Opportunities for Raw Material & Energy Conservation
By Applying
Life Cycle Assessment
As a
Decision making tool

By
Sanjay Samant
Godrej Tooling Division
The Godrej Group today

• Touches the lives of over 1.1 billion consumers everyday, across the globe
• Generates revenues of USD 5 billion, annually
• Constantly builds and leverages the brand Godrej that is synonymous with:
  • Trust, Reliability, Ambition and Innovation
• Employs over 54,000 people - The Godrej ‘Parivaar’
• Maintains a campus of about 3200 acres of land in Mumbai, India
Expanding globally, rapidly

- Operating in 60 countries and represented in over 80 nations
Diversified business interests structured in six firms…
...and over 60 lines of business
Product Diversification: Godrej & Boyce Mfg Co.

Industrial Products
- Tooling
- Material Handling
- Process Equipment
- Precision Engineering
- Aerospace

Consumer Products
- Locking Solutions & Systems
- Interio
- Security Solutions
- Appliances
- Storage Solutions
- Lawkim Motors

Services
- Construction
- Electrical & Electronics
Tooling Division Line of Business
We provide Tooling Solutions

- **Die Casting**
  - Power Train & Engine Castings for 2-wheelers & 4-wheelers OEM & Foundries
  - DC Revenue Share: 50%

- **Press Tools**
  - Press tools/stamping dies for OEMs & tier-1 stampers
  - PT Revenue Share: 30%

- **Industrial Machines**
  - Welding Fixtures for Metros and Railways
  - Turnkey projects
  - IM Revenue Share: 20%

Life Cycle Assessment
Customer Profile

Passenger Vehicle
- Honda
- GM
- Mahindra
- Toyota
- Tata Motors
- Maruti Suzuki
- Renault

Commercial Vehicle
- Volvo
- Eicher
- Piaggio
- MLR Auto Ltd.
- Daimler
- Mahindra Navistar
- Ashok Leyland
- Tata Motors
- Bajaj

Mass Transport
- Mumbai Metro
- Alstom
Life Cycle Assessment

Godrej Tooling Division
Approach for LCA

- Product selection
- BOM Preparation
- GaBi Modelling
- Results and Analysis
The goal of this project is to carry out Life Cycle Assessment (LCA) of one set of Press Tools for a B pillar component (5 dies), to provide a comprehensive view of the life-cycle environmental profile. Study will help to identify opportunities for design improvement and provide approaches for future products.

Evaluation of environmental impacts of all the activities associated with extraction of raw materials necessary for Design, manufacturing – Raw material to finish good Conversion & Assembly. Approach of "Cradle to Gate“ Life Cycle of all stages of product.

Use of one set of Press Tools for B Pillar component.

The manufacturing process at Godrej & Boyce mfg. co. Ltd., Vikhroli plant includes in house processing of various parts and then few parts are purchased outside the boundary and then final assembly is done at the plant site.
**Product Selection- B Pillar Component**

<table>
<thead>
<tr>
<th>Sheet Material</th>
<th>TRC400Y690T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>690 MPa</td>
</tr>
<tr>
<td>Yield Strength</td>
<td>460 MPa</td>
</tr>
<tr>
<td>‘n’ Value</td>
<td>0.194</td>
</tr>
<tr>
<td>‘r’ Value</td>
<td>1.02</td>
</tr>
</tbody>
</table>

Die Process

- OP5 - Blanking
- OP10 - Draw
- OP20 – Trim, Pierce
- OP30 – Re-strike
- OP40 – Pie, Cam Pierce

**Life Cycle Assessment**
More than 80% of Die elements are getting covered in this Case Study
## Life Cycle Assessment

### Reason for Product

<table>
<thead>
<tr>
<th>Product</th>
<th>No. of tools / yr.</th>
<th>Material</th>
<th>Mfg. Process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Castings</td>
<td>Tool</td>
</tr>
<tr>
<td>Draw Tool</td>
<td>40</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Trim Tool</td>
<td>40</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>All Tools of one part</td>
<td>140</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

### Phases of the Life Cycle

- **Production phase**
- **Use phase**
- **End of Life**

**Life cycle stages**

- Preparation of raw materials
- Manufacturing Pre-products
- Tryout
- Use
- Disposal Recycling Deposition

### “Cradle to gate”

### “Cradle to grave”
<table>
<thead>
<tr>
<th>Tool No.</th>
<th>Specs Details</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H/W</td>
</tr>
<tr>
<td></td>
<td>STD</td>
</tr>
<tr>
<td></td>
<td>BOI</td>
</tr>
<tr>
<td>104180 (Blanking)</td>
<td>Insert</td>
</tr>
<tr>
<td></td>
<td>Casting</td>
</tr>
<tr>
<td></td>
<td>H/W</td>
</tr>
<tr>
<td></td>
<td>STD</td>
</tr>
<tr>
<td></td>
<td>BOI</td>
</tr>
<tr>
<td>104181 (Draw)</td>
<td>Insert</td>
</tr>
<tr>
<td></td>
<td>Casting</td>
</tr>
<tr>
<td></td>
<td>H/W</td>
</tr>
<tr>
<td></td>
<td>STD</td>
</tr>
<tr>
<td></td>
<td>BOI</td>
</tr>
<tr>
<td>104182 (Trim)</td>
<td>Insert</td>
</tr>
<tr>
<td></td>
<td>Casting</td>
</tr>
<tr>
<td></td>
<td>H/W</td>
</tr>
<tr>
<td></td>
<td>STD</td>
</tr>
<tr>
<td></td>
<td>BOI</td>
</tr>
<tr>
<td>104183 (Restrike)</td>
<td>Insert</td>
</tr>
<tr>
<td></td>
<td>Casting</td>
</tr>
<tr>
<td></td>
<td>H/W</td>
</tr>
<tr>
<td></td>
<td>STD</td>
</tr>
<tr>
<td></td>
<td>BOI</td>
</tr>
<tr>
<td>104184 (Trim, Cam Pi.)</td>
<td>Insert</td>
</tr>
<tr>
<td></td>
<td>Casting</td>
</tr>
</tbody>
</table>
LCA Modelling in GABI Software

Life Cycle Assessment
Life Cycle Assessment

LCA Modelling in GABI

Casting Assly
Process plan: Mass [kg]
The names of the basic processes are shown.

- Lower Casting: 2.65E003 kg
- Upper Casting: 3.35E003 kg
- Blank Holder: 2.7E003 kg
- Draw Punch_LH: 900 kg
- Draw Punch_RH: 900 kg
### Result Analysis - B Pillar

<table>
<thead>
<tr>
<th>Environmental Impact</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidification Potential (AP) [kg SO2-Equiv.]</td>
<td>625</td>
</tr>
<tr>
<td>Eutrophication Potential (EP) [kg Phosphate-Equiv.]</td>
<td>36.5</td>
</tr>
<tr>
<td>Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]</td>
<td>7.05E004</td>
</tr>
<tr>
<td>Ozone Layer Depletion Potential (ODP, steady state) [kg R11-Equiv.]</td>
<td>1.75E-006</td>
</tr>
<tr>
<td>Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]</td>
<td>30.8</td>
</tr>
<tr>
<td>Human Toxicity Potential (P inf.) [kg DCB-Equiv.]</td>
<td>3.82E004</td>
</tr>
</tbody>
</table>
• Reduce Use of Material by 15%

• Material Substitution by alternate make/ Local Make

• Substitution of Mfg process with process having less environmental impact.

• Reduce Specific Energy consumption 20% by FY2020..
Casting

Raw material weight reduced, by optimizing tool size & machining stock.

Inserts

Raw material weight reduced, by optimizing insert size (standard insert block) & reduced machining stock.
### Tool Size & Weight Optimization

<table>
<thead>
<tr>
<th>CP1000152</th>
<th>TPS Size</th>
<th>Actual Tool Size</th>
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<tbody>
<tr>
<td>Size</td>
<td>2400</td>
<td>1400</td>
</tr>
<tr>
<td></td>
<td>2180</td>
<td>960</td>
</tr>
<tr>
<td>Total Weight (Kg)</td>
<td>8.5T</td>
<td>7.3T</td>
</tr>
<tr>
<td>Saving</td>
<td></td>
<td>70000 Rs</td>
</tr>
</tbody>
</table>

**Savings**
- 1.2 Ton Casting weight (14% Material Saving)
- 1320 KWH Energy (14% Energy Saving)
## Tool Size & Weight Optimization

<table>
<thead>
<tr>
<th>CP1000156</th>
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<th>Actual Tool Size</th>
<th>Savings</th>
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<tbody>
<tr>
<td>Size</td>
<td>2300</td>
<td>2400</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>13.8T</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>56000 Rs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Weight (Kg)</td>
<td>13.8T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saving</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CP1000157</th>
<th>TPS Size</th>
<th>Actual Tool Size</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>2500</td>
<td>2200</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>13.8T</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>336000 Rs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Weight (Kg)</td>
<td>13.8T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saving</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CP1000158</th>
<th>TPS Size</th>
<th>Actual Tool Size</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>2500</td>
<td>2200</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>13.8T</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>300000 Rs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Weight (Kg)</td>
<td>13.8T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saving</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Savings
- 0.8 Ton Casting weight (6% Material Saving)
- 880 KWH Energy (6% Energy Saving)
- 4.8 Ton Casting weight (35% Material Saving)
- 5280 KWH Energy (35% Energy Saving)
- 4.3 Ton Casting weight (31% Material Saving)
- 4730 KWH Energy (31% Energy Saving)
## Tool Size & Weight Optimization

<table>
<thead>
<tr>
<th>CP1000151</th>
<th>TPS Size</th>
<th>Actual Tool Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>2400</td>
<td>2130</td>
</tr>
<tr>
<td></td>
<td>1400</td>
<td>1040</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>800</td>
</tr>
<tr>
<td>Total Weight (Kg)</td>
<td>8.5T</td>
<td>8.0T</td>
</tr>
<tr>
<td>Saving</td>
<td></td>
<td>35000 Rs</td>
</tr>
</tbody>
</table>

**Savings**
- 0.5 Ton Casting weight (6% Material Saving)
- 550 KWH Energy (6% Energy Saving)
Transfer Die Design

1. Considered Pitch as smaller as possible which resulted into saving in Raw material Cost.

Wt Saving of 24 Kg
Elimination of welding/ Fabrication activity
Weight Optimization

Pattern Checking by Designer Manually to ensure the optimum machining stock

Pattern Inspection by Photo - WebEx

3D Model

Thermocol Pattern

Casting

Target is to reduce Machining stock & optimize the weight

Life Cycle Assessment
Pattern scanning by GOM to ensure the optimum machining stock – wt. Optimization

GOM inspection report images

Option 3

Life Cycle Assessment
Inserts wt. optimization by Reducing RM size at ordering stage

BEFORE

- Keeping 10mm stock on Butting faces & 3D area.

Example:
- Finish size: 100 X 100 X 100
- RM SIZE: 110 X 110 X 110
- WEIGHT: 10.4 Kg

AFTER

- On Butting faces 5mm stock
- On 3D profile 8mm stock

Example:
- Finish size: 100 X 100 X 100
- RM SIZE: 105 X 105 X 108
- WEIGHT: 9.3 Kg

Average 200 inserts made in a Quarter

- Avg. Saving (Quarter) = 200 X 1.1 = 220 Kg
- Avg. Saving (1 year) = 220 X 4 = 880 Kg
New method of insert modelling is by using the STD cross section size blocks. Insert block with STD RM sizes which are available in the market is made and kept on server. Designer need to use these insert blocks for modelling of insert with the support of PRL option in the Solid works add-on 3D Quick press.
Insert Modelling by PRL option for Weight Optimization
Tool construction optimization for Reducing material Consumption

Burring & Restrike Die of Fuel Tank 2 Wheeler

LOWER HALF

UPPER HALF

Life Cycle Assessment
As 3D profile eliminated in lower cap, it remains unaffected by updation in data or new part data. Hence, the die can be used for other models by changing only inserts.
2. In upper pad assembly only 2 pad inserts need updation as per new part data. Both inner and outer pads remain the same for every new models.

Life Cycle Assessment
**BENEFITS**

1) **ONLY BY REPLACING THE BELOW 3 INSERTS WE CAN USE SAME TOOL FOR 7 DIFFERENT MODELS**
2) **COST SAVING**
3) **TOOL CHANGE OVER TIME REDUCE**
4) **FLEXIBLE OPERATION**

Total cost of Tool is Rs 4.5 Lacs
Total Cost saved is Rs 4 Lacs

### Saving

<table>
<thead>
<tr>
<th></th>
<th>TOOL (Wt. in Kgs)</th>
<th>REPLACABLE INSERT (Wt in Kgs)</th>
<th>Material Savings in Kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESTRIKE &amp; BURRING DIE</td>
<td>550</td>
<td>35</td>
<td>515</td>
</tr>
</tbody>
</table>

**LOWER DIE INSERT WT. = 23.3 kg**
**INNER PAD INSERT WT. = 4.5 kg**
**OUTER PAD INSERT WT. = 6.7 KG**
Use of Alternative Material to save Machining & operation Cost

HMSI Draw Die (Inner)

COMPONENT

LOWER HALF

UPPER HALF

Life Cycle Assessment
Use of Alternative Material to save Machining & operation Cost

Material changed from SKD11 to Toolox
## Use of Alternative Material to save Machining & operation Cost

<table>
<thead>
<tr>
<th>OPERATION</th>
<th>SKD11</th>
<th>TOOLOX</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAT TREATMENT</td>
<td>REQUIRED</td>
<td>NOT REQUIRED (pre hard)</td>
<td>- Energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- No gas emission</td>
</tr>
<tr>
<td>STRESS RELIEVING</td>
<td>REQUIRED</td>
<td>NOT REQUIRED</td>
<td>- Energy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Time</td>
</tr>
<tr>
<td>CUTTER CONSUMPTION</td>
<td>X</td>
<td>X/2</td>
<td>- Energy</td>
</tr>
<tr>
<td></td>
<td>(2 times machining</td>
<td>(1 time machining)</td>
<td>- Time</td>
</tr>
<tr>
<td></td>
<td>– soft &amp; hard)</td>
<td></td>
<td>- Lead time</td>
</tr>
<tr>
<td>ASSLY (SPOTTING)</td>
<td>HIGH</td>
<td>LOW</td>
<td>- Spotting time reduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Less distortion of 3D surface</td>
</tr>
<tr>
<td>CHROME PLATING</td>
<td>After 50k to 80k</td>
<td>1.5 Lacs stroke no</td>
<td>- Energy</td>
</tr>
<tr>
<td></td>
<td>stroke, dechrome</td>
<td>chrome plating is required</td>
<td>- Time</td>
</tr>
<tr>
<td></td>
<td>plating &amp; chrome</td>
<td></td>
<td>- No gas emission</td>
</tr>
<tr>
<td></td>
<td>plating is required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sustenance & Horizontal Deployment

Sustenance Plan

Design Template kept on server. It can be used during modeling.

Horizontal Deployment

Such type of changes can be done in all future similar fuel tank dies.

This activity helps us to reduce the usage of raw material thereby reducing the environmental effect.
LCA Benefits

- Measure environmental impact of product throughout life cycle
- Identify hot spots in product value chain
- Decision making for material selection while new design or modification
- Focus on operational efficiency and supply chain at product level
- Improve environmental performance through hot spot analysis
- Benchmarking against competitor’s product impact and gain marketing benefits
• PMO Project - Reduce Tool Cost / Tool wt. optimization.

• LCA Study in die casting business for -2 wheeler Crank Case
**Improvement** – Reduce Tool Cost / Tool wt. optimization.

**Crack team leader:** Mr. Jayesh M K

**Sponsor:** Mr. Vinay Gandhi

<table>
<thead>
<tr>
<th>Initiative Description</th>
<th>Activity Plan</th>
<th>Time Line</th>
</tr>
</thead>
</table>
| Reduce Raw matl cost by weight optimization & alternate make. Reduce manufacturing cost by optimizing operation.                                                                                          | Reduce Raw matl cost by weight optimization & alternate make.  
- Study of existing practices/ brain storming with team.  
- Compile the data of actual v/s model stock for casting.  
- Decision making for reducing the machining stock matl in casting as per the overall size.  
- Reduce RM sizes of insert block while ordering by checking the stock requirement in e-drg.  
- Optimize the insert block size in design.  
- Decision making for insert RM size & alternate matl. (Cast D2, Toolox, P20) | 19/06/2018  
26/06/2018  
03/07/2018  
10/07/2018  
17/07/2018  
24/07/2018 |
| **Rationale**                                                     | Reduce manufacturing cost by optimizing operation.  
- Study of existing process/ brain storming with team.  
- Identify & rearrange / compile the sequence of operation.  
- Reduce the post H/T stock matl by studying existing process.  
(To reduce post H/T machining time)                                             | 24/07/2018  
07/08/2018  
14/08/2018 |
| **Benefits**                                                       |                                                                                                                   |           |
| 10% Tool cost reduction.                                            |                                                                                                                   |           |
| **Team members**                                                   |                                                                                                                   |           |
| Umesh Bane                                                         |                                                                                                                   |           |
| Movin D’Mello                                                      |                                                                                                                   |           |
| Jeevan                                                             |                                                                                                                   |           |
Reason for selecting the Product:
More than 70% volume in Die casting Business is of 2 wheeler Crank case dies
THANK YOU