‘TOC’ Promotion – The Tata Steel Experience

Prasanna Kumar Jha
Tata Steel Ltd.

- Medical aid in remote areas
- Patronizing sports
- Providing water in rural areas
- Empowering women
- Adult literacy
- Happy employees
- TATA NANO
- A century of Trust
Prasanna Kumar Jha

21 years of experience in Steel Operations and Supply Chain Management.

Involved in implementation and institutionalisation of Supply Chain, Logistics and Project Management solutions at Tata Steel.

Instrumental in implementing Replenishment solution in Flat Products Division of Tata Steel.

Also involved in execution of around 300 maintenance and sustenance projects using CCPM.

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Agenda:

- Organizational profile
- Supply Chain and Logistics Evolution – Implementation of ‘Availability’
- Project Management - The TOC way
Tata Group - Pioneers in Nation Building (established in 1868)

Founder

Jamsetji Tata (1839 – 1904)

“In a free enterprise, the community is not just another stakeholder in the business, but in fact the very purpose of its existence.”

Guiding Philosophy: Customer focus, Innovation, giving back to Society

Governed by the Tata Code of Conduct and Tata Group Values

144 year old professionally managed Business Group.

No. of companies: 114 in 80 countries
Revenue: US $ 100 billion (FY12)
Employees: 425,000

TSL is Group’s 2nd largest revenue earner: Turnover US $ 26.13 billion (FY12)

TATA Group

Many first in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1902</td>
<td>Hotels</td>
</tr>
<tr>
<td>1907</td>
<td>Steel</td>
</tr>
<tr>
<td>1910</td>
<td>Power</td>
</tr>
<tr>
<td>1911</td>
<td>Education</td>
</tr>
<tr>
<td>1932</td>
<td>Airlines</td>
</tr>
<tr>
<td>1945</td>
<td>Motors</td>
</tr>
</tbody>
</table>
Tata Steel India – Organisational profile

- India’s first steel plant; 100 years old
- Turnover - US $ 8 billion (FY12);
- Believes that society is an important stake holder in business – 5 to 13% of net profit is spent on society
- Own raw material

Unique Industrial Corporation; often cited as a global benchmark in Corporate Social Responsibility
# Tata Steel India – Product and Customers

<table>
<thead>
<tr>
<th>Key Customers</th>
<th>Application</th>
<th>Unique offering</th>
<th>Focused segment</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota, Honda, Maruti Suzuki, Ford, Hyundai, Tata Motors, Sat</td>
<td>Tata Shaktee retail</td>
<td></td>
<td></td>
<td>Hot Rolled (HR) Strips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Auto, • Construction industries</td>
<td>• General Engineering, Appliances</td>
<td>Cold Rolled (CR) Sheets</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Galvanized CR Sheets</td>
</tr>
<tr>
<td>LT, DLF, ESAB</td>
<td>steeljunction</td>
<td></td>
<td></td>
<td>Reinforcement bars for construction</td>
</tr>
<tr>
<td></td>
<td>Selling by pieces</td>
<td></td>
<td></td>
<td>Wire Rods</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Large construction projects</td>
<td>• Individual houses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fastners</td>
<td>• Tyre bead wire</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construction electrodes</td>
<td>• Springs</td>
<td></td>
</tr>
</tbody>
</table>
TQM the Binding Glue – From Mining to End Products

Key TQM Response

- Benchmarking, Innovation, Expert creation
- Introduction of TQM promotion departments (CQA, CS&P)
- Introduction of "KVHS" : a focused problem solving methodology
- Codifying the Tata Steel Way of creating and sustaining change

Business Need

- Customer awareness to customer delight - RVM, SVM, CVM
- Theory of Constraints
- Integrated TQM framework (complete value chain)

Improvement Accelerators

- Deming Grand Prize - 2012
- Deming Application prize - 2008
- TQM Diagnosis for DAP 2005
- TBEM Assessment

Business Need

- Start usage of basic TQM tool, Total Operational Performance
- Revisit Vision,
- Measuring effectiveness by TBEM

- Introduce TQM, TPM pillars
- Training & Education
- Value Engineering, AQUIP

- ISO System, Deployment of IT Systems for Business
- Initiation of Quality Circles

Global outlook, Growth
2005-2008

Cost competitiveness
1997-2004

Modernization of mind
1992-1996

Standardization
1988-1992

Seeking world class
2009 & beyond
Agenda:

- Organizational profile
- Supply Chain and Logistics Evolution – Implementation of ‘Availability’
- Project Management - The TOC way
Due to poor infrastructure in India and internal constraints, no steel manufacturers were able to offer good availability to customers.

Availability was not even measured in Tata Steel till FY-06.

Customers had no choice but to keep high inventory to protect their interest, even then stock-out was common.

A Decisive Competitive Edge (DCE) could be created with very high availability and very low inventory, which no other significant competitor could give.
Problem Identification - 2006

Voice of Customer strengthened by Customer Satisfaction survey & QFD

Retail shops – We lose sales due to stock outs because consumers buy the brand whose complete section-mix is available off-the-shelf.

COUNTERMEASURE

Distributors & Retailers would keep more stocks

Situation in 2006

<table>
<thead>
<tr>
<th></th>
<th>Tata Steel</th>
<th>Distributor</th>
<th>Retailer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory</td>
<td>15</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>(Total 75 Days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stock out %</td>
<td></td>
<td>30-40%</td>
<td>40-50%</td>
</tr>
</tbody>
</table>

Other Related issues

- Additional Space for storage
- Degradation of material
- Pilferage
Understanding Root Cause - 2006

Task force formulation with cross-functional members

1. Conflict
   - Capacity Utilization
   - Operational Flexibility

2. Produce more to reduce fixed cost
   - Longer campaigns
   - Do thicker sections to increase productivity

Forecast driven Supply Chain

Production Plan
- Mills
- Monthly Sales Forecast
- Dispatch against Forecast

Sales Offices / Stockyards
- Distributor Forecast
- Monthly Supply
  - Against Forecast
  - Against Order

The solution
1. Align measurement systems from customers’ point of view to support the above action
2. Supply against actual daily consumption by the customers – A replenishment model
Change in measurement – Commitment to Availability

Old measurement: Despatch Compliance = Compliance against a final despatch week at an item level against sales order or stock transfer order

New measurement: Availability = Physical availability of stock at distributors / dealers yard at an SKU level

Example: Distributor stock status for a day

<table>
<thead>
<tr>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>25</th>
<th>DIST Name</th>
<th>GRADE</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>153</td>
<td>68</td>
<td>8</td>
<td>147</td>
<td>19</td>
<td>20</td>
<td>DESON MKTG JHARGRAM</td>
<td>FE500D</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>256</td>
<td>48</td>
<td>15</td>
<td>196</td>
<td>26</td>
<td>22</td>
<td>NANDAN SAHA STEEL CHANDPARA</td>
<td>FE500D</td>
<td>40</td>
</tr>
<tr>
<td>52</td>
<td>535</td>
<td>0</td>
<td>344</td>
<td>227</td>
<td>35</td>
<td>55</td>
<td>BMW VENTURE LTD PATNA</td>
<td>FE500D</td>
<td>55</td>
</tr>
<tr>
<td>19</td>
<td>103</td>
<td>19</td>
<td>2</td>
<td>69</td>
<td>23</td>
<td>29</td>
<td>SILIGURI BUILDERS PVT LTD SILIGURI</td>
<td>500SD</td>
<td>43</td>
</tr>
</tbody>
</table>

Calculation:
\[ \sum \text{stockout day opportunities} = 28 \]
\[ \sum \text{stockout days} = 1 \]

Availability = \( \frac{(28-1)}{28} \times 100 = 96.5\% \)
Supply against actual consumption by customers

Challenges

- Consumption variability
- Changing roles of distributors from chasers to value creators
- IT for uneducated users

Countermeasures

- Define buffer stocks based on aggregation principles
- Education and training for the sales force, Distributors
- Provide consumption data daily to Tata Steel to replenish.
- IT enablement of data flowing all across the country.
- In-house developed accounting package “Ex-package” for the distributors with extensive training

Pull based supply chain

Effects

- Reduction in daily sales variability
- By FY-09:
  - Availability: 63% to 80%
  - System Inventory: 80 to 45 days

Remaining problems:

- All links of supply chain not covered
- Availability at distributor still much below target of 95%

TOC Practitioners Alliance • TOCPA @ P K Jha, Tata Steel
FY10 to FY12 – Focus on improving channel availability

Causal analysis – FY05 to FY09

- Low Distributor availability
  - Low RWH availability
    - Transportation batch
    - Low PWH availability
      - High RRT
- Fixed Production batch
- Consumption variability exists

Problem areas 1

Fixed production batch

<table>
<thead>
<tr>
<th></th>
<th>FY'06</th>
<th>FY'07</th>
<th>FY'08</th>
<th>FY'09</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of Campaigns/SKU/month</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Action Plan

Challenge

Loss of production due to setup
- Projects to reduce setup time

Stock depletion at Plant Warehouse (NBM)

<table>
<thead>
<tr>
<th>Sep'09 days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKUs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10mm</td>
<td>72%</td>
<td>43%</td>
<td>14%</td>
<td>-25%</td>
<td>-48%</td>
<td>-35%</td>
</tr>
<tr>
<td>12mm</td>
<td>22%</td>
<td>35%</td>
<td>38%</td>
<td>50%</td>
<td>55%</td>
<td>54%</td>
</tr>
<tr>
<td>16mm</td>
<td>21%</td>
<td>25%</td>
<td>29%</td>
<td>41%</td>
<td>60%</td>
<td>82%</td>
</tr>
</tbody>
</table>

Section change
FY10 to FY12 – Focus on improving channel availability

**Problem areas 2**

- Large transport batch and high lead time

**Action Plan**

- Redesigning of supply network – Implementation of Hub & Spoke

**Challenge**

- Increased cost: Planned to cover through low inventory and enhanced sales

**Before**

- Lead time: 11-12 days

**After**

- Lead time: 9 days
- Leadtime to spoke: 4 days

**Problem areas 3**

**Action Plan**

- Demand management through protective capacity and market buffer concept
- Demand management through pricing:

**Consumption variability**
Changes and its effect in FY11

Pull based supply chain coverage

System strengthened for pull based replenishment

Mills → PWH → RWH → Distributors → Dealers → Customers

Effects

Focused actions resulted into coverage of the entire supply chain under pull based replenishment process

By FY11:

Availability improved from 80% to 98%

Remaining Problems:

• Availability at dealers during FY11 was still at 94%

Customer
Mills
PWH
RWH
Distributors
Dealers

Pull based supply chain coverage

System strengthened for pull based replenishment

Effects

Remaining Problems:

• Availability at dealers during FY11 was still at 94%

% Availability: Retail customers
Availability at Dealer Outlets

Customer Need → Availability → Problems/Abnormality

### Present Problem:
- Large number of Days of stockouts (6%) &
- High Month-to-Month Variation in Dealer Availability (Coefficient of Variation (CV%) is 4.5% (Apr-Oct FY12)).

### Challenges Associated

<table>
<thead>
<tr>
<th>Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large All India Dealer Network of around 3,500 Dealers with a wide Geographic Reach in all Districts.</td>
</tr>
<tr>
<td>Buffer Management as per changing consumption trends</td>
</tr>
<tr>
<td>Variation and Uncertainties in Transportation leading to high RRT variation (Reliable Replenishment Time).</td>
</tr>
</tbody>
</table>
Analysis of Dealer Availability – FY12

High Stock-Out Days – Distributorwise for dealers: IT enabled flow disruptor analysis

Counter-measures

- Buffer level for New Dealers to be defined as 0.001 for the initial trial period till sales stabilization
- Prioritization rules set for Dealers based on Categorization
- IT-enabled Visualization & Monitoring started for different categories of Dealers.
- Training of dealers on usage of system
- Flow Disruptor analysis to identify reasons for Stock-outs on a day to day basis
Changing role of the Distributors & Retailers

**FROM**
- Place orders & Follow up for supplies
- Track Inventories
- Monitor ROI and Working Capital

**TO**
- Work Collaboratively with Tata Steel to
  - Focus on consumer sales
  - Build Brand promise

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Key Enablers

- Education and training for the sales force, Distributors and Retailers
- Distributor & Retailer has to provide consumption data daily for Tata Steel to replenish accordingly. This was not possible without IT enablement of data flowing all across the country.
Challenges Faced

- Spread to Remote locations where Connectivity is a concern
- Retailers and Distributors were uneducated

Countermeasures

- Mobile based SMS option for the retailers
- In-house developed accounting package “Ex-package” for the distributors

Visibility across the channel through IT
Effects

Availability of distributors & retail sales

- LP - % Availability (DDP)
- Availability
- Plan Availability
- Retail sales

Number of dealers and stock out

- Number of dealers
- Percentage Stockout
- FY08 FY09 FY10 FY11 FY12

ROIC at Distributors

- Percentage
- FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12

Number of stock out at dealers

- Number of stock out days/month
- Good
Agenda:

- Organizational profile
- Supply Chain and Logistics Evolution – Implementation of ‘Availability’
- Project Management - The TOC way
History of CCPM application in Tata Steel

First application in **December 2005** – E Blast Furnace top repair

Since then ................

- **10** Projects in **Mines**
- **74** Projects in **Blast Furnaces**
- **109** Projects in **Steel Melting & Casting**
- **83** Projects in **Rolling Mills**
  - Strip Mill, Wire Rod Mill
  - Hot Rolling Mill, Cold Rolling Mill
- **132** Projects in **Sinter Plants**
- **12** Projects in **Power Plants**

Over **400** Major Shutdowns & Sustenance Projects
Problems in promotion of CCPM

1. With all good intentions……………
   - Let us apply CCPM in your project
   - He will cut my task times in half

2. The belief: In order to complete the project on time each task must complete on time

3. We need management commitment

4. We have his commitment
   - Implement CCPM
   - CCPM will get implemented …………………
   - ……………… Will the results be there ??
### Definition

<table>
<thead>
<tr>
<th>Maintenance Projects</th>
<th>Sustenance Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance to overcome normal wear &amp; tear of equipment</td>
<td>Based on the need, equipment need to be upgraded for</td>
</tr>
<tr>
<td>Inspect the components which need repair or change</td>
<td>- Higher production</td>
</tr>
<tr>
<td>Cleaning and painting</td>
<td>- Meet certain quality requirement of enriched product mix</td>
</tr>
</tbody>
</table>

- Modification to reduce cost of operation
- Modifications to comply with new environmental and safety regulations.
### Project Environment at Tata Steel (2/2)

<table>
<thead>
<tr>
<th>Maintenance projects</th>
<th>Sustenance Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BELIEFS</strong></td>
<td><strong>BELIEFS</strong></td>
</tr>
<tr>
<td>• Done similar projects earlier</td>
<td>• Many groups can influence</td>
</tr>
<tr>
<td>• Continuously improved</td>
<td>• Majority external agencies. Very less control</td>
</tr>
<tr>
<td>• More time spent, better the quality of work.</td>
<td>• Penalty clauses help complete on time</td>
</tr>
<tr>
<td></td>
<td>• Management tools cannot help</td>
</tr>
</tbody>
</table>

**Challenges**
- Identifying potential losses
- Convincing - times estimates are variable
- Minimize transfer batch (improve flow in planning)
- Protect uncertainties with Buffers (placements)
- Synergizing different groups towards common goal
- Project teams are independent – takes own decision on how to manage projects
- Some common resources used as expertise. Free to seek external support.
Need to apply CCPM ……

As Dr James Holt says:

Maintenance is an interesting profession

- Hard work
- Highly skilled
- Rarely recognized

When was the last time someone came and said,

“Thank you very much for Toilets that Flush”

The goal seems to be:

Keep everything running all the time

Ridiculous!! (from a maintenance point of view)

Do you know of anyone who buys a new car and says,

“Oh, I can’t wait to get the first repair done”
Need to apply CCPM (Performance Gap)

**Maintenance** - In terms of statistics:
- We have about 10% down time / year
- About 8% to 9% of which is Planned
- Industry Benchmark ??
- 1% increase in availability - 38 Mil USD in Sales

**Sustenance**
- Huge demand
- Need to augment capacities to meet demand
- Capture desired market segments
- All this would lead to higher down time

![Steel Demand & TSL Capacity](image-url)
## Classification of Maintenance and Sustenance Projects

<table>
<thead>
<tr>
<th>Project Management</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manage &amp; execute ourselves - some contractor labor used for low end jobs.</td>
<td>A. Short term project</td>
</tr>
<tr>
<td>2. Manage ourselves but use external expertise for execution</td>
<td>- 5 days to 1 month</td>
</tr>
<tr>
<td>3. Offload the entire project including project management</td>
<td>B. Long Term Project</td>
</tr>
<tr>
<td>4. Work coordinated by us - executed by petty contractors but offload project</td>
<td>- 1 month to 1 year</td>
</tr>
<tr>
<td>management &amp; engineering</td>
<td><em>We have not applied CCPM in projects spanning more than 1 year</em></td>
</tr>
</tbody>
</table>
Issues in applying CCPM- Buy In

Necessary Assumption

There is a need for the whole project team to complete the project within (a) Budget, (b) Content & (c) Time. If the project team becomes job less if project is completed early, then Budget and Content may be okay, but finishing early may not be important.

Getting a Buy-in

- Time is NOT deterministic
- Skewed distribution
- In a series of dependent activities some will happen early, some will be late
- Taking advantage of early finishes
## Obstacles to Buy In

### Project Type

<table>
<thead>
<tr>
<th>Manage &amp; Execute ourselves</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Agreed time is probabilistic but time difference between 50% &amp; 90% not that high</td>
<td></td>
</tr>
<tr>
<td>▪ Teams find it difficult to relate to some activities completing early and some getting delayed</td>
<td></td>
</tr>
<tr>
<td>▪ Capitalizing on early finishes - instant reaction: “early finishes are always capitalized on”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Manage ourselves but use external expertise</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Ask the supervisor of the external team - If he is given 8 hours to complete an activity: will he tell the expert that he has 8 hours to complete the job</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Off load project including project management</th>
<th>Obstacles</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Never ask the project manager to complete the project early</td>
<td></td>
</tr>
<tr>
<td>▪ On the contrary - Ask what are the reasons the project can get delayed.</td>
<td></td>
</tr>
</tbody>
</table>
Issues in applying CCPM - Execution

Components of execution

Planning as per CCPM

- Issues
- Staggering
- Buffering

Preparation

Execution as per CCPM

- Issues
- Buffer management
Issues in applying CCPM - Execution

Planning - Issues

- Resources are never well defined: most resources are often men
- India with its 1 Billion+: men appear to be limitless
  - Very skilled manpower has been a constrained
- Equipment resources can be considered: In these environments it is not very difficult to add another resource if required
- Multi-tasking of resource is often invisible
- Buy-in of aggressive times: Task managers need to plan how to achieve these new times
- Reorganize people if required
Execution - Taking advantage of early finish

- **Short duration projects**: *Less than 10 days*
  - In most cases all resources are available
  - Since the belief in themselves is not there: the resource may not be present when needed.
  - Planning to make sure resource is available is essential
  - When the project starts, facilitator should point out the early finishes that were not capitalized on

- **Long duration projects**
  - Resources are not planned as per aggressive schedules
  - The conflict is - If resources are brought in early and incase activity is delayed - it will increase cost
Issues in applying CCPM - Execution

Execution

The problems faced are common to projects whether CCPM applied or not.

- **Short duration projects**: Less than 10 days
  - Scheduling within a shift is very important
  - Major time lost in shift changer over
  - Problems faced during trials remain the same whether the project is short or long
  - The time taken to diagnose the root cause

- **Believe in aggressive schedules**
  - As long as progress is good - people have no issues with aggressive schedules
  - The moment the curve rises steeply up - instant reaction: crushing time did not help
## Common Promotion Practices

<table>
<thead>
<tr>
<th>INITIATIVE</th>
<th>Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td>Once people understand the concept they will adopt</td>
</tr>
<tr>
<td><strong>Brochures &amp; Pamphlets</strong></td>
<td>Once peers discuss the concept people will try to adopt</td>
</tr>
<tr>
<td><strong>Slogans &amp; Drives</strong></td>
<td>If demand is created, people will be eager to try the new concept.</td>
</tr>
<tr>
<td><strong>Competition between peer groups</strong></td>
<td>No one wants to be last in the race.</td>
</tr>
<tr>
<td><strong>Reward &amp; Recognition</strong></td>
<td>People will do anything to earn a few extra bucks</td>
</tr>
<tr>
<td><strong>Senior Management Review</strong></td>
<td>Review - forces people to practice, even if they do not believe in it.</td>
</tr>
<tr>
<td><strong>Mandate from top</strong></td>
<td>Management decisions are always adopted</td>
</tr>
</tbody>
</table>

- NONE of these techniques were adopted to promote CCPM
Approach at Tata Steel

Developed expertise

Build Infrastructure
- Formed a team of facilitators
- Trained on TOC
- Trained on CCPM

Checked appropriateness of measure

Changed priority of measurements
Maintenance
1. Content
2. Budget
3. Time

Expansion
1. Budget
2. Time
3. Content

New priority of measures
1. Content
2. Time
3. Budget

Sanitized present plan

Made technical schedule using concept of flow
1. Planning – Finish to Start
2. Maximize production batch – minimize transfer batch
3. Stagger tasks – prevent resource contention

Protected Plan:
- Interruptions
- Variability
- Covariance

Helped teams identify & agree on cause that limit their performance
1. Interruptions
2. Variability in tasks
3. Covariance
4. Exploit the above problems
   4.1 Aggressive scheduling
   4.2 Buffering
   4.3 Buffer management

• When problems really got solved, people adopted the concept.
• Proposed solutions specific to the project. Not suggest generic concepts
Why was the approach effective?

Assumptions:
If a new concept helps people achieve their goals they will adopt it.

Belief:
Implementing the new concept cannot be a goal in itself. It is only a means to the goal.

1. Teams which saw value, adopted the concept.
2. There was no pressure to adopt the process like a religion.
3. Early project completion was celebrated.
4. The concept became popular by word of mouth. Project teams were encouraged to share their experiences. People were encouraged to discuss the pros and cons of the process.
Effects

- **Execution of CCPM projects more than doubled in last three years**

- **Due date performance of projects has improved by 32% over last five years**

- **88% of projects completed within planned time in last two years**

- **Savings Rs 157 Crs (US $ 30.2 Mil) in FY13**

New areas of CCPM application were tried (proj < 48 hrs and IT/NPD projects). Some new projects delayed because of people not trained enough.
CCPM Case on Primary Crusher Replacement in Noamundi Iron Ore Mines: Business Case

Case area described in this presentation

TOC Practitioners Alliance • TOCPA @ P K Jha, Tata Steel
CCPM Case on Primary Crusher Replacement in Noamundi Iron Ore Mines: Business Case

Background: Crusher was installed in 1967 and it was running at high risk due to many defects and at reduced capacity (70% of rated capacity).

<table>
<thead>
<tr>
<th>Year</th>
<th>Model</th>
<th>Make</th>
<th>Weight</th>
<th>Capacity</th>
<th>Max Feed Size</th>
<th>Lump Size</th>
<th>Motor Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>T.C./S. No. -86555</td>
<td>Fuller KCP</td>
<td>238 T</td>
<td>1800 TPH</td>
<td>900 mm</td>
<td>175 ~ 200 mm</td>
<td>450 HP</td>
</tr>
<tr>
<td>2009</td>
<td>CG-820</td>
<td>SANDVIK</td>
<td>262 T</td>
<td>1200 TPH</td>
<td>200 mm</td>
<td>175 ~ 200 mm</td>
<td>450 HP</td>
</tr>
</tbody>
</table>

- **Hydraulic – Not in operation**
- Weight increased due to welding at many places
- Capacity: 1200 TPH
- Max Feed Size: 200 mm
- Lump size: 175 ~ 200 mm
- Motor capacity: 450 HP

New Crusher:
- Model: CG-820
- Make: SANDVIK
- Weight: 262 T
- Capacity: 1600 - 3500 TPH
- Max Feed Size: 1200 mm
- Lump size: 130 ~ 200 mm
- Motor capacity: 600 HP

Welded body at very high risk
CCPM Case on Primary Crusher Replacement in Noamundi Iron Ore Mines: Business Case

- **Poor reliability** of the crusher was **hampering the output of the plant** (output reduced by 30%)

- **Crusher Shutdown** of one day meant **loss of 10000 metric ton despatch** of iron ore from Noamundi to Jamshedpur.

- Raw material stock (including transit) was 25 days. Hence any **shutdown beyond 25 days** would have resulted in **production loss** at Jamshedpur.

- **Supplier** Indicated **55 days completion period** - Industry Benchmark – 30 days for Crusher installation only

- Any steel plant is a “V” Shaped Plant with higher capacity upstream

- Shutting down any processes **upstream** of steel melting results in **Throughput loss**

- Shutting down **Blast Furnaces** results in **Throughput loss** of more than **$2 Million per day**

- **Minimizing shutdown time** would result in **increased Throughput**

- **ABP Target** of production could only be met if this shutdown was for 25 days.
Factors determining total duration of project

- Resources like crane and skilled manpower not available.
- Working on five different floors and co-ordination with 12 agencies.
- Huge amount of dust due to dumper movement on mining roads.
- Limited space for working and very poor ventilation below 25 meters.
- Low awareness level of contractor workers on safety standards.

Current practices

- Start all activities As Soon As Possible (Early Start Early Finish)
- Resource contention (only one crane for ground level work)
- If project is delayed – Disbelieve plan, Panic & hurry all tasks, introduce more task
- 300 Workmen, 30 Supervising managers, 15 experts and TWELVE external agencies involved in the project
Strategy – Option evaluation and project planning

Shutdown planning using various focused methodologies

- Benchmarking (three shift working)
- Learning from past project - LD2
- Revalidation and establishment of resource dependency
- Learning from previous shutdowns like work centre concept, assigning task manager after ‘Manthan’ sessions

<table>
<thead>
<tr>
<th>Days</th>
<th>Plan submitted by Supplier</th>
<th>Reduction after 1st review</th>
<th>Reduction after 2nd review</th>
<th>Reduction after 3rd review</th>
<th>Final CCPM Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>55</td>
<td>27</td>
<td>7</td>
<td>2</td>
<td>19</td>
</tr>
</tbody>
</table>

Fifth International TOCPA Conference
6-7 April, 2013, Pune, India

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Strategy – Option evaluation and project planning

Application of past learning for reducing S/d time

- Dismantling of Bottom shell: 10 hours
- Dismantling of Apron feeders: 12 hours
- Liner removal: 12 hours
- Erection of Apron feeders: 24 hours
- Erection of crusher: 24 hours
- Trial and commissioning: 12 hours

Total reduction in plan through Incorporation of past learning: 94 hours – 4 days

Example - Erection methodology of Apron feeder modified and saved 24 hours in critical path.

Total Saving of 24 hours in Apron feeder erection

<table>
<thead>
<tr>
<th>Task</th>
<th>Initial Plan</th>
<th>Revised plan based on learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering of Apron in single pieces</td>
<td>24 hours</td>
<td>16 hours</td>
</tr>
<tr>
<td>Positioning</td>
<td>24 hours</td>
<td>12 hours</td>
</tr>
<tr>
<td>Alignment</td>
<td>12 hours</td>
<td>8 hours</td>
</tr>
<tr>
<td>Total</td>
<td>60 hours</td>
<td>36 hours</td>
</tr>
</tbody>
</table>

Monitoring and recording of Time and Quality

<table>
<thead>
<tr>
<th>Quality parameters</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheme Approval with Client</td>
<td>Study of time and implication</td>
</tr>
<tr>
<td>Consultant and supplier supervision</td>
<td>Comparison of duration in 1st Apron feeder</td>
</tr>
<tr>
<td>Sign off protocol</td>
<td>Assessment for next feeder and carried forward</td>
</tr>
</tbody>
</table>
Strategy – Option evaluation and project planning

Build Solution
Facilitators involvement

1. Mitigate resource contention by staggering*
2. Accommodate buffer in project
3. Get buy-in of solution design from project team.

- Completed Open Package Inspection in advance.
- Identified shutdown Scope of work with all stakeholders.
- Completed Off line test in Pre-shutdown time.
- Pictorial presentation and Event Chain affect analysis carried out.
- Break up of job in seven Work Centers and assigned Task Mangers.
- Brain storming session for day wise jobs completed in ten round of discussion.
- Identified challenges of shutdown, critical resources Identified task dependency and variability while fine tuning of the plan.
Implementation – Activity Planning and release control

Develop Rules & Implement

Project Manager Involvement

1. Make project team understand complete project by:
   a) Defining project end.
   b) Why do any task (successors)
   c) What do we need to do a task (predecessors)
2. Prepare for activities in advance through Matrix Analysis
3. Improve project flow by release control.
4. Decide priority of tasks by buffer penetration
## Implementation – Buffer management and Task prioritisation

<table>
<thead>
<tr>
<th></th>
<th>Apron feeder</th>
<th>Primary Crusher</th>
<th>Civil Works</th>
<th>Hydraulic, Lub oil and water</th>
<th>Electrical and automation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5th floor</strong></td>
<td>3rd /2nd floor</td>
<td>1st floor/Zero floor</td>
<td>4th floor</td>
<td></td>
<td>Zero and 2nd</td>
</tr>
<tr>
<td><strong>29th April’10 Night Shift</strong></td>
<td>Alignment of Apron feeders</td>
<td>Motor alignment and Handing over to electrical</td>
<td>Grouting of Primary crusher and Hopper beam of crusher</td>
<td>Cooling tower Installation</td>
<td></td>
</tr>
<tr>
<td><strong>30th April’10 Day Shift</strong></td>
<td>Fixing of Chain , pan and Drive alignment</td>
<td>Lowering of eccentric MPS unit</td>
<td></td>
<td></td>
<td>Power cable termination for crusher motor</td>
</tr>
<tr>
<td><strong>30th April ’10 Night Shift</strong></td>
<td>Fixing of Eccentric, MPS</td>
<td>Fixing of Gentle</td>
<td></td>
<td></td>
<td>Power cable termination for control cables</td>
</tr>
<tr>
<td><strong>1st May’10 Day shift</strong></td>
<td>ID Run</td>
<td>Fixing of main shaft</td>
<td></td>
<td></td>
<td>Scaffolding for fixing of control cables</td>
</tr>
<tr>
<td><strong>1st May’10 Night shift</strong></td>
<td>Motor trials</td>
<td>Fixing sensors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2nd May’10</strong></td>
<td>Fixing of skirts</td>
<td>Fixing of sensors</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Project:** Primary Crusher replacement of the LRP at Narmada Iron Mines

**Milestone:** Project End

---

**Buffer Consumed**

- Longest Chain Complete
- Delay point

**Penetrating Task**
- Alignment of Apron Feeder
- Chain Comp: 40%
- Buf Cnsmd: 74%
Implementation – Daily ‘Evening’ Meeting to finalise resource and buffer recovery plans

Organize & Day to Day Manage execution of plan

Task Managers & Team Involvement

1. Organize resources day to day to execute tasks.
2. Execute Tasks.
3. Estimate remaining duration and enablers to complete tasks.
4. Identify potential interruptions in project.
5. In case of undue buffer penetration – make buffer recovery plans

Evening Meeting in progress
Pictorial Recap – Dismantling of old crusher

Total time – 4 days

- Day 1: Removal of Spider cap
- Day 2: Removal of Spider and mantle
- Day 3: Removal of Top shell
- Day 4: Removal of Middle shell
- Day 3: Removal of Bottom shell

Dismantling of Drive, motor, lub oil, piping and electrics was carried out parallel to above.

Before starting of job proper s/d clearance and positive isolation was carried out.
Pictorial Recap – Erection of new crusher

Day 5:
- Erection of bottom shell on steel frame.
- Fixing and tightening Bolts & nuts at the four sides of Bottom shell with Steel base frame.
- Check the top level of bottom shell and align

Day 6:
- Installation of Eccentric shaft
Pictorial Recap – Erection of new crusher

Day 7:
• Installation of Main Shaft Positioning System

Day 8:
• Installation of Pinion Shaft Assembly
Pictorial Recap – Erection of new crusher

Day 9 :
• Installation of dust color over top of bottom shell

Day 10 :
• Installation of top shell
Pictorial Recap – Erection of new crusher

Day 11:
• Installation of main shaft

Day 12-14:
• Installation of concave liners
Pictorial Recap – Erection of new crusher

Day 15:
• Spider Assembly installation

Parallel Activities:
Day 16-17
Cold trial

Day 18
Commissioning

PLC panel termination
Oil line for MPS
Achievement

- First time in World, Crusher and Apron feeders replaced in 18 days
- Sandvik, the supplier, published this in Bulk Handling Journal, Australia
- ZERO Accident.
- The plant reached its rated capacity in one week

CCPM Target – 19 days
Project Completed – 18 days

Savings about US $ 4.2 Million
Way Forward: Sustaining improvement and ensuring irreversibility

<table>
<thead>
<tr>
<th>Project</th>
<th>CCPM Plan</th>
<th>Actual achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>LD#1 Vessel #2 relining, Mar‘10</td>
<td>8.67 days</td>
<td>8.33 days</td>
</tr>
<tr>
<td>LD#1 Vessel# 1 relining, June ‘10</td>
<td>7.6 days</td>
<td>7.6 days</td>
</tr>
<tr>
<td>LD#1 Vessel# 2 relining, Sept ‘10</td>
<td>7.33 days</td>
<td>6.83 days</td>
</tr>
<tr>
<td>LD#1 Vessel# 1 relining, Dec‘10</td>
<td>7 days</td>
<td>6.08 days</td>
</tr>
<tr>
<td>LD#1 Vessel# 2 relining March‘11</td>
<td>6.8 days</td>
<td>5.56 days</td>
</tr>
<tr>
<td>LD#1 Vessel# 1 relining, Dec‘12</td>
<td>5.5 days</td>
<td>5.1 days</td>
</tr>
</tbody>
</table>

After five iterations and incorporating continuous learning from the past, LD#1 vessel relining shutdown has now reached near touch time level - Best in the world

......... many more projects have reached this status today
### Way Forward: Sustaining improvement and ensuring irreversibility

#### Process/Product Failure Modes and Effects Analysis (FMEA)

<table>
<thead>
<tr>
<th>Process or Product Name:</th>
<th>LD#1 Vessel Relining</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsible:</td>
<td>Arunava Das, Mr. Panigrahi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Debricking, Vessel shell cleaning</td>
<td>Gradall</td>
<td>Gradall is down.</td>
<td>Relining time increases</td>
<td>10</td>
<td>Driver not available. Gradall is down.</td>
<td>5</td>
<td>Spare gradall is kept. Diver is pre informed about his job.</td>
<td>5</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Supervision Under Officers</td>
<td>Officers not available.</td>
<td>Relining time increases</td>
<td>10</td>
<td>Unavailability of officers.</td>
<td>5</td>
<td>Officers from both operation and Mechanical is informed about their availability.</td>
<td>5</td>
<td>250</td>
</tr>
</tbody>
</table>
Route was difficult … initial progress was slow……result was inspiring…

Thank you

Welcome to Jamshedpur, India