CHAPTER – V

CASE STUDY OF NANO CAR

5.1 INTRODUCTION

5.1.1 Automobile industry was only manufacturing commercial vehicles and cars under license from foreign companies for 4-5 decades. Progress has been made during the last 2-3 decades to design and develop vehicles in India. In the current fiercely competitive market, down slide and uncertainties, all automobile companies are trying to reduce manufacturing costs, using innovative processes, latest technologies and materials, but few companies are taking the help of VE consultants/experts. Tata Motors Ltd. is one of the few companies, which have their own R&D centres. TML has established an engineering research centre at Pune (with a strength of around 3500 personnel).

5.1.2 Case study of Nano Car has assumed importance for following reasons:-

(a) Nano was conceived, designed and developed as a people’s car for the first time car buyer’s (at the lowest price of Rs. One lakh only) as a substitute for users of two wheeled vehicles. It is a dream project of Mr. Rattan Tata, Head Tata Group and work on this project was started in 2003. It is the first project of its kind in India. Nano was first exhibited during auto EXPO in March 2008 and this stylish car received highly favourable coverage and appreciation from both domestic and European journalists. Nano has registered 37 patents and has received a number of global awards.

5.1.3 Nano was designed by the Italian auto designer company and the product development project team roped-in a global component suppliers group GKN and other vendors for the supply of steering assembly & other components. A German company had developed the engine control unit (ECU). Sanand plant has the designed capacity to produce 900 cars in 3 shifts per day. Currently, 250-300 cars are being produced to meet the present demand. Tata Nano is more spacious i.e. it has 21% more space as compared to Maruti-800 cc. Nano is a beautifully designed low-cost,
fuel efficient car giving 25.3 kml. It is powered by a 624 cc fuel-efficient petrol engine. and conforms to Euro IV emission norms.

5.1.4 Indian customer psyche is a complex phenomenon to understand. Continuous efforts to gauge the customer needs, preferences, market research and the prevailing economic environment are important factors for consideration to succeed in this fiercely competitive market. The basic model of Nano does not have enough attractive features as perceived by the customers. They want to buy a costly/big car to show off to the public regarding their higher income level status in the society. The lower middle income group population numbers are the maximum and their purchasing power is rising every year. The demand for entry level car is increasing continuously in India.

5.1.5 Customers today want better value added products and services such as those available in the developed countries. Therefore companies must employ the latest techniques and technologies, to remain continuously engaged in monitoring the environment to foresee the changes taking place in customer preferences to develop the necessary techniques for retaining their leadership position in the industry and be ahead of the market. There is lot of scope for growth as long as a firm continues to introduce new technologies, value added products and ensures optimal utilization of resources and minimization of waste material for cost reduction by employing value engineering methodologies.

5.1.6 Nano received great praise during the Automobile Expo-2008 at Pragati Maidan, New Delhi. Nano won the Indian Car of the Year 2010 award at Business Standard Motoring Awards 2010. Nano won the car of the year of Bloomberg UTV-Autocar awards. Nano won the first place in 2010 Edison Awards under transportation category. The company is planning to win the TPM Excellence Award by 2014. The company is planning to win the British 5 Star Rating by 2014 and is also planning to win the Deming Award by 2016. TML has registered 37 patents during PDP of Nano car.
5.2 SURVEY QUESTIONNAIRE

5.2.1 A survey questionnaire was sent to 300 customers to collect data regarding their views, needs and preferences. The Survey was restricted to early supplies of Nano basic model introduced in 2009. The questionnaire was designed for two categories of respondents, namely:

- Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle and customers, who had already experience of owning a four wheeled vehicle and purchased Nano.
- Persons who were associated with Nano Sales & Marketing/Service/Repair & Maintenance or other activities. Survey questionnaire is given below:

5.2.2 Survey Questionnaire (Nano Basic Model)

Respondent Identification

(i) Name of Respondent

(ii) Designation and contact address

(iii) Mobile & Landline No. and E-mail

(iv) Have you shifted from a two wheeled vehicle to a four wheeled vehicle?

Yes / No

(v) Have you shifted from four wheeled vehicle to Nano?

Yes / No

(vi) Are you associated with Nano Sales & Marketing/Service/Repair & Maintenance/Others (Tick as applicable) and since when?

Dealer  Sales  Service Workshop  Repair workshop  Others

☐  ☐  ☐  ☐  ☐  ☐  ☐
(vii) Which car model would you like to purchase (Tick as applicable)?

<table>
<thead>
<tr>
<th>Petrol</th>
<th>Diesel</th>
<th>CNG</th>
<th>Electric</th>
<th>Hybrid</th>
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1. Do you find Nano comfortable to sit and drive?

<table>
<thead>
<tr>
<th>Very Good(5)</th>
<th>Good(4)</th>
<th>Neutral(3)</th>
<th>Bad(2)</th>
<th>Very Bad(1)</th>
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2. Do you find it comfortable (leg space) for passengers sitting on back seats satisfactory?

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3. Do you find its luggage space satisfactory?

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4. Do you find gear shifting smooth?

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5. Do you find its seats ergonomically designed and comfortable?

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6. Do you find its aesthetics and appearance satisfactory?

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7. Do you find its after sales service and warranty clause satisfactory?

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8. Do you find its Interior decor satisfactory?

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</tbody>
</table>
9. Do you find its Air-conditioner performance satisfactory?
   
   
10. Do you find its overall performance satisfactory?
   
   
11. Do you find its engine noise level satisfactory?
   
   
12. Do you find its KPL satisfactory?
   
   
13. Do you find its turning radius satisfactory?
   
   
14. Do you find its braking system performance satisfactory?
   
   
15. Do you find its steering system satisfactory?
   
   
16. Do you find the rear wheel drive performance satisfactory?
   
   
17. Do you find its performance on hilly roads satisfactory?
   
   
18. Do you find its design satisfactory for the Indian road conditions?
   
   
19. Do you find its fuel tank capacity and filter cap design satisfactory?
20. Do you find the performance of electrical system satisfactory?

21. Do you find the accessibility of assemblies, sub assemblies and components for routine maintenance and repairs satisfactory?

22. Do you find its safety features satisfactory?

23. Do you find the quality and reliability of assemblies, sub-assemblies and components fitted on the car satisfactory?

24. Do you find its maintenance cost satisfactory?

25. Do you find its performance/driving on wet roads during monsoon season satisfactory?

26. Do you find its horn performance satisfactory?

27. Do you find its performance of front and rear suspension system satisfactory?

28. Do you find its rear axle assembly performance satisfactory?

29. Do you find the performance of car bumper service satisfactory?
30. Do you find the meantime between failures satisfactory?

☐   ☐   ☐   ☐   ☐   ☐   ☐

31. Do you find meantime to repair satisfactory?

☐   ☐   ☐   ☐   ☐   ☐   ☐

32. Do you find the reliability of the vehicle satisfactory?

☐   ☐   ☐   ☐   ☐   ☐   ☐

DATE:

SIGNATURE

FULL NAME & ADDRESS
Respondents views and findings of survey have been plotted in bar charts and pie diagrams as follows:-

Very good 48
Good 18
Fair 16
Bad 0

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle and those who had previously owned a four wheeled vehicle.

Very bad 4

Question No.1
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.2
Very good 20
Good 14
Fair 14
Bad 22

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.3
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.5
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.6
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.7
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.8
Very good 56
Good 12
Fair 12
Bad 0

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Very bad 2

Question No.9
<table>
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<tr>
<td>Very bad</td>
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</table>

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.10

![Bar chart showing distribution of responses](image1)

![Pie chart showing distribution of responses](image2)
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.11
Very good 36
Good 28
Fair 16
Bad 2

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Very bad 4

Question No.12
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.13
Very good 42
Good 36
Fair 8
Bad 0
Very bad 0

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.14
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Very good: 36
Good: 34
Fair: 10
Bad: 4

Question No.15
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.16

Very good 34
Good 34
Fair 6
Bad 6

Very bad 6
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.17
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.18

<table>
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Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.19

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<tr>
<td>Very bad</td>
<td>6</td>
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</table>
Very good 30
Good 34
Fair 14
Bad 2
Very bad 6

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.20
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.21

![Bar Graph](image)

![Pie Chart](image)
<table>
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<td>Very good</td>
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<tr>
<td>Good</td>
<td>28</td>
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<tr>
<td>Fair</td>
<td>18</td>
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<tr>
<td>Bad</td>
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<tr>
<td>Very bad</td>
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</table>

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.22
Very good 28
Good 34
Fair 10
Bad 4
Very bad 10

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.23
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.24

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<td>Fair</td>
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Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.25

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<td>10</td>
</tr>
<tr>
<td>Very bad</td>
<td>8</td>
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</table>
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.26
Very good: 22
Good: 32
Fair: 22
Bad: 4

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No. 27

Very bad: 6

![Bar chart showing the distribution of responses to the question. The categories are Very good, Good, Fair, Bad, and Very bad.]

![Pie chart showing the distribution of responses to the question. The categories are Very good, Good, Fair, Bad, and Very bad.]

158
Very good 36
Good 32
Fair 10
Bad 6

Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Very bad 2

Question No.28

![Bar Chart]

![Pie Chart]
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.29

<table>
<thead>
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<td>Fair</td>
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<tr>
<td>Very bad</td>
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</table>
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.30
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No.31
Category - Customers who have shifted from a two wheeled vehicle to a four wheeled vehicle, as well as who had previously a four wheeled vehicle.

Question No. 32
Very good 50
Good 20
Fair 6
Bad 0
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.1

![Bar Chart]

![Pie Chart]
Very good: 58
Good: 14
Fair: 4
Bad: 0
Very bad: 0

Category: Sales & Marketing/Repair & Maintenance/Others

Question No.2
Question No.3

<table>
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<tr>
<td>Very bad</td>
<td>4</td>
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Category - Sales & Marketing/ Repair & Maintenance/Others
Very good: 26
Good: 38
Fair: 8
Bad: 4
Very bad: 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No. 4
Very good: 42
Good: 28
Fair: 4
Bad: 2
Very bad: 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.5
Very good 38
Good 24
Fair 10
Bad 4
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.6
Very good 58
Good 14
Fair 2
Bad 2
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.7
Very good 36
Good 30
Fair 10
Bad 0
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.8

![Bar Chart]

![Pie Chart]
<table>
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Very good: 18
Good: 48
Fair: 10
Bad: 0
Very bad: 0

Category: Sales & Marketing/Repair & Maintenance/Others
Question No.10
Very good 14
Good 46
Fair 10
Bad 6
Very bad 0

Category - Sales & Marketing/ Repair & Maintenance/ Others

Question No.11
Very good 28
Good 32
Fair 12
Bad 4
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.12
Very good: 52
Good: 18
Fair: 2
Bad: 4
Very bad: 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.13
Very good 12
Good 36
Fair 16
Bad 12
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.14
Very good 30
Good 34
Fair 10
Bad 0
Very bad 2

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.15
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Question No.16

![Bar chart](image1)

![Pie chart](image2)
**Very good** 20
**Good** 36
**Fair** 8
**Bad** 12
**Very bad** 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.17
Very good 14
Good 36
Fair 20
Bad 6
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.18

![Bar Chart](image)

![Pie Chart](image)
Very good 32
Good 36
Fair 8
Bad 0
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.19
Very good 12  
Good 44  
Fair 18  
Bad 2  
Very bad 0  

Category: Sales & Marketing/ Repair & Maintenance/ Others

Question No.20
Category - Sales & Marketing/Repair & Maintenance/Others

Question No.21

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Good: 40
Fair: 10
Bad: 0
Very bad: 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.22
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Question No. 23

![Bar Chart]

![Pie Chart]
Very good 32
Good 26
Fair 10
Bad 6
Very bad 2

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.24
Very good 24
Good 44
Fair 4
Bad 4
Very bad 0

Category - Sales & Marketing/ Repair & Maintenance/ Others

Question No.25

![Bar Chart](image1.png)

![Pie Chart](image2.png)
Very good 16
Good 44
Fair 14
Bad 2
Very bad 0

Question No.26

Category - Sales & Marketing/Repair & Maintenance/Others
Very good 36
Good 30
Fair 4
Bad 6
Very bad 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.28
Very good: 32
Good: 30
Fair: 12
Bad: 2
Very bad: 0

Category - Sales & Marketing/Repair & Maintenance/Others

Question No.29
Question No.30

Category - Sales & Marketing/Repair & Maintenance/Others

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Category - Sales & Marketing/Repair & Maintenance/Others
Question No.31
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- Series 1
  - 1
  - 2
  - 3
  - 4
  - 5

![Bar Chart](chart1.png)

![Pie Chart](chart2.png)
5.3.1 Majority of Nano Car users are satisfied with the performance of Nano systems and assemblies. They appreciate high fuel efficiency of Nano giving around 23.6 KPL on highways. At speeds of more than 60 -70 kph the car starts vibrating. Starter motor and other defective components have been replaced in all earlier supply cars. While the air conditioner is operating, the vehicle engine is overloaded. Engine vibrations should be reduced for driving at cruising speeds. Following suggestions/complaints were received from the respondents:-

- Nano warranty clause of 4 years / 60,000 KMs and after sales service delivery is highly satisfying for the customers. Repairs and parts replacements are carried out promptly free of charge. In case, a vehicle breaks down on the road, a customer can ring up the local dealer and repairs are carried out promptly in situ/ at authorised dealers workshops.

- Maintainability parameters of Nano are weak. Accessibility of assemblies and parts is difficult for maintenance and repair.

- Accelerator cable gets broken between 500 to700 Kms. in some of the vehicles. Cable should be strengthened and mechanics should be trained to keep it a bit loose.

- Luggage space should be increased.

- Louder horn should be provided.

- Lunch box/ glove box and glass holder space should be provided.

- Both the front doors should be provided with opening locks.

- Length of rear seat belts should be increased.

- All four wheel tyres should be of same size. This will facilitate tyre rotation or replacement of defective tyre by the spare wheel. Most Nano users complained that they are replacing worn out tyres after around 10 to 12 thousand Kms., which increases the maintenance cost.

- Car battery is getting discharged soon. It needs replacement before 2 years.

- Passengers sitting on back seat are experiencing more engine noise, heat and vibrations.
- Bumper thickness and lugs should be improved. Bumpers are damaged and need replacement after slight hitting.
- Aesthetics and body shape should be redesigned.
- Engine noise level on the outside of car is slightly high, but the passengers do not feel much noise inside. Silencer design should be improved to reduce noise.
- Silencer bolts often get broken. Broken bolts have to be removed from the gear box side and replaced.
- Brake shoes require sand papering after 5000 to 6000 km’s. Disc brakes should be introduced in future vehicles.
- Steering assembly-ends connecting the wheels are often bent on bad/broken roads. Wheel alignment is altered resulting in increase of tyre wear.
- Clutch operating cable becomes hard after about 2500 Kms. Clutch wire should be oiled during car service. Clutch plate assembly often needs to be replaced.
- Gear shifting often becomes hard. Gear operating cable should be oiled during service.
- Engine manifold gets cracked from inside. It needs replacement.
- Ground clearance (81 mm) is quite low and should be increased for ease of repair.
- Suspension arm must be strengthened.
- 125 AH battery should be replaced with 135 AH capacity.

TML has already carried out a number of modifications/improvements and has provided replacements for defective parts/components in later models introduced in 2011, 2012 & 2013.
5.4 **COST CUTTING FEATURES**

5.4.1 VE experts were associated with the Nano design and development project right from conceptual stage to the stage of production. The results have been summarised in detail in Appendix-I

- The Nano’s hatch is fixed. The rear seats can be folded down to access the trunk space.
- Only one windscreen wiper is provided.
- Simplified door opening lever is provided.
- Three nuts only are used to fix the wheels instead of four.
- Only one side view mirror is provided.

### COST – TO – FUNCTION ANALYSIS

<table>
<thead>
<tr>
<th>Function</th>
<th>% of Prod. Cost</th>
<th>Cum. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Provide Power (Engine)</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Transmit Power (Transmission)</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>Smooth Ride (Suspension)</td>
<td>5%</td>
<td>35%</td>
</tr>
<tr>
<td>Turning Radius (Steering)</td>
<td>8%</td>
<td>43%</td>
</tr>
<tr>
<td>Transfer Power to Road Wheels (Axles)</td>
<td>17%</td>
<td>60%</td>
</tr>
<tr>
<td>Provide Information for Driving servicing (Instrument Panel)</td>
<td>8%</td>
<td>68%</td>
</tr>
<tr>
<td>To Restrain motion on Road (Brakes)</td>
<td>4%</td>
<td>72%</td>
</tr>
<tr>
<td>Provide Electrical Power for lighting, starting the car etc. (Starter motor, alternator, battery, lights)</td>
<td>6%</td>
<td>78%</td>
</tr>
<tr>
<td>Support engine &amp; passenger load etc. (floor, cradle)</td>
<td>9%</td>
<td>87%</td>
</tr>
<tr>
<td>Control Air-flow (Body shape and structure)</td>
<td>8%</td>
<td>95%</td>
</tr>
<tr>
<td>Profit Margin</td>
<td>5%</td>
<td>100%</td>
</tr>
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Table 5.3 Cost – To – Function Analysis of Nano Car
5.5  **COST OPTIMIZATION**

5.5.1 Mr. N. Rattan Tata had set a challenging task for TML research and design team to produce a people’s car at Rs. 1lakh. Optimization efforts were attuned with the company’s objectives of target-costing. TML design team involved VE experts right from the conceptual stage of Nano project. Throughout the design and planning stage the team worked hard to reduce the cost of materials, labour and processes to achieve the company objective.

5.5.2 All efforts of the design team were directed towards reducing the cost of production of Nano car. Around 80% of the cost of the car was outsourced from the vendors. A large number of vendor companies were allotted land near the TML plant. The vendors were expected to establish their factories in the neighborhood of TML plant at SANAND. Five vendors including CAPARO, JBM, TI METAL, RUCHA and SHARADA have already established their factories near TML. 12 vendors are currently supplying 75 parts to TML. Seven vendors including SHARADA at Noida; RUCHA at Aurangabad; RASANDIK at Noida; STAR AUTO at Mumbai; TECHNICO at Gurgoan; UMW at Pune; and SMR at Pune are supplying parts from their respective distant locations. Parts being supplied by the neighborhood vendors are fitted on the car under assembly in progress within 53 minutes of their production at the vendor’s factory.

5.5.3 Concerted efforts were made by the VE experts and design team to keep the production cost low. Optimum use of materials, labour and processing operations was achieved. Cost savings were realized by appropriate design and use of alternative materials and size of metal sheet or rerouting of pipes and commonisation of parts. Tangible savings were also realized through lean manufacturing in automatic plants, reduction in Takt time and outsourcing of parts, location of ancillary parts factories in the neighborhood of TML, frugal logistic operations and efficient supply chain management. Inventory was reduced at TML and the truck turnaround time of parts from vendors was also reduced.

- Cradle was used in place of chassis. It resulted in 30% weight reduction vis-à-vis a chassis. Cost saving is equal to Rs.1495.
Fuel tank has a lower capacity of 15 liters only. Refueling cap of the tank is located in the nose of NANO car. Therefore, the cost of making a hole in the body is eliminated. Cost saving is equal to Rs.100

Nano is having a single arm wiper system on its front glass only. Cost saving of a wiper and a wiper motor is equal to Rs.500.

Suspension system has Mc pherson strut in front and semi- trailing arm with coil springs on rear wheels. Suspension is attached to cradle and no leaf springs are used. Cost of leaf springs saving is equal to Rs. 300

Engine is made of aluminum and is fitted on the rear side of the car. A balancer shaft is used in engine. In comparison with Maruti 800cc engine cost saving of Rs.8000 has been realized.

Cost of tubeless tyre is less than the normal tyre and it is manufactured by Tata Motors Ltd. Three bolt wheel mounting is used. Cost saving is equal to Rs.600

Steering and instrument panel display is located in the center. Nano has an Ackerman steering mechanism with manual rack and pinion system. Cost saving realized is equal to Rs.100.

Cost of drum brakes, in comparison with disc brakes is less. Cost saving is equal to Rs.500.

Integral and unitized body frame is made of sheet steel of thickness varying from 0.7mm to 3.0mm. Adhesives are used rather than rivets and welding. Cost saving realized is equal to Rs.200.

Tyco terminals are being used for dummy plug in ECU connector instead of Bosch. Cost saving is equal to Rs.120 i.e. approximately 0.12% of Nano cost.

AMW wheel rim is used. Cost saving is equal to Rs.100 i.e. approximately 0.10% of Nano cost.

Through fog lens localization, cost saving is equal to Rs.40 i.e. approximately 0.04% of Nano cost.
· Through pressure switches connector localization, cost saving is equal to Rs.10 i.e. approximately 0.01% of Nano cost.

· Crank angle sensor wheel forming in sheet metal of reduced thickness, results in cost saving equal to Rs.10 i.e. approximately 0.01% of Nano cost.

· Use of single brake line with deletion of two way brush adaptor in line with ACE, results in cost saving equal to Rs.20 i.e. approximately 0.02% of Nano cost.

· Use of RP and bellow mounting with wire clamp instead of metal clamp results in cost saving equal to Rs.1 i.e. approximately 0.001% of Nano cost.

· Use of hollow cam shaft results in cost saving equal to Rs.50 i.e. approximately 0.05% of Nano cost.

· Use of wire hose clamp instead of spring band clamp results in cost saving equal to Rs.40 i.e. approximately 0.04% of Nano cost.

· Use of sheet metal universal joint for steering column results in cost saving equal to Rs.2 i.e. approximately 0.002% of Nano cost.

· Engine housing insulation, results in cost saving equal to Rs.200 i.e. approximately 0.20% of Nano cost.

· Deletion of joints from under body results in cost saving equal to Rs.140 i.e. approximately 0.14% of Nano cost.

· Spoiler wedge deletion from base model, results in cost saving equal to Rs. 50 i.e. approximately 0.05% of Nano cost.

· Body side outer scrap utilization results in cost saving equal to Rs.20 i.e. approximately 0.02% of Nano cost.

· Panel hood inner blank size reduction, results in cost saving equal to Rs.10 i.e. approximately 0.01% of Nano cost.

· Panel front door inner scarp utilization, results in cost saving equal to Rs.10 i.e. approximately 0.01% of Nano cost.
Metal sheet size reduction, results in cost saving equal to Rs.90 i.e. approximately 0.9% of Nano cost.

Rerouting of under body pipe layout, results in cost saving equal to Rs.80 i.e. approximately 0.08% of Nano cost.

Diameter of fuel filler pipe reduction from 35mm to 30mm., results in cost saving equal to Rs.50 i.e. approximately 0.05% of Nano cost.

Change of head liner material from cross linked pU to PET felt, results in cost saving equal to Rs.180 i.e. approximately 0.18% of Nano cost.

Roof panel material changed from 270D to D513.

Change of crankshaft material from 35MnBIB85 to E43c with boron, results in cost saving equal to Rs.40 i.e. approximately 0.04% of Nano cost.

Use of alternative design for stud axle with weight reduction of 0.187kg per stud axle, results in cost saving equal to Rs.15 i.e. approximately 0.15% of Nano cost.

Use of single rate spring for rear suspension for weight reduction and sleeve deletion, results in cost saving equal to Rs.70 i.e. approximately 0.07% of Nano cost.

Reduction of thickness for cover plate longitudinal rear from 1.0mm to 0.7mm, results in cost saving equal to Rs.4 i.e. approximately 0.004% of Nano cost.

Warning triangles commonization across all TML platforms, results in cost saving equal to Rs.4 i.e. approximately 0.004% of Nano cost.

Commonization of first Aid kit for Nano with ACE, results in cost saving equal to Rs.2 i.e. approximately 0.002% of Nano cost.

Commonizing the same gear shifter bellow for all versions with one single stich as in Manza, results in cost saving equal to Rs.2 i.e. approximately 0.002% of Nano cost.

Significant cost-reduction was achieved with the help of VE experts.
5.5.4 Total savings in nano cost is equal to Rs.21,765. It amounts to approximately 21.8% savings of Nano target cost. Appendix-I includes detailed description of savings realized through V.E. methodology application in various components and parts. A comparative chart of specifications of small cars and advantages of different types of wheel drives are also given in Appendix-I.

Appendix-II includes details regarding location and fitting of different assemblies.

5.6 SUGGESTED DESIGN MODIFICATIONS

5.6.1 Nano height is proposed to be reduced by 152mm and the wheel base is proposed to be increased in the front by 152mm. This will provide a smoother airflow over the body and will also increase fuel efficiency.

5.6.2 Nano cost is lowest in the market. The performance of its systems, components and parts is appreciated for their cost by the users. Value engineering experts and the team of designers have done a commendable job. However, Indian customers do not consider Nano as a status symbol and volume sales are not being achieved till date, even with attractive financial incentives and 4 years /60000 Km’s warranty clause.

5.6.3 Body shape is not being appreciated by the customers. Therefore, TML needs to introduce a redesigned car model. Indian customers are sensitive towards car appearance, looks, color, maintenance cost, selling price and after sales service provisions. Performance factors including, fuel efficiency, after sales service and price are being appreciated by the customers. New model should be designed keeping in view the shape of competitor’s vehicles.

5.7 RESEARCH EVIDENCE

- Research evidence underscores the fact that firm commitment of top management and its continuous support is essential throughout the project duration to realize the full potential of cost-effective V.E. methodologies.

- V.E. methodologies provide a competitive edge to the firm. VE methodologies facilitated TML to achieve the target cost of Mr. Ratan Tata's dream car. Nano cost of Rs. One Lakh, was achieved by using V.E. methodologies only.
Customers today want to have full value of their money. Therefore, manufacturers are trying to produce affordable products at competitive rates for the market.

All companies are trying hard to reduce costs by using alternative materials, technologies and processes for their survival in the market.

A strong team of V.E. experts having the requisite depth, breadth of knowledge and experience is required to achieve the project objectives.

Automation in manufacturing processes provides an extra competitive edge to the firm and facilitates quicker response to the competitor's products.

5.8 APPLICATION OF NANO TECHNOLOGY (NT)

5.8.1 TML should try to use the potential of nano technology in its future models. Nano Technology (NT) offers new capabilities to influence almost every major industry in the world. It has the potential to create a broad array of novel materials, composites and structures on a molecular scale for application in automobile industry. NT can be used for developing lighter, stronger and high-performance structures and processes with unique and non-traditional properties for applications in Nano that include, outer skin of the vehicle, the body, interior, engine, automotive drive system, achievement of higher mileage, durability and road grip through use of nano-scaled soot particles and silica. For application in automobile industry a series of nano particles are available like metal nano-particles and nano-powders, magnetic fluids, nano-adhesives, nano-composite polymers, and nano-coatings (anti-fog, anti-reflective, wear and scratch resistant, dirt repellent, biocide, etc.). Nano-particles and nano-powders can be used in Nano to increase the efficiency of heat transfer as coolant in the radiator. NT can be used in Nano for interior of car to produce dirt-repellent seats, air filters, filters for gaseous pollutants, anti-glare coatings of dashboard covers, improvement of combustion efficiency, minimization of engine friction and reduction of exhaust emissions.

5.9 FUTURE RESEARCH AREAS

A number of body shapes can be tried in the wind tunnel experiments to study the important parameters before choosing the best shape of the car body.
· TML should develop an improved aerofoil design for the air flow over the Nano body in collaboration with IISc Bangalore or any one of the IITs. This will further improve fuel efficiency of the car.

· International collaboration can be used to pool knowledge to develop world-class technologies for designing and developing environment-friendly products conforming to latest emission standards and alternative fuels for future automobiles. TML and ERC Pune can access technology developed in their laboratories including Tata Daewoo Commercial Vehicle Company, Hispano Carrocera at Gunsan in Korea and Zaragoza in Spain for producing futuristic vehicles.

· Value Engineering principles can lead the way for use of alternative materials, like reinforced plastics and composites, size and weight reduction, value creation, value addition and cost-reduction without any effect on functional performance, reliability and quality standards of the product. More case studies should be carried out to study the potential of value engineering applications in industry and creating interest among industrialists and entrepreneurs.

· There is lot of scope for growth, as long as a firm continues to monitor changes taking place in customer’s demands, needs & preferences and ensures optimal utilization of physical resources, waste minimization, introduces new technologies & cost reduction for value addition in products to achieve and retain leadership position in industry to remain ahead of the market.

· R & D policy should focus on the determination of changes taking place in the customers preferences and needs as a continuous process to stay ahead in the market. Focus on R&D and VE applications will gain more relevance in the context of next decade, when Nano technology and other new technologies are likely to be introduced.

5.10 CONCLUSION

5.10.1 Value Engineering applications in Automobile Industry are highly effective in raising productivity and profitability of the manufacturing firms. Tata Motors had
associated value engineering experts at the design stage of Nano to achieve the objective of producing the car at the target cost of Rs. 1 lakh. Cost saving of Rs. 21,765/- was achieved at the concept and design development stage of Nano with the association of V.E. experts.

5.10.2 Nano sales are not picking up as expected. It is a stylish lowest priced entry vehicle in the market. The basic model does not have enough attractive features. It is advisable to introduce a new higher priced model with attractive features and improved body design in both petrol and diesel versions to achieve higher volume sales in the market. Maruti Suzuki 800 cc, has been popular with the customers, since 1980s. It is difficult to break Maruti Suzuki’s brand loyalty of customers.

5.10.3 Nano sales were started in a hurry and there were reports of 10 incidents of fire and 3 cases of black smoke coming out of the steering column of the car in the initial supplies to the customers. These incidents started having a dampening effect on sales. Many customers cancelled their initial bookings. Expected higher sales volumes could not be achieved till date. The company initiated a ramp-up phase in 2011 and around 350 Special Nano Access Points (SNAP) were established. TML’s existing one thousand dealer outlets are also being used for sale in rural and urban markets.

5.10.4 TML can depend on the merits of its indigenous design and loyal customer base. There is no advantage of continuing to spend money on marketing efforts to boost the sale of existing model. Delayed introduction of diesel version will further erode the loyalty base of customers. It would be better to introduce a new petrol/diesel small car of around 800cc with three cylinder engine to compete with Maruti 800 cc and foreign make small cars.

5.10.5 After the introduction of a redesigned model of petrol version and diesel Nano, sales volumes are likely to increase.

5.11 References

- The serial numbers refer to References.
CHAPTER VI

FINDINGS

6.1 RESEARCH FINDINGS

6.1.1 Research evidence supports that Value Engineering is an efficient cost-reduction methodology. It emphasizes the use of alternative cheaper & better materials, technologies and processes in the production of automobiles. Today, customers are demanding cars, which are affordable, energy-efficient, use recyclable materials and conform to prescribed emission standards. Most automobile manufacturers are using interdisciplinary knowledge, multi-disciplinary approach and V.E. methodologies for cost-reduction to beat competition and stay ahead of the market.

6.1.2 V.E. methodology is an effective strategic tool for automobile industry. VE methodology and target costing are complementary.

• V.E. methodology facilitates achievement of target cost. Mr. Ratan Tata's dream people’s car target cost of Rs. one Lakh was achieved by using V.E. methodology. Cost saving of around 21.8% was achieved.

• A strong team of V.E. experts is essential for the success of a project. VE experts should have the requisite depth & breadth of knowledge and experience to achieve the project objectives.

• Maximum benefits of V.E. efforts are realized only in the initial concept development & growth stages. However, V.E. experts should be associated from the product concept development stage through growth, maturity and obsolescence stages.

• Research evidence underscores the fact that firm commitment and continuous management support of top management is essential throughout the V.E. project to realize the full potential of cost-effectiveness of V.E. methodologies.

• V.E. methodologies provide a competitive edge to the firm.
TML’s Nano project anticipated to attract two wheeled vehicle users and first time car buyers to garner the maximum share in the small car segment. This objective has not been realized till date. Nano has been dubbed as a cheap car.

The target price of Nano was fixed without considering its anticipated price. Companies have less control over the selling price, since price is determined by the market perception. Nano price should have been fixed with reference to the prices of existing competitive cars.

Popularity of existing cars available in the market, customers preferences and loyalty factors should be considered by the designers team.

Car purchasers, who have shifted from two wheeled vehicles to Nano have found its features and performance satisfactory.

Car purchasers, who already owned a four wheeled vehicle and have purchased Nano, have not liked much its features and performance.

Manufacturers must produce products in accordance with customer preferences at competitive market rates, since customers today want to have full value of their money.

All Automobile manufacturers are trying to reduce production costs by using alternative materials, technologies and processes to capture a higher market share.

Automation and flexible manufacturing systems provide an extra competitive edge to the firm to provide a quicker response to the competitor's products.

In the current fiercely competitive market environment, most indigenous automobile manufacturers and major international players are introducing diesel versions of their popular models to capture a higher market share. Nano diesel model should be introduced early to realize its competitive advantage.

However, if the Govt. suddenly decides to increase taxes on diesel fuel, difficulties can arise for all manufacturers.
· Favourable and unfavourable market factors must be taken into consideration while preparing a marketing program. There are different favourable and unfavourable factors that affect an automobile company’s performance. Implementation process of a V.E. project should be tackled innovatively using creative ideas, since every company presents a new opportunity depending on its organization culture and environment.

· Thorough market research and survey should have been carried out for Nano, before starting the product development process. Life-cycle span performance studies should have been done before starting supplies to the customers.

· Majority of Nano Car users are satisfied with the performance of Nano systems, assemblies & components and appreciate its high fuel efficiency.
CHAPTER – VII

RECOMMENDATIONS

7.1 GENERAL RECOMMENDATIONS

· Automobile industry should focus on optimal utilization of physical resources, cost – reduction, waste minimization, harnessing of new technologies & value addition in products.

· Value engineering circles (like quality circles) should be established in every factory and top management must give priority to value engineering projects to realize their full potential.

· Value Engineering methodology should be used for cost-reduction, productivity & profitability enhancement of manufacturing firms and for import substitution.

· A website of V.E. applications in automobile industry should be created giving details of users achievements regarding its cost-effectiveness and benefits for proliferation of knowledge, publicity, promotion and creation of awareness among the industrialists, academicians, administrators and general public. This web-site will also facilitate interaction, cooperation and collaboration among the users.

· National data base of VE methodology applications in automobile industry and users achievements should be created and updated as a continuous process for use of interested organisations in the country.

· Central & State Governments should use National Productivity Council branches and media services to give wider publicity for the achievements of all VE users. All public and private sector organizations and administrative establishments should encourage the use of VE methodologies to effect improvements in productivity at the national level.

· A pool of VE consultants and professionals/experts should be created to assist industrialists, managers and administrators to promote VE culture and temper in the country.
· Anticipated product market price should be considered before making the target costing decision, since companies have less control over price and price is determined by the market forces.

· Product Development Project (PDP), Product Design & Development (PDD), metrics, ergonomics and VE methodologies should be used by the Automobile industry as complementary technologies to produce affordable vehicles in tune with the customer’s demand and preferences.

· Continuous value addition in products should be employed by the automobile manufacturing companies to achieve a competitive edge in the market. Optimization should be achieved in the use of material, labour, production technologies, processes and supply chain management to realize their full potential for cost-reduction of the product. Use of standard parts, commonization and lean manufacturing practices should be made for cost-reduction.

· No vehicle should be introduced hurriedly in the market without its life –cycle-span tests to obtain the required feedback regarding the vehicle quality, defects, repair, maintenance, maintainability and reliability standards of various parts, components and assemblies. Otherwise, company reputation, sales and customers impressions are affected adversely.

· There is need for a mandatory vehicle recall policy in the country.

· There is also a need for strengthening of vehicle testing and certification procedures.

· Value Engineering methodology should be used in Automobile industry, private sector organizations etc. employing alternative processes, technologies and materials like reinforced plastics and composites for miniaturization of components, size and weight reduction, value creation, value addition and cost-reduction without affecting functional performance, reliability and quality standards of the vehicle to achieve the company objectives. Users should give wider publicity to their achievements for general use.
· More case studies should be undertaken to validate the efficacy of Value Engineering methodologies in automobile industry and for the creation of interest among industrialists and entrepreneurs.

· Result – oriented research in Value Engineering studies should be promoted in Automobile Industry.

7.2 NANO SPECIFIC RECOMMENDATIONS

· Marketing staff should not try to compete with other cars. Nano price is only Rupees one lakh and it cannot have features like luxury cars.

· Nano has not achieved volume sales till date. In order to achieve the volume sales, a new model of the car and diesel version should be introduced. Maruti 800 cc has been popular with Indian customers for the last three decades. It is difficult to break the brand loyalty of customers of Maruti 800 cc. It is advisable that the shape of new model should be kept similar to that of Maruti 800 cc/Alto 800 cc.

· Suggestions received from the grass root level workers of Sanand plant during their weekly/fortnightly meetings or on other occasions should be given due consideration by the management. These suggestions should be evaluated and implemented for effecting continuous improvements in Nano.

· New model of Nano should preferably have the following features :-

  o Height should be reduced by 152 mm, and wheel base should be increased by 152 mm in the front. This will smoothen the air flow over the car body, reduce air resistance and increase fuel efficiency.

  o Engine temperature gauge, altimeter and fuel gauges should be included in the instrument panel.

  o Both front doors should be fitted with door locks.

  o Drum brakes should be replaced by disc brakes.

  o Accelerator cable should be strengthened. Mechanics should be trained to keep the cable a bit loose.
o Mechanics should be trained to provide efficient services at the authorized dealers workshops, since Nano has different components and parts than other TATA vehicles.

o New shape profiles should be tried to check important design parameters for selecting an optimal design and shape profile. Its box like looks as perceived by customers, should be changed.

o Extra thin sheet of metal size 0.7mm used in the car body should be replaced by 1.0mm metal sheet.

· The price of Nano had been fixed by the company with a narrow profit margin and selling price of Rs. 1 lakh. The price of new model of Nano should be decided with reference to the cost of production and in line with the competitor’s price.

· Tata Motors Company is better known for its diesel vehicles, but the petrol versions of diesel car models have not achieved volume sales. A sturdy model of Nano diesel version should be introduced early to achieve higher sales volumes.

· Life-cycle-span field trials for 100,000-150,000 km should be carried out to obtain feedback regarding quality standards, repair, maintenance, maintainability and reliability of parts, components and assemblies before offering it for sales in the market.

· It is recommended that TML should supply 10-12 Nano cars for life-cycle-span tests to the Army Supply/EME corps or any other independent testing agency for trials in different terrains and weather conditions of India. Hero Company had supplied a dozen Hero Pugh 50cc two wheelers to the Army EME corps in 1993 for field trials in all types of terrains and climatic condition of India.

· Value engineering circles (like quality circles) should be established at the TML Sanand plant and the management should give priority to innovative ideas generated in these meetings to realize their full potential.

· Nano sales were started in a hurry in 2009 and 10 incidents of fire and 3 cases of black smoke coming out of the steering column of car were reported in the initial supplies to the customers. These incidents created a dampening effect on Nano
sales. Some of the customers cancelled their initial bookings. Such mistakes should be avoided by TML in future. Specifications of defective components should be upgraded to enhance their reliability.

Nano sales volumes could not be achieved and the company initiated a ramp-up phase in 2011. Around 350 Special Nano Access Points (SNAP) were established and around 1000 dealers network outlets of Tata group are also being used to increase Nano sales in rural area markets. However, volume sales have not picked up till date, despite an investment of Rs.3500 crores in this project. It is no use continuing to spend money on the present model. A new model with extra features in tune with customer’s preferences should be introduced to attract the customers. A cheaper Nano has not found favour with the status - conscious customers in India. TML can depend on the merits of its indigenous design and loyal customer base. TML should not spend more money on marketing efforts to boost the sales of existing Nano model. Diesel version should be introduced early since delayed introduction of diesel version of Nano will erode loyalty base of TML customers.

TML’s Sanand plant & ERC Pune should access knowledge and technology for designing and developing new world class models (from its three sister establishments including Tata Daewoo Commercial Vehicle Company, Hispano Carrocera at Gunsan in Korea and Zaragoza in Spain). TML should employ environment-friendly technologies for use of alternative fuels and adherence to future EURO version emission standards.

Nano body should be manufactured using reinforced plastics, composite materials and Nano technology.

Continuous efforts should be made to improve Nano performance without any collaboration of foreign designers.

Customers today want better value added vehicles and services such as those available in the developed countries. TML should employ latest techniques and technologies, remain continuously engaged in monitoring the environment to foresee changes taking place in customer preferences, develop necessary techniques for retaining its leadership position in industry and remain ahead of the market.