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# "Redesign of Gear Shifter Assembly for Indica Vista using Quality Function Deployment – A Case Study"

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***Abstract:*** *Quality function deployment is one of the total quality management quantitative tool and technique that could be used to translate customer needs and specifications into appropriate technical requirements. This paper presents a redesign of Gear Shifter Assembly for Indica Vista. 'Voice of the Customer' is translated into customer needs which are then converted into technical specifications. Due to this,the frequency of the complaints were reduced drastically hence the market share of the Indica Vista has also gone up and the customers were satisfied which was concluded by the surveys in the public issues, which had a strong impact on the JDP rating as well.*
***Key words:*** *QFD, Customers Needs, Technical specifications, Gear Shifter Assembly.*

## I. Introduction:

In gear shift assembly there are three basic parts i.e Housing, Cable Assembly (Shift), Cable Assembly (Select). It is a power transmission unit between gear box and engine. It was observed that, the cable assembly was transmitting the vibrations and noise to engine assembly. Moreover the gear shifting was bit difficult hence customers were facing the problems. In this case study the customers complaints about gear shift assembly were noted down. The said complaints were converted into technical problems.Their priority improvement was checked using QFD. The problem was resolved using flexible couplings having rubber bush at ends for fitting at engine side. It was done to damp down the vibrations.

According to Hamscher, every company can be seen as a sum of processes that respond to customer needs by creating, producing, supplying and invoicing goods and services [1]. Hammer and Champy (1993), define reengineering as the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary modern measures of performance, such as cost, quality, service, and speed.[2].House of quality and quality function deployment can be used to enhance sales and profit while satisfying customers and reducing the cycle time of new product development. QFD uses four houses to integrate informational customers needs which is translated in to the voice of engineer. [3]

J. "Dave" Power III who worked in auto industry, as a financial analyst started his own research company on April 1, 1968. He collects information regarding consumers' likes, dislikes, habits and tastes regarding the selection, purchase and satisfaction with a given product, then packages this valuable information and sells it to the producers of the product.

The survey results help manufacturers design and sell products that consumers want and show them how consumers feel about products already on the market. Surveys are conducted through telephone, mail and e-mail but survey responders must be familiar with the product being surveyed. The company identifies polling groups, and then selects random consumers to survey. Surveys include questions about a wide range of topics, like ease of use, customer service and satisfaction with various features. However, some topics are weighted more heavily during analysis than others. J.D. Power and Associates then performs a statistical analysis of the information gathered and offers this to companies that are affected by the findings. The company produces reports that compare products using different means of comparison, depending on the industry.

## II. JDP Review

In JDP review, rating of Indica Vista has gone down due to poor quality of Gear Shifter mechanism as far as Feeling and Free Play is concerned as per feedback given by customers. It was highlighted to improve the overall gear shift quality, while the improvements were done in base transmission viz. multicone synchronizers, carbon lined synchrocones, softer gate selection springs, etc to match the competitors / benchmarks in terms of the objective parameters (mainly efforts, shift impulse, shift throws, double bump, etc) so had belief that, still there is further scope and need for improvement, in terms of the basic shift feel/smoothness/vibration damping, etc and also in terms of consistency of performance from vehicle to vehicle.

This was based on subjective assessments of Indica Vista against competitors like Hyundai i10, Hyundai i 20, Suzuki Swift, etc. This was also reflected in JDP scores for gear shift problem symptom.

**Need for redesign forgear shift assembly**

To overcome the flaws of gear shift assemblythis is used for FIAT (LINEA & PUNTO) gearboxes whose ratings were high and to satisfy these flaws with the improvements points mention in the following table. The detailed improvements are shown in pictorial format ahead.

| **Housing** | **Cable** |
|---|---|
| Housing crack | Swivel tube breakage |
| Mono socket crack | Cable end fitting (TA side) comes out/ Bend |
| Select spring thrown off while shifting | Conduit end fitting comes (TA side)out/Bend |
| Housing comes out of the bed | Hard Movement |
| Rattling noise from Gear Shifter lever | Cable end fitting bushing broken |
| Free play in housing | Cable end fitting cap broken |
| Part warranty issue | Cable end fitting cut at neck |
| | Part warranty issue |

**Customer Complaints**

The main objective of the case study is to redesignthe gear shifter cable assembly which is important power transmission part of Indica Vista car. The need for redesignis aroused due to downfall of Indica Vistas JDP rating for the above mentioned component. QFD (Quality function Deployment) approach is integrated with the redesigning exercise to retain customer as a focal point for making improvements.

**Gear shift assembly**

It consists of three parts:

1. Housing
2. Cable Assembly (Shift)
3. Cable Assembly (Select)

Gear Shift Assembly is a power transmission unit of housing mounted on the Shifter side and through the cable (i.e. by shift & select cable) it is connected to the transaxle side. The exploded view of the housing and the cable are shown below:

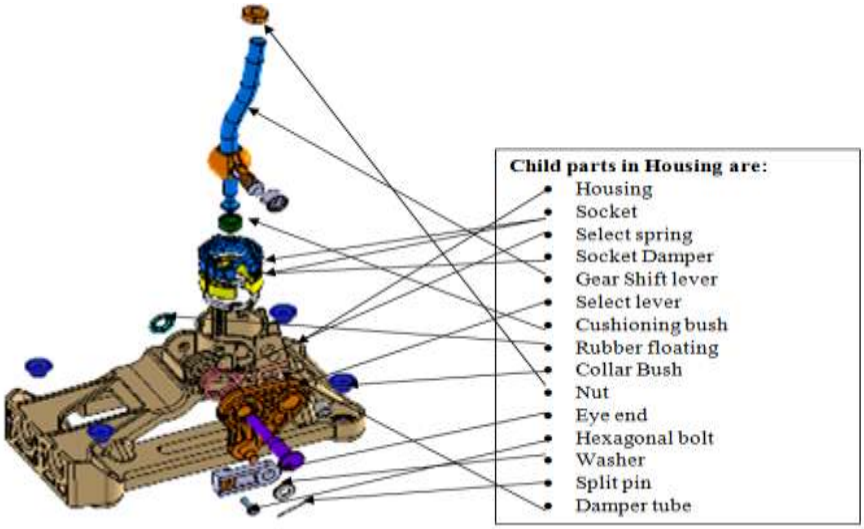


**Fig: 1** Gear Shifter assembly

**Fig: 2** Select Cable

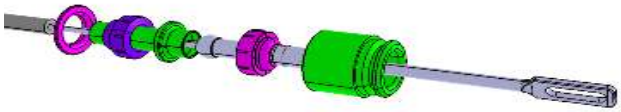

**Fig:3** Select Cable SS Side

**Fig: 4** Select Cable TA Side

| Child parts in**Select Cable SS Side**are: | Child parts in **Select Cable TA Side** are: | |
|---|---|---|
| Swivel tube | Inner Cable | Conduit end fitting T axle side |
| Conduit end fitting | Conduit with liner | Inner cap |
| Short Damper | Mechanical Protector | Outer cap |
| Long Damper | Cable end fitting case | Adjustable slider |
| Washer | Cable end fitting cap | Spring |
| Conduit end fitting cap | Cable end Fitting bushing | Short Damper |
| Eye rod | Ball coupling | Long Damper |
| Bush | Wire cap | Bush |
| Swivel tube | | |

**Fig: 5** Improved Shift Cable

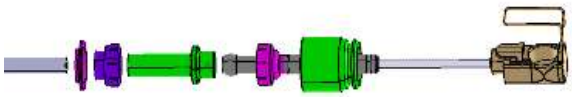

**Fig: 6** Improved Shift Cable SS Side

**Fig:7** Improved Shift Cable TA Side

**Child parts in Select Cable SS Side are:**

Swivel tube
Conduit end fitting
Short Damper
Long Damper
Washer
Conduit end fitting cap
Shift End fitting
Retention Spring
Swivel tube

**Child parts in Select Cable TA Side are:**

| | |
|---|---|
| Inner Cable | Swivel tube |
| Conduit with liner | Conduit end fitting T axle side |
| Mechanical Protector | Inner cap |
| Cable end fitting case | Outer cap |
| Cable end fitting cap | Adjustable slider |
| Cable end Fitting bushing | Spring |
| Ball coupling | Short Damper |
| Wire cap | Long Damper |

| Sr. No. | Improvements | Reference | Benefits (as understood by customer) |
|---|---|---|---|
| | Dampers at the cable end connections (Transmission end) | Fiat Linea | Vibration damping, shift smoothness |
| | Outer conduit Damper at shifter end (currently Vista has only on transmission end) | Fiat Linea | Vibration damping, shift smoothness |
| | Dead mass on cable | Suzuki Swift | NVH improvement |
| | More Number of strands of inner cable | Swift / Linea | Better Flexibility / Jerks damping / Vibration damping |
| | Lubrication between inner cable and outer | Swift / Linea | Friction reduction, efficiency improvement |

| | | | |
|---|---|---|---|
| | cable, alternate lubricants | | |
| | Alternate Liner material | Swift / Linea | Friction reduction |
| | Rigidity of shifter (mainly in cross gate) | Swift / Linea | Improvement of precision, minimize loss of travel / load |
| | Plastic coating on selection pin of shifter to reduce friction | Hyundai i10 | Friction reduction |
| | Rubber pads for shifter spring | Hyundai i10 | Gear shift lever centralization improvement |
| | | | Noise reduction |
| | Play reduction in all shifter joints and cable end connections | Hyundai i10 | Free play reduction at knob |

**Table 1: Flows and improvement points of different car cables**

The following table gives an idea of ratings 3 factors (i.e. **Noise, Vibrations & Harshness**) given by for the improvements which are feasible to carry out and submit the protos required

| Proposal | Gear Shift Quality | Noise | Vibrations | Priority |
|---|---|---|---|---|
| Dampers at the cable end connections ( transmission end) | ** | *** | *** | 1 |
| More Number of strands of inner cable | ** | ** | *** | 1 |
| Alternate Liner material | *** | ** | ** | 1 |
| Rigidity of shifter (mainly in cross gate) | ** | ** | *** | 1 |
| Rubber pads for shifter spring | ** | ** | * | 2 |
| Lever ball double overmoulded | *** | * | * | 2 |
| Double socket dampened in housing | ** | ** | * | 2 |
| Dead mass on cable | = | * | * | 3 |
| Lubrication between inner cable and outer cable, alternate lubricants | = | * | * | 3 |

**Table: 2** Rating Factors

1st priority 2nd priority 3rd priority

The improvements points were prioritized with the rating point which affects the Quality of the cable recommended by the Ficosa which is represented by the QFD i.e. (Quality Functional Deployment). The following figure shows the voice of customer reflecting their complaints like gear shift quality, noise and vibrations. Its conversion in to technical requirements such as dampers at cable and connections, more number of strands of inner cable, alternate liner material, rigidity of shifter, rubber pads for shifters springs, lever ball double molding, double socket damper in the housing, dead mass on cable, lubrication between inner and outer cable or alternate lubricants.

The technical assessment was done and the priority of improvements was suggested.The decision was taken to redesign the dampers of cable connections at transmission end and engine end.It also shows customer evaluation and satisfaction.

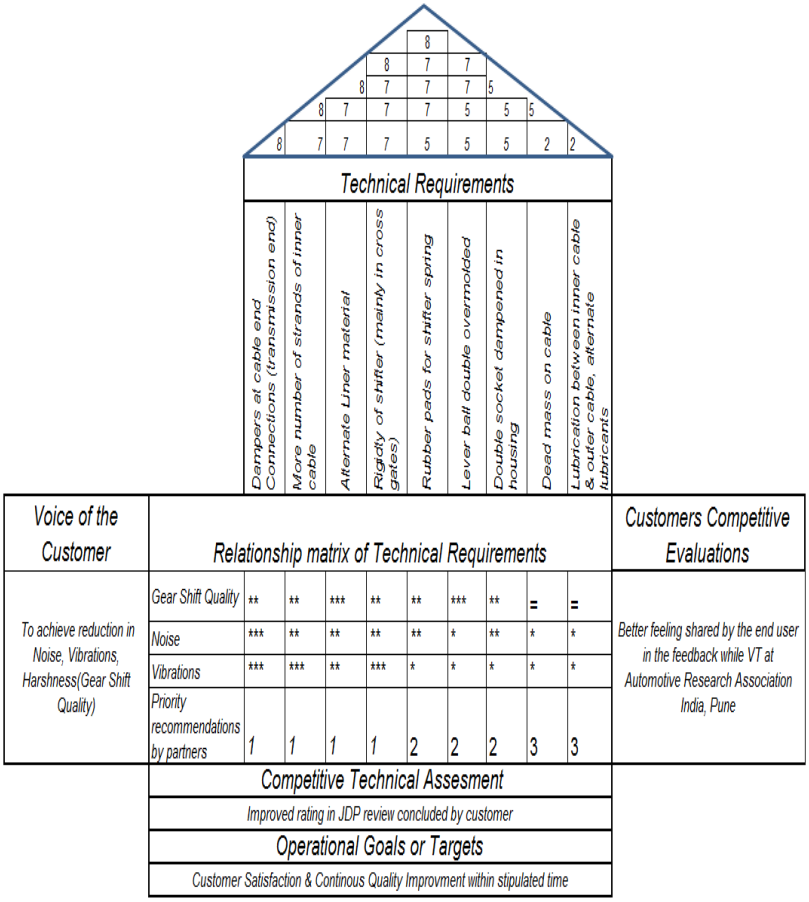


**Fig 8:** House of Quality for QFD

## III. Result Validation:

After redesign of Gear Shifter Assembly for Indica Vista using Quality Function Deployment the complaints of the customers were reduced considerably in terms of following points:

1. Gear Shift Quality (Harshness)
2. Noise
3. Vibrations

Thus frequency of the complaints were reduced drastically due to which the market share of the Indica Vista has also gone up and the customers were satisfied which was concluded by the surveys in the public issues, which had a strong impact on the JDP rating as well. The rating is improved by 70 %.

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