Summer Training Project Report

Tata Motors Limited
Lucknow Plant
19th May – 16th June 2015

Project Guide: Mr. Naveen Agnihotri
Manager, Vendor Improvement Group

Submitted by: Ayush Sinha
Second year B.Tech Mechanical Engineering
Indian Institute of Technology Kanpur
Every project big or small is successful largely due to the effort of a number of wonderful people who have always given their valuable advice or lent a helping hand. I sincerely appreciate the inspiration, support and guidance of all those people who have been instrumental in making this project a success.

I, Ayush Sinha, student of Indian Institute of Technology Kanpur (Mechanical Engineering), am extremely grateful to “Tata Motors Limited Lucknow” for the confidence bestowed in me and entrusting my project.

At this juncture I feel deeply honoured in expressing my sincere thanks to Mr. Naveen Agnihotri, Manager (Vendor Improvement Group) for making the resources available at the right time and providing valuable insights leading to the successful completion of my project.

I express my gratitude to the entire SQ team, especially Mr. Abhinav Garg, Mr. Dheeraj Parihar and Mr. Anil Maurya for patiently teaching me the office procedures and guided me through the entire project.

I am very grateful to the HR Department, especially Mr. Prashant Pandey for providing me this opportunity to work in this prestigious organization.

M/s Mitter Fasteners Lucknow has been very cooperative. I am obliged towards Mr. Rajeev, Quality Control for providing me their data and quickly implementing the plans for the successful completion of the project.

Last but not the least, I place a deep sense of gratitude to my fellow trainees who gave me insights into the working of all the departments in the plant and therefore helped me better understand the ways of the company.
Contents

About the Company

Department Profile: Supplier Quality

Project 1: Problem resolution of specified part

Project 2: Implementation of Quality Gates at Supplier’s end

Additional Observations

Conclusion
About the Company

TATA Group

- The Tata group’s core purpose is to improve the quality of life of the communities it serves globally, through long-term stakeholder value creation based on leadership with trust

<table>
<thead>
<tr>
<th>Brief Synopsis</th>
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<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Private</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td>Global Diversified Enterprise</td>
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<tr>
<td><strong>Founded</strong></td>
<td>1868</td>
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<tr>
<td><strong>Founder</strong></td>
<td>Jamsetji Tata</td>
</tr>
<tr>
<td><strong>Headquarters</strong></td>
<td>Mumbai, Maharashtra, India</td>
</tr>
<tr>
<td><strong>Area served</strong></td>
<td>Worldwide</td>
</tr>
<tr>
<td><strong>Key people</strong></td>
<td>Cyrus P Mistry</td>
</tr>
<tr>
<td><strong>Products</strong></td>
<td>Airline, Automotive, steel, IT, Electricity generation, Chemicals, Beverages, Telecom, Hospitality, Retail, Consumer goods, Engineering, Construction, Financial services</td>
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Tata Motors Limited

- Tata Motors Limited is an Indian multinational automotive manufacturing company and a subsidiary of the Tata Group. Its products include passenger cars, trucks, vans, coaches, buses, construction equipment and military vehicles.

- It is the world's 17th-largest motor vehicle manufacturing company, fourth-largest truck manufacturer, and second-largest bus manufacturer by volume.

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<td><strong>Products</strong></td>
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<td><strong>Services</strong></td>
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Lucknow Plant

- Tata Motors Lucknow (TML-Lucknow) was established in 1992 to meet the growing demand for Commercial Vehicles in the Indian market.

- This plant rolls out commercial vehicles & is specialized in the designing & manufacturing of a range of modern buses which includes Low-floor, Semi Low-floor, and High Deck & CNG Buses.

- Lucknow plant has recently commissioned JV Company, Tata Marcopolo Motors Ltd. in the premises.
The major facilities at the plant comprises of:

- Vehicle Factory - Assembly Plant for Trucks and Bus Chassis

- Integral Bus Factory - Assembly Plant for Module Buses catering to the needs of Tata Marcopolo Motors Limited and FBV operations

- Transmission Factory - Gear Parts, Crown wheel & Pinion and Heat Treatment facility

- Production Engineering Shop catering to the tool design and manufacturing needs

- A well established Training Centre through which around 500 apprentices are trained in various trades.

- Engineering Research Centre with specific focus on buses, including a Digital prototyping lab, use of PLM software etc.

- Service Training Centre providing training to drivers and technicians of the STU's.

- RECON Factory (for Reconditioning Business)

- The satellite plant of TMML which caters to the Hi-end buses for the Northern Market.

- State of the art facilities like the Paint Shop, BIW Shop and the TCF factory with automated lines have been benchmarked with the best in the world.
Tata Motors Lucknow plant has four assembly lines where all the components are assembled onto the frame to complete a vehicle. Also, there are sub-assembly stations such as the Frame shop, the Trim lines and the Transmission assembly etc.

These lines require an uninterrupted supply of good quality components for their continuous operation and hence ensure that the production objectives are fulfilled.

Parts not corresponding to the standards require extra efforts on the assembly line to enable its usage, hence increasing overall cost.
Most importantly, bad quality of parts affects the overall quality of the vehicle and can cause customer dissatisfaction.

Supplier Quality (SQ) department, as the name suggests, works on the quality of parts supplied by the numerous suppliers for TML Lucknow.

SQ is not only responsible for ensuring good quality supply from the ancillaries, but it also works towards Vendor Improvement through tracking the defects in their supplies, implementing WCSQ (World Class Supplier Quality) and even altering process plans.

A predefined procedure is followed to ensure that a check is placed at every stage from process planning at supplier’s end, delivery to the TML plant, till the removal of defects at
the supplier’s end. This procedure involves these three departments:

AQ (Advance Quality)
VQA (Vendor Quality Assurance)
CQ (Current Quality)
(subsets of the SQ department)

- The Supplier designs a process plan for manufacturing the part matching the drawings issued by the ERC (Engineering Research Centre).
  AQ reviews and finally approves this plan. This procedure is known as Development.

- VQA carries out the complete inspection (Layout Inspection) of the first lot received from the supplier in a procedure called PPAP (Production Part Approval Process).
- **CQ** monitors the subsequent manufacturing cycles and is accountable for continuous improvement and continuous problem resolution at the supplier’s end. This procedure is known as **Regula**.

- **VQA** carries out inspection of the subsequent supplies too.
PROJECT 1

Problem resolution after proper Root Cause Analysis of the part Assembly Cross Member (2632 3120 0126) from M/s Mitter Fasteners
Part name : Assembly Cross Member
Part no. : 2632 3120 0126
Supplier : Mitter Fasteners
Fitted at : Frame Shop
## Child Parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Code</th>
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<tbody>
<tr>
<td>Cross Member</td>
<td>2573 3120 8216</td>
</tr>
<tr>
<td>Support Bottom</td>
<td>2573 3120 7101</td>
</tr>
<tr>
<td>Support LH/RH</td>
<td>2632 3120 71 38/39</td>
</tr>
</tbody>
</table>

### Additional Information

- Other Supplier of Part: Jagjit Enterprises
- Status of parts from other suppliers: Not OK

Ayush Sinha
Cross Member
2573 3120 8216
Support Bottom
2573 3120 7101
Support LH/RH
2632 3120 71 38/39
Problems Observed at the Frame Shop

Dimensions 31.5, 24.5, 34.5 mm of hole from end on Support LH/RH are Not OK and hence holes require reaming for assembly.

Induced by variation in Bend angle along the length of the part.

Erroneous Dimensions
Dimension $889 \pm 0.5$ is not uniform along the entire length of Support LH/RH.

Support LH and Support RH are not parallel to each other.
Observing the Manufacturing Process for Tracking the Cause of Defect

**Part 2573 3120 8216**

**Cross Member**

**Material**: Fe 410  
**Processes Involved (in the sequence used):**  
1. Raw material inspection  
2. Shearing  
3. Notching  
4. Piercing 2 holes  
5. Bending  
6. Piercing 10 holes  
7. Piercing 24 holes  
8. Surface treatment

**Part 2573 3120 7101**

**Support Bottom**

**Material**: Fe 410  
**Processes Involved (in the sequence used):**  
1. Raw material inspection  
2. Shearing  
3. Notching
4. Bending
5. Piercing 3 holes
6. Piercing 9 holes
7. Chamfering 5 holes
8. Surface treatment

**Part 2632 3120 71 38/39**

**Support LH/RH**

**Material**: BSK 46

**Processes Involved (in the sequence used)**:
1. Raw material inspection
2. Shearing
3. Notching (in 4 steps)
4. Bending
5. Piercing (in 6 steps)
6. Surface treatment

**Part 2632 3120 0126**

**Assembly Cross Member**

**Processes Involved (in the sequence used)**:
1. Riveting on the riveting fixture
2. Final Inspection using calibrated gauges/instruments
3. Packing and Dispatch
All Die and Fixtures have sufficient number of Stoppers and Locating pins for reducing the probability of error in manufacturing.
Tracking Down the Root Cause

- Regular inspection of parts after every process helps to identify defect causing processes.

- Bending in part 2632 3120 71 38/39 on brake press was producing variation in flatness of part. Punch was found to be worn out.

- Riveting procedure done with the help of a fixture was unable to ensure that 2632 3120 71 38 and 39 were parallel to each other after assembly.
### Solutions

- **Riveting Fixture**

  **BEFORE**

  [Image showing the original fixture]

  Fixture is quite small for handling long parts such as 2632 3120 71 38/39

  **ZOOM IN**

  [Image showing a close-up of the fixture]

  Additional supports with pins welded.

  This redesigned fixture ensures the uniformity of 889±0.5 mm dimension along the entire length.

  **AFTER**

  [Image showing the improved fixture]

  Ayush Sinha
**Punch of Brake Press**

**BEFORE**

Punch has worn out and hence produces unlevelled parts.
This variation in flatness causes the holes to shift from desired position.

**AFTER**

New punch is perfectly linear and hence dimensions 31.5, 24.5, 34.5 mm are OK in produced parts.
PROJECT 2

Implementation of Quality Gates at Supplier’s End (Mitter Fasteners)
Quality Gate

- Installed at the **Dispatch gates/exits** of the plant.
- Provides a check-list for the **final inspection** of parts.
- **Tracks the defects** over a period of time along with the effectiveness of action plans.
- Ensures **100% inspection** of the parts being dispatched.

SQDCME

- Tracks the performance of plant in the six spheres of **Safety, Quality, Delivery, Cost, Morale** and **Environment**.
- Daily updation of this system helps to identify the areas that require improvement and hence enhance productivity.
Implementation at Mitter Fasteners

No. of Dispatch exits: 2 (Gate 1 dispatches large parts
Gate 2 dispatches small parts)
Installation of Quality Gate 2

All the required trackers and information sheets are put-up and are regularly updated.

*Photos taken on 04 June 2015

<table>
<thead>
<tr>
<th>Monthly Customer PPM</th>
<th>Defected parts per million parts supplied</th>
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<tbody>
<tr>
<td>Defect Chart</td>
<td>Tracking customer complaints through PRRs filed</td>
</tr>
<tr>
<td>Quality Alert &amp; Tracking Sheet</td>
<td>Part-wise defect tracking</td>
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**Total Rejection**  
Part-wise rejection data for the complete year

**Work Instruction Sheet**  
Description of procedures to be followed at gate

**Corrective Actions Sheet**  
Defect wise corrective actions taken and date of closure

**Quality Gate Data**  
No. of parts inspected and rejected
Customer Issues Overview
Defect tracking over an year

Visual Defect
Easy to find visual defects in a part

Quality Plan
All the dimensions of a part are given with their inspection method
Quality Gates were successfully installed at both Gate 1 and Gate 2.
<table>
<thead>
<tr>
<th>Tracking safety performance over a month</th>
<th>Daily updation of accident trends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tracking rejections from customer over a month</td>
<td>Daily updation of quality trends</td>
</tr>
<tr>
<td>Tracking no. of delivery stoppages (&gt;10mins) over a month</td>
<td>Daily updation of delivery trends</td>
</tr>
</tbody>
</table>

Ayush Sinha
<table>
<thead>
<tr>
<th>Tracking rejection of tools over a month</th>
<th>Daily updation of tool cost trends</th>
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<tbody>
<tr>
<td>Tracking attendance of operators (&lt;70%) over a month</td>
<td>Daily updation of morale trends</td>
</tr>
<tr>
<td>Tracking air leakages and waste at shop floor over a month</td>
<td>Daily updation of environment trends</td>
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</table>
SQDCME installed and updated daily at Mitter Fasteners
Additional Observations

SQ team and the entire TML plant functions very systematically and is highly organised. A few of the systems/practices were useful for the complete understanding of SQ department.

- **World Class Quality (WCQ)**
  - A five-level system aimed to improve quality of products dispatched from plant.

  1. **1st**  - Defects don't leave the plant
  2. **2nd**  - Defects don't leave the shop
  3. **3rd**  - Defects don't leave the zone
  4. **4th**  - Defects don't leave the station
  5. **5th**  - Defects are not produced
✓ TML Lucknow plant has achieved Level 1.
✓ WCQ requires that the following five principles are inculcated into the functioning of the plant.

- People Involvement (PI)
- Built in Quality (BIQ)
- Standardization (STD)
- Short Lead Time (SLT)
- Continuous Improvement (CI)

✓ Inculcation of these principles imply 33 Core requirements should be met which needs some actions and micro-actions to be performed.
✓ For Level 1, total 295 actions and micro-actions are prescribed, and at least 85% (251) of them must be taken.

✓ SQ aims to implement this system at TML’s suppliers too.
(WCSQ – World Class Supplier Quality)
**PRR (Problem Reporting & Resolution)**

An online system to ease communication about defects from assembly line to supplier via SQ.

- Problem arises on Assembly line
- SQ reviews and approves PRR
  - PRR sent to SQ
  - PRR forwarded to supplier
- Supplier designs an Action plan
  - Action plan sent to SQ
  - Sends disapproval to supplier
- SQ reviews Action plan
  - Approves action plan
- Defect removed
▪ Kanban Two Bin System

✓ A **system of continuous supply** of components/supplies such that workers have what they need, when they need, where they need it.

✓ **Two bins are at assembly line** containing the required parts. Similarly bins are at supplier’s end.

✓ When one bin at assembly line is completely emptied, the supplier refills it with its own bin and manufactures more parts to refill its own bin.

✓ This way, continuous supply is maintained **without the need of big storage** spaces.

Ayush Sinha
Paint Inspection: DFT & Cross-cut Test

- The most common defects are paint defects.
- Two common inspection methods are DFT and Cross-cut test.
- DFT (or Dry Film Thickness) is a test where the thickness of paint film is measured using a DFT meter (in microns) and compared to a standard range.
- Cross-Cut Test
  Making divisions by scratching the surface and using tape to peel it off. If divisions peel off, part is rejected.

Safety

- Safety is Tata’s primary priority. The company emphasises on overall safety- from road safety to safety in manufacturing processes.
- TML has a ‘Wear 3 Carry 3’ policy for shop floor. Everyone is provided with safety shoes, glasses, helmet, masks, earplugs and gloves.
- Safety at plant ensures good working conditions and uninterrupted production leading to overall enhancement of productivity.
Conclusion

During the training period

- Visited the Assembly lines and the Trim lines and studied their functioning - complete assembly procedure along with progressive quality checks and man-machine management.

- Worked with the SQ team and got acquainted with the department’s responsibilities, office procedures and work management. Also, gained hands-on experience working with systems such as PRR using which numerous issues were resolved daily.

- Visited some ancillaries of TML and thoroughly studied their manufacturing processes and analysed their methods for defects reduction.

- Worked along with M/s Mitter Fasteners and successfully eliminated defects arising in part 2632 3120 0126 supplied by them.

- Implemented and ensured daily updation of Quality gates and SQDCME at Mitter Fasteners.

Ayush Sinha
Thank you