

**A Review: Indian Automobile Industry and Analysis**

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**Abstract**

The Indian automobile industry is facing some challenges and difficulties in selection of modules(features) in their vehicles. To resolve and suggestion following problems some analysis are proposed in this paper, on the basis of previous year results.

The function will be classified into different types of modules according to the consideration of manufacturing and assembling of the products with parts as designs. Then modules will be utilize to make changes of results of efficiency, productivity and overall cost to represents the modularity concept of product development and evaluation of effect and modular product design of manufacturing process

**Keywords:** Modular, Product, Design, Manufacturing, Processes, Automobile Industry

**Introduction**

In this paper, basically the discussion will start for the purpose to study of effect and evaluation of modular product design on manufacturing processes. The impact or effect of modularity concept on manufacturing process with the help of automobile industry and its modules will be explained in this dissertation. On another part the evaluation for concept of modularization in auto industry through manufacturing process and some other parameters are also include in this exercise of dissertation. Modularity is an important key issue nowadays in industry. Although it is not a new issue, it has growing in importance in recent years in the auto industry. The aim of this dissertation is not to discuss modularity theoretically, but to discuss some new production arrangements and new design strategies for wide selection by customers in market, which are based on new forms of relationship between assemblers and suppliers through improved manufacturing processes with customers in respect of automobile industry as well as on the use of modular products..

This paper is analyzes the modularization in the world auto industry with previous reviews on manufacturing, sales, costs and designing of multiple products. We can say that following fact suggests that there are at least three important and considerable factors in the phenomenon called “modularization”: Any fixed and traditional factors cannot be mention in favor of automobile industry and their vehicles.

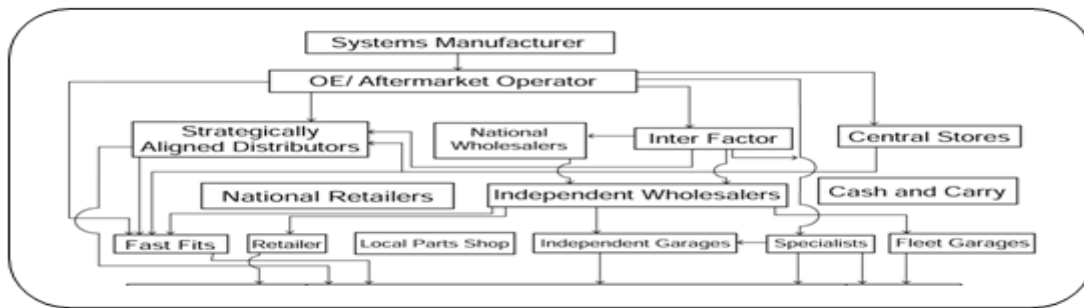
**Literature Review**

The literature reviews are always considered as very important part of dissertation work. Any research cannot be preceding without this section The related topics and points are includes and provide a direction for further work for paper. One by one the all points are mention separately for acknowledgement of report in this chapter.

**A. Automotive supply chain**

This is the first point of this chapter for discussion in this dissertation. There are many theoretical reviews can be possible. This automotive supply chain is very much important to discuss in respect of automobile industry. After 1973,

the year of the first oil shock, the growth rate declined to about 1% per year until 2002, and came to a halt in 2003. The automotive supply chain can be discussed as schematic diagram also. This diagram will help to represent the all important steps and points of automotive supply chain system. The all steps in whole system of supply chain are also involved.



**Fig 1- Automobile supply chain**

In this diagram, complete system of automotive supply chain is discussed in detail. From first to last factors of this supply chain system are focused especially. Through this diagram the different types of suppliers and vendors and their contribution in automotive supply chain system can be understood.

- 1) The cost of stock holding
- 2) Incentives offered to final customers to move the stock.

### **B. New product development**

Improving and updating product lines is crucial for the success for any organization. Failure for an organization to change could result in a decline in sales and with competitors racing ahead.

**Stage 1: Idea Generation**-New product ideas have to come from somewhere. But where do organizations get their ideas for NPD.

**Stage 2: Idea Screening**-This process involves shifting through the ideas generated above and selecting ones which are feasible and workable to develop. Pursuing non feasible ideas can clearly be costly for the company. This step is important step for the new product development process for any kind of organization.

**Stage 3: Concept Development and Testing**-The organization may have come across what they believe to be a feasible idea, however, the idea needs to be taken to the target audience.

**Stage 4: Marketing Strategy and Development**- A proposed marketing strategy will be written laying out the marketing mix strategy of the product, the segmentation, targeting and positioning strategy sales and profits that are expected. These kinds of market strategies are necessary for the customers.

**Stage 5: Business Analysis**-The Company has a great idea, the marketing strategy seems feasible, but will the product be financially worthwhile in the long run? The business analysis stage looks more deeply into the Cash flow.

**Stage 6: Product Development**-At this stage the prototype is produced. The prototype will clearly run through all the desired tests, and presented to a selection of people made up of the target market segment to see if changes need to be made.

**Stage 7: Test Marketing**-Test marketing means testing the product within a specific area. The product will be launched within a particular region so the marketing mix strategy can be monitored and if needed modified before national launch.

**Stage 8: Commercialization**-If the test marketing stage has been successful the product will go for national launch. There are certain factors that need to be taken into account before a product is launched nationally.

These eight stages of product development may seem like a process but they are designed to save wasted time and resources. New product development ideas and prototypes are tested to ensure that the new product will meet target market needs and wants. There is a test launch during the test marketing stage as a full market launch is expensive.

### **C. Modularity**

In an increasingly competitive and segmented global marketplace, the need to diversify is greater than ever before. Advances in production technologies has rendered out many of the differences in product quality, and thus changed the competitive environment companies find themselves in. Traditional mass production has in the past decade been replaced by the concept of mass customization, mass production of customized products. To overcome the great complexity that customization potentially creates in the manufacturing systems, modularization is used as a tool to break the product structure into smaller, manageable units. Under the change of consuming type the lifecycle of a product becomes short while used. How to follow the need of the market to develop new products is increasingly important. CE is regarded as an efficient approach to meet the production requirements.

### **D. Automobile Industry in India**

The Indian automotive industry has emerged as a 'sunrise sector' in the Indian economy. India is emerging as one of the world's fastest growing passenger car markets and second largest two wheeler manufacturer. It is also home for the largest motor cycle manufacturer and fifth largest commercial vehicle manufacturer. India is fourth largest passenger car market in Asia also. In recent years there has been a marked rise in the number of international industrial concern setting up a base in India. The automotive industry is well represented among them.

### **Problem Statement**

As we know that, we are discussing the effect and evaluation of modular product design on manufacturing process with the study of automobile modules. The automobile industry is fastest growing industry in Indian market. Every human being desirable to be the part of this industry as a customer and in other respects. Some of the people are desirable but some of them already associated with this industry also. In previous time, the automobile sector was having the limited choice and options but in this time many of companies with a lot of options are available in the market for customers.

In this chapter of dissertation we are discussing the main concept of modularization in our auto industry with some problems of customers and customization. The concept of modularity as the modular product design can be related to bottom to top products and parts of car. In the duration of assembling of a car and of its parts the changes are possible and changes should be as the demand of our market and customers.

It's going to be much more important to watch the middle of the market and see how consumers there are thinking about or rethinking their purchases of durable goods and looking ahead for the next six months or so. It's going to be interesting, as the new models come in, to see whether people will feel.

- (1) A problem of selection related to the design of a vehicle as per choice of customer.
- (2) Another is related according required power and efficiency of a vehicle in different respect.
- (3) The features of comfort and convenience of a car also important and required indicates another problem of automobile industry.
- (4) Some times a problem of customers related to cost features and expenses for maintenance of vehicle in limited criteria.
- (5) The problem in selection of vehicle also can be related with performance and present additional features also possible as per desire and requirements.
- (6) Some of customers are choose their vehicle as per record analysis of sales figures and demand ratio in market focus a part of serious problem.
- (7) In some cases, customers required many of features in vehicle less budget and high demand of them arise a new problem.
- (8) The customers are also gathered information about result of the vehicle's overall specifications and structured design to avoid the futuristic problem.
- (9) In some other cases, the atmospheric conditions and fulfillment of purpose to purchase the vehicle also important in the selection, which creates a great confusion as a problem
- (10) In study of few cases, the users are also affected with modularity; they are affectionate about requirements of advancement in vehicle also generate some problems.

### **Methodology**

In this paper as mention on the top, we will discuss some of the steps and ideas to find out many new results and solutions for some specific problems of customers in respect of automobile industry. The selection of steps and ideas for methodology of any dissertation due to purpose of new research and results are very important. On the basis of nature in this methodology and subject, this dissertation can be classified as a case study and survey based research with based on a literature review including a classification and its analysis. It is imperative to any research project that the field being researched is defined and understood, which involves identifying the current theoretical and empirical state of knowledge in the subject.

In this paper of methodology of dissertation, the effect and evaluation of modular product design on manufacturing process can be discuss by some of exercise on modules of automobile industry. The modules of such automobile companies will be well known and important symbols for their reputation and prestige in market between customers. The selections of customers are based on utilization of following modules in assembling and formations of vehicles.

#### **A. Dividing automobile into various modules**

The all exercise of dissertation to understand the concept of modular product design in manufacturing processes with its effects can be possible with module-factor. The six major modules of a car can be as-

- |                 |             |
|-----------------|-------------|
| A. Body Types   | (Module M1) |
| B. Engine Types | (Module M2) |

- C. Transmission Types (Module M3)
- D. Suspension Types (Module M4)
- E. Fuel Types (Module M5)
- F. Vehicle Feature Types (Module M6)

The classification of modules is considered as different parts of automobile. The automobile module (vehicle) is having many parts and following parts are consider as modules. The high and low rate of utilization is based on sales figures in market by customers. The sale figure is varies according the costs of the modules. That's by these all modules can be classified as multiple options for following module.

### ***B. Identifying various options for each modules***

This is another step of methodology for this dissertation. This is having the important role for study of effect and evaluation of modular product design on manufacturing processes. There are many automobile companies are available in the Indian automobile market but the selection of highly demanded and reliable companies is important for this work. These main automobile five companies will be involved are as-

#### **(I) Maruti Suzuki Limited**

These all automobile companies are very famous and well known companies in Indian market between customers. The highest models of cars are used by customers of these five involved companies. The all class families is using the cars of these automobile companies widely. They are also providing the all classes of choices in cars for Indian market. As we now, in this step after listing and division the all options, this is very necessary to for all to identifying them.

### ***C. For each of company, classifying each model (variant) as an equation of various modules***

In this section, we will classify the all models (different variants) as a mathematical equation for each company. So that all cars of different models and different companies can be express in a similar way. Firstly the combination of vehicle parts will be noted according to the considered options of the flow chart. Small values of engine capacity are decrease and increase to arrangement and matching with other engine types.

**Table 1- Modules & Their Sub Modules**

| S.N | Name Of Module | Symbols | Name of Sub- Modules | Symbols |
|-----|----------------|---------|----------------------|---------|
| 1   | BODY TYPE      | M1      | SEDAN TYPE           | B1      |
|     |                |         | HATCHBACK TYPE       | B2      |
|     |                |         | SUV/MUV TYPE         | B3      |
| 2   | ENGINE TYPE    | M2      | 814 CC               | E1      |
|     |                |         | 998 CC               | E2      |
|     |                |         | 1086 CC              | E3      |
|     |                |         | 1197 CC              | E4      |
|     |                |         | 1248 CC              | E5      |
|     |                |         | 1396 CC              | E6      |
|     |                |         | 1586 CC              | E7      |

|   |                      |    |                          |     |
|---|----------------------|----|--------------------------|-----|
|   |                      |    | 1797 CC                  | E8  |
|   |                      |    | 2199 CC                  | E9  |
|   |                      |    | 2393 CC                  | E10 |
| 3 | TRANSMISSION TYPE    | M3 | MANUAL                   | T1  |
|   |                      |    | AUTOMATIC                | T2  |
| 4 | SUSPENSION TYPE      | M4 | LEAF SPRING TYPE         | S1  |
|   |                      |    | COIL TYPE                | S2  |
|   |                      |    | AIR SPRING TYPE          | S3  |
|   |                      |    | TORSION TYPE             | S4  |
|   |                      |    | ANTI ROLL TYPE           | S5  |
| 5 | FUEL TYPE            | M5 | PETROL TYPE              | F1  |
|   |                      |    | DIESEL TYPE              | F2  |
|   |                      |    | HYBRID TYPE              | F3  |
| 6 | VEHICLE FEATURE TYPE | M6 | POWER STEERING TYPE      | V1  |
|   |                      |    | AIR BAGS TYPE            | V2  |
|   |                      |    | POWER WINDOW TYPE        | V3  |
|   |                      |    | ANTI BRAKING SYSTEM TYPE | V4  |
|   |                      |    | CENTRAL LOCK TYPE        | V5  |

Table 2- (Maruti Suzuki Segment's-Specifications of Different Models)

| S.N | Name of Car | Model | Body Type      | Engine      | Transmission | Suspension   | Fuel Type   | Equations                  |
|-----|-------------|-------|----------------|-------------|--------------|--------------|-------------|----------------------------|
| 1   | ALTO        | LX    | Hatchback (B2) | 814 CC (E1) | Manual (T1)  | Torsion (S4) | Petrol (F1) | B2+E1+T1+S4+F1             |
| 2   |             | LXI   | Hatchback (B2) | 814 CC (E1) | Manual (T1)  | Torsion (S4) | Petrol (F1) | B2+E1+T1+S4+F1+V1          |
| 3   |             | VXI   | Hatchback (B2) | 998 CC (E2) | Manual (T1)  | Torsion (S4) | Petrol (F1) | B2+E2+T1+S4+F1+V1+V3+V5    |
| 4   |             | K 10  | Hatchback (B2) | 998 CC (E2) | Manual (T1)  | Torsion (S4) | Petrol (F1) | B2+E2+T1+S4+F1+V1+V3+V4+V5 |
| 5   |             | CNG   | Hatchback (B2) | 998 CC (E2) | Manual (T1)  | Torsion (S4) | Hybrid (F3) | B2+E2+T1+S4+F3+V1          |
| 6   | A-STAR      | LXI   | Hatchback (B2) | 998 CC (E2) | Manual (T1)  | Coil (S2)    | Petrol (F1) | B2+E2+T1+S2+F1+V1+V3       |
| 7   |             | VXI   | Hatchback (B2) | 998 CC (E2) | Manual (T1)  | Coil (S2)    | Petrol (F1) | B2+E2+T1+S2+F1+V1+V3+V5    |
| 8   |             | ZXI   | Hatchback      | 998 CC      | Manual (T1)  | Coil (S2)    | Petrol      | B2+E2+T1+S2+F1+V1+         |

|    |                         |        |                    |                 |                |              |                |                                   |
|----|-------------------------|--------|--------------------|-----------------|----------------|--------------|----------------|-----------------------------------|
|    |                         |        | k (B2)             | (E2)            |                |              | (F1)           | V3+V4+V5                          |
| 9  |                         | VXI AT | Hatchbac<br>k (B2) | 998 CC<br>(E2)  | Automatic (T2) | Coil (S2)    | Petrol<br>(F1) | B2+E2+T2+S2+F1+V1+<br>V2+V3+V4+V5 |
| 10 | <b>WAGONR</b>           | LX     | Hatchbac<br>k (B2) | 998 CC<br>(E2)  | Manual (T1)    | Coil (S2)    | Petrol<br>(F1) | B2+E2+T1+S2+F1                    |
| 11 |                         | LXI    | Hatchbac<br>k (B2) | 998 CC<br>(E2)  | Manual (T1)    | Coil (S2)    | Petrol<br>(F1) | B2+E2+T1+S2+F1+V1                 |
| 12 |                         | VXI    | Hatchbac<br>k (B2) | 998 CC<br>(E2)  | Manual (T1)    | Coil (S2)    | Petrol<br>(F1) | B2+E2+T1+S2+F1+V1+<br>V3          |
| 13 |                         | AT     | Hatchbac<br>k (B2) | 998 CC<br>(E2)  | Automatic (T2) | Coil (S2)    | Diesel<br>(F2) | B2+E2+T2+S2+F2+V1+<br>V2+V3+V4+V5 |
| 14 |                         | DUO    | Hatchbac<br>k (B2) | 998 CC<br>(E2)  | Manual (T1)    | Coil (S2)    | Hybrid<br>(F3) | B2+E2+T1+S2+F3+V1+<br>V3+V5       |
| 15 | <b>RITZ</b>             | LXI    | Hatchbac<br>k (B2) | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B2+E4+T1+S4+F1+V1+<br>V3          |
| 16 |                         | VXI    | Hatchbac<br>k (B2) | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B2+E4+T1+S4+F1+V1+<br>V3+V5       |
| 17 |                         | ZXI    | Hatchbac<br>k (B2) | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B2+E4+T1+S4+F1+V1+<br>V2+V3+V4+V5 |
| 18 |                         | LDI    | Hatchbac<br>k (B2) | 1248 CC<br>(E5) | Manual (T1)    | Torsion (S4) | Diesel<br>(F2) | B2+E5+T1+S4+F2+V1+<br>V3+V5       |
| 19 | <b>SWIFT</b>            | LXI    | Hatchbac<br>k (B2) | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B2+E4+T1+S4+F1+V1                 |
| 20 |                         | VXI    | Hatchbac<br>k (B2) | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B2+E4+T1+S4+F1+V1+<br>V3+V5       |
| 21 |                         | ZXI    | Hatchbac<br>k (B2) | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B2+E4+T1+S4+F1+V1+<br>V3+V4+V5    |
| 22 |                         | LDI    | Hatchbac<br>k (B2) | 1248 CC<br>(E5) | Manual (T1)    | Torsion (S4) | Diesel<br>(F2) | B2+E5+T1+S4+F2+V1+<br>V3          |
| 23 |                         | VDI    | Hatchbac<br>k (B2) | 1248 CC<br>(E5) | Manual (T1)    | Torsion (S4) | Diesel<br>(F2) | B2+E5+T1+S4+F2+V1+<br>V2+V3+V4+V5 |
| 24 | <b>SWIFT<br/>DEZIRE</b> | LXI    | Sedan<br>(B1)      | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B1+E4+T1+S4+F1+V1+<br>V3          |
| 25 |                         | VXI    | Sedan<br>(B1)      | 1197 CC<br>(E4) | Manual (T1)    | Torsion (S4) | Petrol<br>(F1) | B1+E4+T1+S4+F1+V1+<br>V3+V5       |
| 26 |                         | LDI    | Sedan<br>(B1)      | 1248 CC<br>(E5) | Manual (T1)    | Torsion (S4) | Diesel<br>(F2) | B1+E5+T1+S4+F2+V1+<br>V3+V5       |
| 27 |                         | ZXI    | Sedan              | 1197 CC         | Manual (T1)    | Torsion (S4) | Diesel         | B1+E4+T1+S4+F2+V1+                |

|    |        |        |               |               |    |                |                      |                |                                    |
|----|--------|--------|---------------|---------------|----|----------------|----------------------|----------------|------------------------------------|
|    |        |        | (B1)          | (E4)          |    |                | (F2)                 | V2+V3+V4+V5    |                                    |
| 28 |        | AUTO.  | Sedan<br>(B1) | 1197<br>(E4)  | CC | Automatic (T2) | Torsion (S4)<br>(F1) | Petrol<br>(F1) | B1+E4+T2+S4+F1+V1+<br>V3+V5        |
| 29 | SX 4   | VXI    | Sedan<br>(B1) | 1586<br>(E7)  | CC | Manual (T1)    | Torsion (S4)         | Petrol<br>(F1) | B1+E7+T1+S4+F1+V1+<br>V3           |
| 30 |        | ZXI    | Sedan<br>(B1) | 1586<br>(E7)  | CC | Manual (T1)    | Torsion (S4)         | Petrol<br>(F1) | B1+E7+T1+S4+F1+V1+<br>V3+V4+V5     |
| 31 |        | VDI    | Sedan<br>(B1) | 1248<br>(E5)  | CC | Manual (T1)    | Torsion (S4)         | Diesel<br>(F2) | B1+E5+T1+S4+F2+V1+<br>V3+V5        |
| 32 |        | ZDI    | Sedan<br>(B1) | 1248<br>(E5)  | CC | Manual (T1)    | Torsion (S4)         | Diesel<br>(F2) | B1+E5+T1+S4+F2+V1+<br>V3+V4+V5     |
| 33 |        | ZXI AT | Sedan<br>(B1) | 1586<br>(E7)  | CC | Automatic (T2) | Torsion (S4)         | Petrol<br>(F1) | B1+E7+T2+S4+F1+V1+<br>V2+V3+V4+V5  |
| 34 | ERTIGA | LXI    | MUV<br>(B3)   | 1396<br>(E6)  | CC | Manual (T1)    | Torsion (S4)         | Petrol<br>(F1) | B3+E6+T1+S4+F1+V1+<br>V3           |
| 35 |        | VXI    | MUV<br>(B3)   | 1396<br>(E6)  | CC | Manual (T1)    | Torsion (S4)         | Petrol<br>(F1) | B3+E6+T1+S4+F1+V1+<br>V3+V5        |
| 36 |        | LDI    | MUV<br>(B3)   | 1248<br>(E5)  | CC | Manual (T1)    | Torsion (S4)         | Diesel<br>(F2) | B3+E5+T1+S4+F2+V1+<br>V2+V3+V5     |
| 37 |        | ZXI    | MUV<br>(B3)   | 1396<br>(E6)  | CC | Manual (T1)    | Torsion (S4)         | Petrol<br>(F1) | B3+E5+T1+S4+F1+V1+<br>V2+V3+V4+V5  |
| 38 |        | VDI    | MUV<br>(B3)   | 1248<br>(E5)  | CC | Manual (T1)    | Torsion (S4)         | Diesel<br>(F2) | B3+E5+T1+S4+F2+V1+<br>V3+V4+V5     |
| 39 |        | ZDI    | MUV<br>(B3)   | 1248<br>(E5)  | CC | Manual (T1)    | Torsion (S4)         | Diesel<br>(F2) | B3+E5+T1+S4+F2+V1+<br>V2+V3+V4+V5  |
| 40 | VITARA | MT     | MUV<br>(B3)   | 2393<br>(E10) | CC | Manual (T1)    | Torsion (S4)         | Petrol<br>(F1) | B3+E10+T1+S4+F1+V1<br>+V2+V3+V4+V5 |
| 41 |        | AT     | MUV<br>(B3)   | 2393<br>(E10) | CC | Automatic (T2) | Torsion (S4)         | Diesel<br>(F2) | B3+E10+T2+S4+F2+V1<br>+V2+V3+V4+V5 |

#### D. Calculating percentage utilization of each module.

In all previous sections we worked as the theoretical exercises and explanations of modules in different ways like the classification, identification and after arrange them in mathematical equations.

**Table 3 - (Maruti Suzuki Segment's-Utilization Of Each Module)**

| S.N | Module Options |       | Code | No. of models using the |  | Total no. of | Percentage of |
|-----|----------------|-------|------|-------------------------|--|--------------|---------------|
| (A) | (B)            | (C)   | (D)  | (E)                     |  | (F)          | (F)=E/F * 100 |
| 1   |                | Sedan | B1   | 10                      |  | 41           | 24.39%        |



|    |                  |                     |     |    |    |        |
|----|------------------|---------------------|-----|----|----|--------|
| 2  | Body Type        | Hatchback           | B2  | 23 | 41 | 56.10% |
| 3  |                  | SUV/MUV             | B3  | 08 | 41 | 19.51% |
| 4  | Engine           | 814 CC              | E1  | 02 | 41 | 4.87%  |
| 5  |                  | 998 CC              | E2  | 12 | 41 | 29.26% |
| 6  |                  | 1197 CC             | E4  | 10 | 41 | 24.39% |
| 7  |                  | 1248 CC             | E5  | 10 | 41 | 24.39% |
| 8  |                  | 1396 CC             | E6  | 02 | 41 | 4.87%  |
| 9  |                  | 1586 CC             | E7  | 03 | 41 | 7.31%  |
| 10 |                  | 2393 CC             | E10 | 02 | 41 | 4.87%  |
| 11 | Transmission     | Manual              | T1  | 36 | 41 | 87.80% |
| 12 |                  | Automatic           | T2  | 05 | 41 | 12.19% |
| 13 | Suspension       | Coil                | S2  | 09 | 41 | 21.95% |
| 14 |                  | Torsion             | S4  | 32 | 41 | 78.04% |
| 15 | Fuel Type        | Petrol              | F1  | 29 | 41 | 70.73% |
| 16 |                  | Diesel              | F2  | 11 | 41 | 26.82% |
| 17 |                  | Hybrid              | F3  | 01 | 41 | 2.44%  |
| 18 | Vehicle Features | Power Steering      | V1  | 39 | 41 | 95.12% |
| 19 |                  | Air Bags            | V2  | 14 | 41 | 34.14% |
| 20 |                  | Power Window        | V3  | 35 | 41 | 85.36% |
| 21 |                  | Anti-Braking System | V4  | 19 | 41 | 46.34% |
| 22 |                  | Central Lock        | V5  | 29 | 41 | 70.73% |

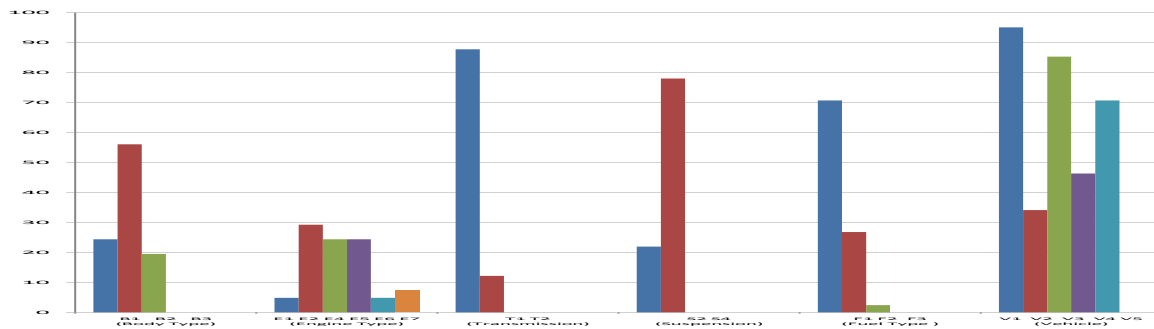
This table represents the details of car and models for Hyundai Company. In the table all the columns are provide the details for different parameters. Column B is for selected representation of selected modules for dissertation work. Column C is for available modules options for exercise. Next Column D is for coding and symbols notification of options. Another Column E is providing the quantity ratio of modules and using among all model of car in that company. Column F Says that how many modules are using for the analyses. The last column G is providing final result of in form of percentage of utilization for each module and options.

#### ***E. Identifying important modules for using graphical representation.***

This step of methodology is helpful to understand the clear positions of the modules that they are using to express the concept of effect with modular product design. The graphical representation of the modules can easily define the exact percentage of their utilization by customers. At one axis we consider the percentage of utilization of modules and at another axis name of that particular module to express the position of utilization among customers. There are some of the general benefits considered for the graphical representation of some values or mathematical equations.

1. Graphical Representations makes it easy to understand and interpret data at a glance.

2. It also helps to do comparisons among many things.
3. Moreover it makes data easy to recall.



#### F. Calculating sales and cost data for each variant for all five companies.

The effect of modularization concept can be justified by exercises of some data related to different cases of specification and equations. The exercises and analyses should be related to cost and sales factors of car with different models. The study by different cases of vehicle studies at different stage and methods can be expressed as the success and failure rates of the all exercises. The permanent results of success and failure rate are possible by a specific method of exercise of related topics. These tables are provides exact idea about demand ratio of customers in market for each car model and every automobile company. The variations are possible due to multiple available options for customers in market. The growth and loss rates are justified by following figures of sales of car in market.. These figures play an important role in selection of popular car model & company.

**Table 4- (Maruti Suzuki Segment's-Costs Figures & Percentage)**

| Name of Car | Model  | Price    | Differences in Cost from Base Model | Percentage Increase ( Cost) |
|-------------|--------|----------|-------------------------------------|-----------------------------|
| ALTO        | LX     | 2,81,738 | 00                                  | 00.00%                      |
|             | LXI    | 3,00,403 | 18,665                              | 6.21%                       |
|             | VXI    | 3,17,135 | 35,397                              | 12.56%                      |
|             | K 10   | 3,23,443 | 41,705                              | 14.80%                      |
|             | CNG    | 3,48,895 | 67,157                              | 23.83%                      |
| A-STAR      | LXI    | 3,82,961 | 00                                  | 00.00%                      |
|             | VXI    | 4,14,200 | 31,239                              | 8.16%                       |
|             | ZXI    | 4,40,899 | 57,938                              | 15.12%                      |
|             | VXI AT | 4,65,797 | 82,836                              | 21.64%                      |
| WAGON-R     | LX     | 3,58,152 | 00                                  | 00.00%                      |
|             | LXI    | 3,87,701 | 29,549                              | 8.25%                       |
|             | VXI    | 4,13,063 | 54,911                              | 15.34%                      |

|                         |        |          |          |        |
|-------------------------|--------|----------|----------|--------|
|                         | AT     | 4,44,899 | 86,747   | 24.22% |
|                         | DUO    | 4,48,512 | 90,360   | 25.23% |
| <b>RITZ</b>             | LXI    | 4,22,923 | 00       | 00.00% |
|                         | VXI    | 4,25,532 | 2,609    | 0.62%  |
|                         | ZXI    | 4,26,485 | 3,562    | 0.85%  |
|                         | LDI    | 5,15,245 | 92,322   | 21.82% |
| <b>SWIFT</b>            | LXI    | 4,56,029 | 00       | 00.00% |
|                         | VXI    | 4,97,156 | 41,127   | 09.01% |
|                         | ZXI    | 5,82,268 | 1,26,239 | 27.68% |
|                         | LDI    | 5,64,865 | 1,08,836 | 23.86% |
|                         | VDI    | 6,10,157 | 1,54,128 | 33.79% |
| <b>SWIFT<br/>DEZIRE</b> | LXI    | 5,00,585 | 00       | 00.00% |
|                         | VXI    | 5,52,896 | 52,311   | 10.44% |
|                         | LDI    | 6,11,391 | 1,10,806 | 22.13% |
|                         | ZXI    | 6,44,451 | 1,43,866 | 28.73% |
|                         | AUTO.  | 6,77,286 | 1,76,701 | 35.29% |
| <b>SX 4</b>             | VXI    | 7,32,223 | 00       | 00.00% |
|                         | ZXI    | 8,11,297 | 79,074   | 10.79% |
|                         | VDI    | 8,38,120 | 1,05,897 | 14.46% |
|                         | ZDI    | 9,28,470 | 1,96,247 | 26.80% |
|                         | ZXI AT | 9,22,684 | 1,90,461 | 26.01% |
| <b>ERTIGA</b>           | LXI    | 7,08,976 | 00       | 00.00% |
|                         | VXI    | 7,34,565 | 25,589   | 03.60% |
|                         | LDI    | 7,56,765 | 47,789   | 06.74% |
|                         | ZXI    | 7,87,654 | 78,678   | 11.09% |
|                         | VDI    | 8,76,567 | 1,67,591 | 23.63% |
|                         | ZDI    | 8,56,654 | 1,47,678 | 20.08% |
|                         | MT     | 1034567  | 00       | 00.00% |

|        |    |         |        |        |
|--------|----|---------|--------|--------|
| VITARA | AT | 1076786 | 42,219 | 04.80% |
|--------|----|---------|--------|--------|

In this basically price or cost of particular model is using to differentiate with another model. Firstly all models of Honda Company and their prices are listed then comparison between two models is expressed.

TABLE 5 - (MARUTI SUZUKI SEGMENT'S SALES FIGURES & PERCENTAGE)

| Name of Car  | Model  | Record of Monthly Sales & Variation from Base Model (January - August) 2012 |       |          |       |       |       |       |       |      |       |      |       |      |       |        |       | Percentage Increase (Sales) |           |         |
|--------------|--------|-----------------------------------------------------------------------------|-------|----------|-------|-------|-------|-------|-------|------|-------|------|-------|------|-------|--------|-------|-----------------------------|-----------|---------|
|              |        | January                                                                     |       | February |       | March |       | April |       | May  |       | June |       | July |       | August |       |                             | September |         |
| ALTO         | LX     | 2556                                                                        | 00    | 2676     | 00    | 2790  | 00    | 2846  | 00    | 3046 | 00    | 3215 | 00    | 3354 | 00    | 3641   | 00    | 3876                        | 00        | 00.00%  |
|              | LXI    | 3234                                                                        | 678   | 3345     | 669   | 3567  | 777   | 3924  | 1078  | 4241 | 1195  | 4359 | 1144  | 4412 | 1058  | 4554   | 913   | 4790                        | 914       | 26.52%  |
|              | VXI    | 3456                                                                        | 222   | 3678     | 1002  | 3897  | 1107  | 3902  | 1056  | 4412 | 1366  | 4665 | 306   | 4792 | 1438  | 5128   | 1487  | 5476                        | 1600      | 35.21%  |
|              | K 10   | 1245                                                                        | -2211 | 1456     | -1220 | 1565  | -1225 | 1634  | -1212 | 1845 | -1201 | 2045 | -2620 | 2241 | -1113 | 2421   | -1220 | 2565                        | -1311     | -51.29% |
|              | CNG    | 1123                                                                        | -122  | 1265     | -191  | 1390  | -175  | 1436  | -198  | 1687 | -158  | 1754 | -291  | 1542 | -699  | 1925   | -496  | 1809                        | -756      | -56.06% |
| A-STAR       | LXI    | 376                                                                         | 00    | 413      | 00    | 498   | 00    | 539   | 00    | 656  | 00    | 665  | 00    | 654  | 00    | 751    | 00    | 876                         | 00        | 00.00%  |
|              | VXI    | 698                                                                         | 322   | 786      | 373   | 777   | 279   | 895   | 356   | 754  | 98    | 921  | 256   | 845  | -191  | 954    | -203  | 1012                        | -136      | 85.64%  |
|              | ZXI    | 409                                                                         | -289  | 462      | -324  | 545   | -232  | 696   | -199  | 554  | -200  | 485  | -438  | 413  | 432   | 505    | 449   | 638                         | -374      | 11.86%  |
|              | VXI AT | 105                                                                         | -304  | 113      | -349  | 145   | -400  | 195   | -501  | 148  | -406  | 189  | -296  | 202  | 211   | 267    | 238   | 197                         | -441      | -74.58% |
| WAGON-R      | LX     | 3098                                                                        | 00    | 3243     | 00    | 3456  | 00    | 3512  | 00    | 3454 | 00    | 3624 | 00    | 3545 | 00    | 3721   | 00    | 3876                        | 00        | 00.00%  |
|              | LXI    | 3779                                                                        | 681   | 3845     | 602   | 4671  | 1215  | 4924  | 1412  | 4852 | 1398  | 4998 | 1374  | 4715 | -1170 | 5158   | -1437 | 5342                        | -1466     | 21.98%  |
|              | VXI    | 3435                                                                        | -344  | 3547     | -298  | 3356  | -1315 | 3511  | -1413 | 3145 | -1707 | 3645 | -1353 | 3841 | 874   | 3012   | 2146  | 3389                        | 1953      | 10.88%  |
|              | AT     | 897                                                                         | -2538 | 997      | -2550 | 876   | -2480 | 1152  | -2359 | 879  | -2266 | 1241 | -2404 | 952  | 2889  | 1123   | 1889  | 1209                        | -2180     | -71.04% |
|              | DUO    | 2676                                                                        | 1779  | 2340     | 1343  | 2431  | 1555  | 2778  | 1626  | 2954 | 2075  | 2845 | 1604  | 2754 | -1802 | 3142   | -2019 | 3225                        | -2016     | -13.62% |
| RITZ         | LXI    | 1876                                                                        | 00    | 1980     | 00    | 2098  | 00    | 2058  | 00    | 2256 | 00    | 2112 | 00    | 2378 | 00    | 2345   | 00    | 2245                        | 00        | 00.00%  |
|              | VXI    | 1987                                                                        | 111   | 2154     | 174   | 2060  | -35   | 2245  | 187   | 2187 | -69   | 1845 | 1634  | 1542 | 836   | 1925   | 420   | 2141                        | 104       | 5.38%   |
|              | ZXI    | 1768                                                                        | -225  | 1890     | -264  | 2234  | 174   | 2145  | -100  | 2153 | -34   | 1954 | 109   | 2021 | -479  | 2445   | -520  | 2257                        | -116      | -5.91%  |
| SWIFT        | LDI    | 2453                                                                        | 685   | 2343     | 453   | 2786  | 552   | 2542  | 397   | 2451 | 298   | 2914 | 960   | 2865 | -844  | 2641   | -196  | 2876                        | -619      | 65.86%  |
|              | LXI    | 6035                                                                        | 00    | 6145     | 00    | 5678  | 00    | 6045  | 3503  | 6245 | 00    | 6341 | 00    | 6541 | 00    | 6504   | 00    | 6434                        | 00        | 00.00%  |
|              | VXI    | 6345                                                                        | 310   | 5674     | -471  | 5484  | -194  | 6349  | 304   | 6265 | 20    | 6841 | 500   | 6142 | 399   | 6741   | -237  | 7098                        | -664      | 5.13%   |
|              | ZXI    | 4132                                                                        | -2213 | 4234     | -1440 | 4676  | -808  | 5034  | -1315 | 4885 | -1380 | 4541 | -2300 | 4842 | 1300  | 4385   | 2356  | 5064                        | 2034      | -31.53% |
|              | LDI    | 7765                                                                        | 3633  | 7546     | 3312  | 7234  | 2558  | 7348  | 2314  | 7356 | 2471  | 7902 | 3361  | 8217 | -3375 | 8128   | -3743 | 8356                        | -3292     | 28.66%  |
| SWIFT DEZIRE | VDI    | 7567                                                                        | -202  | 7654     | 08    | 6876  | -358  | 7251  | -97   | 7314 | -42   | 7589 | -313  | 7745 | 472   | 7558   | 370   | 7876                        | 480       | 25.35%  |
|              | LXI    | 4908                                                                        | 00    | 4653     | 00    | 4456  | 00    | 4815  | -2436 | 4987 | 00    | 4571 | 00    | 4685 | 00    | 5140   | 00    | 5324                        | 00        | 00.00%  |
|              | VXI    | 5231                                                                        | 323   | 5345     | 692   | 4890  | 434   | 4717  | -101  | 5165 | 178   | 5241 | -2130 | 5365 | 680   | 5412   | -272  | 5098                        | 226       | 6.58%   |
|              | LDI    | 5432                                                                        | 201   | 5564     | 219   | 5198  | 308   | 5645  | 928   | 5254 | 89    | 5512 | 271   | 5745 | 380   | 5615   | -203  | 5790                        | -692      | 10.67%  |
|              | ZXI    | 3856                                                                        | -1576 | 4532     | -1032 | 4003  | -1195 | 4478  | -1167 | 4241 | -1013 | 4548 | -964  | 4351 | -1394 | 4812   | 803   | 5134                        | 656       | -21.44% |
| SX 4         | AUTO.  | 3791                                                                        | -95   | 3546     | -986  | 3407  | -596  | 3312  | -1166 | 3010 | 1231  | 3254 | -1294 | 3345 | -1006 | 3180   | 1632  | 3564                        | 1570      | -22.75% |
|              | VXI    | 232                                                                         | 00    | 256      | 00    | 303   | 00    | 341   | -2971 | 312  | 00    | 381  | 00    | 290  | 00    | 354    | 00    | 365                         | 00        | 00.00%  |
|              | ZXI    | 190                                                                         | -42   | 178      | -78   | 267   | -36   | 265   | -76   | 320  | -08   | 280  | 101   | 215  | -75   | 295    | 59    | 309                         | 56        | -18.10% |
|              | VDI    | 312                                                                         | 80    | 276      | 98    | 278   | 11    | 255   | -10   | 260  | 60    | 284  | 04    | 260  | 45    | 310    | -15   | 331                         | -22       | 34.48%  |
|              | ZDI    | 303                                                                         | -09   | 187      | -89   | 245   | -33   | 266   | 11    | 255  | -05   | 285  | 01    | 251  | -09   | 285    | 25    | 312                         | 19        | 3060%   |
| ERTIGA       | ZXI AT | 110                                                                         | -193  | 90       | -97   | 180   | -65   | 125   | -141  | 120  | 135   | 145  | -140  | 227  | -24   | 233    | 52    | 207                         | 105       | 52.58%  |
|              | LXI    | 1787                                                                        | 00    | 1987     | 00    | 2045  | 00    | 2158  | 2033  | 1951 | 00    | 2241 | 00    | 2354 | 00    | 2545   | 00    | 2668                        | 00        | 00.00%  |
|              | VXI    | 2234                                                                        | 447   | 2654     | 667   | 2589  | 544   | 2451  | 293   | 2354 | -403  | 2514 | 273   | 2954 | 600   | 3145   | -600  | 2870                        | -202      | 25.02%  |
|              | LDI    | 2456                                                                        | 222   | 2678     | 24    | 2908  | 319   | 2946  | 495   | 3245 | -891  | 3456 | 942   | 3652 | 698   | 3825   | 680   | 3909                        | -1039     | 37.43%  |
|              | ZXI    | 2002                                                                        | -454  | 2212     | -466  | 2345  | -563  | 2341  | -605  | 1956 | 1289  | 2554 | -902  | 2243 | -1409 | 2425   | -1400 | 2678                        | 1231      | 12.04%  |
| VITARA       | VDI    | 2098                                                                        | 96    | 2132     | -80   | 2432  | 87    | 2254  | -87   | 2021 | -65   | 2535 | -19   | 2841 | 598   | 2721   | -296  | 2543                        | 135       | 17.40%  |
|              | ZDI    | 1532                                                                        | -566  | 1832     | -300  | 1765  | -667  | 1845  | -409  | 1556 | 465   | 1841 | -694  | 1787 | -1054 | 2023   | 698   | 2131                        | 412       | -14.26% |
|              | MT     | 23                                                                          | 00    | 34       | 00    | 28    | 00    | 21    | 00    | 28   | 00    | 40   | 00    | 21   | 00    | 35     | 00    | 42                          | 00        | 00.00%  |
|              | AT     | 12                                                                          | -11   | 21       | -13   | 27    | -01   | 15    | -06   | 23   | -05   | 46   | -06   | 12   | -09   | 24     | -11   | 38                          | -04       | -47.82% |

## G. Identifying the cost of each module based on cost difference and judgmental/experience of professionals

In this last section, we are identifying the cost of each module from the all models and their cost. To evaluate the exact value of module two types of values will be used. One of them is judgmental value by some of experts and professionals and second one is by difference between costs of models of same companies. Some of small parts are gathered after that a final product is produced in manufacturing process. This practice will be done for all companies with similar way and than modules will be comparing in next process easily.

Table 6- (Maruti Suzuki Segment's-Value of Each Module)

| Name of Car<br>(A) | Options<br>(B) | Value of cost difference |         | Judgmental values |      | %age      | Arithmetic mean for exact value |
|--------------------|----------------|--------------------------|---------|-------------------|------|-----------|---------------------------------|
|                    |                | In                       | In %age | In                | In   | Variation |                                 |
| ALTO               | V1=(LXI – LX)  | 18665                    | 6.22    | 25000             | 8.32 | 0.25      | 7.27%                           |
|                    | V3=(VXI – LXI) | 16732                    | 5.28    | 18000             | 5.67 | 0.06      | 5.46%                           |
|                    | V5=(VXI – LXI) | 6308                     | 5.28    | 15000             | 4.72 | 0.11      | 5.00%                           |

|                 |                  |       |       |       |        |      |        |
|-----------------|------------------|-------|-------|-------|--------|------|--------|
|                 | V4=(K10 – VXI)   | 6308  | 1.95  | 10000 | 3.09   | 0.36 | 2.52%  |
|                 | F3=(CNG-K10)     | 25452 | 7.29  | 30000 | 8.60   | 0.15 | 7.94%  |
| <b>A - STAR</b> | V5=(VXI – LXI)   | 31239 | 7.54  | 10000 | 2.42   | 2.11 | 4.98%  |
|                 | V4=(ZXI – VXI)   | 26699 | 6.05  | 20000 | 4.54   | 0.33 | 5.29%  |
|                 | V2=(ZXI – VX AT) | 24898 | 5.35  | 15000 | 3.22   | 0.66 | 4.28%  |
|                 | T2=(ZXI -VX AT)  | 24898 | 5.35  | 20000 | 4.72   | 0.13 | 5.04%  |
| <b>WAGON R</b>  | V1=(LXI -LX)     | 29549 | 7.62  | 20000 | 5.15   | 0.47 | 6.38%  |
|                 | V3=(VXI -LXI)    | 30362 | 7.35  | 25000 | 6.05   | 0.21 | 6.70%  |
|                 | T2=(AT- VXI)     | 51836 | 11.14 | 50000 | 10.75  | 0.03 | 10.95% |
|                 | F2=(AT- VXI)     | 51836 | 11.14 | 60000 | 13 .48 | 0.17 | 12.31% |
|                 | V2=(AT- VXI)     | 51836 | 11.14 | 20000 | 4.49   | 1.48 | 7.81%  |
|                 | V4=(AT- VXI)     | 51836 | 11.14 | 40000 | 5.98   | 2.16 | 10.06% |
|                 | V5=(AT- VXI)     | 51836 | 11.14 | 15000 | 3.37   | 2.30 | 7.25%  |
|                 | F3=(DUO-AT)      | 23613 | 4.83  | 20000 | 4.09   | 1.80 | 8.92%  |
| <b>RITZ</b>     | V5=(LXI -VXI)    | 5609  | 1.30  | 50000 | 1.16   | 1.20 | 2.46%  |
|                 | V4=(VXI - ZXI)   | 37953 | 8.13  | 30000 | 6.43   | 0.26 | 7.28%  |
|                 | V2= (VXI - ZXI)  | 37953 | 8.13  | 20000 | 4.68   | 0.73 | 6.40%  |
|                 | E5=(ZXI- LDI)    | 48760 | 9.46  | 40000 | 7.76   | 0.21 | 8.61%  |
|                 | F2= (ZXI- LDI)   | 48760 | 9.46  | 50000 | 9.70   | 0.02 | 9.58%  |
| <b>SWIFT</b>    | V3= (LXI –VXI)   | 41127 | 8.27  | 20000 | 4.02   | 1.35 | 6.74%  |
|                 | V5= (LXI- VXI)   | 41127 | 8.27  | 25000 | 5.02   | 0.64 | 6.64%  |
|                 | V4=(VXI- ZXI)    | 35112 | 6.60  | 25000 | 4.70   | 0.40 | 5.65%  |
|                 | E5=(ZXI -LDI)    | 32597 | 5.78  | 30000 | 5.32   | 0.08 | 5.55%  |
|                 | F2=(ZXI -LDI)    | 32597 | 5.78  | 40000 | 7.08   | 0.18 | 6.43%  |
|                 | V2=(VDI -LDI)    | 45292 | 8.02  | 20000 | 3.52   | 1.26 | 5.78%  |
|                 | V4=(VDI -LDI)    | 45292 | 8.02  | 40000 | 7.08   | 0.13 | 7.55%  |
|                 | V5=(VDI- LDI)    | 45292 | 8.02  | 15000 | 2.65   | 2.02 | 5.33%  |
|                 | V5=(LXI -VXI)    | 42311 | 7.80  | 35000 | 6.45   | 0.20 | 7.12%  |

|                        |                  |        |       |       |      |      |       |
|------------------------|------------------|--------|-------|-------|------|------|-------|
| <b>SWIFT<br/>DZIRE</b> | E5=(VXI - LDI)   | 68495  | 11.20 | 50000 | 8.18 | 0.36 | 9.70% |
|                        | F2=(VXI - LDI)   | 68495  | 11.20 | 35000 | 5.72 | 0.95 | 8.46% |
|                        | V4=(VXI - LDI)   | 68495  | 11.20 | 30000 | 4.90 | 1.28 | 8.05% |
|                        | V2=(LDI- ZXI)    | 33060  | 5.13  | 30000 | 4.66 | 0.10 | 4.90% |
|                        | E4=(LDI- ZXI)    | 33060  | 5.13  | 40000 | 6.20 | 0.17 | 5.66% |
|                        | T2=(ZXI- AT)     | 45835  | 6.65  | 40000 | 5.80 | 0.14 | 6.22% |
|                        | F1=(ZXI- AT)     | 45835  | 6.65  | 30000 | 4.43 | 0.50 | 5.54% |
| <b>SX 4</b>            | V4=(VXI- ZXI)    | 49074  | 6.05  | 35000 | 4.32 | 0.40 | 5.18% |
|                        | V5=(VXI-ZXI)     | 49074  | 6.05  | 15000 | 1.84 | 2.28 | 3.94% |
|                        | E5=(ZXI-VDI)     | 46823  | 5.45  | 45000 | 5.25 | 0.03 | 5.35% |
|                        | F2=(ZXI-VDI)     | 46823  | 5.45  | 30000 | 3.57 | 0.52 | 4.51% |
|                        | V4=(VDI-ZDI)     | 35350  | 3.95  | 30000 | 3.35 | 0.17 | 3.65% |
|                        | T2=(ZXI AT- ZDI) | 49,214 | 5.22  | 40000 | 4.25 | 2.22 | 4.73% |
|                        | E7=(ZXI AT- ZDI) | 49214  | 5.22  | 50000 | 5.38 | 0.02 | 5.30% |
|                        | V2=(ZXI AT- ZDI) | 49214  | 5.22  | 20000 | 2.15 | 1.42 | 3.68% |
| <b>ERTIGA</b>          | V5=(LXI-VXI)     | 25589  | 3.48  | 20000 | 2.72 | 0.28 | 3.10% |
|                        | E5=(VXI- LDI)    | 22200  | 2.93  | 20000 | 2.65 | 0.10 | 2.79% |
|                        | F2=(VXI-LDI)     | 22200  | 2.93  | 35000 | 4.62 | 0.36 | 3.77% |
|                        | V2=(VXI-LDI)     | 22200  | 2.93  | 20000 | 2.64 | 0.10 | 2.78% |
|                        | V4=(LDI-ZXI)     | 30889  | 3.92  | 25000 | 3.18 | 2.23 | 3.55% |
|                        | E6=(LDI-ZXI)     | 30889  | 3.92  | 50000 | 6.35 | 0.38 | 5.13% |
|                        | F1=(LDI-ZXI)     | 30889  | 3.92  | 25000 | 3.17 | 0.23 | 3.54% |
|                        | F2=(ZXI- VDI)    | 38913  | 4.70  | 30000 | 3.62 | 0.29 | 4.16% |
|                        | E5=(ZXI- VDI)    | 38913  | 4.70  | 45000 | 5.13 | 0.08 | 4.91% |
|                        | V2=(VDI-ZDI)     | 30087  | 3.52  | 25000 | 2.92 | 0.20 | 3.22% |
| <b>VITARA</b>          | T2=(AT-MT)       | 42219  | 4.85  | 40000 | 3.72 | 0.30 | 4.28% |
|                        | F2=(AT-MT)       | 42219  | 4.85  | 50000 | 4.64 | 0.04 | 4.74% |

There are three different kind of values are identified through this table, which makes an appropriate result for module option in car. After the last step of methodology to identifying cost of each module with the help of judgmental values and experiences valuation for finding the effect of modular product design on manufacturing process with proper evaluation, some of other results are generated for further exercises and studies. The information about a particular module of any car company for any model can be understood also. The last column is important because the ratio between cost figure in percentage and sales figure in percentage is calculated.

TABLE 7- (Maruti Suzuki Segment's-Overall valuation of modules).

| Name of Car (A) | Module (B) | %age of Utilization (C) | %age Increase in Cost (D) | %age Increase in Sales (E) | Ratio of %age Increase in Sales & Cost |
|-----------------|------------|-------------------------|---------------------------|----------------------------|----------------------------------------|
| <b>ALTO</b>     | V1         | 7.27%                   | 6.21%                     | 26.52%                     | 4.27%                                  |
|                 | V3         | 5.46%                   | 12.56%                    | 35.21%                     | 6.44%                                  |
|                 | V5         | 5.00%                   | 12.56%                    | 35.21%                     | 6.44%                                  |
|                 | V4         | 2.52%                   | 14.80%                    | -51.29%                    | -3.46%                                 |
|                 | F3         | 7.94%                   | 23.83%                    | -56.06%                    | -.2.36%                                |
| <b>A-STAR</b>   | V5         | 4.98%                   | 8.16%                     | 85.64%                     | 10.50%                                 |
|                 | V4         | 5.29%                   | 15.12%                    | 11.86%                     | 0.78%                                  |
|                 | V2         | 4.28%                   | 21.64%                    | -74.58%                    | -3.45%                                 |
|                 | T2         | 5.04%                   | 21.64%                    | -74.58%                    | -3.45%                                 |
| <b>WAGON-R</b>  | V1         | 6.38%                   | 8.25%                     | 21.98%                     | 2.66%                                  |
|                 | V3         | 6.70%                   | 15.34%                    | 10.88%                     | 0.70%                                  |
|                 | T2         | 10.95%                  | 24.22%                    | -71.04%                    | -2.94%                                 |
|                 | F2         | 12.31%                  | 24.22%                    | -71.04%                    | -2.94%                                 |
|                 | V2         | 7.81%                   | 24.22%                    | -71.04%                    | -2.94%                                 |
|                 | V4         | 10.06%                  | 24.22%                    | -71.04%                    | -2.94%                                 |
|                 | V5         | 7.25%                   | 24.22%                    | -71.04%                    | -2.94%                                 |
|                 | F3         | 8.92%                   | 25.23%                    | -13.62%                    | -0.54%                                 |
| <b>RITZ</b>     | V5         | 2.46%                   | 0.62%                     | 5.58%                      | 9.00%                                  |
|                 | V4         | 7.28%                   | 0.85%                     | -5.91%                     | -6.95%                                 |
|                 | V2         | 6.40%                   | 0.85%                     | -5.91%                     | -6.95%                                 |
|                 | E5         | 8.61%                   | 21.82%                    | 65.86%                     | 3.02%                                  |

|                 |    |       |        |         |        |
|-----------------|----|-------|--------|---------|--------|
|                 | F2 | 9.58% | 21.82% | 65.86%  | 3.02%  |
| SWIFT           | V3 | 6.74% | 09.01% | 5.13%   | 0.56%  |
|                 | V5 | 6.64% | 09.01% | 5.13%   | 0.56%  |
|                 | V4 | 5.65% | 27.68% | -31.53% | -1.14% |
|                 | E5 | 5.55% | 23.86% | 28.66%  | 1.20%  |
|                 | F2 | 6.43% | 23.86% | 28.66%  | 1.20%  |
|                 | V2 | 5.78% | 33.79% | 25.35%  | 0.70%  |
|                 | V4 | 7.55% | 33.79% | 25.35%  | 0.70%  |
|                 | V5 | 5.33% | 33.79% | 25.35%  | 0.70%  |
| SWIFT<br>DEZIRE | V5 | 7.12% | 10.44% | 6.58%   | 0.64%  |
|                 | E5 | 9.70% | 22.13% | 10.67%  | 0.48%  |
|                 | F2 | 8.46% | 22.13% | 10.67%  | 0.48%  |
|                 | V4 | 8.05% | 22.13% | 10.67%  | 0.48%  |
|                 | V2 | 4.90% | 28.73% | -21.44% | -0.75% |
|                 | E4 | 5.66% | 28.73% | -21.44% | -0.75% |
|                 | T2 | 6.22% | 35.29% | -22.75% | -0.65% |
|                 | F1 | 5.54% | 35.29% | -22.75% | -0.65% |
| SX 4            | V4 | 5.18% | 10.79% | -18.10% | -1.68% |
|                 | V5 | 3.94% | 10.79% | -18.10% | -1.68% |
|                 | E5 | 5.35% | 14.46% | 34.48%  | 2.38%  |
|                 | F2 | 4.51% | 14.46% | 34.48%  | 2.38%  |
|                 | V4 | 3.65% | 26.80% | 30.60%  | 1.15%  |
|                 | T2 | 4.73% | 26.01% | 52.58%  | 2.02%  |
|                 | E7 | 5.30% | 26.01% | 52.58%  | 2.02%  |
|                 | V2 | 3.68% | 26.01% | 52.58%  | 2.02%  |
|                 | V5 | 3.10% | 03.60% | 25.02%  | 6.95%  |
|                 | E5 | 2.79% | 06.74% | 37.43%  | 5.55%  |
|                 | F2 | 3.77% | 06.74% | 37.43%  | 5.55%  |



|               |    |       |        |         |        |
|---------------|----|-------|--------|---------|--------|
| <b>ERTIGA</b> | V2 | 2.78% | 06.74% | 37.43%  | 5.55%  |
|               | V4 | 3.55% | 11.09% | 12.04%  | 1.08%  |
|               | E6 | 5.13% | 11.09% | 12.04%  | 1.08%  |
|               | F1 | 3.54% | 11.09% | 12.04%  | 1.08%  |
|               | F2 | 4.16% | 23.63% | 17.40%  | 0.74%  |
|               | E5 | 4.91% | 23.63% | 17.40%  | 0.74%  |
|               | V2 | 3.22% | 20.08% | -14.26% | -0.72% |
| <b>VITARA</b> | T2 | 4.28% | 00.00% | 00.00%  | 00.00% |
|               | F2 | 4.74% | 04.80% | -47.82% | -9.96% |

**Table 8 - Final Selected Modules Car Companies**

| MODULES                  | No. of Module | No. of Module |
|--------------------------|---------------|---------------|
|                          | 08            | 07            |
| POWER STEERING (V1)      | √             | √             |
| MANUAL TRANSMISSION (T1) | √             | √             |
| POWER WINDOW(V3)         | √             | √             |
| TORSION SUSPENSION(S4)   | √             | √             |
| PETROL FUEL TYPE(F1)     | √             | √             |
| CFENTRAL LOCK(V5)        | √             | √             |
| HATCHBACK BODY (B1)      | √             | ×             |
| ANTI BRAKING SYSTEM(V4)  | √             | √             |
| COIL SUSPENSION(S2)      | ×             | ×             |
| DIESEL TYPE(F2)          | ×             | ×             |
| ANTI ROLL SUSPENSION(S5) | ×             | ×             |
| AIR BAGS (V2)            | ×             | ×             |

**Table 8 - Final Selected Modules Car Companies**

As we noticed in previous tables, some of the modules are common in different types of models. The all kind of modules like, body type, engine types, transmission types, suspension and others are available in all models. The compilation of all

demanding modules according previous tables in important to recognize the final desirable modules of customers. This exercise will be affected for all car companies with all models. The overall results of previous five tables will be listed similarly in a table. The non-demanding or non using modules are denoted by NA. The discussed table represents the demanding modules after draw a pareto chart for all five companies. The all modules of every car company with are discussed in pareto chart. This pareto chart developed with combination all frequencies and values of modules in percentages. This table provides final result after all methodological exercises and this is based on demanding ratio of modules. The selected modules of all companies are based in variation of draw line pareto chart, which shows the decreasing values from a specific point. The module before those points are considered is this table of all companies and remaining is dropped. The modules are short listed due to finalize the demanding modules by customers in market.

### **Finding and Result**

These points can be considered as results for customers of market to sort out their problems and confusions easily. Some of other results and conclusions are also discovered after exercises of methodology. Then finally to fulfill the purpose of expression and discussion for the remaining other results of all exercise in methodology can be listed through following points.

(1) Due to the exercises in methodology of dissertation, a benefit generate automatically that the automobile modules (car) and their specifications at the time of assembling as well as modeling and in other process can be defined as a mathematical equation easily. (2) The selection at the time of production and assembling of different automobile products can be very easy and comfortable for automobile companies after expression of modules and options as mathematical equations. The expression of automobile modules in mathematical coding defined exact option.(3) Another result or finding of this methodology in respect of automobile modules is that the all types of modules can be calculated in form of percentage ratio due to their utilization by customer in market, which provides some appropriate results for changes in strategies and process for modularity and production by automobile companies(4)With the help of graphical representation, the graphical values of modules in figures of different modules for all discussed automobile companies provides us some details of their choice ratio and demands between customers so effectively. The choice and demand ratio for a particular module can be identified quickly between all modules(5)The modules of automobile of different car companies are having different values of costs.Thatsby these modules are increasing the overall cost of a car in market. The differences between costs of modules are calculated easily and effectively with the help of a step of methodology. (6) Another finding of the methodology is related to justification of module values with a special and new process of arithmetic mean of mathematical language, which provides us the almost similar values of a car modules for any car company if verifies from market (7) One of the results discovers that costs are increase not only due to increasing in number of modules but behavior and type of modules are also important parameters(8) These analysis generate a special result and hypothesis which says that the choice of customers in market about options for various modules of automobile are also change with changes in car company. The variations in choice by customers are also possible with reputation and reliability of automobile company in this industry due to effectiveness of modules (9) The accurate value of a module in any model of car can be calculated easily by comparing study from base model.

## Discussions and Futuristic Logics

In the whole study to understand the effect and evaluation of modular product design on manufacturing processes some of the new logics and ideas are generated after many exercises. These all ideas and results can be useful for Indian automobile industry with market as well as customers. This part of dissertation is also provides enough good solution for consumer of products/modules respectively. This chapter of dissertation is involved some of the discussion after whole exercise on automobile module with some useful logics in respect of some additional points.

Some new ideas and results of this case study provide information about automobile modules and options differently in details. This case study totally based on data's of vehicles of all automobile companies. The several steps of methodology involved the different methods and ideas for finding the required solutions of discussed problems. The methodology proves the efforts about modularity concept with some useful solutions and outputs. They all cannot be useful for future logics but important to discuss for more up gradation of products/modules with various options for related field.

(I) Modular products are selected by customers according reviews of market (II) The demand and choice is vary according cost/value of product in market by customer (III) The sale factors and figures are directly related to modularization of products(IV) The common popular modules/products are provide by all automobile companies (V) The values of some modules neither low nor high according automobile company (VI) Utilization of modules also depends on model of car in market (VII) A car and its combinations can be discuss as a mathematical equations (VIII) Conventional modules are still popular for all automobile companies in vehicles(IX) Vehicles costs/values can be customize by modularization/manipulation in module(X) Valuation of a specific module from combination of modules.

## Conclusions

In the discussion part after complete exercise on related topic of dissertation, the final results and some conclusion are consider. The overall summary of this dissertation can be including in this chapter. The contents of this chapter are based on whole methodology for finding the results and solutions of discussed problems also. The objectives of this research generate some new ideas and solutions for automobile industry. These all points can be helpful for customer and customization for vehicles for automobile companies. First of all, the analysis of research says that demands of the modules are change according the need of customer. The several types of modules are available in market. Those all modules are selected by customer only. The conversion in their selection is focused by different companies. One of the conclusions after whole exercise says that the modularization in modules/products can change the choice of customer very easily. This conversion can be possible when another is providing additional features in nominal costs. So optimization for product customization in market for customers is very essential. Another conclusion is related to sort out the confusion in selection of any module, if it is a modular product also. The customer seems confused in choice of module and demand in features. The differences in demand and choice factor can be solved by previous record of sales and result of module as performance. The performance results are depends on high choice module in market. It proves that this particular module is demanded and satisfactory in performance. in products for manufacturing in market.

## References

1. Baldwin, Carliss Y. and Kim B. Clark (2000). *Design Rules: The Power of Modularity* Cambridge, MA: MIT Press.
2. Clark, Kim B. and Takahiro Fujimoto (1991). *Product Development Performance*
3. Harvard Business School Press. Cusumano, Michael A. and Akira Takeishi (1991). "Supplier Relations and Management: A Survey of Japanese, Japanese-Transplant
4. Advantage. Reading, MA: Peruseus Books. Fujimoto, Takahiro (1999). *The Evolution of a Manufacturing System at Toyota*. New York: Oxford University Press. Fujimoto, Takahiro (2001). "Akitekucha no Sangyoron
5. *Bijinesu Akitekucha: Seihin, Soshiki, Purosesu no Senryakuteki Sekkei* [Business Architecture: Strategic Design of Products, Organizations, and Processes] Tokyo: Yuhikaku. Fujimoto, Takahiro and Ge Dong Sheng (2001).
6. *Components and Choices of Transaction Systems*." In Takahiro Fujimoto, Akira Takeishi and Yaichi Aoshima (eds.), *Bijinesu Akitekucha*:
7. *Strategic Design of Products, Organizations, and Processes* Tokyo: Yuhikaku. Fujimoto, Takahiro, Takashi Matsuo, and Akira
8. *Torihiki Patan no Hatten to Henyo: Wagakuni Ichiji Buhin Meka heno Anketo*
9. *Chosa Kekka wo Chushin ni* [Development and Transformation of Car Component
10. *Transaction Patterns: Results from a Questionnaire Survey*
11. Tokyo. Fujimoto, Takahiro and Akira Takeishi (1994). *Jidosha Sangyo 21-seiki heno Shinario*
12. [The Automobile Industry: A Scenario towards the 21st Century]