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ＪＳＷ Steel Limited, Salem Works

SUMMARY OF THE WINNERS' PRESENTATION

JSW STEEL LIMITED, SALEM WORKS, INDIA

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1. Outline of the Organization

1.1 JSW Group

A $13 Billion Conglomerate, with presence across India, USA, South America, Italy & Africa, the JSW group is a part of O.P. Jindal Group with strong footprints across the core economic sectors namely Steel, Energy, Infrastructure, Cement, Paints also in Ventures and Sports. The Group continues to strive for excellence with its strength, differentiated product mix, state-of-the-art technology, excellence in execution and focus on sustainability.

1.2 JSW Steel

JSW Steel is a flagship company of JSW Group. JSW steel is one of India's leading integrated steel manufacturers with a capacity of 18 MMTPA. It is one of the fastest growing companies in India with a footprint in over 140 countries. With state-of-the-art manufacturing facilities located in Karnataka, Tamil Nadu and Maharashtra, it is recognized for its Innovation and Quality. With largest product portfolio in steel, JSW Steel is India's largest steel exporter, shipping to over 100 countries across 5 continents.

1.3 JSW Steel, Salem works

JSW, Salem Works (JSWS) is India's largest Integrated Special Steel (Long Products) plant located in Salem, Tamilnadu with installed capacity of 1.0 MMTPA. JSWS mainly caters to the requirements of automotive sector. It is an environment friendly, zero effluent plant. Earlier, this company was known as Southern Iron and Steel Company limited (SISCOL) and it was formed in the year 1991 with capacity of 0.3 MMTPA predominantly producing commodity steel. It ran into huge losses. By end of 2004, JSW took over the ailing plant with accumulated loss of 54 Million USD (Rs.3.7 Billion), infused fresh capital to revive this sick unit and expanded to one MMTPA with additional investment of 220 Million USD (Rs.15 Billion).

JSWS was a Commodity steel producer. Production of commodity steel was not economically viable due to higher transportation cost of input materials. As the plant had advantage of proximity to the Automobile hubs like Chennai, Bangalore and Coimbatore, company decided to shift from Commodity steel to Special steel. The strategic diversification helped the company for a faster turnaround. Since then the company has been growing steadily with a turnover of around 512 million USD. Details of distinctive features of JSWS is shown in Table 1.1

Table 1.1 Unique / Distinctive features of JSWS

No.	Distinctive Features of JSWS	Value	At Level
1	Largest Integrated Special steel plant	1 MMTPA	India
2	Largest Energy optimizing Furnace	65 MT	World
3	Rail steel production through Tank degassing	-	World
4	Energy optimizing Furnace gross yield	88.3%	World
5	Market leader in Bearing Steel	-	India
6	Market leader in Forging, Free Cutting Steel	-	India

1.4 JSWS's Vision

In line with the strategic shift from Commodity to Special Steel, JSWS formulated its vision as mentioned below:
"**To become the preferred supplier of special steel long products for domestic and global end users**"
The Vision has two key focus elements:

1. Preferred supplier: Commitment to meet customer's Quality and Delivery requirement through proactive Product Development.
2. Global end User: Customer-focused strategy to serve Global automotive and non-automotive makers having production facilities in India or sourcing from India.

1.5 Manufacturing Process

Entire Value chain along with departmental organization of JSWS is shown in Fig 1.1

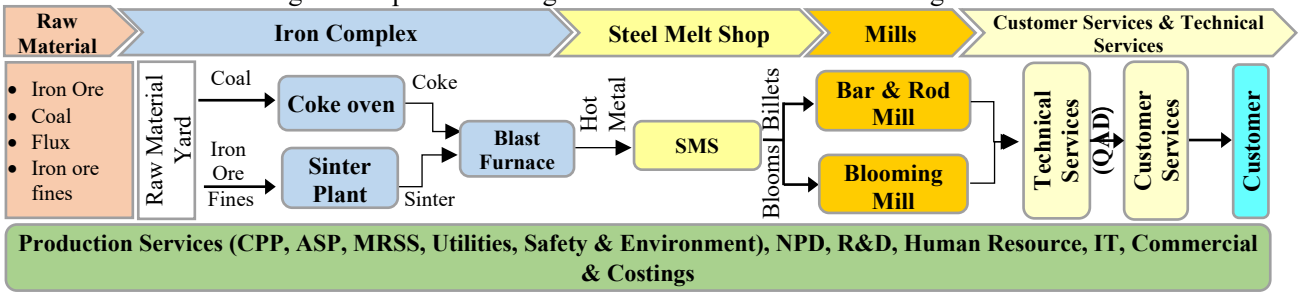


Fig 1.1 Value chain of JSWS

The Steel manufacturing value chain at JSWS is a complex combination of both continuous process and batch process and is described below:

- The major input raw materials such as Iron ore, Coal, Lime stone, Dolomite and other fluxes are sourced from various locations within India and imported from other countries and transported through Sea, Rail and Road.
- Coal is converted to metallurgical Coke in Coke Oven plant by Carbonization process. Sinter is produced from Iron ore fines, process waste materials which are generated in-house and other fluxes through agglomeration

process in Sinter plant. In Blast Furnace, Hot metal is produced from Iron ore, Sinter, Fluxes and Coke & Coal through reduction process.

- In Steel Melt Shop, liquid hot metal is converted into Liquid Steel through Energy Optimizing Furnace (EOF). In Ladle Refining Furnace (LRF) and Vacuum Degassing (VD) Liquid Steel is refined as per customer requirements and converted to solid form as per the required size in Continuous Casting Machines (CCM) as Billets and Blooms.
- Billets and Blooms are rolled in Bar and Rod Mill and Blooming Mill to the required shape and sizes and converted to finished goods.
- Coils and Bars produced in Mill complex are further heat treated in Annealing complex as per customer requirement.

Production services (Air Separation Units, Captive Power plant and Utilities) department provides support to the production units.

Table 1.2 Product Segment and applications

Products		Application
Name	%	
Forging Steel	48	Crank Shaft, Connecting Rods, Bearing, Gears, Front Axle bearings
Bearing Steel	6	Bearings
Fasteners Steel	8	Bolts, Nuts, High tensile bolts
Free Cutting Steel	6	Machined Components - Spark plug
Spring Steel	10	Leaf Springs ,Coil Springs
Rail steel	16	Railway Tracks
Others	6	Boiler, Oil & gas, electrodes, etc.,

% refers the Proportion

1.6 JSWS's Products

The main product segments of JSWS are Forging Steel, Bearing Steel, Fasteners Steel, Free cutting Steel, Spring Steel, Rail steel and Boiler Grade steel. The main product segments and their applications are shown in table 1.2. The end products from mills are as follows: i) Flats, Bars, Coils and Hexagon from Bar and Rod mill (BRM) and

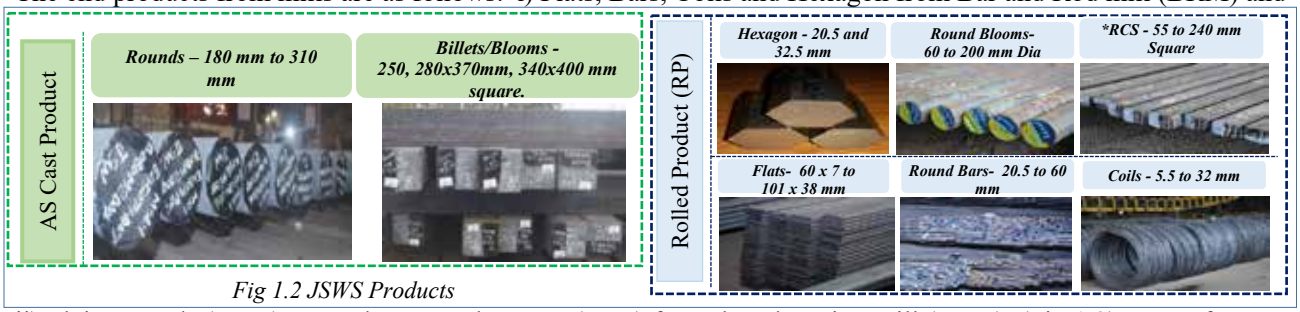


Fig 1.2 JSWS Products

ii) Plain Rounds (RND), Round Cornered Square (RCS) from the Blooming mill (BLM). (Fig 1.2). Apart from this, JSWS also produces 'As cast' saleable products (Billet, Bloom) from Steel Melt Shop (SMS). JSWS caters to the needs of various customers by providing wide range of grades (around 1180) and sizes (> 225) under one roof

1.7 Organization Profile

JSWS is headed by Plant Head, to whom all functional heads report. Iron complex, Steel Complex, Mills Complex, Technical services, Production services and Customer services are the various functions in JSW Salem. The organization structure of JSW Salem is shown in Fig 1.3. JSW Salem has total workforce of 1709, out of that 969 Company employee and 740 regular contract workers. Human Resources, Finance and Accounts, Commercial, BE, R&D and Marketing functions are also functionally reports to Corporate office, Mumbai

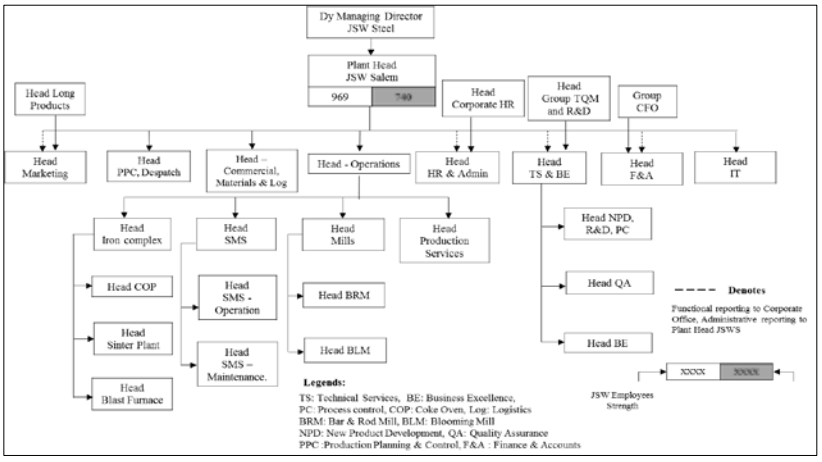


Fig 1.3 Organization structure

1.8 JSWS's Customers

JSWS is the market leader in Special Steel segment with wide range of products and capable to meet the requirements of Automotive, Boiler, General engineering, Agricultural, Defence and railways. The customers of JSW Salem are predominantly automotive component manufacturers.

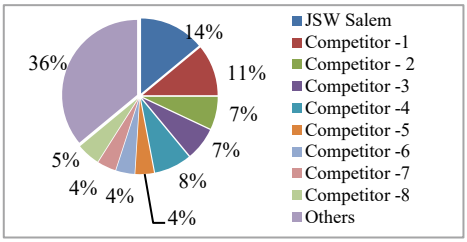


Fig 1.4 RP Market share of JSW Salem (FY19)

Along with the Special Steel As-cast product, **JSW Salem holds No.1 Position in the Special Steel market in India** for the past three years. Rolled product (RP) market share is shown in Fig 1.4.

1.9 Business Growth

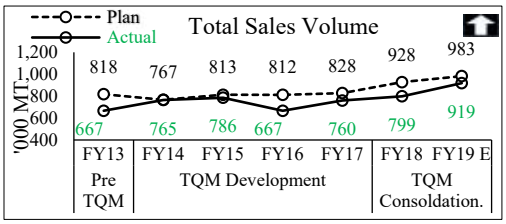


Fig 1.5 Total Sales Volume

Table 1.3 Management System Certifications

ISO 9001-Quality Management System (2003)
ISO/TS 16949- International Quality Management System (2008)
ISO 14001-Environment Management System (2009)
OSHAS 18001-Occupational Health and Safety System (2014)
AS 9100C-Aerospace Standards System (2015)
International Automotive Task Force (IATF)

JSWS embarked on the Global Management systems (Table 1.3) like Quality, Environment and Safety systems for continuous improvements in all the processes.

2. Business Objectives and Strategies

2.1 Industry condition in Pre TQM Phase

In Pre TQM phase, the Indian steel market was characterized by high growth rate supported by favourable government policies. Following was the scenario of the Indian steel market:

a) High growth rate in Special Steel Long Product segment, b) Favourable Government policies c) Entry of Foreign pioneer steel making companies

The Indian Automotive market was growing with a CAGR of 11-15% and 8 - 12% in the passenger and the commercial vehicle segments respectively. The Automotive industry was a key driver for India's economic growth with approx. 4% contribution to GDP. OEM industry consumes 2/3rd of the Automotive Components produced in the country. With favourable macro-economic and demographic trends, India was projected to grow to become the 4th largest Automotive producer in the globe by 2021. In FY13, the Special Steel long products in India had a market potential of approx. 4.57 MMT which includes both Automotive and Non-Automotive segments. Looking at the market potential and considering the advantage of proximity to automobile hubs in Southern and Western regions, JSWS strategically diversified from commodity to Special Steel long products. While diversifying to the new regime of Special Steel long products, JSWS encountered several issues which led to the following four challenges.

2.2 Challenges during Pre TQM Phase (~FY13)

Challenge 1: Creating a robust Business Planning process

Challenge 2: Developing a structured NPD system to make Value Added (high NSR) products

Challenge3: Debottlenecking of assets for improving throughput and margins

Challenge 4: Strengthening Delivery Management and IT support services for a Special Steels plant.

2.3 Business Objectives and Strategies adopted in the TQM Development Phase (FY14-FY17)

To address the four challenges described in 2.2, JSWS set the following Business Objectives under which strategies and strategic initiatives (Policies) were planned.

2.3.1. Business Objective No.1: Improving the Business Planning Process

1) Developing Vision for JSWS

With the shift from Commodity Steel to Special Steel products, JSWS formulated the vision **"To become the Preferred supplier of Special Steel long products for domestic and global end users"**

2) Building a robust Business Planning Process: From TQM Development phase, the Strategic Business Planning process (Fig. 2.1) is being carried out using S7 tools. This is done using Environment analysis for measuring business attractiveness, product analysis to map customer needs and identify potential customers along with market segments.

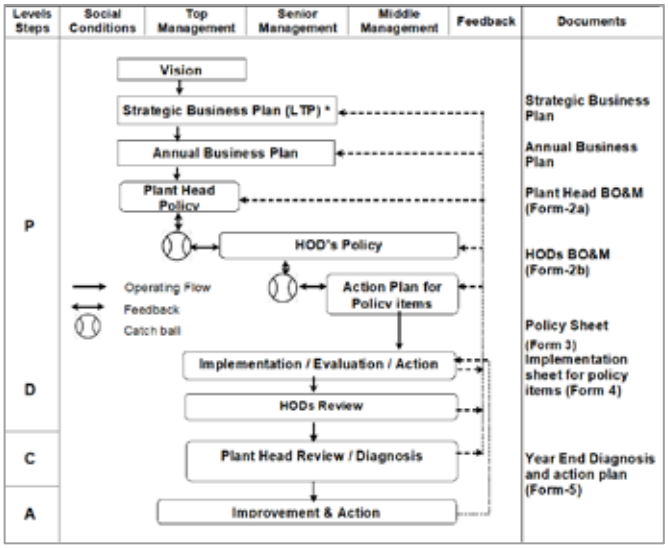


Fig 2.1 Business Planning process

The allocation of resources and their prioritization is mapped in the Annual Business Plan (ABP). From the ABP and Year End Analysis, Plant Head's Business Objectives and Means (BO&M) are finalized. This is then validated and cascaded to next levels using Catch ball mechanism. Target setting is done through benchmarking and statistical analysis. Process and technical Benchmarking exercises are done with various better performing units within and outside the Group.

Based on TQM diagnosis feedback, KPIs in BO&M are categorized into Policy Management and Daily Management and are maintained separately. The process of Policy Management and Daily Management are

explained in Chapter 3 - TQM Journey. Both Policy Management KPIs and Daily Management KPIs are reviewed periodically and course corrections are taken up. Year End Diagnosis is carried out by capturing 'Things Gone Wrong (TGW)', 'Things Gone Right (TGR)' and appropriate actions on the KPIs are initiated for the subsequent year. Implementation of this Business Planning process has streamlined gap identification and problem-solving approach.

2.3.2 Business Objective No.2: Improve Capability for manufacturing Value added Products through NPD

To address the challenge, JSWS conducted, a) Market study for the demand of Special Steel long products, and b) Product Portfolio analysis for Special Steel segments. Analysis in FY13 revealed that 69% of the demand was for material in the form of rolled bars. Product Portfolio Analysis in FY13 indicated that the focus of JSWS should be in the market segments of Bearing, Free Cutting, Fasteners (Cold Heading Quality steel) and Forging grades which were having high market attractiveness. With this projected business scenario, JSWS laid focus on Automotive industry and initiated various capability building and New Product Development initiatives.

After implementing various initiatives, JSWS showed significant change of product portfolio and profitability.

2.3.3 Business Objective No.3: To improve Manufacturing capabilities

Table 2.1 Manufacturing Capability improvement initiatives

Strategies	Means	Sub-Means
Debottlenecking at Hot Metal and Cast stage to achieve 1.0 MMTPA of cast steel production	1. Increase throughput of BF2 from 1650 TPD to 1900 TPD 2. Enhance output in SMS 1 line from 1100 TPD to 1300 TPD	1a. BF2 refractory lining modification to increase capacity from 550m^3 to 640m^3 1b. Converting main runner design as Non-drainable type with runner mass (which was done for the first time in Mini BFs in India) 1c. Introduction of 4th stove in BF2 to increase Hot Blast Temperature 2a. EOF1 augmentation to increase Heat size from 45 T to 65 T 2b. Modify the ladle car and tundish car in CCM 1 to enable flying tundish practice
Increase Blooming Mill capacity utilization	1. Increase in customer base 2. Cycle time reduction	1a. Introducing Hit ratio and Coverage ratio 1b. In house development of slow cooling facilities to meet customer quality 2a. Reducing Reversible mill cycle time by increasing output size and bloom length 2b. Reducing cutting time in Hot Saw
Cost Optimization	1. Cost reduction / improvement initiatives 2. Increase Solid waste utilization 3. Logistics Cost reduction	1a. Cost savings through Deep Drive projects 1b. Yield improvement projects in manufacturing 1c. Energy saving projects 2a. Increase Recycling of in house generated 'Fe' bearing material 2b. Use of Slag for making Paver blocks 3a. Material sourcing through Rail-Sea-Rail mode. 3b. Reduce types of Coals and discharge ports in Coal imports for Coke Oven Plant

2.3.4 Business Objective No.4: Building systems and processes of IT, Delivery Management and Service

1) Improving the Delivery Management: Special Steel industry is characterised by multiple grades and small quantity orders to a large customer base which makes Delivery Management significant. Delivery performance is monitored for improvement and initiatives are taken to strengthen it. Focus is laid on improving the delivery capabilities and reducing the lead time.

2) IT system development: During TQM development phase, IT function saw major development through focus on building infrastructure across the plant, integration of independent systems and implementation of ERP for all business functions. The focus is now on customization of existing system for better workflow and development of customised portals / value applications. Through the effective implementation of IT infrastructure, improvements have been observed in business KPIs related to Quality, Cost, Delivery and Safety.

2.4 BO&S: TQM Consolidation Phase (FY18~)

With the various initiatives taken in development phase, JSWS could establish itself in the special steel long product market with sustainable business growth and achieved market leadership in specific segments. To consolidate the market leadership and sustain the business growth, JSWS focused on widening the special steel product mix and significantly improved the proportion of high EBIDTA margin products. Key strategies and initiatives taken to address the above during this consolidation phase are explained in table 2.2.

Table 2.2 Strategies and strategic initiatives in TQM consolidation phase

Strategies	Means	Sub-Means
Cost optimization	1. Reduction of Raw Material blend cost	1a. Usage of low-grade Iron Ore in Sinter making 1b. Reducing Hard-Coking Coal usage in Coal blend
	2. Reduction of fuel cost	2. Installation of high efficiency top combustion stoves in BF1 to increase Coal injection rate
Increasing Productivity	1. Increase productivity in Mills	1a. Installation of sliding strand to increase throughput of BRM 1b. Improving OLE in all the 3 routes of BRM 1c. Increasing availability of Continuous Mill in BLM

	2. Increase Productivity in SMS	2a. Heat size improvement from 60 to 64 MT in SMS
		2b. Improvement of conversion ratio of Pourable Hot Metal to Gross Cast production
		2c. Commissioning of CCM3 to have flexibility in production planning
	3. Increase Productivity in Iron Complex	3a. Installation of high efficiency top combustion stoves in BF1 to increase productivity
		3b. Modification of Sinter Plant #2 equipment to increase agglomeration input to blast furnace
Proactive product development	1. Focus on Category 3 NPD	1. Development of Cost effective Steel for Automotive and agricultural applications
	2. Value addition through infrastructure and process development	2a. Heat treatment facility for Cold Heading Quality grades 2b. Installation of advanced inspection and testing equipment 2c. Process improvements to manufacture Ultra Clean Steel

2.5 Organizational learning and competencies developed after TQM Implementation

Table 2.3 Key organizational strengths *developed after TQM implementation*

Challenges faced	Key Organizational Strengths
1. To improve Business Planning Process 2. To Strengthen Delivery Management and IT Support services 3. To improve Net Sales Realisation through Structured NPD system 4. To improve margins through debottlenecking and Cost reduction	• Expertise in debottlenecking facilities at faster pace • Pioneering NPD in high end segments in India enabling importing substitutions and hence value creation to customer. • Single source supplier for key auto OEMs like Honda, FAG, Hyundai etc. • Collaborative approach with stake holders (Customers and Suppliers) • First Company in India to develop Rail Steel for European market • Market leader in Bearing Steel Segment, Free Cutting Steel Segment

3. TQM Promotion

3.1 TQM Journey at JSW Salem

JSWS implemented ISO systems from 2003 onwards and started its TQM Journey at the end of FY13 (2012-13). While shifting from commodity steels to special steels manufacturing, JSWS made significant efforts in building systems, processes and employees' capability. During implementation of TQM, real improvements in quality culture started taking place. The key initiatives in JSWS TQM journey are shown in Table 3.1. The TQM practices were developed and implemented under the guidance of TQM Senseis. Feedback from TQM Diagnosis in 2017 helped strengthen the systems further.

Table 3.1 Key initiatives during TQM Implementation

Phase / Aspects	Pre TQM phase (~FY13)	TQM Implementation	
		TQM Development phase (FY14-FY17)	TQM Consolidation phase (FY18 ~)
Objectives and Major Initiatives	▪ Individual improvements by the departments ▪ Kick off TQM by the end of FY13	Create awareness and establish TQM Practices, Promote TQM practices ▪ Development of TQM model ▪ Launch of TQM with JH, 5S ▪ MSCs for CFM	Improving TQM promotion further to support Business Goals
Initiatives on PM and DM	Performance Management System	▪ Introduction of Policy Management ▪ Introduction of Daily Management ▪ Target Setting Process ▪ Catch Balling ▪ Year End Diagnosis	▪ Separation of Policy Management and Daily Management ▪ Introduction of Four students model analysis (2x2 analysis) ▪ Introduction of BO&M sheet ▪ Stability vs Conformity analysis ▪ Plant Head Diagnosis
Initiatives on Capability Building and Employee Engagement	Training & Awareness on TQM	▪ Training on Basics of TQM tools ▪ Training on 5S & JH ▪ Training on TQM Modules ▪ Advanced Statistical tools training ▪ Classification of TEI projects ▪ R&R Schemes ▪ TQM Newsletter (Salem Snippets) ▪ Monthly Communication Meeting ▪ TQM Books, Online TQM quiz ▪ Plant Best Kaizens for Contract workers ▪ Internal Conventions, TQM Audits	▪ Structured Competency mapping ▪ Introduction of 0757 campaign ▪ Introduction of 4i methodology ▪ Training on QFD ▪ Capability Building Framework ▪ Refresher training on problem solving tools ▪ J1+ Certification, J2 training program

Effects	-	▪ 5499 TEI projects done in FY17 ▪ 5S practices implemented in plant ▪ Participation rate in Kaizen increased from 13% in FY14 to 97.4 % in FY17 ▪ Participation rate in QCC increased from 14% in FY14 to 92% in FY17	▪ Kaizen Participation rate increased to 99 % in FY19, QCC Participation rate increased to 96.1 % in FY19 ▪ Customer end rejections reduced from 0.17 to 0.019% in FY13-FY19 ▪ Number of problem-solving experts increased from 60 to 161
Challenges left	▪ TQM Awareness ▪ participation on TEI ▪ TQM Education ▪ Structured PM & DM ▪ Start CFM	▪ Strengthening Year End Policy Diagnosis ▪ Quality of Kaizens and Improvement Projects	-

3.2 Pre TQM Phase (~FY13)

3.2.1 Key Business challenges faced in Pre TQM Phase

With the strategic shift from commodity to Special Steels production, meeting the stringent customer requirements became a big challenge for JSWS. Enhancing the process / manufacturing ability with available resources has become a key concern. Changing market dynamics and increasing competition has created lot of challenges as well as opportunities in expanding the business. In addition to that, improving the capability of people & processes and developing the New Products to penetrate in the Special Steel market were the focus areas for sustainability and Business Growth.

3.2.2 Objectives behind introduction of TQM

In order to be more competitive and to have greater customer focus, JSWS felt the need to adapt a better management system to improve Operational Efficiency with better Quality and Cost. Hence, it started implementing TQM from 2013 onwards for enhancing its competitiveness and creating more value for customers. In line with this, JSWS set its Vision:

"**To become the preferred supplier of Special Steel Long Products for domestic and global end users**"

3.3 TQM Implementation (Development and Consolidation phases)

During TQM implementation period, JSWS had faced lot of challenges. To address those challenges, JSWS started many initiatives which are described below.

3.3.1 TQM Promotion

To promote the TQM activities across the plant, JSWS has taken several initiatives as described below:

a) TQM Model: During TQM implementation, it was important to provide guidance to the entire organization through an integrated TQM framework. The TQM Model (Fig 3.1) was developed for aligning and promoting the TQM practices across the Organization. The model rested on the foundation of change management through leadership and employee engagement using standardization, JH, and 5S, along with NPD, innovation and Knowledge Management.

The Model built itself on the 4 'principles', used the 'vehicles' of PM, DM, SGA and CFM and used a range of 'methods' for problem solving and task achieving. The model aimed to achieve sustainability of PQCDSME parameters and ultimately aiming at customer, employee, societal and stakeholders' delight.

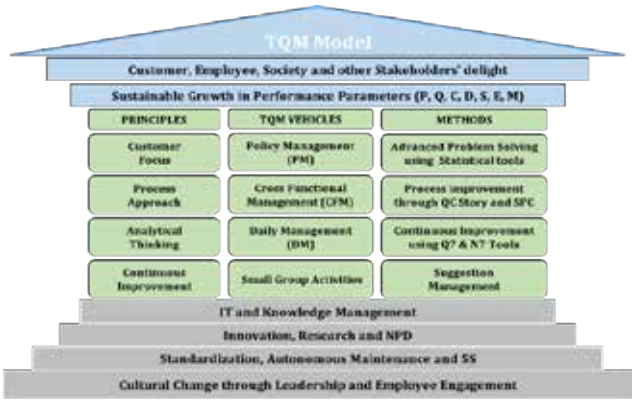


Fig 3.1 TQM Model

b) TQM Governance Framework (TQM Organization): TQM Governance Framework (Fig 3.2) at JSW Salem, consists of TQM Apex Committee, Zonal / Departmental TQM Steering Committees and TQM Promotion office (Business Excellence Department).

TQM Apex Committee: The TQM Apex committee comprises of Plant Head, Functional heads and Business Excellence Head reviews the progress of TQM initiatives every month at plant level. The key responsibilities of the committee are to develop the key polices and guidelines on TQM implementation.

Zonal / Departmental TQM Steering Committees: This Committee comprises of Zonal In-charge, HOD, Section Heads, and departmental TQM coordinators. The committee reviews the TQM progress every month at department level. The key responsibilities of Zonal / Departmental TQM Steering Committees are to drive TQM implementation, motivate the employees and implement the improvement points.

TQM Promotion Office (Business Excellence Department): TQM Promotion Office comprises of Business

Excellence (BE) Head and plant TQM coordinators provides guidance, support and promotes TQM implementation across the plant. BE department coordinates with HR and other departments for various trainings on TQM and Employee Engagement initiatives. In addition to that, BE department updates the status of TQM implementation to Senior Leadership.

3.3.2 TQM Education and Training

Education and Training are the key focus areas for creating awareness and promoting the TQM culture across the plant. JSW Employees and Contract workers were trained on Problem solving tools (Q7 & New Seven Tools), QC Story methodology, 5S practices, Elements of Total Productive Maintenance (TPM) and TRIZ principles. Training on Six Sigma, Advanced statistical tools like Design of Experiments (DOE), Multi Regression Analysis (MRA) and QFD are also conducted to improve the problem-solving skills and develop Problem Solving Experts.

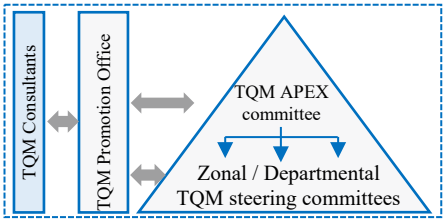


Fig 3.2 TQM Governance Framework

Further, refresher training programs on TQM concepts are regularly conducted on need basis. To check the knowledge on TQM concepts, 'J1 plus', an Online Certification program was started for all managers & above (350 employees). Online tests are conducted through TQM portal.

3.3.3 Employee Engagement

To promote the TQM, various employee engagement initiatives were implemented at JSWS as shown in (table 3.2)

Table 3.2 Improvement of Employee Engagement

Pre TQM (~FY13)	TQM Development Phase (FY14 - FY17)	TQM Consolidation Phase (FY18~)
• Individual improvements by departments.	• TQM Trainings • Structured TEI projects categorization • Communication meetings • Online Quiz, Internal Conventions • TQM Book launch, Rewards & Recognitions	• TQM Campaign 0757 • Deputy MD (DMD) live

a) Communication: JSWS strongly believes that proper and timely communication is very important. Communication forums like Monthly Communication Meeting and 'DMD live' connect senior leadership to all level of employees. Communicating relevant information makes employees feel engaged as explained below:

i) Communication Meetings: Communication meeting is being conducted every month by Plant Head at company level which covers both JSW employees and contract workers. Followed by this meeting, Departmental / Zonal HODs conduct the Communication Meetings at their respective departments. The Purpose of the meetings are to share information pertaining to the Plant Performance, Market scenario, TQM activities, Safety related points, CSR activities and distributing Awards / Rewards for winners of Monthly best Kaizens, Safety Skits and External competitions.

ii) TQM Book Launch Function: TQM Book Launch function is conducted every year. Selected projects are compiled as a book, in the name of "Journey towards TQM" and Top Leadership releases the book during the function in presence of Customers, Suppliers, JSW employees and Contract employees. Till now, JSWS has published 5 volumes of books. JSW employees and Contract workers share their experiences on TQM. Plant Best Kaizen of the year, Highest Kaizen contributor, Best Contract worker Kaizen are awarded in this function.

iii)TQM Portals: To promote TQM through IT, JSWS has developed Portals like Kaizen portal and TQM Portal. Till FY16, Kaizen approval and compilation were done manually. It was a time consuming process.

With increased number of Kaizens, it was also difficult to prepare the MIS and analyze manually. To overcome these problems, Kaizen portal was developed which can be accessed by all the eligible employees. The key features of the system are: i) Automatic mails are sent to concerned employees for faster approval and ii) It provides the consolidated data for easy compilation, retrieval of records and analysis. Based on the TQM diagnosis feedback, option has been provided in Kaizen portal to list out the horizontally deployable Kaizens. Till now, 311 horizontally deployable Kaizens were captured and implemented.

TQM portal was developed to improve the communication & knowledge on TQM. Initially, TQM modules, External competition winners, Monthly best Kaizen winners, etc., were displayed in TQM portal. Based on Diagnosis feedback, the portal was redesigned to include various training modules, TQM News Letter and other relevant information pertaining to TQM. Various Communications also made through the portal. All these portals help to create awareness among employees and also work as a knowledge repository.

Fig. 3.3 TQM Newsletter

iv) TQM News Letter: TQM in-house magazine "Salem Snippets" (Fig 3.3) was introduced every quarter which comprises of TQM and Corporate Social Responsibility (CSR) activities carried out in JSW Salem. Now the TQM News Letter is being released monthly for better and

quicker communication on various TQM activities. The News Letter also talks about the usage of various problem solving tools. The magazine is circulated to all the employees through mail and copies are displayed in the notice boards and also made available on the TQM Portal.

v) Shop Floor TQM Campaign '0757': A TQM campaign-0757 was introduced in FY18 to improve the kaizen culture at Gemba. '0757' targeted Zero Injury, Defect, waste and Breakdowns through use of Basic 7 tools, Implementation of 5S and elimination of 7 wastes at shop-floor. The initiative was adapted from JSW Group. 0757 booklets were distributed to all employees in English and local languages (Tamil and Hindi)

vi) TQM Quiz: Every quarter, online TQM Quiz is conducted. The Quiz aims at increasing the awareness of employees at all levels.

b) Internal and External Competitions: To promote the TQM activities, various Internal competitions like QCC Convention, QIT Convention, 5S Competitions and TPM Competitions are conducted once in a year. Additionally, Monthly Best kaizen award was also started. Initially, one plant best Kaizen was selected for total plant. Later, best kaizen award for services departments also started. The winners are awarded by Plant Head in Monthly Communication Meeting. To motivate the employees and contract workers, the selected best improvement projects (Kaizens, QCCs and QITs) are nominated for external competitions (being held at State level, National level and International level).

c)Rewards & Recognitions: To motivate employees and contract workers, a structured Total Employee Involvement (TEI) projects categorization and Rewards & Recognitions system are put in place for the completed TEI projects (Suggestions, Kaizens, QCC and QITs) as shown in table 3.3.

Table 3.3 Categorization of TEI Projects and Rewards & Recognitions System

Methodology					Improvement Activity (TEI Projects)	Rewards & Recognition		
Suggestion	Kaizen (Why-Why Analysis)	QC story (7 Step)	DMAIC	4i		Department level Rewards (Monthly)	Plant level Rewards (Monthly)	Plant level Rewards (Yearly)
✓	✗	✗	✗	✗	**Suggestion** (Small Improvements by lower level Operators)	✓	✗	✗
✗	✓	✗	✗	✗	**Kaizen Projects** (Small Improvement by upper level Operators & Executives)	✓	✓	✓
✗	✗	✓	✗	✗	**Quality Circles Projects** (Medium Improvement projects by team – Upper level Operators)	✓	✗	✓
✗	✗	✓	✓	✓	**Quality Improvement Team (QIT)** (Large Improvement projects by team-Executives)	✗	✗	✓

3.3.4 Policy Management

Policy Management (PM) is an important element of TQM implementation for realization of Organization's Vision and Business Objectives. The process of Strategy and Policy Management at JSWS is shown in Chapter 2 Section 2.3.1. The implementation of Policy Management is shown in Table 3.4.

Table 3.4 Improvement of Policy Management

Pre TQM (~FY13)	TQM Development Phase (FY14 - FY17)	TQM Consolidation Phase (FY18~)
• KRA Methodology • PMS review	• Introduction of Structured Policy Management • Target Setting and catch balling • Year End Diagnosis • Business Environment Analysis	• Introduction of BO&M sheet • Separate tracking of policy items • Introduction of 2x2 (BO Vs M) analysis • Plant Head Diagnosis

The process of Policy formulation and Deployment is explained in Figure 3.4. Based on Business Environment analysis, Business Issues are identified as per the Annual Business Planning Cycle, which are used to derive Business Objectives & Means (BO&M) for planning and deployment of Business Objectives. Based on Business Environment Analysis and last Year-End analysis of BO&M, Plant Head's BO&M are identified, from which the departmental BO&M are derived.

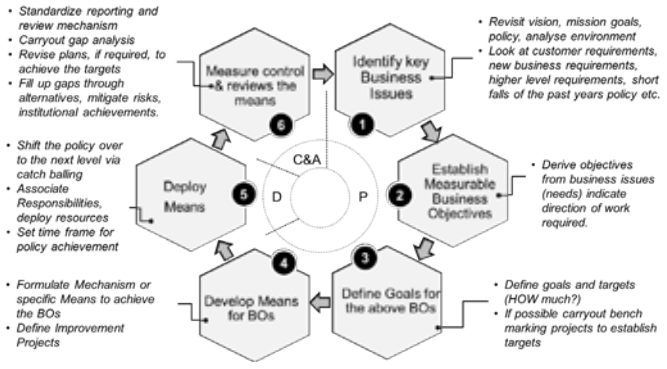


Fig 3.4 Policy Management Cycle

Target for each Business Objective is derived through structured target setting process and "Catch balling". Depending on the importance of BO&M, line items are divided into Policy and Daily Management (MP-CP sheet). To facilitate and standardize the PM, Form 1-5 are introduced which are explained in table 3.5. The Policy Sheet is derived from the BO&M document. Policy items are segregated on the basis of difficulty of KPI improvement as: a) Major stretch in KPI target, b) Major Innovation, c) High on complexity, d) Very high level of Cross-functionality and e) Change Management. Rest of the KPI targets move to Improvement Plan to be carried out through Daily Management.

Year End Diagnosis is carried out by capturing Things Gone Wrong (TGW), Things Gone Right (TGR) and appropriate actions are deliberated wherever required.

Based on TQM diagnosis feedback, clarity between PM and DM is brought out by introducing BO&M sheet and separate tracking of policy items. MP-CP sheet is separated from Form#2 and continued for Daily Management. 2x2 analysis for Business Objectives Vs Means is introduced to further strengthen the Year End Diagnosis and the results are used in next year BO&M finalization.

Table 3.5 Policy Management formats

Form No.	Purpose	Used by				Required for	Frequency of Making/Review
		TM	SM	MM	LM		
Form 1	Identification of Business Issues	√	√	√		Plant Head	Annual / Annual
Form 2a Form 2b	Bi BO&M BO&M	√	√			Plant Head, Dept Head	Annual / Monthly
Form 3	Policy Sheet		√	√		Plant Head, Dept Head	Annual / Monthly
Form 4	Planning, Implementation & Review		√	√	√	Plant Head, Dept. Level	Annual / Monthly
Form 5	Year End Diagnosis	√	√	√		Plant Head, Dept. Level	Annual / Annual

TM: Top Management SM: Senior Management MM: Middle Management
LM: Line Management

3.3.5 Daily Management

The improvements made in Daily Management (DM) are summarized in below table. 3.6.

Table 3.6 Improvement of Daily Management

Pre-TQM (~FY13)	TQM Development Phase (FY14 - FY17)	TQM Consolidation Phase (FY18~)
• Monitoring of Departmental KPIs	• Introduction of Daily Management • Role clarity, Linkage Matrix • Gap analysis, Year End Diagnosis	• RACI Matrix * • Stability vs Conformity analysis • Recurrence Prevention
* RACI: Responsible, Accountable, Consulted and Informed		

The elements of DM are explained in Figure 3.5. It starts from identifying the roles from Job Description (JD) and mapping on RACI (Responsible, Accountable, Consulted and Informed) matrix. Process visualization is being done by KPI drilldown. Means from the superior's BO&M sheet are deployed to next level as Managing Points (MP) and captured in MP-CP sheet for individuals. Checking Points (CP) are identified to achieve the Managing Points. Checking points of superior become the MP of next levels. While Managing points are the parameters which measure the results of a role or objective of the job, checking points are the parameters which measure the process to realize the role or objective. For each MP, target is arrived by structured target setting process and "Catch Balling". MPs are monitored regularly as per defined frequency.

For identified gaps in MP-CP sheet, correction, corrective actions are taken through abnormality analysis. Abnormalities occurred due to standards non-availability, non-adherence and inadequate have been found by using Abnormality analysis frame work and Standards are revised / made wherever applicable and required.

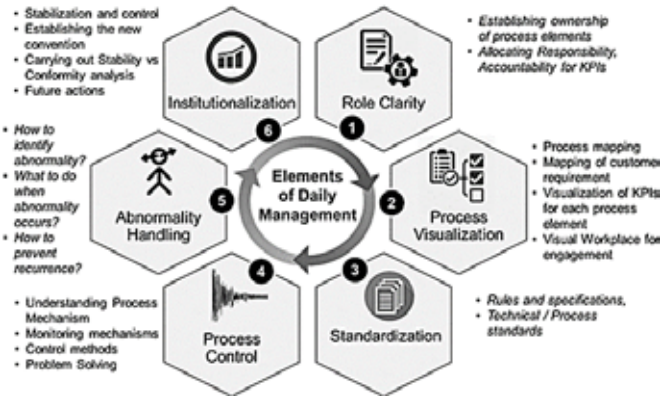


Fig 3.5 Daily Management Steps

As a learning from TQM Diagnosis, critical Managing Points monitored through control charts are reviewed by using 2 x 2 analysis (Stability Vs Conformity shown in Fig. 3.6) on quarterly basis to understand the status / healthiness of Managing Points. Stability refers to the KPI with in the control limits. Conformity refers to the KPI with in the specification limits.

Based on the interpretation from the analysis, improvement activities are carried out to improve the performance of the Managing points. Gap analysis is carried out to identify the "Things Gone Right (TGR)" and "Things Gone Wrong (TGW)" and appropriate disposal actions are initiated. This analysis is also helpful in identifying improvement projects and justifiable targets for next year. DM audits are conducted to check the effectiveness of DM practices.

Conformity of KPI			
	Yes	**Quadrant 3** (Abnormalities present, Target met)	**Quadrant 4** (Abnormalities absent, Target met)
	No	**Quadrant 1** (Abnormalities present, Target not met)	**Quadrant 2** (Abnormalities absent, Target not met)
		No	Yes
		Stability of KPI	

Fig. 3.6 Stability - Conformity Matrix

All the improvement projects initiated based on the ideas generated, based on the gaps observed in PM and/or DM are standardized after completion of the improvement projects to ensure sustenance. Standardization is carried out either by revising the existing SOPs or creating new SOPs.

The focus of Daily Management in maintenance is to improve the availability of equipment by reducing the equipment breakdowns. All the major breakdowns are analyzed on frequency vs impact and improvements are initiated. improve the capability of Maintenance teams, trainings are conducted on selected elements of TPM (JH, PM and KK). Selected critical machines are being taken for implementing JH in a phased manner.

3.3.6 Cross Functional Management (CFM)

JSWS is an Integrated Steel Plant and the process involves complex Value Chain consists of Iron making including Raw material handling, Steel making and Rolling. While PM sets the direction for each vertical function and DM ensures management of routine KPIs, certain horizontal functions where higher interdependencies between

processes are there, require collaborative approach between various departments which is addressed through Cross Functional Management.

All the processes (like QA, NPD, Delivery Management etc.) involving KPIs having cross functionality are mapped through Management System Charts (MSCs) which exemplifies the detailed process flow involving various departments. MSCs help to clarify the roles played by each department / function to attain their overall objectives.

4. Manufacturing Management

4.1 Overview

In steel manufacturing value chain, the Iron complex uses various raw materials to produce one type of Hot Metal and Steel Melt Shop casts Billets and Blooms in over 1200 steel grades. These Billets and Blooms are then rolled in Bar and Rod Mill (BRM) and Blooming Mill (BLM) into Rounds, Round Cornered Squares (RCS), Flats, Bars and Coils (>225 different sizes) as per customer requirement. JSWS operates with a "Manufacturing Management Model" (Fig 4.1) to manage the constraint among the following three focus elements:

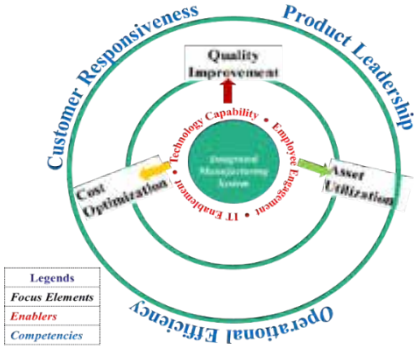


Fig. 4.1 Manufacturing Management Model

a) Quality improvement: Manufacturing variety of products to meet customer's product and service requirement. **b) Cost Optimization:** Producing homogeneous Hot Metal with low-grade iron ore **c) Asset utilization:** Continual improvement in throughput by customized operation and maintenance practices. With the strategic shift from Commodity to Special Steel segment, JSWS was facing the challenge of high variation in raw material quality and low equipment availability. JSWS strategically decided to optimize the processes to overcome the variations in raw material quality. JSWS also focused on strengthening the maintenance practices to improve the availability.

In order to develop the capability to serve the growing demand of automotive long products and to mitigate the above challenges, JSWS strengthened the systems and processes majorly focusing on 1) Customizing Operation and maintenance practice to improve OLE and 2) Technology development and adoption to meet customer's product and service requirements.

4.2 Customizing operation and maintenance practice to improve OLE

a) Process control through Daily management of KPIs: JSWS has established the usage of Statistical Process Control to meeting the stringent quality requirements of Special Steel customers for long-term business sustainability. The product quality is drilled down to individual manufacturing units and then mapped in the QA matrix against the process characteristics (Fig 4.2). The Quality KPIs, which are identified from KPI drill down and QA matrix, are monitored through Daily Management at Gemba. The process abnormalities are identified using control/trend charts. When an abnormality occurs, the KPI owner takes correction to normalize the process. The abnormality is then checked using the Abnormality Analysis Frame Work with respect to adherence to the SOP and appropriate corrective actions are initiated. Additionally, Stability Vs Conformity analysis is carried out at the end of each quarter for quality KPIs. From the analysis, appropriate actions are taken to move the KPIs from Qd1, Qd2 and Qd3 to Qd4.

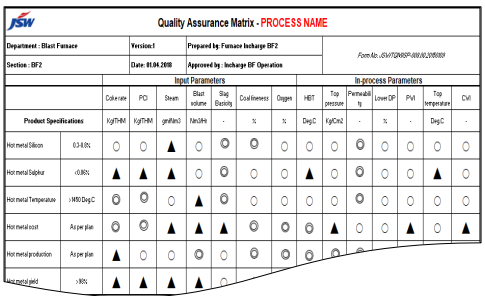

Quality Assurance Matrix - PROCESS NAME

Fig. 4.2 Quality Assurance Matrix

During TQM Development phase, Internal Customer Satisfaction Survey was initiated to gather feedback from internal customers on various attributes to improve the process. For the attributes identified through Memorandum of Understanding (MoU) between internal supplier and customer, the performance is assessed on a scale of 1 to 4 by the customer department. Wherever the attribute has a score of "1 (Strongly disagree)" or "2 (Disagree)", Correction/Corrective actions are taken by the internal supplier and the same is communicated to internal customer. Outcome of the improvements are reviewed again with the internal customer for the same attribute until the satisfaction score reaches minimum "3 (Agree)". This survey was previously done once in 6 months. Based on TQM Diagnosis feedback, the survey frequency is changed to once in 3 months.

b) Customized Maintenance Practices: To strengthen the maintenance practices, JSWS developed a unique system for Daily Management in Maintenance. Maintenance management at JSWS focuses on three attributes: a) Equipment segmentation through Equipment Tree, b) Equipment prioritization through Criticality Assessment and c) Scheduling of maintenance activities through Maintenance Planning. An IT based ERP module to plan and manage maintenance tasks supports the model. From the ERP master data, notifications are generated for maintenance jobs. Along with the above mentioned maintenance practices, improvements are carried out focusing on: a) Infrastructure strengthening to reduce MTTR, b) Life enhancement of equipment to improve MTBF, c) Reduction of process delays and d) Set up time reduction using tools like Time & Motion study and SMED.

4.3 Technology development and adoption to meet customer's product and service requirement

Being a Special Steel manufacturer, JSWS continuously upgrades its process technology to enhance the product quality and delivery to meet the changing demands from customer. JSWS is able to achieve sustainable business growth in Automobile sector and extend its business in Defence, Railways, Agriculture, Oil and Gas sectors with Technology adoption and development. The Technology needs are captured through customer requirements and benchmarking analysis. Technology identification and development process is detailed in *Chapter 6 (New Product Development)* of General DTQMP. Technology needs are finalized after assessing the capability of existing facilities. Through these technological capability enhancements, JSWS has increased its high value product mix from 51% to 91%. The technology adoptions are complemented by configuration management for controlled implementation and producing intended performance.

5. Quality Assurance

5.1 Overview

JSW Salem (JSWS) is the largest integrated Special Steel (Long Product) plant in India catering to automobile, energy, railways and general engineering industries. Quality Assurance is ensured on new product quality, incoming raw material quality, manufacturing quality, service quality and customer quality. Manufacturing units in JSWS consist of Iron Zone, Steel Melt Shop and Rolling Mills. The Iron Zone primarily converts iron ore into molten hot metal, the quality of which is maintained by ensuring checks on the raw materials and process parameters. The Steel Zone converts hot metal to customer specified molten steel composition, which is cast and hot rolled in Rolling Mills to make Special Steel products. Customer specifications are ensured through focused quality checks on process parameters and composition at every stage of melting, casting and hot rolling. All the above functions of quality are governed by an integrated Quality Management System (QMS).

5.2 Evolution of Quality Assurance (QA) System at JSWS

In pre TQM phase, QA System at JSWS was limited to the traditional quality control approach. During TQM Development phase, the QA system was modified to focus on increasing the volume of value added steels in specific market segments. Systems were upgraded to meet the challenges such as (a) Meeting stringent quality requirements of Special Steels (b) Overcoming quality failures in new products by systematic NPD approach (c) Overcoming internal rejection during mass production. Evolution of QA system at JSWS is shown in Table 5.1.

Table 5.1 Evolution of QA System at JSW Salem

	Pre TQM Phase (~FY13)	TQM Development Phase (FY14 – FY17)	TQM Consolidation Phase (FY18~)
Focus of QA System	Interim containment and corrective actions for quality defects	Preventive approach for defect prevention	Enhanced Quality Assurance Management System
QA in NPD	Advanced product quality planning	• Cross functional approach involving all stakeholders • Categorization of new products • Design reviews for NPDs	• Early vendor involvement • Simultaneous product and process design • Usage of QFD
QA in incoming raw material	Incoming raw material inspection	• Introduction of Supplier audit system	• Improved supplier performance monitoring
QA in Manufacturing	• Operator training, SOPs • Use of Process flow diagram and FMEA • Usage of Basic SPC tools • Actions for Containment, Correction	• Technology development/adoption • Process improvement projects using advanced statistical tools • Measurement System Reliability • Early Detection and control of defects • Problem solving through CFTs • Internal customer satisfaction survey • Layered process audit • QASC chart	• Integrated Quality Assurance Chain (iQAC) • QA Matrix • QM Matrix
QA in Service Quality	Manual Test certificate generation	• Proactive Customer visits for quality improvement • Special packaging methods • Auto E-mail delivery notification to customers	• Automatic test certificate generation with Poka-Yoke • Bar code scanning for Finished Goods
QA in Customer Quality	• Training provided to inspectors on customer needs • Manual inspection of products	• Training on Measurement devices and defect detection • Automatic Online and offline inspection • Customer Complaint Management System (CCMS)	• Capturing customer specific requirements • Benchmark analysis of product characteristics

5.3 JSWS QA System

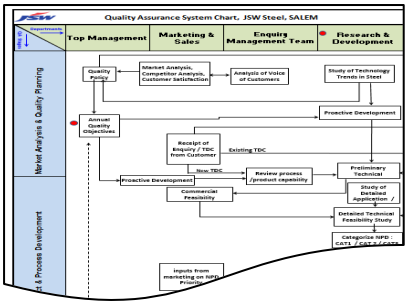


Fig 5.1 Quality Assurance System Chart (Annexure)

The entire value chain from the customer requirements to post-sales support is managed by the deployment of QA System Chart (QASC) (Fig.5.1). Based on TQM diagnosis feedback, QA system chart is revised by covering the function of six key stages, activities managed by responsible departments and KPIs for ensuring right product quality reaches the customer. Elaborate New Product Development (NPD) process is also addressed in QASC. In order to achieve the customer requirements, the Quality KPIs of each manufacturing unit are sequentially interlinked and aligned by an integrated Quality Assurance Chain (iQAC).The specified technical delivery condition as agreed with the customer is drilled down to individual department as quality requirements at each stage through product standard document. In addition, the critical process and product quality characteristics of the manufacturing zones are captured through memorandum of understanding [MOU] between internal customers and suppliers. Cross functional teams address chronic issues through Quality improvement projects.

5.4 New Product Quality

To ensure faster development of new products with lower rejection rate, JSWS adopted cross functional approach for NPD which consists of two independent CFTs, a) Development CFT and b) Reviewer CFT. At each phase of development, Development CFT captures all the developmental requirements followed by Reviewer CFT which reviews the quality related improvements and issues related to the process and product. CFT focuses on the following activities at different phases of NPD to ensure the quality of New Product.

Plan and Define: Customer specific requirements are captured and initial feasibility for new product is carried out by referring to Things Gone Right (TGR) and Things Gone Wrong (TGW) for grades produced with nearby chemical composition.

Product Design: CFT ensures the quality of raw materials, gauges required for development and capture the special characteristics required for the product.

Process Design: Process flow, Floor layout, Process Failure Mode Effect Analysis (PFMEA) and Control Plan (CP) are prepared covering each stage of manufacturing. Internal product standard which encompasses all the specific requirements of customer is released to the manufacturing departments.

Process and Product Validation: Trial manufacturing of new product is carried out and the process/product quality requirements are validated. Based on TGR-TGW study, PFMEA and control plan are revised. Trial lot is supplied to the customer along with Production Part Approval Process (PPAP) documents.

Feedback and Assessment: The product moves to the stage of bulk production if the customer accepts the trial, otherwise Corrective Action and Preventive Action (CAPA) is initiated, PFMEA and control plan is updated and CAPA effectiveness is monitored.

5.5 Incoming Raw Material Quality

JSWS monitors the incoming raw material quality by inspection and testing wherever required. JSWS conducts Supplier Audits by Cross Functional Team comprising of Quality, Commercial and Manufacturing for all the ferro alloys and refractory suppliers.Supplier performance is rated every year based on the Quality and Delivery. Recommendation for the subsequent supply is based on the supplier performance. Supplier's performance was assessed with more emphasis on quality by changing the performance critreria in 2017.

5.6 Manufacturing Quality

To improve manufacturing quality, critical process parameters are identified and monitored by the respective process owners through daily management. Manufacturing quality is enhanced continuously through reviewing the quality of product at every stage of manufacturing on day-to-day basis and nonconformance is analyzed followed by initiation of necessary actions through CAPA. Failure modes are identified for process and product characteristics and the same is incorporated in PFMEA and control plan periodically and improvements are effected for the top 3 RPN values. Process capability is monitored for the stability of all critical parameters using relevant Statistical Process Control (SPC) concepts. Measurement System Analysis (MSA) is being carried out to ensure the repeatability of the instruments and reproducibility of operators. Periodic calibration of gauges and measuring instruments are done to ensure the correctness of measured values. QA team works closely with the manufacturing teams to design the process parameters for defect prevention.

5.7 Service Quality

To ensure quicker deliveries to customer, fourteen numbers of stockyards are established across the country and well connected with the plant through ERP network. All the products supplied by JSWS are batch managed. Each batch is uniquely identified bar code labelled, packed and bundled as per customer standard for complete tracking which ensures that right material reaches the customer. Delivery details and batch information are communicated

to the customer on daily basis through auto e-mail notification. JSWS also extends its service to the customers for solving technical problems faced at customer end.

5.8 Customer Quality

Customer quality looks at the performance of the product at customer end. Customer quality is enhanced through capturing all customer specific requirements, aligning testing methods at JSWS with customers' methodology, and effective Customer Complaint Management System (CCMS). Customer complaints/claims and rejections are handled through CCMS. Every complaint is analyzed for root causes either in the manufacturing process, inspection process or system failures. Counter measures are taken and recurrence is prevented by reviewing and updating of PFMEAs, control plans or work instructions. Proactive customer visits by senior management and functional heads of Manufacturing, Quality Assurance and Planning are carried out. This enables better understanding of the customer quality needs, application and new grades. Customer end technical issues are solved through collaborative approach.

Customer Quality is measured through Customer Satisfaction Surveys. JSWS conducts two types of Customer Satisfaction Surveys (CSS), a) CSS conducted by external agency once in two years b) CSS conducted by JSWS team once in six months. Based on the survey, necessary actions are taken for low score attributes.

5.9 Quality Assurance through Quality Management System audits

Implementation of Quality Management System is ensured through various audits (Table 5.2) that are conducted with a defined frequency for the whole QA chain to ensure products of the right quality are delivered to the customer.

Table 5.2 Quality Management System Audit

Scope of Audit	Nature of Audit	Audit body	Frequency	KPIs
Quality Management System	Internal / External	Internal Auditor / External auditor	Once in 6 months / once in a year	Repeat non conformances
Supplier quality management system	Supplier Audit	CFT (Commercial / Manufacturing / QA)	12 different suppliers in a year	Supplier performance and Incoming material rejection
Process compliance as per work instruction / control plan	Layered Process Audit	QA Engineer / Section Incharge / HOD	Once in Fortnight/ Monthly/ Quarterly	Number of process improvements
	Process Audit	Internal Auditors	Once in 6 months	
Product characteristics against customer specification	Product Audit	Internal Auditors	Once in 6 months	Number of deviations in product characteristics

6. New Product Development (NPD)

6.1 Overview

Moved from Commodity Steel to value added Special Steels production (such as Forging Quality Steels, Bearing Steel, Spring Steel, Rail Steel, Cold Heading Quality and Free Cutting Steels), required a strong NPD infrastructure. Over the years of TQM implementation, JSWS has built a robust NPD system that starts with a systematic process for VOC, product planning, product development with design reviews leading to commercialization and mass production. A CFT approach is used to bring together various interacting departments like Marketing, QA, R&D, Manufacturing, Production Planning and Control (PPC), Commercial and Finance etc., to develop high quality, value-added new products. JSWS classified the new steels for automotive applications into 3 different NPD approaches, depending on difficulty levels of NPD. The 3 categories are shown in Table 6.1.

Table 6.1 NPD definition

	Category-1	Category -2	Category -3
Definition	Product existing in JSW, improvements in chemical composition to achieve specific mechanical and metallurgical properties as per customer specific requirements	2A – Product new to JSW but already existing in market, developed with the existing facilities 2B – Product new to JSW but already existing in market, developed with the new facility addition	Product new to Industry, developed through R&D
Sales Monitoring Period	One year	Two Years	Four Years

6.2 Evolution of the NPD Function at JSWS

For transformation to Special Steel production, NPD system evolved through a structured process flow with facility additions. The evolution of the NPD system at JSWS is shown in table 6.2. The points in red font are explained as cases studies.

Table 6.2 Evolution of New Product Development

Period / Aspects	Pre TQM (~FY13)	TQM Development Phase (FY14 - FY17)	TQM Consolidation Phase (FY18~)
NPD System	NPD for customer requirements (NPD without Design reviews)	• Development of NPD system with design reviews (refer 6.3 and 6.3.1) • Utilization of IT in New Product Development (refer 6.4)	• Proactive development through Early vendor involvement (Category 3) • Concurrent Engineering

Product Segment Focus	• Carbon Steel forging grades • High Carbon wire rods • Plain carbon Cold Headed Quality • Chrome- Carbon Spring Steel • Plain resulfurized free cutting steel • Plain chromium bearing steel for secondary market • Mild Steel Cast Products	• Low alloy forging grades • Tyre Bead wire rods • Boron Cold Headed Quality • Micro alloyed Spring Steel • Lead based free cutting steel • Bearing grades for races and wheel hub application • Rail Steel Cast product for European market	• Micro alloyed forging grades • Tyre cord wire rods • Heat Treated Cold Headed Quality • Silicon Chrome Spring Steel with high strength • Lead Tellurium based free cutting steel (Import Substitution) • Bearing grades for high-end applications (high dynamic load) • Cast product for high temperature applications (for boilers)
NPD Infrastructure	Standard Laboratory Testing Equipment	• Technology Adoption (refer 6.5) • Advanced Characterization Equipment	• Heat Treatment Facility for value addition • Rolling simulation software • Pilot melting facilities

6.3 Developing a Structured NPD System with Design Reviews and EVI

During Pre TQM phase, NPD system without Design Reviews led to higher NPD lead time and higher rejections. A CFT based system was developed with design reviews at each stage of development with following stages (fig 6.1):

1) **Customer requirement Mapping** through QFD (for Category-2&3 products) followed by feasibility analysis.
2) **Concept development** for Category-3 products through research (alloy design, process design, characterization,)
3) **Product design** based on application requirements through literature review, theoretical analysis, modelling and simulation, DOE and plant data
4) **Process design** which includes Process Flow Diagram, process capability studies, PFMEA and Control Plan.
5) **Validation Trial** lot production and validation with respect to customer requirement.
6) Customer feedback and **mass production**.

NPD system is institutionalized through NPD Management System Chart.

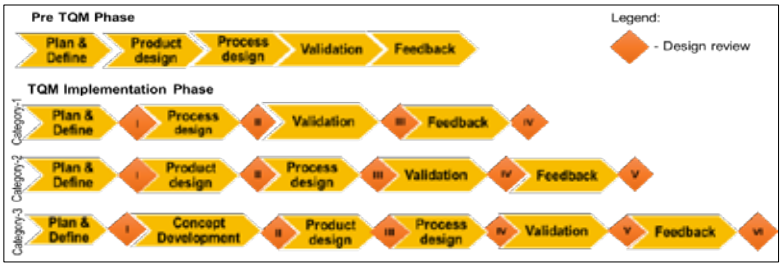


Fig 6.1 Comparison of NPD process

6.3.1 Utilization of Design Reviews (DR)

Design review is a structured way of reviewing the development phases, which helps in identifying the hindering factors pro-actively for timely execution of NPD. The current NPD process consists of two levels of CFT. Reviewer CFT is independent from Development CFT and reviews every phase, provides decision on development and commitment for resources required based on the feedback from development CFT. Design reviews followed in NPD process are described below,

- DR I - Review on Plan and Define: CFT reviews the feasibility of new product with respect to risk assessment, sub-contracting requirements, feasibility and costing.
- DR II- Review on Concept Development: CFT reviews the concept for category- 3 products and alloy design for product properties.
- DR III - Review on Product Design: CFT reviews the requirement of raw materials, facilities, tools, product special characteristics, packing and bundling standards.
- DR IV - Review on Process Design: CFT reviews process flow, PFMEA, control plan and reviews the planning schedule for alignment with the launch date.
- DR V - Review on Process and Product validation: CFT reviews the product and process validation reports, lessons learnt through trial lot production, updated PFMEA and control plan
- DR VI - Review on Feedback and Assessment: CFT reviews the customer feedback, corrective actions taken and signs off for the bulk production.

TQM Diagnosis feedback pages 5,11,40, Design review checklist is revised to review the content of checklist items. The process flow for category 3 is revised by including steps such as identification of raw materials, facilities, spares and tools requirements, release of internal product standard, measurement system analysis plan, etc., Also inputs from other departments like Marketing, Manufacturing, QAD, PPC, Commercial and Finance are derived from initial stages of development to commercialization.

6.4 Utilization of IT in New Product Development

To reduce the lead time for NPD, IT based tools were developed based on problems arising at various stage-gates. Simulations like hardenability calculator and property data base helped reduce the 'product design' lead time.

Similarly, process models like carburizing model, dehydrogenation model, denitrogenation model, slag model etc., helped reduce the 'process design' lead time. These IT tools were used to predict tensile strength, hardness, carburizing time, etc., which helped to reduce physical experimentation time through modelling and prediction.

a) Utilization of Hardenability calculator: JSWS uses hardenability calculator to predict hardness values that gives guidance to get intended range of hardenability as per the customer requirement. A customer came up with a specific hardenability requirement of J15 mm = 35-42 HRC, with a different chemical composition. It was a challenge to achieve the required hardness with restriction in one of the hardenability influencing element (Molybdenum). With the help of the hardenability calculator, the design of chemical composition was done faster by balancing other hardenability influencing element (Manganese). The designed chemical composition resulted in achieving the required hardenability values consistently.

b) Database Development: JSWS generates a wide range of technical data of various properties which is stored in digital form. This forms a large data base for the company which is generated after several trials. The development lead times are reduced by effective usage of database for feasibility assessment of new grades. The response time which was 5 days in FY13 has now reduced to 3 days. In the case of CHQ grade steels, the UTS (Ultimate Tensile Strength) and % RA (Reduction in Area) are important mechanical properties, which vary with alloying constituents and diameter of the wire rod. From CHQ property data base, a model has been developed for predicting mechanical properties as a function of wire rod diameter and chemical composition. Alloying elements have been optimized for best properties using this model. This has been validated for supplies made to other customers also.

6.5 Technology Adoption

Technology needs are derived from customer inputs (visit, audit and complaints), customer facility analysis and technology inputs from OEM equipment suppliers. Based on customer's current and future requirements, technology adoption is done. Technology selection is made from technology need by comparing technology available in the market. Suitable technology is selected and parameters are designed from various inputs namely literature review, equipment manual, research input and customer feedback. After trial and validation, the equipment is used for mass production.

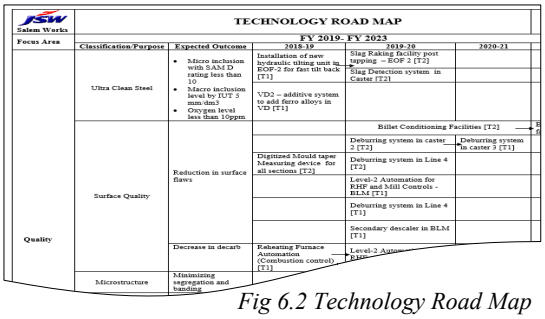


Fig 6.2 Technology Road Map

6.5.1 Technology Road Map: Technology needs are mapped in Technology Road Map (Fig 6.2)

Technology adoption has been classified as

- Type 1 (T1) – Improvement of existing technology / Process
- Type 2 (T2) – Technology new to JSW Salem
- Type 3 (T3) – Technology new to India

7. Delivery Management

7.1 Overview

JSWS had changed its focus from Commodity to Special Steel segments, which demands a robust Delivery Management System for servicing variety of Steel Grades with higher quality and multiple lot orders. Catering to a larger customer base with stringent service delivery requirements is key challenge in Delivery Management. The Order to delivery process is shown in Fig 7.1.

7.2 Evolution of Delivery Management process:

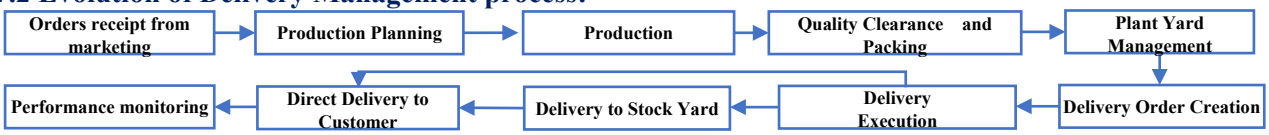


Fig 7.1 Order to Delivery process

Over the period, the elements of JSWS Delivery Management have evolved in the manner as shown in Table 7.1

Table 7.1 Evolution of Delivery Management System

Phase / Elements	Pre TQM Phase (~FY13)	TQM Development Phase (FY14 – FY17)	TQM Consolidation Phase (FY18~)
Production Planning	• Manual order management • Fixed pattern of production schedule	• Order management through ERP • Customization of Planning & Delivery management process	• Reduction of stage wise lead time to improve delivery performance
Quality requirements	• Packing as per customer requirement	• Heat wise, FIFO in dispatches • Bar code scanning for despatches	• Development of Customised / Special packing • Reduction of Transit damage
Inventory Management	• Lot-size /quantity based inventory management • Make to stock	• Flexible pattern of production schedule to meet customer schedules • Make to order	• Focus on FG, WIP and NCO inventory control

Service Delivery Performance	• Only Dispatch compliance tracked • Delivery performance monitoring for cumulative quantity	• Delivery performance monitoring based on demanded order quantity (D1) and delivery time adherence (D2) separately • Strengthening of Supply Chain Network and Yard Management	• Commitment of delivery date to customers • Delivery performance monitoring as On Time In Full (OTIF)

7.3 Customization of Planning & Delivery management process

The production planning to delivery management process is shown in Fig. 7.2

Fig 7.2 Production planning to Delivery

a) Production Planning: In order to meet delivery requirements of the customer, multi pass roll introduced to have a demand based flexibility in production system by repeating the size multiple times with quick change over.

b) Production: A customized online production tracking system was developed through SAP**.** During production confirmation, a unique batch ID is assigned for each product. Post quality inspection and testing, batch wise quality status is updated in SAP. With the introduction of unique batch IDs in SAP, identification and traceability of materials has improved.

c) Delivery Planning: To improve delivery planning, IT enabled customised reports were developed in SAP. This has improved the communication system with better co-ordination among marketing, PPC and logistics for meeting customer delivery schedules.

Table 7.2 Customized Reports in SAP

#	Report	Application
1	Pending Orders Report	To know the status of an order at any point of time.
2	QC Clearance report	Status of QC clearance of batches
3	Current Stock report	To know the status of inventory against order at any point of time
4	Pending MR report	To know the status of FG materials waiting for delivery.
5	Credit limit report	To know the status of credit limit availability for delivery planning
6	Dispatch Plan Monitoring	To monitor the Dispatch process stage by stage

d) Delivery: To improve quality of delivery execution, IT enabled Poke yoke system developed using bar code scanning and linked with SAP to ensure that correct batches are loaded against delivery order**.**

e) Delivery performance monitoring: In Pre TQM phase, delivery performance was monitored only by total order quantity. However, individual order quantity wise delivery fulfilment and timely delivery was required for improving the delivery performance. During TQM development phase, monitoring of order wise fulfilment of quantity within the tolerance (D1) and the scheduled time (D2) was done and detailed analysis was carried out for each order individually. Various IT enabled customized SAP features were developed (Table 7.2) which led to improvement in delivery performance.

7.4 Strengthening of Supply Chain Network and Yard Management

Delivering the material to customer on time with increase in the customer base, destination base (*Fig 7.3*) and small lot orders (*Fig 7.4*) has created the need for increased truck requirement, strengthening of logistics process, flexibility in mode of transportation and increasing the availability of yard network (Table 7.3). The delivery management system was redesigned as an optimisation model.

Table 7.3 Supply chain Evolution

#	Actions taken	Benefits
1	Increasing transporters –23 Nos in FY15 to 36 Nos in FY19	More availability of Trucks
2	Increase stock yards – 9 Nos (FY13) to 14 Nos (FY19)	Quick supply of materials
3	Introduce Transporter penalty clause	Control on transit time
4	Railway despatch for rolled products	Contingency plan established

A freight committee was formed to analyse the requirement of trucks with criteria such as required quantity, destination, number of transporters required, mode of transportation, and multiple destination deliveries by single rake, which enabled increased fleet to cater to the multiple destinations across the country. Warehouse requirements were finalized and yards at various locations were designed to service variety of SKUs (Stock Keeping Units) across the country.

An IT enabled live tracking system using GPS was introduced for tracking the trucks. This Live information helps to monitor the truck status, raise alert /communication to transporters / customers, analyse the transporters performance for necessary improvement. Above actions resulted in reduction of transit time (*Fig 7.5*) and strengthening of logistics set up leading to increase of rolled products despatch from 482,000MT in FY13 to 704,124MT. Yard management improvements were also done to meet customer delivery requirements.

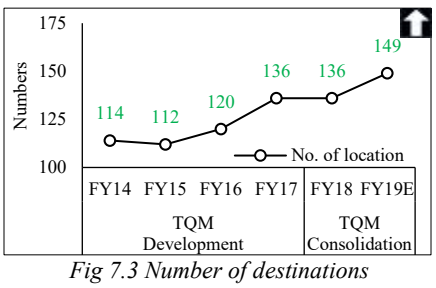


Fig 7.3 Number of destinations

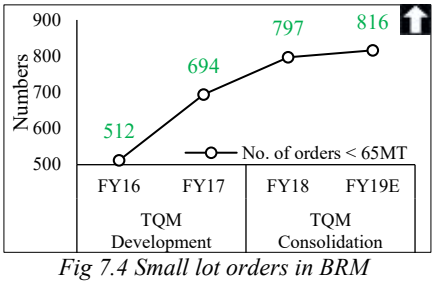


Fig 7.4 Small lot orders in BRM

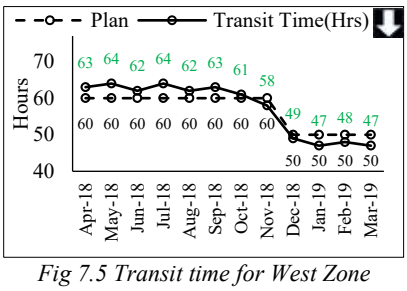


Fig 7.5 Transit time for West Zone

8. Cost Management

8.1 Overview: JSWS is operating in a competitive market with the quest of having a healthy profit margin. Through implementation of TQM, JSWS has initiated various measures that have led to improved profitability. Cost management system is an integral component of JSWS's profit planning exercise to enable achieve its financial goals. It aims at controlling costs at element levels and continually reducing the overall cost by integrating efforts from all parts of the organization including activities during planning stage like New Grade Development, Technology Selection etc.

The annual cost management activities of JSWS include ABP process considering availability of raw materials, process improvements, new manufacturing facilities, product mix and resource allocation. This is followed by anticipation of disruptions and preparation of alternate plans to meet the ABP along with the related risk mitigation strategies. The element-wise cost structure for JSWS enables to drive individual departments to focus on cost reduction initiatives in order to improve the profitability. Cost planning is made considering the techno-economic parameters at both process and product levels to arrive at the Target Cost. Cost Management helps to arrive at the optimum mix of various inputs, optimize the consumption of spares, consumables and utilities by analysis of operating cost at process and product levels.

8.2 Evolution of Cost Management

Table 8.1 Evolution of Cost Management System

#	Pre TQM Phase (~FY13)	TQM Development Phase (FY14- FY17)	TQM Consolidation Phase (FY18~)
Cost Planning	Preparation of Annual Business Plan (ABP) considering average cost of processes	Preparation of ABP based on product	Elementwise tracking of cost of production at finished goods level
Cost Control	Cost control at process	• Preparation of Cost MIS based on Grades and Sections of the product • Multi-level cost review	Sub-grade wise cost control through Product Standard Number (PSN)
Cost Improvement	Reporting the deviations with regard to Business plan and driving the stake holders to take action.	Cost improvement initiatives based on Techno Economic Parameters department wise. Deep Drive initiatives and mid-course corrections.	Digitalization Initiatives Cost improvements under 0757 Product mix optimization

8.3. Cost Planning

Annual Budgeting: Cost planning activity for the next financial year starts with the preparation of ABP (Annual Business Plan) in the last quarter of the current financial year as a part of SBP Process. Based on the global economic outlook, market demand, plant capability and the growth plan of JSWS, guidelines are issued to departments to prepare a draft of business plan for the coming year. Costing department collates inputs from Marketing department, Production Planning and Control department and from all process owners and prepares the draft ABP document. Overall Sales and Production plan is prepared, based on which the expected cost and EBITDA figures are arrived at. This exercise goes through a rigorous Catch-ball process involving the Senior Vice President, the senior management team, HoDs and the corporate office and finally the Annual Business Plan is finalized and approved by the board after several iterations. Targets on various techno-economic parameters are derived considering the overall cost, production targets and previous year achievements. While preparing the ABP, raw material prices for bulk raw material are calculated considering the price trends / projections and index values to mitigate the price variance. From FY18, element-wise tracking of cost of production at the finished goods level is being monitored.

8.4. Cost Control

Preparation of Cost Management Information System (MIS): JSWS has a robust multi layered cost-review structure. Cost MIS is prepared on weekly and monthly basis. Cost data captured in the ERP system are compiled and Process / Product wise cost MIS is circulated to all the departments. The deviation against the targets are analysed for price/usage variance and necessary corrective action are initiated. These corrective actions are monitored for implementation on a regular basis by the finance team. Further, on a monthly basis, cost MIS is further broken down into Grade wise /Section wise cost of the product. In the consolidation phase the cost is now being further broken down into sub-grade level by introducing PSN (Product Standard Number) wise cost to enable effective decision making. The cost monitoring structure is explained in table 8.2

Table 8.2 Multi-level Cost Review Structure

Level	Reviewed by	Frequency of Review	Review of
I	Plant Head with HODs	Weekly/Monthly	Deliberations on cost variance and action plan for cost improvement.
II	Joint MD / Deputy MD	Monthly	Cost performance with Plant Head in EC meeting and directions for further improvement in upcoming months.
III	Chairman and MD	Quarterly	Plant performance including cost performance for the current quarter and assessing the projections for the next quarter with guidelines for further improvement

8.5. Cost improvement

Table 8.3 Cost Improvement Initiatives

#	Cost Lever	Cost Improvement project
1	Yield improvement	Yield improvement in Rolling Mills
2	Recycling and reuse of waste	Sludge usage in Sinter making to replace Iron ore fines
3	Reduction in Handling loss	Coal handling loss reduction in COP

8.5.1 Deep Drive: Cost improvement initiatives under the process of "Deep Drive" was started in FY17 to explore the opportunities for cost savings beyond the business plan targets. This is a successful initiative in engaging employees to explore new avenues to save cost. Following are the few examples of Cost Improvement initiatives (Table 8.3).

9. Safety and Environment Management

Table 9.1 Interfaces of Safety & Environment Department

Interface	Activities
Manufacturing departments	• Highlight environmental aspects (positive / negative) • Communication of online emission parameters exceedance for Corrective Action Preventive Action (CAPA) • Communicating updated statutory requirements for compliance
Regulatory agencies	• Obtaining consent orders for plant operations • Submission of periodical statutory compliance reports

9.1 Overview: JSW Salem (JSWS) strives to provide an injury free workplace to all its employees. Safety department is responsible for inculcating safe work culture by implementing Safety Management System and also rendering necessary assistance and guidance on safety aspects to all departments. Safety department performs the following roles: a) Development & Implementation of Safety Management System, b) Statutory compliance, c) Implementation of OHSAS 18001 d) Training and Communication, e) Risk Mitigation, f) Emergency Preparedness, g) Employees Engagement & Participation and h) Safety Inspection and Auditing.

Environment department is responsible for overall environmental management while performing the following roles: a) Monitoring, measuring and controlling stack emission, fugitive emission, ambient air quality, water quality, source and ambient noise parameters, b) Operation and maintenance of Sewage Treatment plant, c) Implementation of Environmental Management System (ISO 14001). The Department has interfaces with manufacturing departments and regulatory agency as shown in the table 9.1

9.2 Evolution of Safety and Environment Management System

Table 9.2 Evolution of Safety and Environment Management System

		Pre TQM (~FY13)	*TQM Development Phase (FY14-17)*	*TQM Consolidation Phase (FY18~)*
Safety	**Focus**	Safety Monitoring and Statutory Compliances	Implementation of comprehensive Safety Management System	Strives to create an injury free work place through Total Employee Involvement
	Initiatives taken	• Implementation of basic Safety Management System • Site safety patrols by safety officers • Employees are driven in reactive culture • Statutory compliances fulfilment	• Designing & Implementation of Safety Standards • Environment Health Safety (EHS) / Apex Safety Committee governance • Implementation of IT enabled Safety observation and Incident Investigation system. • Implementation of OHSAS 18001 • Safety line walk audit / Inspection	• Monthly theme based activities (Inspection, Safety Skit) • Implementation of IT enabled contractor safety management • Implementation of high risk standards • Specialized training for high risk jobs
Environment	**Focus**	Restricted to statutory compliances	Infrastructure augmentation for online tracking, control and scientific management of waste utilization	Exceeding performance beyond statutory norms
	Initiatives taken	Monitoring of Stack emission, fugitive emission, ambient air quality through physical methods	• Stack emission and effluent parameters connectivity to CPCB. • Continuous Ambient Air Quality Monitoring • Installation of dedusting systems in Blast Furnace & Steel Melt Shop • Installation of Reverse Osmosis (RO) plant to reduce high Total Dissolved Solids (TDS) waste water • Utilization of solid waste in the manufacturing processes	•Water sprinkler and dry fog systems for dust suppression at raw material yards •Implementation of tyre washing unit •Installation of Paver block unit using SMS crushed slag (solid waste)

9.3 Safety Management System

9.3.1 Establishing Comprehensive Safety Management System:

JSWS commits to provide safe and healthy work environment by setting up safety standards and procedures. Comprehensive safety management system was adopted as a part of safety excellence journey to transform the safety culture of the organization from reactive to interdependent. The safety review system was restructured to include various committees as shown in table 9.3. After TQM

Table 9.3 EHS Committees Structure

Committees	Nos.	Functions
EHS/Apex	01	Set goals and objectives and oversee the functioning of sub-committees and monitor plant safety performance.
Sub-Committees (SC)	07	Inculcate the safety standards and procedures throughout the plant through DICs and update the status to Apex.
Divisional Implementation Committee (DIC)	05	Develop and rollout roadmap for standards in each department and review on monthly basis and update the status to SCs
Departmental Safety Committee / Area Implementation Committee	14	Implementation of standards and procedure in each section and update the status to DICs.

development, to improve safety culture in the organization, safety suggestions, ideas, Kaizens and near misses were captured by involving all employees and contract workmen. The 'Safety Idea Mela' was introduced from FY18 based on the TQM diagnosis feedback to encourage more workers' proactive participation towards safety improvement initiatives. In Total, 1013 numbers of safety ideas were implemented.

9.3.2 Safety Training & Communication: Till FY13, safety training was conducted on general safety, gas and fire safety only. After TQM implementation, a structured way of training methodology was adopted. Training needs were identified based on specific job requirement and trainings were imparted. Training plan covers 12 safety modules such as Safety Observation, Incident Investigation, permit to Work, Confined Space, Work at Height, Lock Out Tag Out, Conveyor Safety and training effectiveness is being evaluated. Based on the TQM diagnosis feedback, Risk based safety training programs are being conducted and Safety standard handbook is provided to line managers for better implementation of safety standards. Apart from safety training, monthly safety campaigns on various themes such as Work at Height, Road Safety, Electrical Safety etc., are being conducted to promote awareness.

9.3.3 Implementation of Safety Observation (SO) System: The high risk jobs were mainly performed by the workgroup having basic safety knowledge and low safety consciousness. Hence employees and contract workmen committed Unsafe Acts (UA) unknowingly which resulted in most of the injuries. A proactive measure of safety observation process (Behavior Based Safety Approach) was put in place to build safety culture by involving all line managers. A six-steps safety observation process was adopted as shown in the Fig. 9.1 and all the eligible employees were trained to implement pro-active and two-way safety conversation with workgroup at their work place to minimize unsafe acts. An online IT portal was developed to capture Unsafe Act / Unsafe Condition (UC) for effective analysis and action. Number of injuries due to Unsafe Acts / behaviors have significantly reduced. Monthly review of SOs at DICs, SO Sub-Committee and Apex meetings are being done to monitor continual improvements.

Fig 9.1 Six Steps of SO

9.3.4 Implementation of Incident Reporting and Investigation Procedure: In Pre TQM phase, incidents were captured and investigated in an un-structured manner. In absence of a structured system, it was difficult to promote safe working environment. A systematic Incident Investigation (8 Steps) process was developed in FY17 to ensure that incidents are investigated, analyzed and corrective actions are taken. An online IT portal was developed to track incidents reporting and closure of recommendations. All incidents were communicated through automated mail from portal to members to ensure preventive measures and horizontal deployment. Review of incidents and investigations at DICs, Sub Committee and Apex committee are being done on monthly basis.

9.4 Environment Management System (EMS)

9.4.1. Implementation of Environmental Management System: Aspect impact study related to environmental activities was conducted to identify the major aspects in all the processes. Environmental Management Programs (EMP) are taken based on the significant aspects and the total EMPs completed as on Feb. 2019 are 625. It has resulted in resource conservation, energy conservation, emission reduction, and conversion of waste to wealth.

The revised EMS ISO 14001:2015 standard was implemented across the plant which mainly focusses on 'sustainability' together with its key intended outcomes. The revised standard emphasises on: (i)The needs and expectations of ''interested parties'' both internal and external and their impact on the environment, (ii) Determination of risks and opportunities and their effective management and (iii) Concept of considering a life cycle perspective.

9.4.2. Monitoring of Environmental aspects:

1) Ambient air quality: To ensure ambient air quality various initiatives have been taken. Dedicated dedusting systems are installed in stock house and cast house of both BFs. Secondary dedusting systems are installed in Energy Optimizing Furnace (EOF) and Ladle Refining Furnace of SMS. Concrete roads were laid covering about 15 Km inside the plant and two road sweeping machines are provided to control fugitive emission due to vehicular movement. A tyre washing system is installed to minimize vehicular dust emissions. Stack emission monitoring systems are also installed for continuous monitoring of suspended particulate matter. Proactively, limits are introduced at 60% of the standard to serve as an early indication for controlling the stack parameters well within the permissible limit.

Greenery is maintained in all the areas and contributed to improve the ambient air quality. Various species of trees are continuously planted and nurtured every year. Bheema bamboo trees that are known to have higher Carbon di-oxide absorption potential are planted in the periphery of the plant. As on Feb 2019, there are 2,05,250 trees in our plant area.

2) Water consumption: Water being a precious resource, its usage is monitored in various processes. The waste water generated from the process is collected, treated in guard pond and reused to ensure Zero Liquid Discharge. Reverse Osmosis (RO) plant of 4 Millions of Liters per Day (MLD) was installed in the upstream process to eliminate high TDS waste water generation from the softener plants. By using RO blended water in cooling towers,

blowdown waste water generation in cooling towers was reduced.

3) Waste utilization: Effective utilization of resources and their management is of prime focus in all processes. The major solid waste is slag which is generated from BF and SMS. BF granulated slag is entirely sold to cement industries. EOF Slag is used in-house for road formation and also sold to cement industries. Collaborative effort with R&D to utilize EOF slag for paver block manufacturing has improved the utilization. 'IPR' has been filed for this innovative idea. JSWS is the only plant in India, using EOF slag as a coolant in EOF process. It is also used in Sinter plant as hearth layer to replace the raw material in smaller proportions. Dust from the bag filters, cyclones and filter cake from the gas cleaning plant are completely recycled in the Sinter Plant. Fly ash generated from the power plant is sold to fly ash brick manufacturing units. An innovative idea was developed wherein fly ash was reused in coke oven plant as a top layer in Coke making to minimize the burning loss. Through these initiatives, Waste utilization has increased from 65% in FY13 to 78% in FY19.

10. People Management and Corporate Social Responsibility

10.1 Overview

JSW Salem (JSWS) is India's largest integrated Special Steel Long Product plant with a capacity of One Million Metric Ton Per Annum (MMTPA). Special Steel making requires specialized skills and effective people management is critical for better quality and maximizing productivity. The focus is on building workforce capabilities through structured training programme and creating a highly engaged workforce.

10.2 Evolution of People Management

During Pre TQM Phase, JSWS concentrated on improving the plant infrastructure, improving the skills for Special Steel making, building systems for core processes, online payroll system, developing public relations and meeting statutory compliances. The following were the challenges faced: 1) Lack of skills required for making value added products in the existing employee base, 2) Low engagement levels among workforce, 3) High attrition rate among Contract Workers leading to lower skill level, poor safety, lower productivity and lower employee morale.

Table 10.1 Evolution of Human Resource (HR) Practices

Challenges	Pre TQM Phase (~FY13)	TQM Development Phase (FY14-17)	TQM Consolidation Phase (FY18 ~)
Lack of skills required for making value added products in the existing employee base.	• Skilled in commodity steel production • Cursory assessment of skills • Trainings on technical skills (OJT)	• **Capability building of workforce** o Skill mapping and skill enhancement for operators and supervisors (L01-L06) o Competency mapping for managers (L07-L14)	• **Capability building framework** o Leadership Development -Future Fit Leaders, Springboard for women o Competency enhancement o J1+, J2 trainings o JSW learning academy
Low engagement levels among workforce	• Need based improvement projects	• **Employee Engagement** o Communication o Training & Education o Participation in problem solving o Rewards & Recognitions	• Employee Empowerment Model • DMD (Deputy Managing Director) Live
High attrition rate in contract workers	• Differential wages • Low welfare facilities • Need based engagement	• **Effective management of contract workers** (Explained in chapter 12) o Performance based wages o Welfare, transport, medical facilities o Skill improvement (Highly Skilled & Skilled) o Contract workers engagement	• Wage correction

During FY14-17, JSWS invested in capability building of the employees, created systems to effectively manage contract workforce and improved the employee morale through various employee engagement forums.

10.2.1 Capability building of JSWS workforce

In JSWS, 55% of workforce consists of JSW employees and remaining 45% are contract workers. JSWS faced difficulties in meeting customer expectations due to lack of required skills and capabilities among its people. Trainings during the pre TQM phase were mostly technical, delivered through OJTs (On the Job Trainings). The training needs sourced from Performance Management System (PMS) and skill gaps were sourced from a cursory system.

During TQM implementation, shortcomings were analysed and a new system to improve the knowledge, skills and competencies of workforce was developed. This system enabled JSWS to identify the improvement areas, customize the trainings to suit the requirements and choose the effective training methods.

1). Skill mapping & evaluation system: JSWS introduced skill mapping & evaluation system for Operators, Supervisors (L01 to L06) and contract workers (Skilled and Highly Skilled). Class room sessions were conducted to close generic skill gaps and OJTs for enhancing the technical skills. Overall skill level (SL3+SL4) improved from 72.6% (FY17) to 94% (FY19).

2). Competency mapping was introduced for Managers and Executives (L07 to L14). 249 unique job positions were identified and competencies were mapped. Competencies were categorized into managerial and functional competencies. Technical trainings were given to stay abreast of technological advances in the Special Steel industry. Leadership and behavioural trainings were conducted to improve the soft skills of our executives. This resulted in better work environment, team cohesiveness and enabled the managers to lead their teams better.

3). Capability Building Framework: During TQM consolidation phase, based on TQM diagnosis, JSWS developed an all-inclusive Capability Building Framework that integrated feedback into the training system, helped renew the capabilities and sustain performance levels. The following were the improvements done: 1) Training needs assessment was widened to encompass the improvements arising out of skill and competency evaluation 2) Leadership trainings and behavioural trainings were given focus 3) Skill and competency enhancement trainings were institutionalized. This framework (shown in Fig 10.1) was effective in a) Giving clear direction for employees to advance their career, b) Managers and Head of Departments (HoDs) identifying futuristic training needs for teams and c) Bringing an all-inclusive training calendar to meet institutional needs.

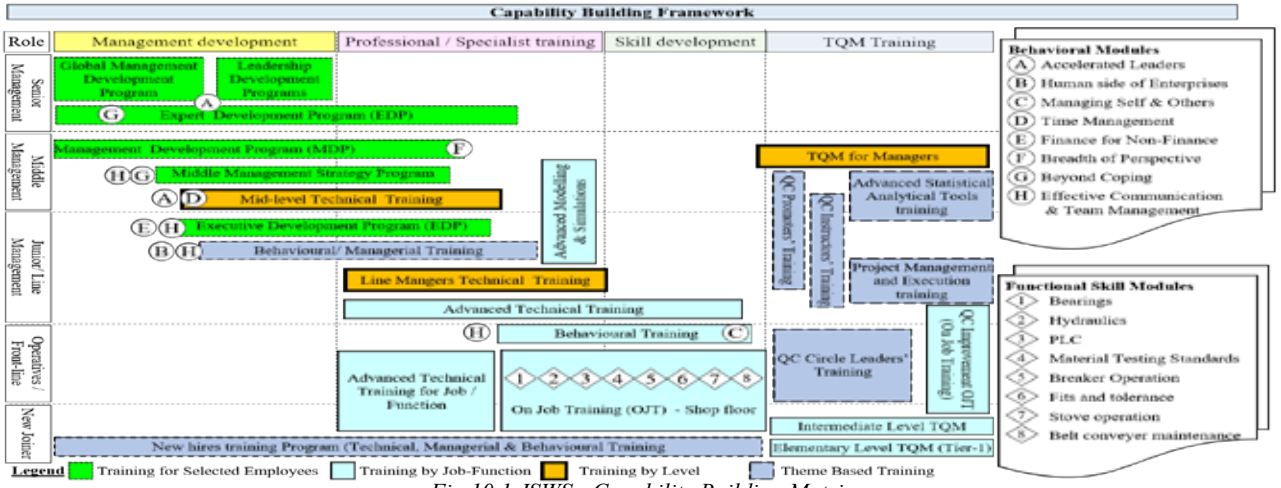


Fig 10.1 JSWS - Capability Building Matrix

JSWS introduced experiential learning through online JSW Learning Academy. Harvard Manage-Mentor, Skill soft platforms were extended to all our employees. These platforms allowed the employees to learn at their own pace.

Evaluation of Training effectiveness: JSWS has continuously improved the methods of evaluating training effectiveness based on TQM diagnosis feedback. Pre and post-tests are administered for class-room trainings to measure knowledge gain. The individuals, respective Heads of Departments/reporting managers are involved in post training assessment three months after training, which helped to measure the improved workplace performance.

10.2.2 Employee Engagement

The changing market scenario necessitated that human resources be increasingly motivated to meet the challenges. During TQM development phase, JSWS developed an employee empowerment model comprising of four elements of engagement as in Fig 10.2

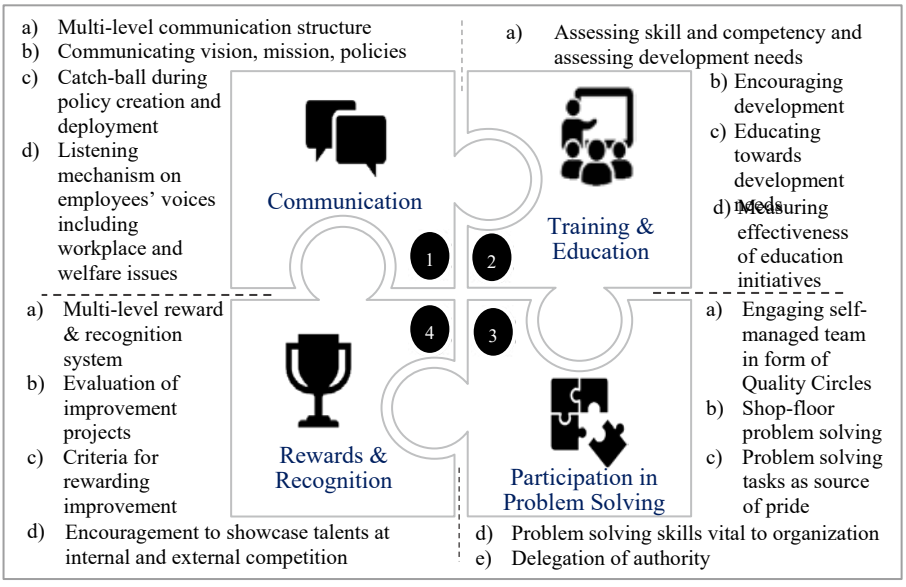


Fig 10.2 JSWS Employee Empowerment Model

1) Communication: Refer Chapter 3 TQM Promotion

2) Training and Development: Capability building model was developed. Trainings on Six Sigma Green, Black Belt, Statistical Process Control, Measurement System Analysis, Design of Experiments (DoE) and Quality Function Deployment were conducted.

3) Participation in problem solving: Individuals were encouraged to give suggestions and Kaizens. Small group activities promoted through department level Quality Circles to solve problems at shop floor. Quality improvement teams with managers formed to solve high level cross-functional issues. This resulted in de-centralisation of decision making and became a source of pride.

4) Rewards and recognitions were standardized to ensure timely appreciation of individual and team achievements. Employees are honoured with rewards during monthly communication meetings. Systematic approach towards improving employee participation has resulted in high engagement levels.

10.5 Corporate Social Responsibility (CSR)

JSWS is working for upliftment of people in surrounding villages through community development programmes. The programme areas are health, education, environment, rural infrastructure development and sports. In the Pre TQM phase, need based projects were implemented, considering the request from people representatives, government officials and school fraternity. Community satisfaction was not measured.

Table 10.2 Evolution of CSR programmes

Challenges	Pre TQM Phase (~FY13)	TQM Development Phase (FY14-17)	TQM Consolidation Phase (FY18 ~)
Water Scarcity	• Drinking water taps in the periphery of plant • Drinking water augmentation	• Reverse O water plants in villages • Watershed programme ○ Soil and water conservation measures ○ Deepening of surface tanks and ponds ○ People institutions to maintain and manage the water bodies	• Water Positive villages ○ Long term plan for restoring all water bodies within 5km radius of company ○ Watershed management through Farmer Producer Companies
20-30% of children in govt. schools not able to read and write	• Merit Scholarships	• Piloting remedial c/lasses to slow learners • Improved access to sanitation infrastructure	• Improving learning outcomes in govt. schools ○ Remedial Education, Life skill education ○ Extra-curricular activities, ○ Health Education ○ Scholarships, Class-rooms

During FY14-17, JSWS moved on from project mode to programme mode with long term plans, internal process improvements, prioritized projects, multi-stakeholder approach, mid-course corrections and measurement of effectiveness. From FY18, JSWS aligned its objectives with the global Sustainable Development Goals (SDGs) and strategies worked out to create sustainable impact in people's lives.

JSWS measures the effectiveness of CSR programmes through internal assessments through field visits and meetings with community and external assessment through society satisfaction surveys. Tata Institute of Social Sciences (TISS), an external professional agency (a premier institute in the field of social work), is measuring the satisfaction levels of the community, once in two years, starting from 2015. The survey also indicates the needs and concerns of the community based on which we upscale / improve our existing projects and implement new projects.

11. Information Technology

11.1 Overview

Information Technology (IT) plays a vital role in JSWS as a support system to improve efficiency of business processes by optimizing process flows aiding decision making and creating value to internal users and customers. The major business needs of JSWS are accomplished by ERP (Enterprise Resource Planning) and Value Applications (Value Apps) with IT platform. Table 11.2 explains the interaction of IT with other business functions.

Table 11.1 IT Platform

Major Business Needs	IT Platform
▪ Integration of Business functions ▪ Interpretation of ERP data ▪ MIS and Reporting ▪ Providing Custom application	SAP ERP & Value Apps

Table 11.2 IT Solutions for Business Functions

#	Business Process	Business Needs	IT Solutions	KPIs influenced by IT Solutions
1	Production	Integration at all levels for Data collection, assimilation, Production Process, Plant Automation	▪ Process automation ▪ JPOD ▪ ERP PP	Inventory (Raw Material, Work in process & Finished Goods)
2	Maintenance	Standard process for Maintenance practices, Asset Standardization	▪ ERP Plant Maintenance	Overall Line Efficiency (OLE)
3	Supply Chain & Logistics	Planning, operational scheduling and delivery compliance Efficient in-bound and out-bound logistics, planned deliveries & reduced turnaround time	▪ ERP Advanced Planning and Optimization ▪ ERP Sales and Distribution ▪ Truck tracking system	OTIF (On Time in Full) Service Quality TTAT
4	Procurement	Manage entire Procure to Pay cycle: Ensure material availability in time through Material Requirement Planning (MRP), vendor management	▪ ERP Material Management	Purchase Request to Purchase Order Cycle Time
5	Finance & Costing	100% statutory compliance, manage B/S, P&L and report to the Board	▪ ERP Finance & Controlling	Monthly/Annual Book Closure
6	HR	Effective employee engagement.	▪ ERP Human Capital Management, Success Factors	TEI Participation

7	Safety and Environment	Provide visibility on safety incidents, analyse data. Environment Statutory compliance system.	▪ Safety Observation System ▪ Incident tracking and investigation system ▪ Stack monitoring system	SOS Capture and closing. Environment Exceedance alarms

11.2 Evolution of IT Systems

IT system evolution (Table 11.3) in JSWS saw major development by focusing on building infrastructure across the plant, integration of independent systems and implementation of SAP ERP for all business functions. The focus is now on customization of existing systems for better workflow and development of customised value apps.

Table 11.3 Evolution of IT

	Pre TQM(~FY13)	TQM Development Phase (FY14-FY17)	TQM Consolidation Phase (FY18~)
Improvement & Decision making (TIER 1)	***Oracle ERP*** **Projects:** 1. Creation of centralised database 2. Integration of finance and procurement functions	***SAP ERP Implementation*** **Projects:** Integration of all business functions	**SAP Customization** **Projects:** 1. Customization of reports 2. Customization of work flow
	Process Automation **Projects:** 1. Raw material Proportioning 2. Reheating Furnace Control	***Process Automation*** **Projects:** 1. BF Gas network monitoring 2. Stack monitoring System 3. Online Size measurement system in BLM	***Value Applications*** **Projects:** 1. Portal for Raw material analysis for Iron Complex 2. Compressed air generation and consumption
		Tool: Value Applications **Projects:** TQM portal & Kaizen Portal	
Optimization (TIER 2)	***Value Applications*** **Projects:** 1. Weigh bridge integration 2. Quality module	***SAP Customization*** **Projects:** Billet /Bloom charging with Barcode (P2) **Unique Activity**	***Process Automation*** **Projects:** BFG gas optimization in stoves
		Value Applications **Projects:** 1. Carbon prediction model 2. Safety Observation System 3. Online coil defect detection system	***Value Applications*** **Projects:** 1. BRM daily production scheduling 2. Incident Tracking System 3. Ferro alloys optimization
Value Creation (TIER 3)	***Oracle ERP Implementation*** **Projects:** 1. Integration of sales functions	***SAP Customization*** **Projects:** 1. Customer complaint management system 2. Finished goods barcode delivery system(P2) **Unique Activity - Multiple delivery picking**	***SAP Customizations*** **Projects:** 1. Auto test certification 2. OTIF-Delivery Compliance
			Value Applications **Projects:** 1. GPS delivery tracking system 2. 8 meter length billet rolling in GC 3. Wagon tippler weighment system

11.3 Management of IT function

IT, as a function at JSWS, is managed with a cross functional project management approach. Based on business requirements / needs, cross functional teams are formed with members from IT, user department, Costing team and external supplier (if necessary), and improvements are made project by project.

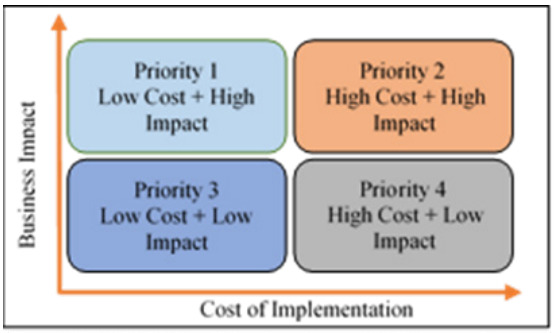


Fig 11.1 Prioritization through 2X2 matrix

11.3.1 IT Project Planning and Implementation process

IT needs for business processes captured from all departments are prioritized using 2X2 matrix (Business Impact vs. Cost of Implementation, Fig 11.1). The projects are prioritized in four categories and implemented through internal development, external development and/or SAP enhancement & customization as explained below:

Priority1: Internal development of projects with SAP Customization and value applications (business applications developed in Java,VB.net and ASP.Net).

Priority 2: Internal or external development of projects with new ERP modules / customization and process automation software for ERP interface.

Priority 3: Internal development of Process automation Projects.

Priority 4: Externally developed software to fulfill customer and statutory requirements.

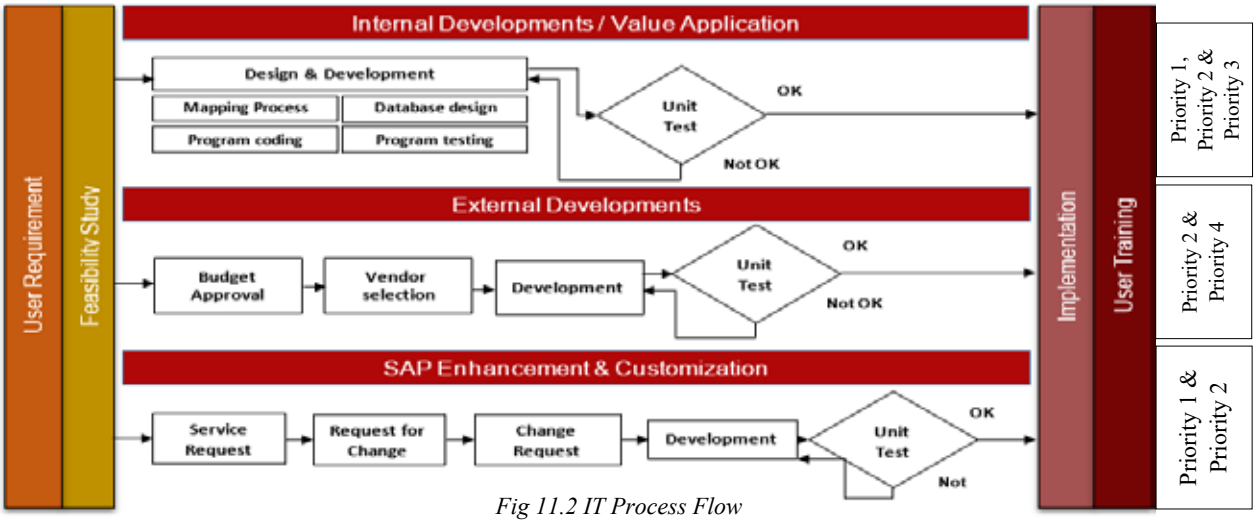


Fig 11.2 IT Process Flow

12. Outstanding Activities

12.1 Establishing market leadership through collaborative New Product Development (NPD) with Stakeholders

The Strategic shift from Commodity Steel to Special Steel has always inspired JSWS to formulate unique strategies and innovative solutions for sustainable business development. Collaborative approach with stakeholders for value creation through technological development and process innovations is the distinctive feature at JSWS. This approach has enabled a win-win situation for JSWS and the stakeholders such as customers and suppliers as demonstrated in following two case studies.

12.1.1 Case Study 1: Collaborating with customer for development of Bearing steel

Bearings are used in moving parts which are subjected to fatigue loading. The steel used in the manufacture of bearings demands high level of cleanliness with lower Oxygen, lower Titanium and good surface quality. With objective to speed up the NPD and commercialisation of the products, JSWS collaborated with customer. The cross-functional team was formed with the customer with objective to identify the technological and process needs.

Table 12.1 Key Issues and Analysis and Innovative Solutions

	Key Issues	Analysis	Innovative Solutions
Technology Development	Higher Inclusion level	• Water Modelling to study Flow Pattern in Tundish	• Residence Time Distribution Optimization • Slag Engineering • Purging Modification in vacuum degassing • Introduction of new section 340X400
Process Innovation	Higher Oxygen level	• Process Capability analysis • Technical assistance with Group company	• Argon purging in tundish • New Deoxidation Practice

a) Technology development and Process innovation for clean steel: Achieving the lower inclusion to produce clean steel was a challenge with current process capability. The table 12.1 summarises the key issues faced, analyses done and innovative solutions implemented.

b) Establishing joint Quality Assurance procedures: Customer had not approved the initial blooms because of low cleanliness level which was affecting the yield of Bearing grade steel. JSWS offered the customer to develop joint quality assurance procedures for quality clearances. After series of joint sampling and testing procedures, supplier accepted the initial blooms through testing, field validation and application. This has resulted in elimination of down gradation and yield improvement.

12.1.2 Case Study 2: Collaborating with Supplier for Development of rail steel for export

JSWS was offered to develop a steel grade for manufacture of rails by Customer (Italy). The application was studied and found that grade quality requires ultra-low level of Hydrogen content in steel (<2.4 ppm). This level of hydrogen in steel is achievable through RH degasser facility only. However, JSWS doesn't have this facility and it has only tank degassing facility.

a) Redesigning operation to overcome infrastructure disadvantage: To achieve the desired level of Hydrogen through existing tank degassing process, the operational procedures and process parameters were redesigned. With modifications such as fresh lime usage, increasing degassing duration and increasing Tundish preheating duration, hydrogen level was brought down to 2.5 ppm which was the threshold maximum limit for rail steel application.

b) Redesigning refractory mass with supplier: Mapping of hydrogen level at various stages of steel making revealed that there is a hydrogen pickup of 0.7 ppm in Tundish. Further analysis revealed that the present binders are used in refractory mass are an input source of hydrogen in Tundish. JSWS collaborated with supplier and developed a new refractory mass with different binder. With the use of different binder, the hydrogen pickup is lesser ppm which enabled to achieve the customer requirement.

12.1.3 Results: The above mentioned strategic collaborations and innovations have given JSWS unparalleled results such as

1. Market Leadership in Bearing Steel: JSW share in the bearing market increased from 7 % in FY15 to 13% in FY19.

2. Collaborative approach in NPD System: Tundish spray mass with inorganic binder is developed in collaboration with supplier for the *first time in India*.

3. Unique process design: Rail Steel Production through Tank Degassing facilities with In-house developed solutions (Process innovation) for *the first time in India.*

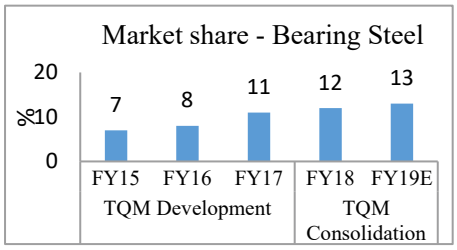


Fig 12.1 Market Share of Bearing steel

12.2 Creating Sustainable Water Management Solution: CSR Program

JSWS promotes inclusive growth of communities in the areas of its operations through CSR initiatives. In line with the development needs identified by the Government for each area, JSWS develops various CSR projects for improving situation. The CSR programs focus on areas of agriculture, health, education, environment, rural infrastructure development and sports. In the Pre TQM phase, the nearby villages faced perennial water scarcity with following problems:

1. Fluoride in ground water made it non-potable and the community was dependent on other sources of water
2. Insufficient supply of drinking water during summer months by the government due to scarce availability
3. Depletion of ground water tables due to over drafting of water for irrigation

JSWS first addressed the immediate issue by providing drinking water to the community throughout the year via water taps installed at the periphery of the company and augmenting drinking water through hiring water tankers and supplying the same to the villagers for free during summer. Later, it started working on a comprehensive system to address the drinking water problem in long term.

12.2.1 Migrating from Projects to Program mode

a) Comprehensive Long term plan for Water Management Program: During TQM development phase, JSWS adopted a proactive approach and a five-year plan for water conservation was developed with the objectives of a) conserving rain water and b) creating safe drinking water sources in the villages.

b) Multi stakeholders approach: Partners like National Bank for Agriculture & Rural Development (NABARD), 'Hand in Hand' (a NGO partner) and local panchayats, with common developmental goals were brought together. The following were the major projects implemented during FY14-17.

i) Innovative Watershed Project: In FY14, an innovative community participation exercise was started by forming a watershed association with beneficiary farmers. In a period of 4 years, soil and water conservation measures in 2500 acres in 15 villages were implemented through field bunds, farm ponds, check dams, well recharge pits and deepening of ponds. This was supplemented through fodder crops, vegetable fields and orchards to raise the farmers' income. 3429 farmers were benefitted and 485 million cubic liters of water was recharged so far.

ii) Safe drinking water project: Three Reverse Osmosis (RO) units were set up in villages in partnership with local panchayats to ensure safe drinking water for the villagers. ~8000 people from the villages are benefitted.

12.2.2 Integrating Sustainability Goal to attain "*Water Positive*" community.

During TQM consolidation phase, JSWS aligned its goals in water management program with the UN Sustainable Development Goal 6 (SDG:6) of ensuring availability and sustainable management of water for all.

a) Water Positive program: To achieve the sub-goals of SDG 6, the following projects are being implemented

SDG 6

Sub goal 1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all

Sub goal 2: By 2030, ensure sustainable withdrawals and supply of fresh water to address water scarcity and subsequently reduce the number of people suffering by water scarcity

1) Problem Mapping in Direct Impact Zone (DIZ): All tanks and ponds within 5 Km were identified and mapped.
2) Improving water capacity: Desilting of tanks, ponds and deepening of water channels is being done.
3) Promotion of Farmer Producer Companies (FPC): As a next step, the watershed association has been converted to FPCs, the purpose of which is to aggregate farmers, enable them to get a better bargaining power and marketing their agricultural products. So far, two FPCs are promoted.
4) Watershed management through FPCs: Building on the experience of involving communities in effective implementation of watershed project, FPCs are involved in watershed management.
5) Groundwater recharge through defunct bore-wells: Due to excessive water drafting from ground water aquifers, the ground water levels had gone down and lot of bore-wells have become dry and defunct. JSWS took the task to recharge ground water aquifers and through a pilot project, to create awareness among the farmers, defunct bore wells are converted into rainwater harvesting structures which is well received by them.
6) Safe drinking water for all: JSWS continue building RO water plants in the villages and supplies the water to people at a nominal cost to ensure equitable access to safe drinking water for everyone in the villages.

12.2.3 Results

The initiatives taken by JSWS benefited the nearby community with sustainable development.

12.3 Creating satisfied contract workforce

12.3.1 High attrition among contract workers: The contract workforce constitutes 45% of the total workforce, and contributes significantly towards Productivity and Quality improvement. During FY14, the attrition of contract workers was as high as 10.20%.

12.3.2 Satisfaction and Motivation factors: Through various interaction sessions and grievances, the major contributors for high attrition rate among the worker were collected and mapped into 2x2 matrix of Satisfaction level vs Motivation level. The factors were classified in four categories (Fig 12.2) and those in absence of which, workers were highly dissatisfied and demotivated were selected for priority initiatives. It was observed that the wages varied between contractors for the same skill sets due to independent hiring done by contractors. There was no system for annual wage revision. Substandard Personal Protection Equipment (PPEs), non-compliance of statutory payments, improper payment of wages by the contractors were the major issues. All these had resulted in low engagement levels and high attrition.

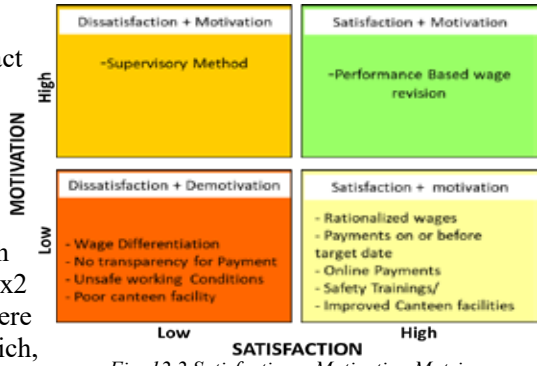


Fig. 12.2 Satisfaction – Motivation Matrix

12.3.3 Improving Satisfaction and Motivation: Initiatives taken to promote higher satisfaction and motivation level were:

a) Compensation *:* To reduce the wage differentiation among contractors, improvements like rationalizing wages, ensuring timely payment, performance based compensation and payments through bank were introduced.

b) Welfare: The welfare facilities were extented to the contract workers at par with JSW employess. Improved Canteen and Anuual Health checkup facilities were introduced.

c) Safety: More emphasis was given to safety trainings to ensure contract workers safety at the work place. Initiatives like strenthening the safety training and extending it to all skilled and highly skilled contract workers at par with JSW employees were implemented.

d) Engagement: Contract workers were encouraged to participate in improvement activities like Kaizens and QCCs. They were motivated to participate in State level and National level competitions. Since FY17, they were included in communication meetings also.

Major actions that were taken year on year to improve the satisfaction and motivation level are listed in *Table 12.2.*

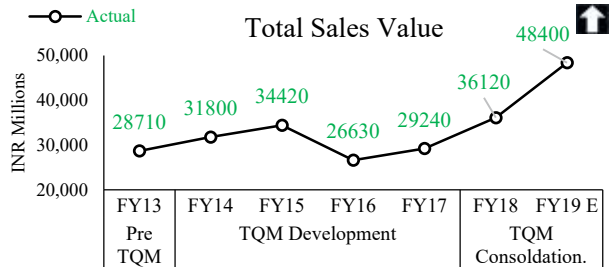
Table 12.2 Major initiatives for higher satisfaction and motivation

	FY 14	FY 15	FY 16	FY 17
Compensation	Rationalising Wages based on education, experience and job expertise	On time payment of wages and Production incentives	- Performance based compensation - Payments through banks only	
Welfare	Tea & Snacks Change rooms & locker facilities	Extension of canteen and transport facilities	-On time bill clearance -Annual health check-up -Intra-mural sports -Welfare Visits	Inclusion in communication forums
Safety	Extension of safety facilities as per JSW	Job based Safety trainings	- Safety trainings as per applicability	Refresher trainings
Engagement		TQM awareness trainings	- Skill enhancement -Kaizen and QC projects, Rewards & Recognitions	Participation in QCFI events

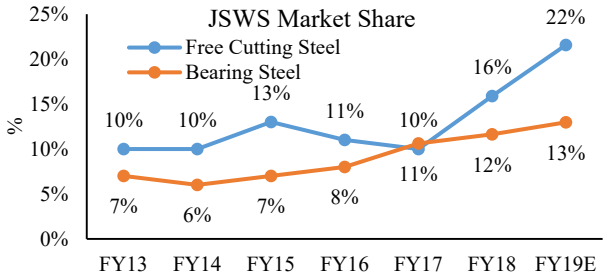
12.3.4 Result: These improvement initiatives helped in bringing transparency in the system and built a sense of trust among the JSWS contract workers. This in turn helped to improve the satisfaction and motivation level. Attrition reduced to 5.2% in FY 18 and the scores of employee opinion survey has improved.

13. Key Effects & Way Forward

Overall Growth and Business Impact

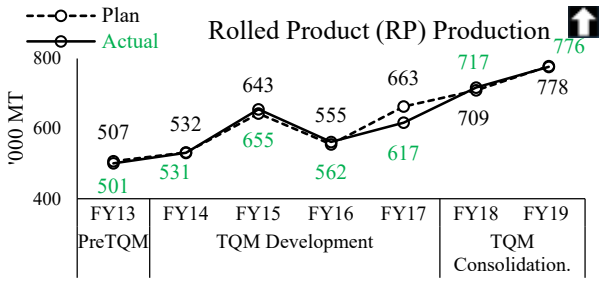


68% increase in Total Sales Value for last 6 years



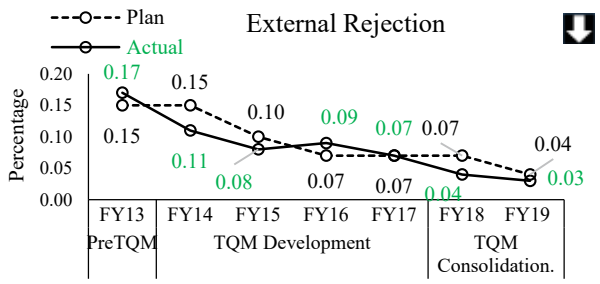
Increase in market share in value added steel segments

Productivity



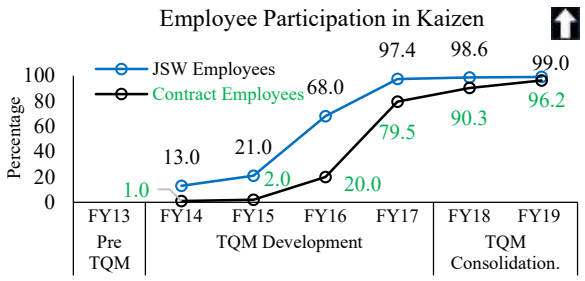
~55 % increase in RP Production for last 6 years

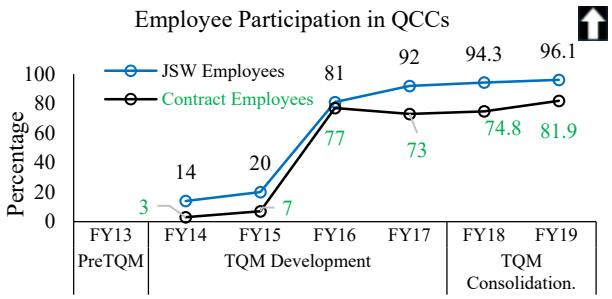
Quality



External rejection dropped by ~6 times in last 6 years.

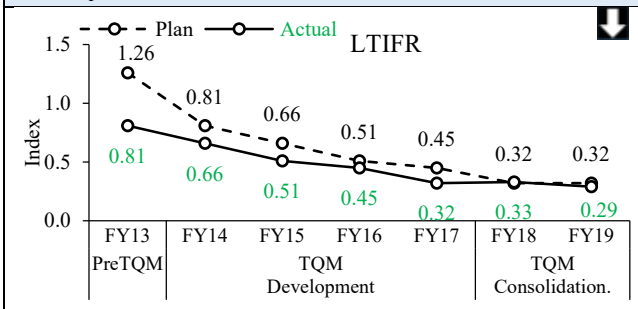
Employee Engagement

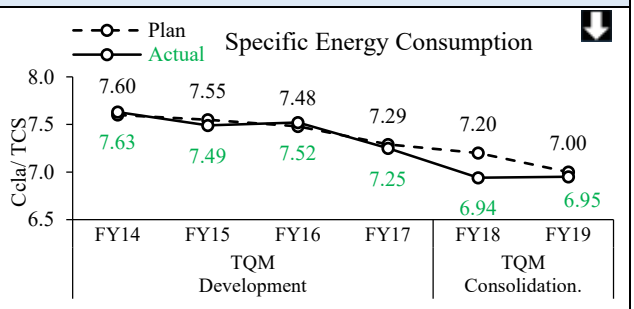




Year on Year improvement observed in Kaizen and QCC participation of JSW Employees & Contract workers.

Safety & Environment





Implementation of proactive safety practices helped in reduction in LTIFR

Energy saving measures helped to reduce Specific Energy Consumption

Intangibe Benefits of TQM Deployment

JSW Salem progressed well on its vision" **To become the preferred supplier of Special Steel Long products for domestic and global end users**" by sustainable growth in Productivity, Quality, Cost, Delivery, Safety, Environment and Morale.

- Our employees take **pride** in Salem becoming India's largest Special Steel plant and it reflects in employees' commitment levels, their joy at work.
- Employees feel secure working in JSW Salem and as a result,attrition rate of JSW employees and Contract workers are reduced (one of the lowest among industry)
- With TQM implementation, JSW Salem employee satisfaction levels are improved which are measured through EOS (Employee opinion Survey).
- The ownership and belongingness of the employees has been improved through Employee Engagement practices.
- Future fit leadership drive has helped to create a rich pipeline of leaders who promote excellence and continuous improvement in the organization.

Frequently Used Terminology and Abbreviation	
Abbreviation or Terminology	**Explanation**
4i	A high-end Analytics program of JSW, that provides development inputs to select high-potential persons to be groomed as problem solving experts and future leaders. The program aims to integrate the process of leadership development into management of improvement projects.
Identification	Identification phase of 4i that primarily focuses on Project Identification, Problem Identification and Root Cause Identification
Ideation	Ideation phase of 4i that focuses on Idea generation, prioritization and solution development
Implementation	Implementation phase of 4i that focuses on Pilot and Full Scale implementation
ABP	Annual Business Plan
ASP	Air Separation Plant
BF	**Blast Furnace:** Blast Furnace, a vertical shaft furnace operating as per counter current principle.
Billets	A semi-finished form of steel with a square cross-section of 165 mm^2 that is used for making Long Products such as Rebars, Wire Rods etc.
BLM	Blooming Mill
BRM	**Bar Rod Mill:** Unit that converts billets into Thermomechanically Treated Rebars
BO&M	Business Objectives & Means
CAGR	Compounded Annual Growth Rate
CAPA	Corrective Action and Preventive Action
CCM	Continuous Casting Machine
CCMS	Customer Complaint Management System
CFM	Cross Functional Management
CFT	**Cross Functional Team:** A group of people with different functional expertise working towards a common goal.
Coils	A finished product of Hot Rolled of Cold Rolled steel such as strip or sheet that has been coiled after rolling to facilitate storage and transportation.
Coke	It is a processed form of coal and is used as a fuel in Blast Furnace to produce Hot Metal.
Coking Coal	Primary raw material used for coke making.
CR	**Cold Rolled:** Product produced at Cold Rolling Mill by rolling of Hot Rolled Coils.
Crude Steel	First solid steel product upon solidification of liquid steel.
CSR	Corporate Social Responsibilities
CSS	Customer Satisfaction Survey
DIC	Divisional Implementation Committee
DM	Daily Management
DMD	Deputy Managing Director
DOE	Design of Experiment
EBIDTA	Earnings Before Interest, Depreciation, Tax and Amortizations
EFMEA	Equipment Failure Mode and Effect Analysis
EHS	Environment, Health & Safety
EMS	Environment Management Systems
EOF	Energy Optimizing Furnace: Primary steel making unit which converts hot metal to primary steel
EOS	Employee Opinion Survey: Employee Opinion Survey- Process of Collecting employee opinion through Survey
ERP	Enterprise Resource Planning
Fe	Iron
FIFO	First In First Out
Ferro Alloy	Ferro Alloy refers to various alloys of Iron with a high proportion of one or more other elements such as manganese, Aluminium or Silicon; is used for production of Steel with desired chemical properties
Flux	An inorganic component used to enhance the quality of hot metal/liquid steel by removing impurities which are present in the raw material.
FMEA	Failure Mode and Effect Analysis
FY	**Fiscal Year:** Used for accounting purpose and preparing financial statement for e.g. FY18 means the period between 1st April 2017 to 31st Mar 2018.
GI	Galvanized (Zinc Coated Steel Sheets)
GDP	Gross domestic product
GPS	Global Positioning System
HoD	Head of Department
HR	Human Resource
HRD	Human Resource Department
INR	Indian National Rupee; 1 INR= 1.63 JPY
IO	**Iron Ore:** The primary raw material in the Iron Making process to produce hot metal
JD	Job Description
JH	Jishu Hozen
JSW	Jindal South West
JSWS	JSW Salem

Km	Kilometer (Unit of distance)
KPI	Key Performance Indicator
KRA	Key Result Area
LRF	Ladle Refining Furnace
LTIFR	Loss Time Injury Frequency Rate
LTP	Long Term Plan
LP	**Long Products:** It includes Billets, Rebars, Wire Rod etc.
mm	Millimeter
MMT	Million Metric Ton
MOU	Memorandum of Understanding
MP	Managing Point
MRA	Multiple Regression Analysis
MRSS	Main Receiving step down Sub Station
MSA	Measurement System Analysis
MSC	Management System Chart
MT	Metric Ton
MMTPA	Million Metric Ton Per Annum
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MW	Mega Watt
MWH	Mega Watt Hour
N7	New 7 Tools
NCO	Non Conformed Orders
NPD	New Product Development
OEE	Overall Equipment Effectiveness
OJT	On Job Training
OLE	Overall Line Efficiency
OTIF	**On Time In Full:** A measurement of delivery performance
PDCA	Plan Do Check Ac
PPAP	Production Part Approval Process
PPC	Production Planning Control
PPM	Parts per Million
P,Q,C,D,S,M,E	Productivity, Quality, Cost, Delivery, Safety, Morale, Environment
PFMEA	Process Failure Mode Effect Analysis
QA	Quality Assurance
QC	**Quality Circle:** A group of employees who meet regularly to consider ways of resolving problems and improving work conditions and processes within their area of work.
QFD	Quality Functional Deployment
QMS	Quality Management System
R&D	Research & Development
RCS	Round Corner Square
Sinter	Sinter is a porous irregular shape agglomerate (Size 5 to 40mm) of Iron Ore Fines, fluxes, coke fines and metallurgical wastes.
Slag	By-product of Iron and Steel making process
SMED	Single Minute Exchange of Dies
SMS	**Steel Making Shop:** Steel making unit comprising of EOF, LRF, VD and CCM which converts liquid Hot Metal to solid Billets, Blooms and Rounds
TCS	Ton of Crude Steel
TEI	Total Employee Involvement
TGR	Things Gone Right
TGW	Things Gone Wrong
TRIZ	A problem-solving tool based on the concept of "Theory of inventive problem solving
UA & UC	Unsafe act & Unsafe condition
UTS	**Ultimate Tensile Strength:** The maximum load which a material can withstand under tensile load
VD	Vacuum Degassing: One of the process in SMS. It is used to remove the dissolved gases present in steel
VOC	Voice Of Customer
WIP	Work in progress