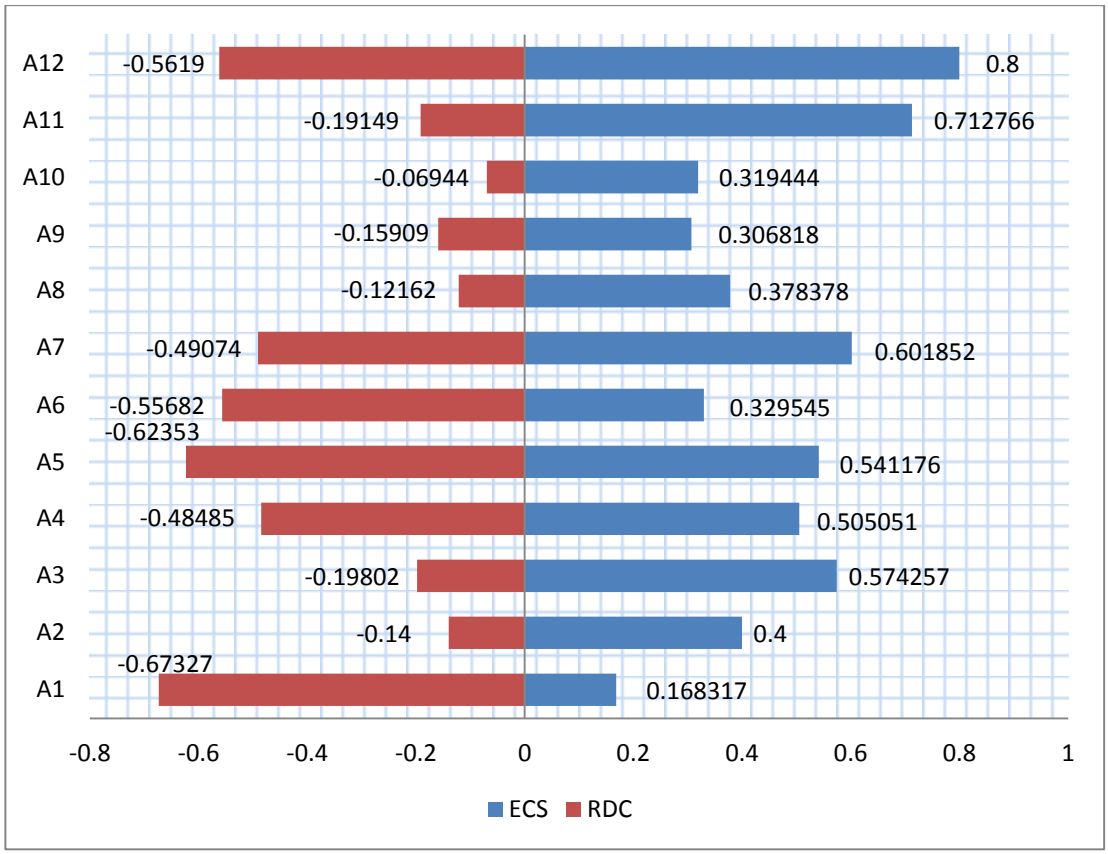

Figure 4-1 Representation of ESC and RDC

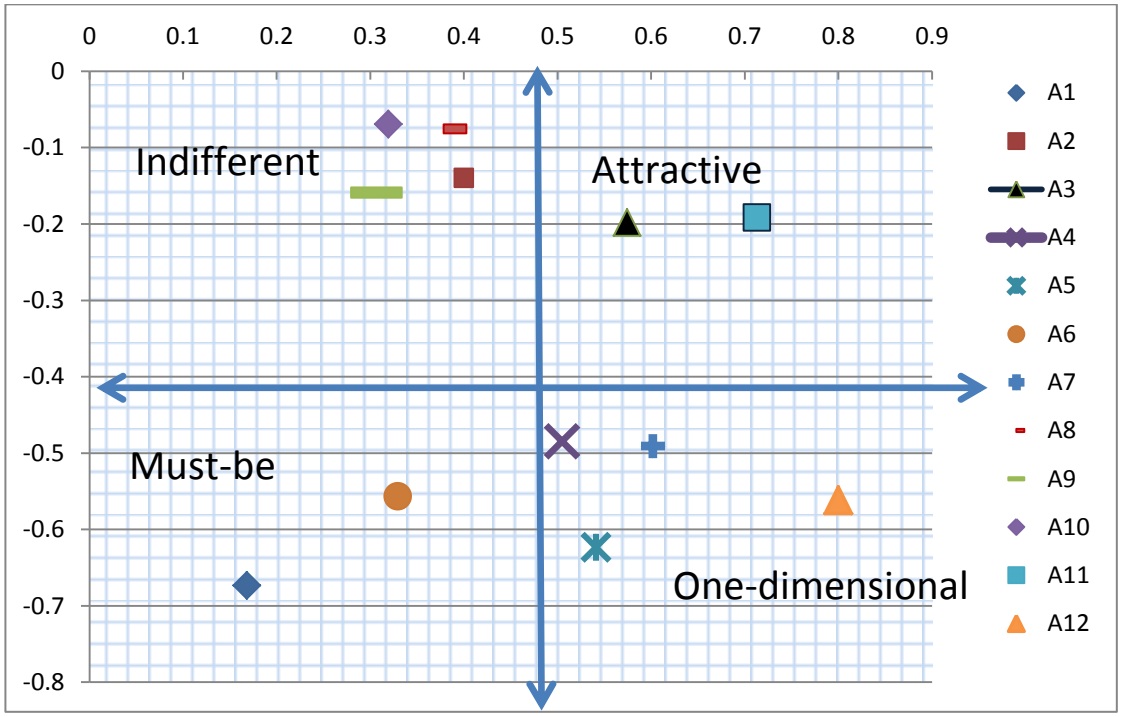

Figure 4-2 Categorization of Dichotomous Attributes

4.2 Conjoint Analysis

Conjoint analysis was developed in the 1970s (Lohrke et al. 2010, 261). It was developed to help and understand how respondents give preferences for any product, service or idea. It is a multivariable regression technique, which uses the actuality and permutation of various attributes and levels. To measure the customer utilities, is the fundamental concept of conjoint analysis. The utility is a subjective judgment of choice that is unique to every respondent. It is also the conceptual source for calculating value, a concept very important for this research.

4.2.1 Selection of the Attributes and Levels

The focus group activity finalized the top 4 attributes. Determination of the number of levels is a key next step. The number of levels determination has a significant bearing on the conjoint experiment. This concern is called the number-of-levels effect (Currim, Weinberg and Wittink, 1981). Johnson et al, 2013 states that, if the attribute is qualitative (e.g.,. Brand value), then the number of levels need to be more than 2. However, if the attribute is quantitative, as it is in this study, the levels can be 3.The DOE (Design of Experiments) was used to create a list of 'experiments' or 'product configurations'. With 4 attributes, each at 3 levels, a total of 81 combinations (3 Prices * 3 Cylinder Capacities * 3 Body-types * 3 Claimed millages) of the product is possible. The top 9 combinations was selected with the help of DOE software.

Table 4-5 Multi-level Attributes description and attribute levels

	Attributes							
	Price (INR)		Cylinder Capacity (cc)		Body -type		Claimed Millage(kmpl)	
Levels	< 60,000	P-1	< 125	CC-1	Sports	B-1	< 45	M-1
	60,000-90,000	P-2	150-220	CC-2	Commuter	B-2	45 - 65	M-2
	>90,000	P-3	> 250	CC-3	Cruiser	B-3	> 65	M-3

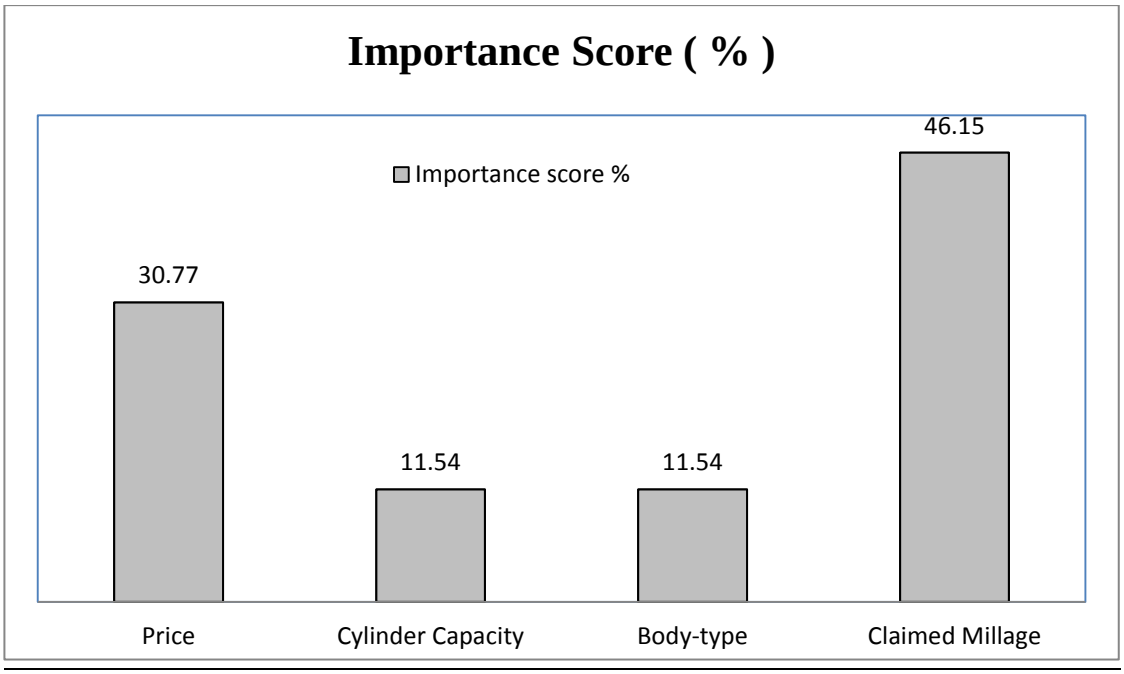

Figure 4-3 Importance Score (%)

Table 4-6 All Possible Profiles

Stimulus	Price	Cylinder Capacity	Body-type	Claimed Millage	***Stimulus***	Price	Cylinder Capacity	Body-type	Claimed Millage
1	1	1	1	1	**42**	2	2	2	3
2	1	1	1	2	**43**	2	2	3	1
3	1	1	1	3	**44**	2	2	3	2
4	1	1	2	1	**45**	2	2	3	3
5	1	1	2	2	**46**	2	3	1	1
6	1	1	2	3	**47**	2	3	1	2
7	1	1	3	1	**48**	2	3	1	3
8	1	1	3	2	**49**	2	3	2	1
9	1	1	3	3	**50**	2	3	2	2
10	1	2	1	1	**51**	2	3	2	3
11	1	2	1	2	**52**	2	3	3	1
12	1	2	1	3	**53**	2	3	3	2
13	1	2	2	1	**54**	2	3	3	3
14	1	2	2	2	**55**	3	1	1	1

15	1	2	2	3	**56**	3	1	1	2
16	1	2	3	1	**57**	3	1	1	3
17	1	2	3	2	**58**	3	1	2	1
18	1	2	3	3	**59**	3	1	2	2
19	1	3	1	1	**60**	3	1	2	3
20	1	3	1	2	**61**	3	1	3	1
21	1	3	1	3	**62**	3	1	3	2
22	1	3	2	1	**63**	3	1	3	3
23	1	3	2	2	**64**	3	2	1	1
24	1	3	2	3	**65**	3	2	1	2
25	1	3	3	1	**66**	3	2	1	3
26	1	3	3	2	**67**	3	2	2	1
27	1	3	3	3	**68**	3	2	2	2
28	2	1	1	1	**69**	3	2	2	3
29	2	1	1	2	**70**	3	2	3	1
30	2	1	1	3	**71**	3	2	3	2
31	2	1	2	1	**72**	3	2	3	3
32	2	1	2	2	**73**	3	3	1	1
33	2	1	2	3	**74**	3	3	1	2
34	2	1	3	1	**75**	3	3	1	3
35	2	1	3	2	**76**	3	3	2	1
36	2	1	3	3	**77**	3	3	2	2
37	2	2	1	1	**78**	3	3	2	3
38	2	2	1	2	**79**	3	3	3	1
39	2	2	1	3	**80**	3	3	3	2
40	2	2	2	1	**81**	3	3	3	3
41	2	2	2	2					

The 9 combinations were ranked on a scale of 1 to 5 (5 most likely to buy) by an Online-Survey with the help of Google-Document utility of Google. The conjoint experiment was initiated on the top 9 Product Design using MS-Excel.

Table 4-7 Top Product Profile

Stimulus	P-2	P-3	CC-2	CC-3	B-2	B-3	M-2	M-3	Preferences
80	0	1	0	1	0	1	1	0	3
46	1	0	0	1	0	0	0	0	4
65	0	1	1	0	0	0	1	0	2
37	1	0	1	0	0	0	0	0	3
79	0	1	0	1	0	1	0	0	1
43	1	0	1	0	0	1	0	0	3
6	0	0	0	0	1	0	0	1	5
76	0	1	0	1	1	0	0	0	2
33	1	0	0	0	1	0	0	1	3

The consumer test results are then run through the regression. Each coefficient is the measure of value that the consumer places on the product attribute associated with that particular utility.

The regression equation is:

Rating = 4.00 + (-2) P2 + (-5)P3 + (1)CC2 + (2)CC3 + (1)B2 + (0)B3 + (2)M2 + (0)M3

Regression analysis is used to calculate a coefficient for each independent attribute as part of the regression output equation. Each coefficient denotes the measure of value that the respondent places on the product attribute associated with that utility.

4.2.2 Utility Measurement

Following empirical formula is used to calculate **Overall Utility** of an Alternative

$$\mathbf{U(X)} = \sum_{i=1}^{m} \sum_{j=1}^{k_i} a_{ij}\, x_{ij}$$

where, U(X) = Overall Utility of an Alternative

a_{ij} = Utility of Level j of Attribute i

k_i = Number of Levels of Attribute i

m = Number of Attributes

x_{ij} = 1 if Level j of Attribute i is present 0 otherwise

Table 4-8 Utilities Calculation and Importance value

			RANGE	**WEIGHT**
P-1	b_{11}= 0	a_{11}= 2.667	5.00	5/10 = 50 %
P-2	b_{12}= -2	a_{12}= 0.667		
P-3	b_{13}= -5	a_{13}= -2.333		
CC-1	b_{21}= 0	a_{21}= 0.667	2.00	2/10 = 20 %
CC-2	b_{22}= 1	a_{22}= 1.667		
CC-3	b_{23}= 2	a_{23}= 2.667		
B-1	b_{31}= 0	a_{31}= 0.000	1	1/10 = 10 %
B-2	b_{32}= 1	a_{32}= 1.000		
B-3	b_{33}= 0	a_{33}= 0.000		
M-1	b_{41}= 0	a_{41}= -0.333	2.00	2/10 = 20 %
M-2	b_{42}= 2	a_{42}= 1.667		
M-3	b_{43}= 0	a_{43}= -0.333		
			10.00	100 %

Following figures show Part worth utility:

A) Price

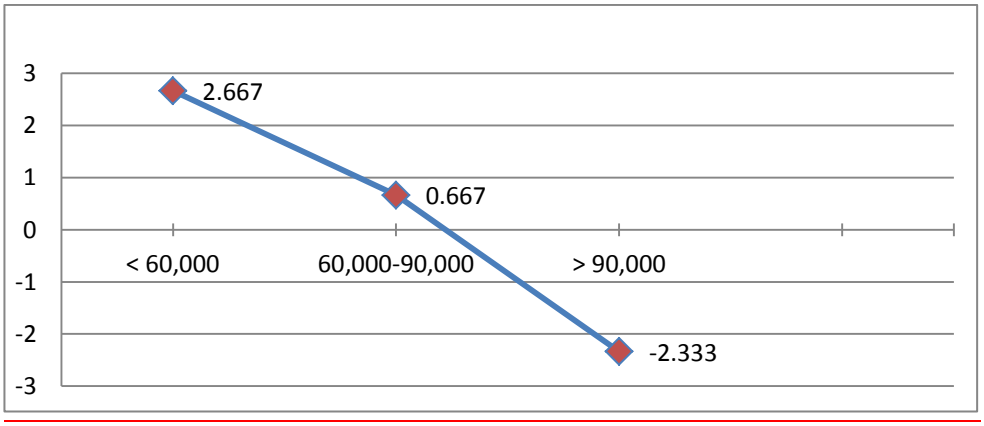

Figure 4-4 Part worth utility of Price

B) Cylinder Capacity

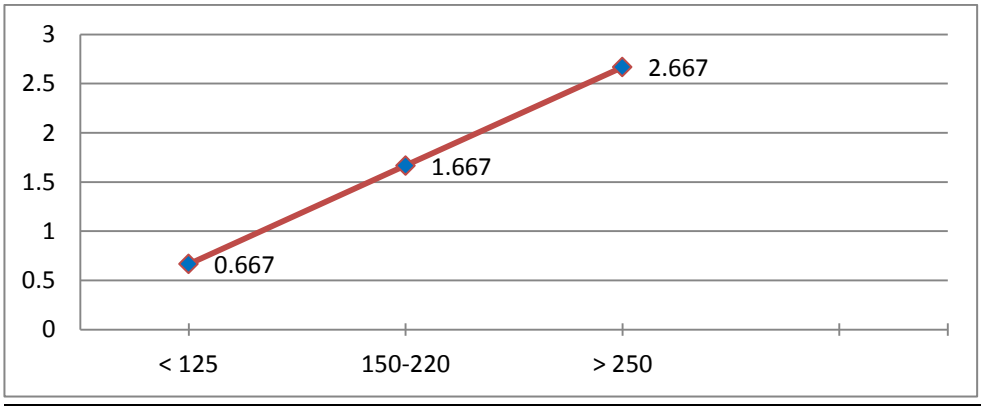

Figure 4-5 Part worth utility of Cylinder Capacity

C) Body Type

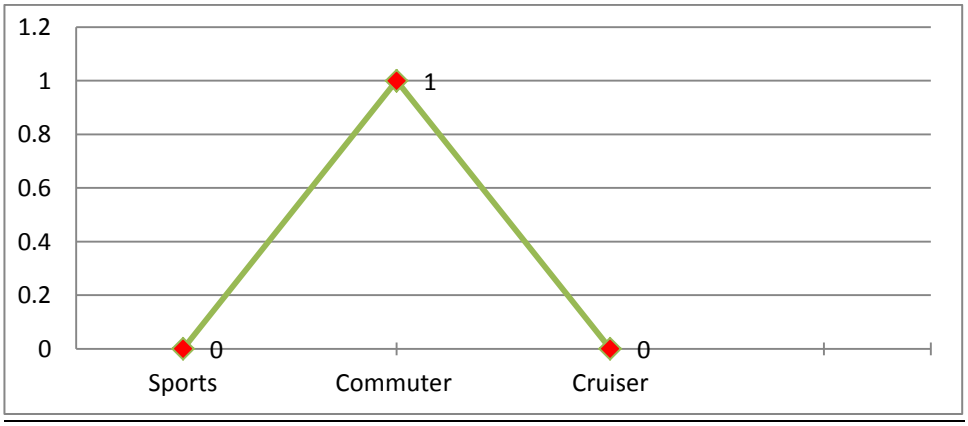

Figure4-6 Part worth utility of Body-type

D) Claimed Millage

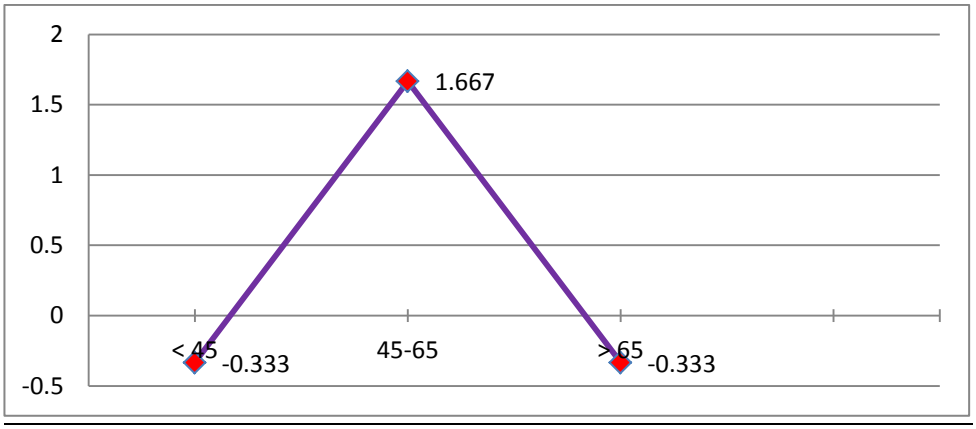

Figure 4-7 Part worth utility of Claimed Millage

Table 4-9 Total utility of the profiles

	Price			Cylinder Capacity			Body-type			Claimed Millage			
Stimulus	P1	P2	P3	C1	C2	C3	B1	B2	B3	M1	M2	M3	Utilities
23	1	0	0	0	0	1	0	1	0	0	1	0	8.001
14	1	0	0	0	1	0	0	1	0	0	1	0	7.001
20	1	0	0	0	0	1	1	0	0	0	1	0	7.001
26	1	0	0	0	0	1	0	0	1	0	1	0	7.001
5	1	0	0	1	0	0	0	1	0	0	1	0	6.001
11	1	0	0	0	1	0	1	0	0	0	1	0	6.001
17	1	0	0	0	1	0	0	0	1	0	1	0	6.001
22	1	0	0	0	0	1	0	1	0	1	0	0	6.001
24	1	0	0	0	0	1	0	1	0	0	0	1	6.001
50	0	1	0	0	0	1	0	1	0	0	1	0	6.001
41	0	1	0	0	1	0	0	1	0	0	1	0	5.001
2	1	0	0	1	0	0	1	0	0	0	1	0	5.001
8	1	0	0	1	0	0	0	0	1	0	1	0	5.001
13	1	0	0	0	1	0	0	1	0	1	0	0	5.001
15	1	0	0	0	1	0	0	1	0	0	0	1	5.001
19	1	0	0	0	0	1	1	0	0	1	0	0	5.001
21	1	0	0	0	0	1	1	0	0	0	0	1	5.001
25	1	0	0	0	0	1	0	0	1	1	0	0	5.001
27	1	0	0	0	0	1	0	0	1	0	0	1	5.001
47	0	1	0	0	0	1	1	0	0	0	1	0	5.001
53	0	1	0	0	0	1	0	0	1	0	1	0	5.001
32	0	1	0	1	0	0	0	1	0	0	1	0	4.001
38	0	1	0	0	1	0	1	0	0	0	1	0	4.001
44	0	1	0	0	1	0	0	0	1	0	1	0	4.001
4	1	0	0	1	0	0	0	1	0	1	0	0	4.001
6	1	0	0	1	0	0	0	1	0	0	0	1	4.001
10	1	0	0	0	1	0	1	0	0	1	0	0	4.001

12	1	0	0	0	1	0	1	0	0	0	0	1	4.001
16	1	0	0	0	1	0	0	0	1	1	0	0	4.001
18	1	0	0	0	1	0	0	0	1	0	0	1	4.001
49	0	1	0	0	0	1	0	1	0	1	0	0	4.001
51	0	1	0	0	0	1	0	1	0	0	0	1	4.001
29	0	1	0	1	0	0	1	0	0	0	1	0	3.001
35	0	1	0	1	0	0	0	0	1	0	1	0	3.001
40	0	1	0	0	1	0	0	1	0	1	0	0	3.001
42	0	1	0	0	1	0	0	1	0	0	0	1	3.001
1	1	0	0	1	0	0	1	0	0	1	0	0	3.001
3	1	0	0	1	0	0	1	0	0	0	0	1	3.001
7	1	0	0	1	0	0	0	0	1	1	0	0	3.001
9	1	0	0	1	0	0	0	0	1	0	0	1	3.001
28	1	0	0	1	0	0	1	0	0	1	0	0	3.001
46	0	1	0	0	0	1	1	0	0	1	0	0	3.001
48	0	1	0	0	0	1	1	0	0	0	0	1	3.001
52	0	1	0	0	0	1	0	0	1	1	0	0	3.001
54	0	1	0	0	0	1	0	0	1	0	0	1	3.001
77	0	0	1	0	0	1	0	1	0	0	1	0	3.001
31	0	1	0	1	0	0	0	1	0	1	0	0	2.001
33	0	1	0	1	0	0	0	1	0	0	0	1	2.001
37	0	1	0	0	1	0	1	0	0	1	0	0	2.001
39	0	1	0	0	1	0	1	0	0	0	0	1	2.001
43	0	1	0	0	1	0	0	0	1	1	0	0	2.001
45	0	1	0	0	1	0	0	0	1	0	0	1	2.001
68	0	0	1	0	1	0	0	1	0	0	1	0	2.001
74	0	0	1	0	0	1	1	0	0	0	1	0	2.001
80	0	0	1	0	0	1	0	0	1	0	1	0	2.001
30	0	1	0	1	0	0	1	0	0	0	0	1	1.001
34	0	1	0	1	0	0	0	0	1	1	0	0	1.001
36	0	1	0	1	0	0	0	0	1	0	0	1	1.001

59	0	0	1	1	0	0	0	1	0	0	1	0	1.001
65	0	0	1	0	1	0	1	0	0	0	1	0	1.001
71	0	0	1	0	1	0	0	0	1	0	1	0	1.001
76	0	0	1	0	0	1	0	1	0	1	0	0	1.001
78	0	0	1	0	0	1	0	1	0	0	0	1	1.001
56	0	0	1	1	0	0	1	0	0	0	1	0	0.001
62	0	0	1	1	0	0	0	0	1	0	1	0	0.001
67	0	0	1	0	1	0	0	1	0	1	0	0	0.001
69	0	0	1	0	1	0	0	1	0	0	0	1	0.001
73	0	0	1	0	0	1	1	0	0	1	0	0	0.001
75	0	0	1	0	0	1	1	0	0	0	0	1	0.001
79	0	0	1	0	0	1	0	0	1	1	0	0	0.001
81	0	0	1	0	0	1	0	0	1	0	0	1	0.001
58	0	0	1	1	0	0	0	1	0	1	0	0	-0.999
60	0	0	1	1	0	0	0	1	0	0	0	1	-0.999
64	0	0	1	0	1	0	1	0	0	1	0	0	-0.999
66	0	0	1	0	1	0	1	0	0	0	0	1	-0.999
70	0	0	1	0	1	0	0	0	1	1	0	0	-0.999
72	0	0	1	0	1	0	0	0	1	0	0	1	-0.999
55	0	0	1	1	0	0	1	0	0	1	0	0	-1.999
57	0	0	1	1	0	0	1	0	0	0	0	1	-1.999
61	0	0	1	1	0	0	0	0	1	1	0	0	-1.999
63	0	0	1	1	0	0	0	0	1	0	0	1	-1.999

Chapter 5

DISCUSSION AND CONCLUSIONS

The satisfaction portfolio of a product can be drawn and appropriate measures can be taken if a company or a researcher is attentive of the relative importance of product attributes and its assessment from the viewpoint of customers in comparision to the lead competitors and the information about the level of the influence of a product attributes to the product quality and its effect on the customer satisfaction. Those product attributes which are regarded as an important attributes and show disadvantages over competitors' products, are placed at the topmost priority. The long-term goal is to increase customer satisfaction about important product attributes to create sustainable competitive advantages.

The following critical inferences emerge: fulfil all must-be requirements, be competitive about one-dimensional requirements and stand out regarding attractive requirements!

Quadrant I: Attractive Attributes, one stand out on attractive attributes, mainly A3 and A11. They are those attributes which attract a customer.

Quadrant II: *Indifferent Attributes*, which makes no difference to the customers, mainly A2, A8, A9, and A10.

Quadrant III: *Must-be Attributes*, which should be fulfilled in any circumstances, mainly A1 and A6.

Quadrant IV: *One-dimensional*, which gives the competitive advantage over others, mainly A4, A5, A7, and A12.

Indifferent	Attractive
➢ Five Gears ➢ Split Seats ➢ Cylinder Position ➢ Mono Shock Absorber	➢ Tubeless Tyres ➢ Hazard Light
Must-be	**One-dimensional**
➢ Alloyed Wheels ➢ Ignition with Self Start Plus Kick Start	➢ Digital Console ➢ LED Headlamp ➢ Liquid Cooled Engine ➢ Disc Brake on both wheels

Figure 5-1 Categorization of Dichotomous Attributes

The way in which the conjoint analysis study helps the individual in decision making processes is its usefulness. In this thesis, after analysing the results, the usefulness of conjoint analysis is achieved. Now, it is possible that a decision maker makes some decision considering the customer preferences. As the time passes, impact of attributes changes and become visible to the companies and after that required modifications should be done to be competitive in the market. Survey is a common method to capture VoC. Conjoint analysis is statistical, and therefore, it is direct 'design diffusible'. As the factorial combinations of Conjoint create, new offerings (by combining the different attributes and levels), the unstated need of the consumer has a greater chance of being captured and built into the product. Innovation and creativity products help drive sales and sustain the company's growth. Conjoint, allows designers to experiment with the form and features and hence fosters creativity. The utility of a product's feature is a matter of subjective judgement of consumer's preference and is unique to each end user. The conjoint analysis places a part-worth value to this utility and helps transform the abstract preference to an objective and measurable attribute and addresses the complexity.

In the present research study, a top profile, Stimulus No. 14, of motorcycle having following attributes is proposed:

Table 5-1 Product Profile of top preference

Attributes	Levels
Price (INR)	< 60,000
Cylinder Capacity (cc)	150 - 220
Body-type	Commuter
Claimed-Millage (kmpl)	45 - 65

The only obstruction in this profile is cylinder-capacity, which is not available in the market presently. However, this is sweet-spot where a Company's RandD team should think to work to capture the market.

However, if a company prefers to work in the existing modal of motorcycle the Stimulus No. 5 is most preferred by the respondents, having the following attribute:

Table 5-2 Product Profile of top feasible product

Attributes	Levels
Price (INR)	< 60,000
Cylinder Capacity (cc)	< 125
Body-type	Commuter
Claimed-Millage (kmpl)	45 - 65

Hence, the complete profile of a motorcycle is having following specifications:

- Alloyed Wheels
- Tubeless Tyres
- Digital Console
- LED Headlamp
- Liquid Cooled Engine
- Body type- Commuter
- Price less than Rs. 60,000
- Disc Brake on both wheels
- Cylinder Capacity less than 125 cc
- Ignition with Self Start Plus Kick Start
- Claimed Millage in the range of 45 to 65 kmpl.

Chapter 6

LIMITATIONS AND FUTURE SCOPE

Such type of pruducts for which the customers' evaluation is based on intangible attributes or image are difficult to analyse. In spite of rational side, emotional factors are present in these type of products and hence in case of these products logical conjoint analysis fails. Another limitation of this thesis is that only Indian users' data is available to do research. If data from some other countries were available to us, the result would become a generalised one. Case studies can be made to increase the detail of information and enrich it. Also, this research intended at categorization and understanding the variations in consumer preference about its attributes. Function of attributes like demographics, length of ownership, usefulness, consumer-intended use of the product which helps the researcher to understand the variation in preference of the customer is not considered in this thesis. This information and other such relevant information will provide additional knowledge to undersatnd the preference about the attributes of a product.

An attribute in its introduction phase might not be attractive to the customer but it will be in its growth phase of the market. This tendency of an attribute to move between quality factors in its lifespan is consistent with the findings of L¨ofgren and Witell (2008). Perception of a particular attribute may become attractive with satisfaction or dissatisfaction varying with the level of its achievement. Over a span of time, as the customer accepted this attribute as attractive, it will become a basic factor.

In future studies, customers' dynamic desires and other product features like aesthetic factors are predicted with the integration of artificial neural networks or Kansei engineering with our framework. Also, to increase the reliability of the categorisation method, the effect of time on the categorisation of quality attributes should be considered in future researches.

Also, more research could be directed to the identification of the significance of Kano categories when the distribution of survey inputs cannot be approximated to a normal distribution and when the number of inputs is low. Moreover, finally, more

applications on other product design problems would further test the usefulness of this method.

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APPENDICES

Appendix A- Survey Questionnaire for Kano Analysis

Survey regarding Customer Perception about Attributes of a Motorcycle

This survey is intended to investigate the Customer Perception about Attributes of a Motorcycle. Please spare 3-5 minutes of your valuable time to provide responses to the questions asked below, based on your personal choice.
All the personal details will be held strictly CONFIDENTIAL.

Section I

Name (optional) _____

Email-id (optional) _____

Age (in years) _____

Profession _____

Section II

If following Features are provided in a Motorcycle, how would you feel about it.
Please rate the features according to your choice
Mark only one oval per row.

Attributes	I Like it	It Must be present	Neutral	Can Live with it	Dislike it
Alloy Wheels					
Spoke Wheels					
Disc Brake on One Wheel Only					
Disc Brakes on Both Wheels					
LED Head Lamp					
Halogen Head Lamp					
Five Gears					
Four Gears					
Tube-Less Tyres					
Tube-Tyres					
Hazard Light					
No Hazard Light					
Digital Console					
Analog Console					
Ignition with Self Start plus Kick Start					
Ignition with Self Start Only					
Ignition with Self Start Only					
Split Seats					
Flat Seat					
Liquid Cooled Engine					
Air- Cooled Engine					
Mono Shock Absorber					
Twin Shock Absorbers					
Vertical Cylinder					
Horizontal Cylinder					

Relevant Comments:

_____

_____

_____

_____

Appendix B- Survey Questionnaire for Conjoint Analysis

Customer Perception about Specifications of a Motorcycle

This survey is intended to capture customer desires regarding the specifications of a Motorcycle. Please 3- 5 minutes of your valuable time to provide responses to the questions asked below, based on your personal choice as a perspective buyer.
All the personal details will be held strictly CONFIDENTIAL.

Section I

Name (optional) _____

Email-id (optional) _____

Age (in years) _____

Profession _____

Section II

Suppose you are about to purchase a new Motorcycle. Please rate the following Motorcycle profiles on your likeliness to purchase a motorcycle with given set of specifications (1 = Least likely to buy, 5 = Most likely to buy)
[Price; Cylinder Capacity; Body Type; Mileage]
Mark only one oval per row.

Motorcycle profiles	1	2	3	4	5
More than Rs. 90,000; More than 250cc; Cruiser; 45-65 kmpl					
Rs. 60,000-90,000; More than 250cc; Sports; Less than 45 kmpl					
More than Rs. 90,000; 150-220 cc; Sports ; 45-65 kmpl					
Rs. 60,000-90,000; 150-220 cc; Sports; Less than 45 kmpl					
More than Rs. 90,000; More than 250cc; Cruiser; Less than 45kmpl					
Rs. 60,000-90,000; 150-220 cc; Cruiser; Less than 45 kmpl					
Less than Rs.60,000; Less than 125cc;Commuter; More than 65kmpl					
More than Rs. 90,000; More than 250cc; Commuter; Less than 45kmpl					
Rs 60,000-90,000; Less than 125 cc; Commuter; More than 65 kmpl					

Please rate the importance of following Factors while making a decision to buy a Motorcycle:

[1 = not important at all, 5 = extremely important]

Mark only one oval per row.

Factors	1	2	3	4	5
Price					
Cylinder Capacity					
Body Type					
Mileage					

Relevant Comments:

_____

_____

_____