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JSW Steel Limited, Vijayanagar Works



SUMMARY OF THE WINNERS' PRESENTATION
JSW STEEL VIJAYANAGAR WORKS, INDIA

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1. Organization Profile

1.1 JSW Group

JSW Group is one of India's largest conglomerates with an Annual Turnover of 11 Billion USD and a global presence in over 140 countries including Asia, Europe, USA, South America and Africa. With strong market presence in sectors of Steel, Energy, Infrastructure, Cement, Paints and Sports, the Group employs over 48,000 people across the world. Over the years, JSW has defined the purpose of accelerating growth and prosperity of its stakeholders, thus helping the group to expand its business portfolio while contributing to India's economic growth in core sectors. Its tagline 'Better Everyday', represents the ethos of JSW towards continual improvements and is the reason of its strong brand presence.

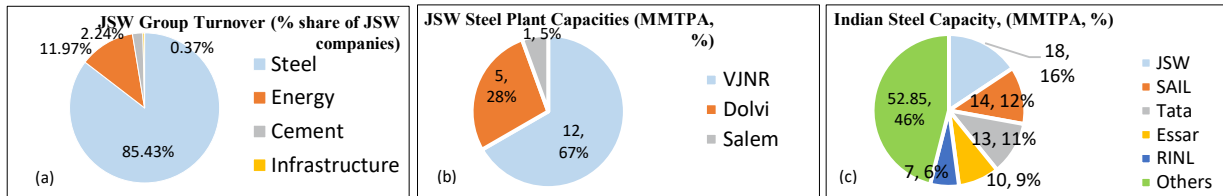


Figure 1.1: (a) Company wise turnover of JSW Group, (b) JSW Steel plant capacities, (c) Indian players based on capacity

1.2 JSW Steel

JSW Steel, with an Annual Turnover of 9.27 billion USD, is the flagship company of JSW Group, contributing to 85 % of group's Turnover. It started operations 1982 and is currently the largest steel producer in India with manufacturing facilities at 6 locations in India with 3 integrated steel plants at Vijayanagar, Dolvi and Salem and 3 downstream steel manufacturing units located at Vasind, Tarapur and Kalmeswar. JSW Steel is the largest exporter of Steel and the fastest growing Steel company in India, which has grown from 0.8 in 1999 to 18 MMTPA in 2016 . It offers a wide variety of Flat Products and Long Products in the ratio of 74:26 with strong market presence in Automobile, Infrastructure & Construction, Pipes & Tubes, General Engineering, Yellow Goods and White Goods segments.

The company has contributed to India's growth through its Steel manufacturing capacity expansion and building plants and service centres across the country. With a vision of "to bring positive transformation to every life we touch", it has always respected human values and attempted to achieve excellence in all aspects of business while bringing happiness to its customers, employees and stakeholders. JSW Steel was ranked World's 6th best steel maker by World Steel Dynamics in FY17 based on assessment of 23 parameters and is the only Indian company in top 10 of that list.

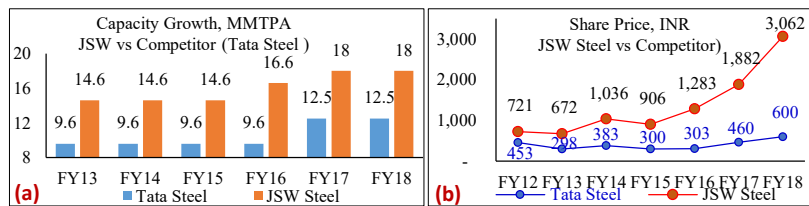


Figure 1.2: Growth of JSW Steel vs Competitor; (a) Capacity, (b) Share price

1.3 Vijayanagar Works

JSW Steel, Vijayanagar Works (referred as VJNR hereafter), located in Karnataka state, is the largest integrated steel plant at single location in India of 12 MMTPA capacity. Distinctive features of VJNR are mentioned in Table 1.1. In 1971, the foundation stone was laid in VJNR for a government owned steel plant which couldn't happen. In 1994, JSW took the opportunity to set up the steel plant and VJNR's dry and inhabitable looking land (Figure 1.3a), in a span of 2 decades, was converted to a green Steel Plant with facilities for modern living (Fig 1.3b).

#	Distinctive Features of VJNR	Value
1	Largest Integrated Steel Plant	12 MMTPA
2	Fastest growing Steel Plant	20% YoY growth (20 yrs)
3	Lowest Steel Conversion Cost	USD 90/MT
4	Highest Manpower Productivity	1006 Ton/Employee/Year
5	Highest Growth Rate in Automotive	10% YoY
6	Only Zero effluent discharge Plant	95% recycling
7	Widest and largest Hot Strip Mill	2250 mm width
8	Largest Iron Ore beneficiation facility	20 MMT

VJNR has an area of 31.6 km² with 1.71 million trees covering 7.3 km². It has grown from 0.8 to 12 MMTPA (Figure 1.4) in just 17 years, and contributes to 12% of India's Annual Steel production.



Fig 1.3: VJNR from (a) barren land to (b) green steel plant

Figure 1.4: Capacity growth of VJNR

1.4 VJNR Steel Manufacturing Value Chain complexity

The Steel manufacturing value chain at VJNR is a complex combination of batch and continuous processes. It starts with the Raw Material Handling System (RMHS), that receives Raw Materials and optimizes blends for quality and cost for the next stages to produce Iron bearing agglomerates like Pellet and Sinter and metallurgical Coke. Using Pellets, Sinter and Coke (Fuel), along with fluxes, Iron Making units produce molten Iron known as Hot Metal (HM), which is transported in molten form in transfer ladles to the Steel Melt Shops (SMS), where it gets converted to Liquid Steel, through Basic Oxygen Furnaces (BOF) and Electric Arc Furnace (EAF) and then cast into Steel Slabs and Billets. Slabs

are rolled for making HR Coils and Billets are rolled to make Long Products. HR Coils are further rolled to make Cold Rolled Coils. The Production Services departments provide assistance to all these production units.

The entire Value Chain structure along with departmental organisation is shown in Figure 1.5.

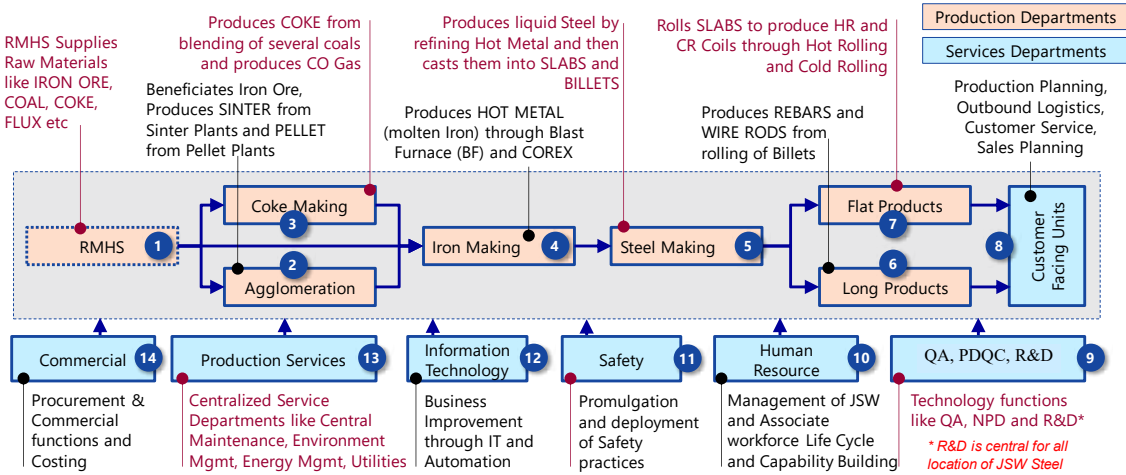


Figure 1.5: VJNR Value Chain and Role of major units

The Steel manufacturing value chain has a complicated **converging-diverging shape** as shown in Figure 1.6.

Nearly 108 types of RMs are used to produce 1 type of Hot Metal. From this, Steel Making Shops (SMS) casts 4976 grades of Steel, which are then rolled into 17500 types of Flats and Long Products, which are used to service ~24500 SKUs.

The above converging-diverging value chain construct throws two major challenges: a) handling Raw Materials from 108 different sources (with wide variation in properties), homogenising them and converting them into one consistent Quality of Hot Metal, b) manufacturing 17500 types rolled steel products and servicing ~ 24500 SKUs with wide variety of product and service requirements that require a very dynamic and agile Delivery Management System (Production Planning, Outbound Logistics and Customer Services).

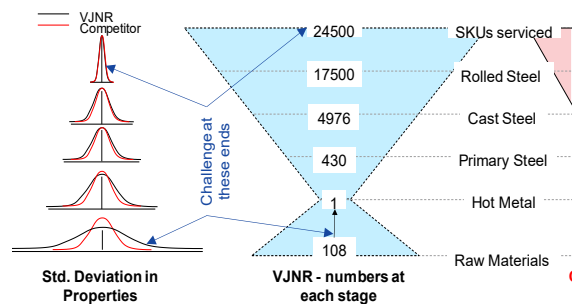


Figure 1.6: The converging-diverging Steel value chain

1.5 Cost Structure of VJNR

Figure 1.7 shows the Cost Structure of VJNR for FY18. As shown, the Raw Material Cost is approximately 80% of the Hot Rolled Coil cost. Of this, Fuel (Coal) constitutes 59% and Iron Ore constitutes 28%. VJNR's major Indian competitors have an advantage of having captive mines from early years. JSW VJNR, being a late entrant into the Steel Industry, must source Iron Ore and Coal from multiple sources across the world, making it a challenge. However, VJNR has mitigated a part of this risk by reducing its conversion costs through operational innovations.

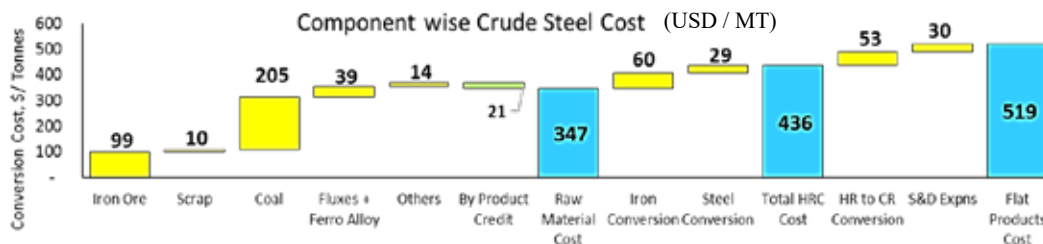


Figure 1.7: Cost Structure of VJNR

1.6 VJNR's Mission

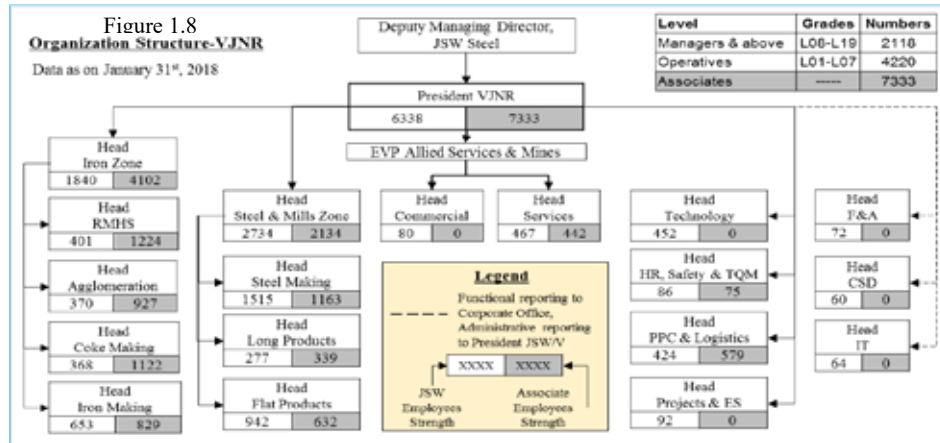
VJNR created its Mission considering the business environment and the Group's vision and values at its core. In 2017, VJNR has relooked its mission statement to widen the scope. The mission statement of VJNR has been reformulated as:

'To become the largest Value Added Steel Supplier in India by 2021, while being country's largest Steel Plant'.

Mission	Mission elements	Meaning
To become the largest Value Added Steel Supplier in India by 2021, while being country's largest Steel Plant	Value Added Special Steel Supplier	Increase share of Value Added Products by New Product Development, improving Quality and reducing Conversion Costs
	Largest Steel Plant	Growing ahead of competition to remain India's largest Steel Plant in capacity

1.7 Organisation Profile of VJNR

VJNR has a total workforce of 13,671 (average employee age of 30.8 years) which includes 7,333 Associates. It is headed by President VJNR, whose linkage with reporting unit heads is shown in Figure 1.8.



1.8 Business Growth of VJNR

From FY12 to FY17, Indian Crude steel output grew 5.9% year-on-year (YoY) to 101.2 MMTPA. For the same period, VJNR had 68% increase in Crude steel production from 6.75 to 11.13 MMTPA (Figure 1.9). Operating EBIDTA grew at CAGR of 5.03% from INR 5826 Crore to 7448 Crore from FY13 to FY17.

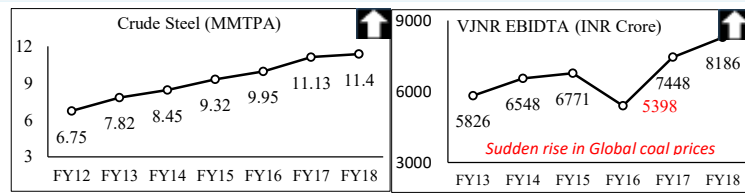


Figure 1.9 Crude steel production growth and EBIDTA growth of VJNR

1.9 VJNR's Markets, Products and Customers

VJNR currently has a market share of 9% in Indian Steel industry with a CAGR of ~5.9% over last 4 years and its share of Value Added Special Products (VASP) has grown from 30.7 to 53.9% in last 5 years. VJNR's growth in Automotive sector (Figure 1.10a) with a CAGR of 18.4% has been a real success story. Table 1.2 shows the current mix of VASP and Non-VASP products (FY17).

Table 1.2: Production of VASP (MMTPA) in FY17

	HR Product	CR Product	Long Product	Total
VASP	1.88	2.9	0.41	5.19
Non-VASP	3.66	0.13	1.88	5.67
Semis	Slabs = 0.18, Billets=0.08			0.27
Total	5.54	3.04	2.29	11.12

With an objective to acquire leadership position in VASP, VJNR has strategically moved from Hot Rolled (HR) products to VASP through Cold Rolled (CR) route (Figure 1.11b) which was further supported by increased Indian demand of CR products. The market share in CR segment went up from 5.5% to 13.1% in 5 years. The diversified portfolio of VJNR, including exports, is one its biggest strength, and not only acts as a natural hedge against sector volatility, but also gives agility to implement strategies best suited to Indian economic environment. VJNR is the largest Indian exporter of Steel to over 29 countries including Europe, South-East Asia, contributing to 30% of Indian steel export.

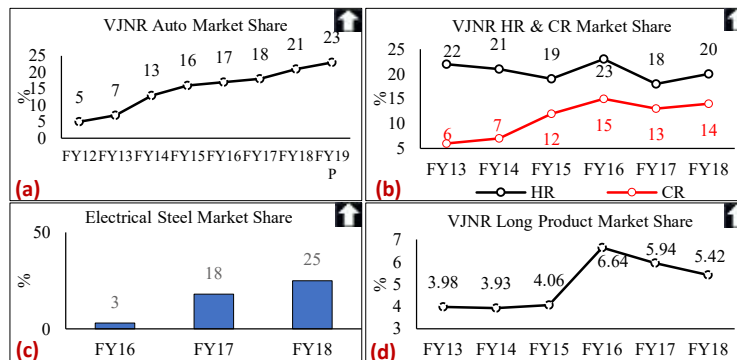


Figure 1.10: Market Shares of a) Auto, b) HR & CR, c) Electrical Steel, d) LP

Distribution & Retail

To reach out to the end users directly, JSW has succeeded in pioneering organised steel retailing (which was not popular in India) by introducing JSW Shoppe in 2007, a unique distribution model. In 2010, it became a Harvard Business School case study for its unique approach to transform a transactional model to a relationship-based distribution model for franchising. Refer Table 1.3 for JSW's approach to Retail.

Table 1.3: JSW's segmented approach to address different retail segments

Metro/Urban	Urban/Semi-urban	Semi-urban/Rural
JSW Explore (18 Nos)	JSW Shoppe (415 Nos)	JSW Shoppe Connect (320 Nos)
- Multiproduct service centre for steel solutions	- Steel distribution	- Smaller retail format linked to JSW Explore/ Shoppe
- JIT, value-added services	- Enhanced customer experience	- Last mile link to rural areas
- Franchisee model		- To end consumers and MSMEs
~8600 Outlets	575 Districts with retail footprint	Contributes 22% to total business of VJNR
		Engaged 7500+ influencers

1.10 Joint Ventures (JV)

JSW Steel has a strategic collaboration with JFE Corporation, Japan for providing technical support for development and stabilization of new steel grades (esp. Automotive), helping in technology adoption, providing technical assistance in setting up of facilities and joint service to customers for marketing, sales and application engineering. It also entered into a JV with Marubeni Itochu Steel Inc., Tokyo to set up a state-of-the-art Steel Processing Centres. These technological collaborations resulted in a steeper learning curve for VJNR and helped enhance its business share of VASP.

1.11 Research & Development (R&D)

VJNR's R&D has been able to develop many technologies like beneficiation of lean grade Iron Ore, Micro-Pelletization, Slime recovery, Mill scale briquetting for the first time in India.

Development of these technologies helped reduce Steel Conversion Cost by improving solid waste utilisation significantly and helped recover from the Iron Ore supply crisis, thus making it the 1st Steel Plant in India to use Ore as low as 46% Iron content. VJNR also does in-house collaborative research work in areas of alternative Iron making processes, energy saving, recycling and reuse of waste along with various Indian Research Laboratories. It is first in India company to work on BHQ (Banded Haematite Quartz) which will be future of Iron Making, once reserves of high grade of IO deplete.

#	Facilities	In-house Developed Technologies
1	Beneficiation	BHQ Beneficiation, Mill scale briquetting,
2	Pot-sinter	Micro-Pelletization, Slime processing for iron recovery, Sand from Blast Furnace
3	Pilot coke-oven	Slag, Iron and Carbon recovery from dust & sludge, Steel slag as coarse aggregate
4	Pilot coal briquetting	for road construction, Refractory castable from Steel Slag
5	Pilot pellet simulator	
6	Thermo-mechanical simulation	

1.12 CSR – “Creation of economic value by creation of societal value”



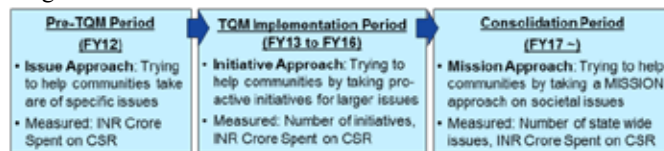
Figure 1.11: CSR Activities of VJNR

VJNR's policies emphasise on striking a balance between profitability and societal development (“*creating economic value by creating societal value*”). At the beginning, VJNR had a major challenge of setting up social infrastructure to fulfil basic civic needs of accommodation, sanitation, health, education in its area of operation. VJNR has built and maintains 4 townships for nearly 6500 families along with a 200 bed multi-speciality hospital and civic infrastructure including external roads, drainages etc. On the CSR front, VJNR practices CSR for 40 villages around to make life better for communities with its various initiatives is shown in Figure 1.11.



Figure 1.12: The Shared Value Philosophy of VJNR

Evolution of VJNR's CSR philosophy: VJNR's CSR philosophy evolved in TQM Implementation period to an INITIATIVE approach to help communities take proactive initiatives for issues like Healthcare, Sanitation, livelihood, education etc



Moving from Initiative Approach to Mission Approach: Towards the end of TQM Implementation period, in FY16, VJNR improved its CSR philosophy from **initiative approach to Mission approach**. Today, VJNR is in a Mission mode against some of the nation's most chronic issues for its Direct Impact Zones (DIZ) through two big flagship campaigns:

A) Mission Against Malnutrition (MAM): Aimed at suppressing malnutrition amongst more than 40,000 children and women in Bellary district. VJNR's CSR team reached out to CFTRI (a CSIR facility dedicated for improving nutrition) and urged them to study malnutrition in Bellary district. An innovative idea of administering Spirulina supplement to the malnourished people was developed resulting in children coming out of malnutrition. India CSR Group conferred upon JSW "**CSR Project of the year for large impact**" in the year 2017.

B) Janam Se Janani Tak: Women health is a big issue in India and VJNR is working on the seven stages where care is needed to help them become healthy and able: 1) Pregnancy, 2) child birth, 3) children, 4) Children (School going), 5) Adolescence (14-19), 6) Empowerment (19-24), and 7) Earning (24-25).

2. Business Objectives & Strategies

2.1 Indian Steel Business Scenario in Pre-TQM period

JSW Steel been the frontrunner during growth of Indian steel industry. VJNR, currently India's largest Steel Plant, has in turn been pivotal in this journey of JSW Steel's growth, evolving and pioneering with new products and technologies. In Pre-TQM period (2012) for VJNR, the Indian Steel Industry had:

- Higher CAGR:** Global Steel industry had CAGR of 3.65%, while 5.8% of India.
- Deficit in Steel supply:** India had a deficit (Demand vs Production) of nearly 4% despite imports.
- Growth Opportunity in Cold Rolled and Automotive Segments:** the automotive industry was growing rapidly and demand and consumption analyses projected good business opportunity in future for CR and Automotive Steels.

Thus, JSW Steel perceived sizeable opportunities for growth in the Indian Steel industry and formulated its BO&S.

2.2 Challenges of VJNR during Pre-TQM Period (Pre-FY12)

Despite locational disadvantages with VJNR in Pre-TQM period, a major advantage was its proximity to Iron Ore (IO) mining sources. Mining was banned in this area by Supreme court of India in FY12 resulting in acute shortage of IO for VJNR. Without captive mines, VJNR was forced to use low grade IO available at higher cost, affecting its earnings. At the same time, Indian automotive market segment was expanding while sourcing from evolved steel makers with NPD expertise. Thus, VJNR faced a two-way challenge (upstream and downstream) as shown in Figure 2.1:

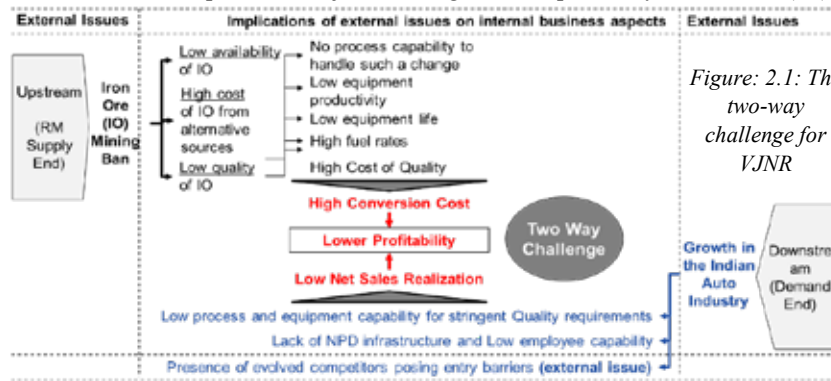


Figure: 2.1: The two-way challenge for VJNR

1) High conversion Cost due to poor quality IO which was prized higher, 2) Low Net Sales Realization (NSR) due to lack of NPD resulting in low share of VASP (Value Added Special Products). Also, VJNR had low Employee Engagement due to a large percentage of new employees and higher attrition rates. After introduction of TQM in 2012, VJNR worked on its Business Planning Process towards improving the situation.

2.3 Evolution of Business Planning Process at VJNR

VJNR has created a comprehensive Policy / Strategy Management system which has helped in adapting to changing business environment through **formulation** of high quality Policies and cascading company level **Objectives (O)** to **Strategies (S)** and **Means (M)** for **implementation** at different levels. The process starts with identifying the business issues to achieve the Long Term Business Objectives through which a 5-year Long Term Plan (LTP) is prepared. First, measurable Business Objectives (O) are derived from key Business Issues (required to be addressed) and their implementation.

Once the Objectives are arrived at, they are converted into Strategies and Means at VJNR level, in the form of *Plant Annual Policy and Improvement Plan* (President's OSM helps develop Strategies that are realised through Means or improvement projects). This is then cascaded to the Department Level in form of *Department Annual Plan* with the respective Objectives, Strategies and Means (OSM) finalized with use of benchmarking and Catch Ball validation. Once finalised, the Means are classified into Policy Management and Daily Management Means depending on their a) complexity, b) breakthrough nature, c) stretch in KPI targets, d) level of Cross functionality and e) extent of change management. The Policy Management Means flow into *Policy Sheet* and are reviewed with greater rigor. *Deployment of strategies under TQM framework has benefitted VJNR in systematically improving the Policy and Daily Management activities through improvement projects for each KPI, tracking and review.* The current form of its Business Planning process has evolved through several stages, and is explained in Table 2.1.

Table 2.1: Evolution of Business Planning Process at VJNR

#	Stages	Issues faced	Period	How they were addressed
1	Strategy Formulation	Lack of a comprehensive system of Back-end Analysis (limited to SWOT Analysis)	FY14	Multi-dimensional Back-end Analysis looked at Product Portfolio, Segments, Geographies, value chain integrations
		Confusion in prioritization due to OSM containing both Policy and DM line items	FY15	Introduction of Policy Sheet. Policy items are now identified based on 5 criteria elements
2	Strategy Implementation	Unclear direction/ plan of work due to cascading of objectives	FY14	Cascading of policies through OSM; introduction of OSM as a tool for formulation and cascading of policies
		KRAs co-existed along with OSM	FY15	Formulation of KRAs through OSM
		Absence of Linkage in ERP to Superior's Objectives leading to confusion	FY18	IT enabled OSM in KRAs through SuccessFactor® on SAP with compulsory cascading of objectives (superior)
		Mid-Course corrections in ABP were not clear on process (how to do?)	FY16	Process for Mid-course corrections introduced
		End Result Analysis process not clear	FY16	2X2 matrix for analysis Objective X Strategy introduced
		End results analysis not highlighting system deficiencies and generic learning	FY18	Introduction of President's Diagnosis for assessment of both results and systems shortfall
		Policy items not managed through a project management approach leading to shortfalls	FY18	4i-J3 Leadership Development Program introduced in Oct 17 after TQM Diagnosis to take care of this

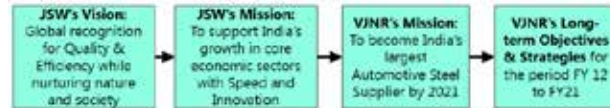
2.4 Business Objectives & Strategies: TQM Implementation Period

2.4.1 Developing VJNR's Mission

The struggle through the experience in Pre-TQM period brought about a realization in leadership team about having proactive and agile systems that could deliver sustainable results for VJNR in event of any crisis. A need was felt to have complete alignment of the organization to a common goal of continual improvement. During the strategic meet in FY12, the senior leadership team deliberated on various long-term aspects of business growth and decided to **adopt a comprehensive TQM framework** towards developing a sustainable and long-term Business Management Process.

Purpose of the Mission: This Mission was set with the core purpose to improve VJNR's upstream manufacturing processes by infusing stringent quality standards (posed by Automotive Steel requirements), thus improving cost competitiveness and also improving its sales realization through value added products. It was also implicitly understood that this process of realizing the new Mission will improve capabilities of people, align them and engage them better. The first step in the above journey was to formulate a Mission statement in line with long term analysis of its business environment, characteristic strengths (DNA), business philosophy and growth aspirations, VJNR decided to work towards improving its product portfolio through Value added products (especially the Automotive segment) while improving its cost competitiveness to global levels. The leadership team decided to set the Mission as: **“to become the largest automotive steel supplier in India by 2021”.**

Objective	Strategies
Increase share in Indian Automotive Steel Segment	Building infrastructure for Automotive Steel
	NPD infrastructure to enhance new product offerings
	Relationship building with key customers through strategic alliance and Early Vendor Involvement
Reduce Conversion Cost	Develop Delivery management system for Automotive quality
	Reduce RM Cost
	Improve Solid Waste Utilization
	Reduce Steel Conversion Cost



2.4.2 Key Objectives & Strategies (TQM Implementation Period: FY13 to FY16): For realization of the Mission, a clear long term roadmap was developed. This was done through systematic analysis of the internal and external business environments to arrive at strategies. Figure 2.2 shows the SWOT analysis used for the formulation of the long term strategies for VJNR in FY13. The long term objectives were aimed to increase its *market share in Indian Automotive Industry* by efficiently managing the Business Issues at hand. With inputs from market research, study of competitor product portfolio, Voice of Customers and the core strengths of speed and agility, VJNR developed its key strategies to accomplish its Mission by 2021. Effective deployment of policies helped VJNR realize its objectives.

Strength	Weakness	Opportunity	Threats
<ul style="list-style-type: none"> + Strong hold in Southern Region + Proximity to auto manufacturers (Geographical advantage) + Strong basket of cash cow products 	<ul style="list-style-type: none"> - Brand recall of JSW - Lack of Expertise in the target segment - Lack of infrastructure and facilities 	<ul style="list-style-type: none"> + Foreign Investment in the auto segment + Increasing PPP of India + High Imports of Cold Rolled Steel + Positive demand gap for CR and Galvanized steel 	<ul style="list-style-type: none"> - Presence of evolved competitors in the market - High entry barrier in the auto segment

Figure 2.2: VJNR SWOT Analysis for FY13

2.4.3 Organizational learning and competencies developed during TQM Implementation period

More than just achievement of Business Objectives and results, the TQM implementation period for VJNR resulted in large scale organizational learning, capability building and development of unique competencies (Table 2.2).

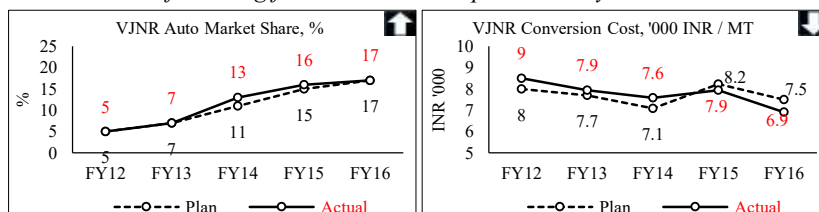
Table 2.2: Organizational learning and competencies developed during TQM Implementation period

#	Challenges Faced	Approaches taken	Results Obtained / Competencies developed	Remaining Problems
1	Large variation and inconsistency of incoming raw material leading to high conversion costs	a. Process Control strengthened thru QA, b. Redesigning Upstream operations (Beneficiation, Blending, Iron Making) c. Technology development for Solid Waste Utilization d. Stabilization of new Steel grades	a. Superior capability in Operations (Flexi Operations with low grade RM) b. Pioneering new technologies for Solid Waste utilization in India c. Industry best conversion costs	<ul style="list-style-type: none"> • Further reduction of conversion costs • Proactive Product Development • Leadership in Auto Market Segment
2	Lower capabilities and expertise in high end steel making	a. JFE Strategic collaboration b. Infrastructure augmentation – NPD and Application Engineering	a. First time grades for Automotive (AHSS and UHSS) b. Establishing Customer connect.	<ul style="list-style-type: none"> • Market development in high end product segments of emerging markets
3	change adaptability	a. Multifaceted capability building model	a. Highest manpower productivity	

2.4.4 Key Effects of TQM Implementation period (FY13 to FY16)

The results for the TQM implementation period reinforced management's belief in TQM approach.

By the end of FY16, VJNR had made significant contribution in making JSW steel a preferred supplier in the Indian Automotive market segment along with achieving superior results on lowest conversion cost. VJNR had been able to successfully convert the environmental challenges into strategic advantages for business. Accumulation and dissemination of learning from the various improvement cycles led to VJNR becoming a Steel Plant with:



1. globally lowest conversion costs
2. ability to manufacture Automotive steel despite poor quality of Iron Ore
3. highest manpower productivity

2.5 BO&S: TQM Consolidation Period (FY17 onwards)

The leadership team analyzed the Annual Policies during the half yearly review of FY18, the first time through President's Diagnosis. Market Segment wise demand analysis was done and which indicated that infrastructure, Automotive and Energy would be growing faster than other segments. Complete analysis of markets segments and their demand was redone and the team came up with the following conclusions:

a) Greater focus on high end **Electrical steels and Long products** having good future prospects, b) Optimization of product mix within each segment to maximize profit, and c) need to move from cost efficiency to value addition model for next generation products in each segment proactively. The three important segments were analyzed for further detail.

Competition Analysis wrt Market presence: Before recasting the Mission wrt its product and segment portfolio, VJNR analyzed the market presence of key Indian Steel makers in various segments and sub-segments. The study findings of analysis of key competitors was compared to the study of FY14. This helped VJNR identify gaps and define way forward in chosen segments. The study reinforced the belief that VJNR needed to diversify further while consolidating its presence in chosen segments.

2.5.1 Recasting the MISSION for VJNR in 2017: Based on the back-end analyses, short falls in the previous policy, TQM Diagnosis feedback and organizational competencies, VJNR recast its Mission statement to lay special focus on widening its product mix from Automotive to entire range of VASP (Value Added Special Products) and increase proportion of VASP. A detailed plan was laid out while aiming to effectively percolate the Mission to each employee. The new Mission attempts to instill pride in employees to contribute towards building capacity ahead of competition and helping VJNR remaining India's largest Steel plant by and also working towards widening the scope of VJNR's product portfolio from just Automotive to a range of VASP across chosen segments for next generation of products. VJNR's plan for deploying the new Mission converged into 3 prime approaches:



1) Maintain Cost leadership while developing markets for high end products: Having gained cost leadership, VJNR must now leverage its cost competency to develop & commercialize high end products at lower costs in target markets of *UHSS Automotive steel, high end electrical steel and high strength Rebars* in LP segment. Faster commercialization of these new products should remain top priority for VJNR.

2) Establishing leadership in VASP: The LTO of becoming largest VASP supplier in India requires more work in the area of Electrical Steel and chosen LP segments and improve Service quality through collaborative development with customers.

3) Enhancing capacity and capability: VJNR's Mission of remaining the largest steel plant in India is driving its current expansion plans and building capability remains a challenging task, given the rate of growth of the plant. Competitor analysis shows that competition will add capacity and hence VJNR must focus on quickly building capacity along with capability towards higher share of VASP. Comprehensive plans around employee and plant capability have been made and deployed for action.

2.6 Key Effects of TQM Deployment

VJNR improved the Automotive market share and lowered its conversion cost in the TQM Implementation period. It has widened

Table 2.3: Competitor Analysis for Product segments

Competitor analysis for market presence									
Products	VJNR	Tata	SAIL	Essar	Bhusan	POSCO (India)	CSC	RINL	
Cold Rolled	TRIP	○							
	DP	●	○			○			
	HSLA	●	●	□	□	□	○		
	IFHS	●	○	□	□	●	●		
	Martensitic & CP	*							
	TWIP	*							
GA/GI	Low Density	*							
	DP	●	○				□		
	HSLA	●	●				○		
	STRUCTURAL	●	●				○		
	IFHS	●	●				○		
	Galvalium	*	●			○			
Hot Rolled	CP	*							
	API (Line Pipe)	●	○	□	●	□			
	Med Carbon	●	●	○	○	□			
	HSLA	●	●	□	○	○			
	DP	○	○	□	○	□			
	FB	●	○	□	○	○			
Electrical	API X80	*	□		□				
	API Sour Application	*			○	□			
	Low Si(<0.6%)	●		○			○	○	
	Mid Si (0.6-2%)	●		○			○	○	
	High Si (2-3%)	○					○	○	
	Very High Si(>3%)	*					□	□	
Long	CRGO	*							
	TMT	●	●	○					○
	TMT-CRS	●	●	□					○
	WR-LC	●	●	○					○
	WR-MC	○	○	□					○
	WR-HC	○	○	□					○

LEGEND
 ● Very Strong Presence □ Weak Presence * future development
 ○ Moderate Presence No Presence

Table 2.8: Improved Automotive Product presence (Auto Body Components)

Component	Outer/Inner Panel				Reinforcement								Energy Absorption			
	Hood	Door	Side	Tail	Door Inner	Roof Cross	Bumper Beam	Floor Cross	Seat Rail/Parts	Floor Side	A/B Pillar	Wheel	Chassis Part	C Pillar	Front Side Member	Back Side Member
FY13						590-HR				340R	440R	SAPH-440	SAPH-440	440R		
FY14	270E	IFHS340	270E/D	270E	IFHS390			750-HR				260LA/300LA	SPFH-590			
FY15	270E-E				HSLA 340		22MnB5					590R	SPFH-590	HSLA340	590 DP/R	590 DP/R
FY16		340BH-E	270E-GA	270E-GI	HSLA 420	780DP	780DP	780DP	780DP	HSLA 420	780DP			780DP	780DP	780DP
FY17		IFHS440	180BH-E		IFHS440		DP1180	DP590-GA	HSLA 550		980DP		FB 590	980DP	DP1180	DP1180
FY18		390BH				780TRIP	780TRIP	780TRIP	900 LA	780 YH	780 YH	\$700MC	BSK-46	980YH	780TRIP	DP780-GA
	Import Substitution grades					Import Substitute+ First Time in India							Cold Rolled Grades		Hot Rolled Grades	

its focus on VASP on a large range of Value-Added Products. Also, during the period, apart from improving its market share in Automotive, it has become the preferred supplier in Indian Automotive industry due to its ability to create the widest range of product offerings and also being able to substitute high end import grades in India as shown in Table 2.4.

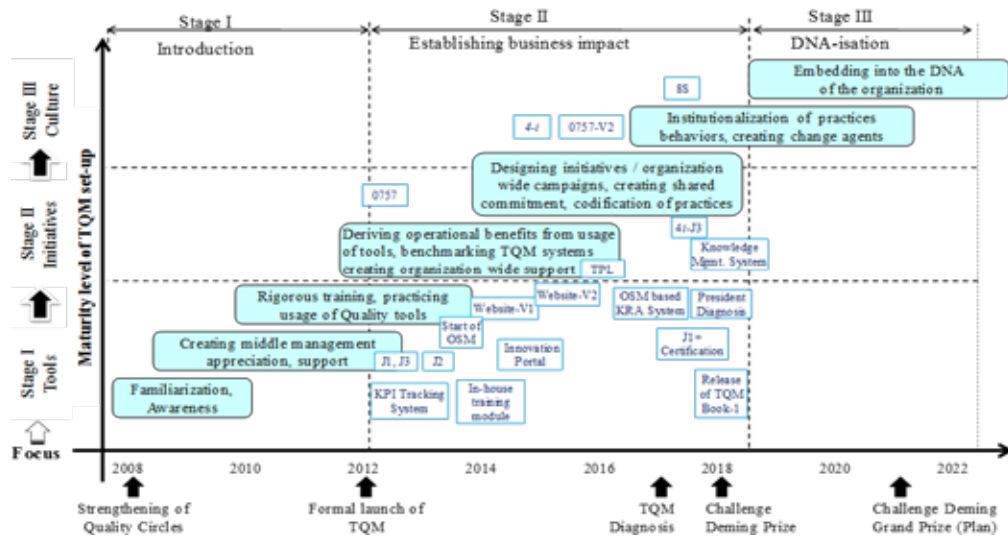
3. TQM Promotion at VJNR

3.1 Overview

While growing in capacity in 4 major phases over the past 2 decades, VJNR has made significant efforts to build systems and processes required for sustainability of its operations. The journey started in 2001 with the adoption of ISO and, later, adoption of Quality Circles in 2004. The Quality Circle culture did not take roots and efforts were again made in 2008 with a more structured approach. The real breakthrough in culture, however, came when TQM was adopted as a Management system in 2012 (in line with VJNR's 5-year LTP). Accordingly, a master plan for TQM implementation was made. The journey of TQM and its future roadmap is shown in Figure 3.1 which also illustrates the set of actions taken during the **TQM Implementation period (FY13 to FY16)** and **Consolidation Period (FY17 onwards)**.

As depicted in Figure 3.1, VJNR is in the second stage of its journey of **"Establishing Business Impact from TQM"**. During the period, good TQM practices were developed with the help of TQM Senseis leading to **superior Employee Engagement** and **better Problem Solving skills** in the organisation. Further, the TQM Diagnosis in 2017 resulted in assimilation of several valuable feedbacks. The current focus is towards institutionalizing good practices and behaviours and building formative practices and to continue on an endless TQM journey.

Figure 3.1: TQM at VJNR - journey and future roadmap



3.2 Objective behind introduction of TQM

The above crisis brought a realization in the leadership team about the need to have agile systems at VJNR to counter such situations through large scale employee capability building for analysis and innovative experimentation.

During the Company's Strategic meet in 2011, it was decided to focus on further improvement of existing systems through introduction of an organisation-wide Quality Management System as part of the 5-year LTP for FY12 to FY16. The leadership team debated on various alternative Business Management systems or methodologies and decided to adopt TQM as it felt that TQM is highly systems oriented and would complement VJNR's DNA of high result orientation. Also, the TQM implementation exercise was seen as the new phase of growth (modernisation of mind).

3.3 Challenges in TQM Implementation Period (FY13 to FY16)

As the various elements of TQM started getting implemented, the program faced several challenges for which VJNR developed strategies one by one.

Introduction of integrated TQM Framework

VJNR started multiple practices during the beginning of TQM implementation period to help speedy implementation of TQM. However, these efforts were scattered and the leadership team felt the need to have an **Integrated TQM Framework** to bring together all these elements and which was introduced in 2014 (Figure 3.2). The framework has a simple input-output concept. On the **Input side** there are TQM Functions, Vehicles and Methodologies.

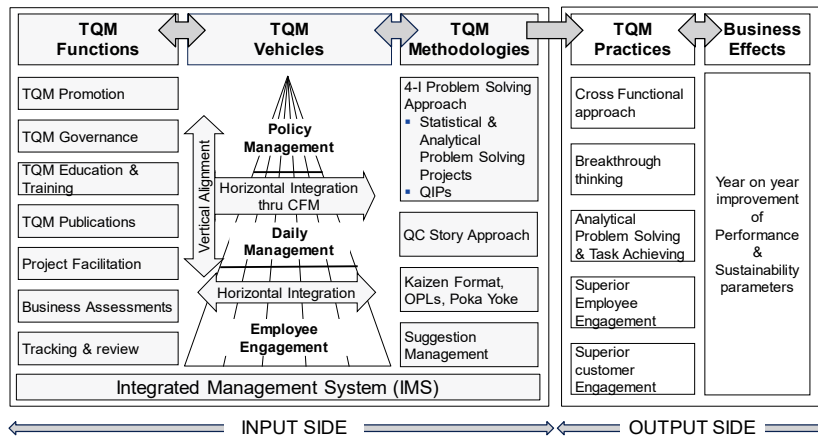


Figure 3.2: Integrated TQM Framework at VJNR

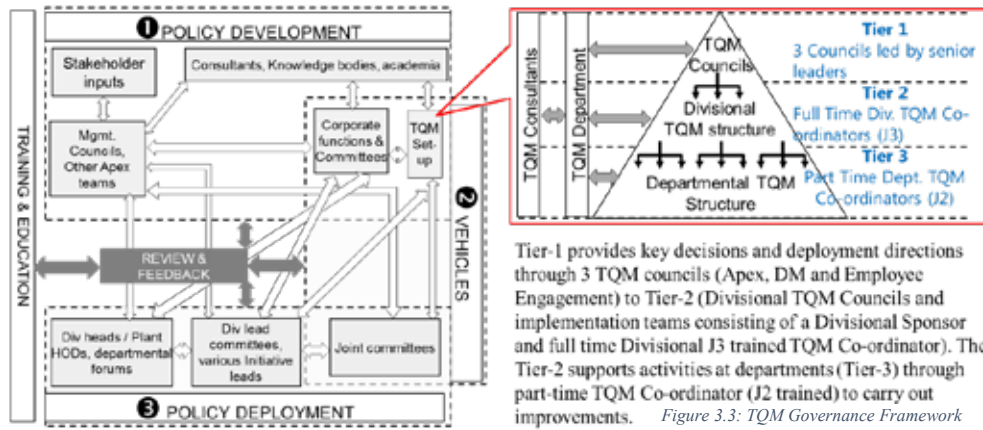
a) **TQM Functions** are the roles of the TQM resources at VJNR. b) **TQM Vehicles** are the three means for transmitting and deploying TQM in the organisation; namely Policy Management (PM), Daily Management (DM)

and Employee Engagement. c) **TQM Methodologies** are the tools and methods through which various forms and levels of problem solving and employee engagement activities would be carried out in the organisation. The **output side** defines the desired effects from the TQM deployment program and refers to improved practices of Cross-functionality, breakthrough thinking, analytical problem solving, employee and customer engagement as **TQM practices**.

The framework sees year-on-year improvement of performance and sustainability parameters as the final **Business effects** or success criteria of the TQM deployment Program.

Governance Framework for deployment of practices: To facilitate systematic and speedy implementation of TQM

practices in line with the Integrated TQM Framework, a TQM Governance structure was put into practice (Figure 3.3). *It is a 3-element structure comprising 1 Policy Development, 2 Vehicles and, 3 Policy Deployment.*



1 Policy Development is carried out by interaction between Management

councils, Apex teams etc. The dissemination of these policies is done by **2 TQM vehicles** to various departments for **3 deployment of policies**. The TQM set-up shown in the governance framework is a 3-tier structure.

Building Capability through Innovative TQM Promotion methods

In Pre-TQM period, only training of Basic QC tools was provided to employees. In the period, VJNR launched its signature 3-tier TQM Capability Building Programs called J1, J2 and J3 in FY14. Gradually, the TQM Capability building Model evolved and developed with 3 elements: **A) a 3-tier Training Program Architecture, B) an interactive TQM Website and, C) a 6-layered Training Content.** J1-J2-J3 provided 3 levels of training Certification for knowledge and facilitation skills required for Improvement Projects. J1 refers to the QC facilitator level and J2 and J3 refer to Problem Solving Expert levels to facilitate higher level of improvements.

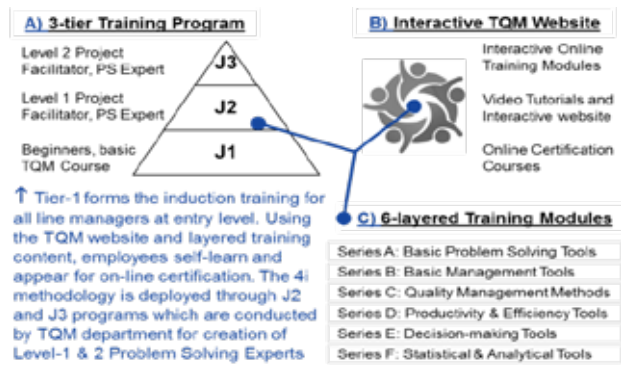


Figure 3.4: TQM Capability building Model

Element-1: Seeding change and customisation of training design (FY14): After starting TQM, it was important to create knowledge and capability fast. The campaign started with creating a **seed pool** of 50 Problem Solving experts at J3 level using Analytical Tools training through external faculty (had 18 Head of Departments) These were to be change agents for subsequent efforts and with their help, within 18 months, TQM team trained 1750 numbers (62% of Line Managers) through J1 to facilitate the QC culture at Shop-floor. To further foster learning, comprehensive training modules (6 series) on various tools were developed in-house and introduced by TQM team in 2014. These covered Problem-Solving methodologies and tools, backed up by real in-house implementation examples from Plant. Figure 3.5 shows how various training module series were mapped with Training Programs (assisted by modules sent on e-mails to all employees) to promote self-learning and on-line self-certification and also be able to provide catalogued as well as customised training inputs.

Program Content	Series A: Basic Quality Tools	Series B: Basic Mgmt. Tools	Series C: Quality Mgmt.	Series D: Productivity and Efficiency Tools	Series E: Decision Making Tools	Series F: Statistical and Analytical Tools
J1 (Duration: 1- Day)	●	●	○	△	△	△
J1 Plus (Duration: 2- Day)	●	●	●	○	△	△
J2 (Duration: 6- Day)	○	○	●	●	○	○
4I-J3 (Duration: 12- Day)			○	●	●	●

△ Not covered ○ Beginners' Level Training Inquired ● Higher Level training Inquired
Figure 3.5: Customization of TQM Training Design

Element 2- Making TQM available to everyone with an Interactive TQM Website (built in-house, FY15): With growing demands for training and retraining of employees, e-mailed training modules were not found to be enough and there was a need of having a knowledge repository accessible by all, whenever required. The website created served to be a one-stop solution for all requirements related to TQM and hosted information on training modules (including High End Statistical tools), video tutorials, training calendar, MIS reports, QC performance reports, Audit reports, upcoming activity list, Online Project log-in, capturing training requirements, online Query resolution etc. Today, large part of communication on TQM (promotion) activities is done through the website.

Element-3: Multi-layered Communication and Distinctive TQM Promotion model. *This came with the feedback from the employees that they required greater exposure to TQM practices from a global standpoint.* To help employees know more, initiatives like TQM Quiz, Monthly TQM Newsletters and many more were started. **TQM Newsletters** were introduced in 2015 to reach the grassroots level of employees and promote awareness on TQM at shop-floor through multi-lingual newsletters (Hindi, English and local language Kannada). It talked about TQM activities of the past month, Senior Management thoughts on ongoing TQM activities, usage and application of Problem Solving tools, amongst other things. These are put up on the TQM Website, displayed on all Departmental and Sectional Notice Boards and all offices.

Element-4: TQM Premier League (FY17): *The various engagement and TQM promotion forums were like standalone initiatives driven one by one without a clear measure of effectiveness. To trigger quicker learning and deepen knowledge of employees, it was decided to put forward the Promotion campaign in form of competition.* This yielded great results in terms of engaging employees in various learning events of the competition. This model for TQM promotion is called **TQM Premier League (TPL)**, a program designed to foster learning through spirit of competitiveness among the four divisions of the plant - Iron, Steel, Products & Customers and Services.

Element-5: Fostering self-learning through On-line Video tutorials (FY16): *To cater to growing demand of quick refresher training, video tutorials were developed in-house and introduced.* In addition to the comprehensive training modules, video tutorials helped facilitate quick learning of various tools. This addressed a large number of employee concerns on refresher training as they were able to have self-learning.

Element-6: On-line Certification Program called J1 Plus (FY18): *A lot of training and re-training was happening but the efficacy of these were not getting checked.* J1 Plus, an on-line certification program, was started to assess the effectiveness of the J1 training exercise (for all 2150 Managers) and helped managers obtain online certification. It was started in Oct'17. The J1 Plus Online tests are conducted through our TQM website on JSW intranet by the TQM team.

Employee Engagement

Table 3.2: Employee Engagement improvement initiatives	Pre-TQM Period	TQM Implementation Period (FY13 to FY16)	Consolidation Period (FY17 onward)
	<ul style="list-style-type: none"> QCs Kaizens Sujhavs 	<ul style="list-style-type: none"> 0757 ©, 4i Methodology © J1-J2-J3 Training Model © Kaizen and QC Audits TQM Website based education Online Quizzes 	<ul style="list-style-type: none"> 8S Employee Engagement Model © 0757 version 2 TQM Premier League J1 Plus Certification © 4i-J3 High End Analytics Program ©

Engaging employees at Shop Floor through TQM Campaign '0757' (Introduced in 2014): With start of TQM

implementation in FY13, the first big challenge for leadership team was to create an initiative that could connect the entire population of employees at grass-root level and bind them through a common objective. Thus, 0757, a shop-floor campaign aimed at “achieving zero injury, zero defect and zero waste through use of 7 basic tools, implementation of 5S and elimination of 7 wastes at shop-floor” was introduced. This was the **first PDCA** in tackling the challenge to embed Quality Circle (QC) as a culture at shop-floor and connect all employees to KPI improvement on the 3 zeroes: Injury, Defect and Waste. The initiative was successful and immediately gained popularity. Based on TQM diagnosis feedback followed by internal analysis, ‘Zero Breakdown’ was added as the 4th element, and, accordingly, Version 2 of the campaign launched in October 2017 (Figure 3.6). Everyone at VJNR uses a 0757 booklet that has the KPI list and the improvement projects taken by the person for the FY.



Figure 3.6: 0757 Version 2 Poster (Illustrative)

Everyone at VJNR uses a 0757 booklet that has the KPI list and the improvement projects taken by the person for the FY.

Employee Engagement Forums, Improvement Formats, Rewards & Recognition

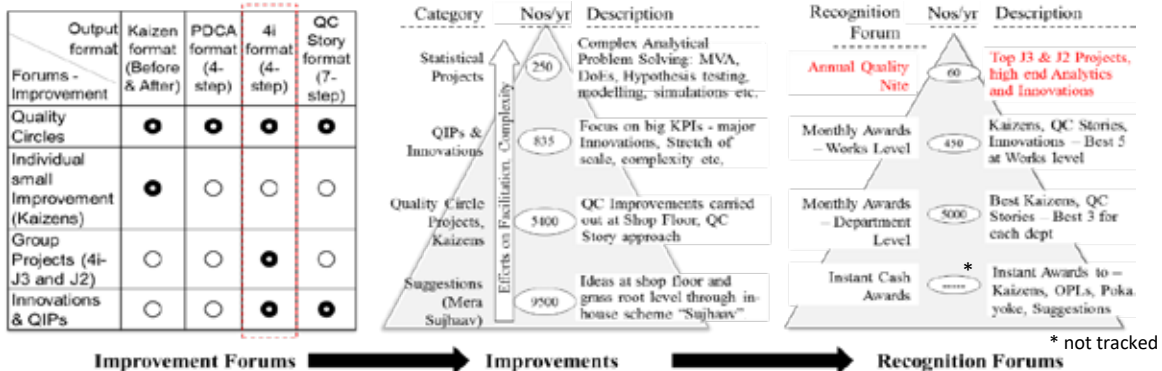


Figure 3.7: Improvement Forums, Format and recognition

As shown in Figure 3.7, employees engage in various Improvement Forums like QCs, Individual Kaizens, Group Projects where they contribute to different kind of Improvements (from suggestions through *Sujhāv* scheme to highest level of Statistical Analytics projects or major Innovations). These Improvements are evaluated for impact and rewarded (refer photographs below). The Annual Quality Nite is held every year and is attended by the top leadership team. Similarly, the Works level awards are given by the President, VJNR and the departmental rewards by the HoDs.

Improvement Project Management through 4i methodology

In the TQM Implementation Period, after using a variety of adopted methods for process improvements, VJNR decided to develop a unified approach to create common understanding of process of improvement for better acceptance with employees. In April 2016, an in-house approach was developed, that served the dual role of being a (i) Process improvement methodology (ii) improvement framework. The new approach was based on Deming's PDCA cycle and was named as *4i*. Figure 3.8 explains both roles of *4i*. *4i* is a stage based structured approach that uses various tools that can be used according to the problem. It employs a four-step approach – 1) Identification, 2) Ideation, 3) Implementation and 4) Institutionalisation

The 4i Project Summary Format: 4i begins with Project identification to develop the business case, then ideation and evaluation of suitable solutions, followed by implementation of improvement projects and ends with institutionalising them. For prioritization, 4i methodology uses an I-C-I-T-E matrix (Impact, Cost, Innovation Quotient, Time, Ease of implementation).

4i-J3 Program to train and cultivate project leaders (Oct'2017): TQM

Diagnosis suggested to improve integration between the process of Project Management and Leadership development at VJNR. While the 4i methodology was good, VJNR was not able to apply the method to project management and train and cultivate leaders for cross functional projects. In line with the above, a comprehensive program called 4i-J3 was designed and launched. This high-end Analytics program provides development inputs to select high-potential persons to be groomed as problem solving experts and future leaders. It involves a 2-Dimensional tracking of individual's performance through progress on DP (Individual Development Plan) and TP (Transformation Project). TPs are usually items from the departmental Policy Sheets involving stretched, complex and cross-functional projects that have high impact on organisation's top line or bottom line. Classroom training is supplemented by reading material, papers and Peer Learning Group (PLG) discussions. During this leadership development program, while the participant improves his project management skills through a TP, they learn several leadership skills like emotional intelligence, authenticity, resilience, mindfulness etc. while working on their DP.

Integrating employee Engagement Initiatives through '8S'

Following feedback of TQM Diagnosis towards integrating employee engagement activities, VJNR launched '8S', which

Figure 3.8: 4i Methodology

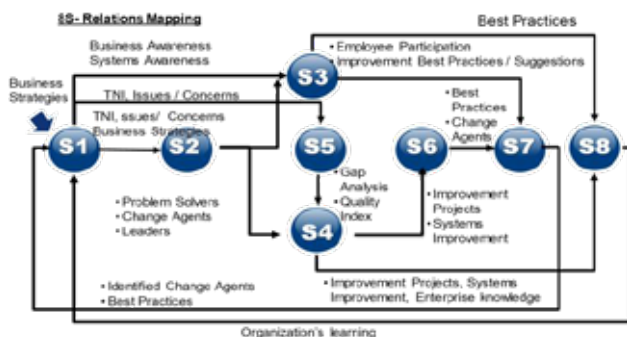


Figure 3.9: '8S' elements, Relationship Matrix

has an approach of integrating various employee engagement activities under one umbrella. '8S', the new integrated model for employee engagement (Figure 3.9), looks at engagement as a closed-loop process.

It looks at integrating Engagement through improvement in: **a) Communication (Sampark)**, **b) Education & Training (Shiksha)**, **c) Problem Solving (Sujhav for Suggestions, Sudhaar for Kaizens, Sameeksha for assessments of improvements and Spardha for learning through competitions)**, **d) Reward & recognitions (Samman to improve employee morale)** and **e) Improved Enterprise Knowledge (Samedh)**. Various forums and initiatives were designed to address the elements of Employee Satisfaction & Engagement as shown in Table 3.3

Table 3.3: 8S elements and initiatives

#	Element	Purpose	Various Initiatives deployed to embed the element
S1	<i>Sampark</i>	Improving communication	<i>Sampark, Samooh</i> , DMD Live, Executive Dialogue, General Dialogue
S2	<i>Shiksha</i>	For inclusive education of employees	Capability building framework , Leadership Development Programs, Behavioural Competency Development, Functional Expertise Development, Development Assessment Centre (DAC), General and TQM Training, J1-J2-J3, J1 Plus, 4i-J3 Program, TQM Website
S3	<i>Sujhav</i>	For constructive suggestions	<i>Mera Sujhav</i> Scheme, <i>Sujhav</i> Melas
S4	<i>Sudhaar</i>	continuous improvement	IQM Portal, <i>Sudhaar</i> Scheme, 4i Methodology,
S5	<i>Sameeksha</i>	Assessments through coaching to foster learning	President's Diagnosis, DM Assessments, Improvement Projects Assessment System for Innovations, assessment of J2 and J3 Projects, Performance Management System
S6	<i>Spardha</i>	For learning and engagement through competition	Best Sujhav, Best Annual awards, Safety Quiz, TQM Premier League (TPL), Competitions for QC, Kaizen, Best OPLs and Poka Yoke
S7	<i>Samman</i>	Rewards and Recognition System	Various award categories, Annual Quality and TPL Nites, President Kaizen Awards, HoD Kaizen Awards, Quarterly Champions, Sponsoring for National Shram Awards
S8	<i>Sumedh</i>	Enterprise Knowledge thru Knowledge Management	Online Jindal Knowledge Centre, Learning Management System, KM System called <i>Sumedh</i> , Knowledge Sharing Sessions (KSS)

“8S”, with its inter-related elements, the model ensured easy identification of gaps and validation for end to end efforts. It is helping VJNR improve capability of its workforce leading to its overall objective of higher manpower productivity and employee satisfaction and also realise deeper meaning of ‘Employee Engagement’.

Policy Management (referred to as PM)

Table 3.4: Improvements in Policy Management

Pre-TQM Period	TQM Implementation Period (FY13 to FY16)	Consolidation Period (FY17 ~)
<ul style="list-style-type: none"> KRA Methodology PMS Review CFTs 	<ul style="list-style-type: none"> Introduction of OSM, TQM Governance Councils Policy Mgmt. cascade and reviews thru Forms 1-5 CFM, 4Q Analysis Business Environment Analysis 	<ul style="list-style-type: none"> OSM Based KRA platform (<i>SuccessFactors @ SAP</i>) President's Diagnosis Integrated QA and NPD Systems

The process of Policy Formulation and Deployment uses catch-ball and Cascading methodologies and is executed in a 7-step method shown in Figure 3.10. Analysis of business environment is done at President VJNR's level and business issues are identified as per the Annual Business Planning Cycle. After analysing the business issues, the Strategy Management exercise uses the OSM template for planning. The format is used to drill down all major objectives for Productivity, Quality, Cost, Delivery, Safety, Morale and Environment (P,Q,C,D,S,M,E).

From the President's OSM, the departmental OSM is derived. Depending on the importance of the OSM line items (as shown in Figure 3.11), they are divided into Policy Sheet and Daily Management Sheet (M-KPI, C-KPI). To facilitate and standardize the process of PM, Forms 0-5 were introduced (Figure 3.11) which guide the user through the complete process of planning and execution. Form 0 is used only at the President Level. The Policy sheet is derived from the OSM document. Policy items are segregated on basis of difficulty of KPI improvement as: a) major stretch in KPI target, b) Major innovations, c) high on complexity, d) Very high level of cross-functionality, e) Change Management.

Rest of the KPI targets move to the Improvement Plan to be carried out through Daily Management. The PM Process (Step 1-7) is deployed through Forms 1-5 as explained in Figure 3.11. Post TQM Diagnosis, VJNR has reinforced its mechanism of review through multi-level review structure and the inclusion of “President's Diagnosis”. The pilot President Diagnosis was conducted in Oct 2017 to assess the Q2 (Quarter 2) of ABP FY18. After learning from it, the second edition of President's Diagnosis was done in January 2018 to review Q3 ABP performance. This will now be conducted Quarterly by the leadership team to verify the condition of the VJNR's PM Process wrt systems and capabilities. The multi-level review system for PM and the difference between the Policy Reviews and Policy Diagnosis is explained in the Figure 3.12 While periodic reviews focus on non-compliances or failures and corrections thereof, the President's Diagnosis is helping VJNR improve the quality of review by identifying system gaps and enabling mid-course corrections and will also improve end-year review.

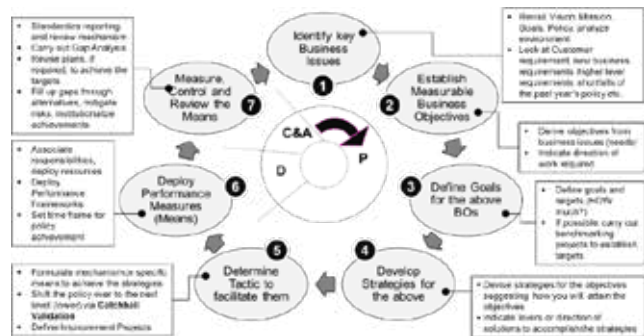


Figure 3.10: The 7-step Policy Management cycle

Figure 3.11: The Departmental OSM, Policy Sheet and DM

Business Issues	Business Objective	Strategy	Means, KPI	Sub-means, KPI	Current level	Benchmark value	Target	
	Business Objective No.1	Strategy No.1						Policy Sheet Improvement Plan (DM)
		Strategy No.2						
		Strategy No.3						

#	Form No.	Description / Purpose	Used by	Required for	Frequency of making, review
1	Form-0	Back-end Analysis	1 2	Site Head Level	Annual, Annual
2	Form-1	Identification of business issues	1 2 3	Site Head Level	Annual, Annual
3	Form-2	O-S-M Sheet,	2 3	Site Head, Dept. Level	Annual, Quarterly
4	Form-3	Policy Sheet	2 3	Site Head, Dept. Level	Annual, Quarterly
5	Form-4	Planning, Implementation & Review	2 3 4	Site Head, Dept. Level	Annual, Monthly
6	Form-5	End result analysis	1 2 3	Site Head, Dept. Level	Annual, Annual

1 Top Management, 2 Senior Management, 3 Middle Management, 4 Line Management

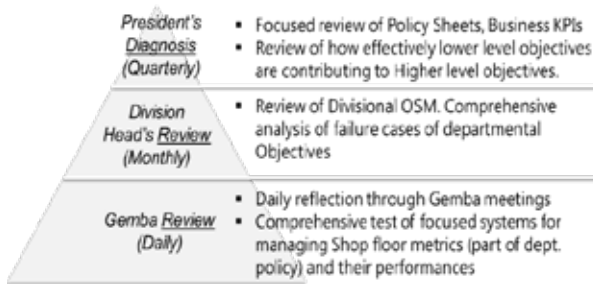


Figure 3.12: President's Diagnosis Structure

Criteria	Policy Review	Policy Diagnosis
KPI Performance Test - Stability vs Conformity analysis - Waterfall Analysis assessing both negative and positive gaps (for all KPIs with target deviation)	☑☑	☑
Systems Test - Maturity of systems for execution and management of policies	☑	☑☑
Sufficiency Test - Correctness of deployment of policy - Linkage of policies at different levels - Necessity of policy items - Thoroughness of policies	☑	☑☑

☑☑ checked Comprehensively ☑ check if required

Daily Management (Referred to as DM)

	Pre-TQM Period	TQM Implementation Period (FY13 to FY16)	Consolidation Period (FY17 ~)
Table 3.5: Daily Management Improvements	<ul style="list-style-type: none"> ▪ Monitoring of Major KPIs 	<ul style="list-style-type: none"> ▪ KPI Drill Down, ▪ Role clarity through M-KPIs, C-KPIs ▪ Gap Analysis ▪ Stability-Conformity Analysis ▪ Criticality Analysis and 2X2 matrix for Maintenance ▪ DM Audits 	<ul style="list-style-type: none"> ▪ <u>Abnormality Analysis</u> ▪ <u>Recurrence Prevention</u> ▪ <u>KPI Linkage Matrix</u> ▪ <u>OEE and Loss Cost Matrix</u> ▪ CERM Model for Maintenance © ▪ <u>Strengthening SOP Culture</u>

While the PM focuses largely on Steps 1-2-3-4 of Figure 3.10, the DM takes over from Step 4 and goes up to Step 7. The DM process at VJNR draws from the Strategy / Policy development process. The DM Process takes over from where the Strategy Management process leaves, as explained in Figure 3.10. Thereafter, it is managed by departmental forums and being practiced by all employees. DM has been adopted as a TQM vehicle to manage its KPIs (Q,C,D,S,M and E) on a daily basis and has the elements as shown in Figure 3.13. The abnormalities are addressed as and when they occur while the chronic issues are taken up as 4-i improvement projects.

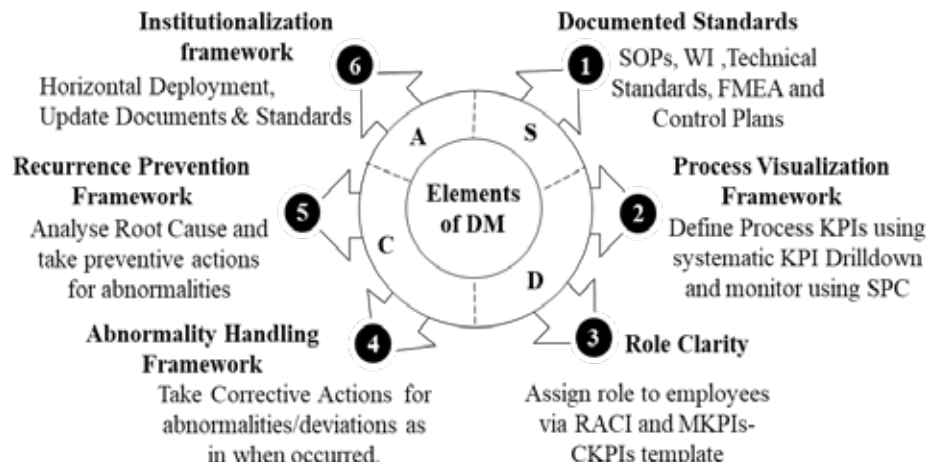


Figure 3.13 Elements of Daily Management

Post improvement, the position of KPIs is tracked and improved on a Stability-Conformity matrix through a 4-Quadrant approach as shown in Figure 3.14. The driving philosophy of DM is to attain stability first, followed by capability, thus moving KPIs from Quadrant 1, 2 & 3 to Quadrant 4 (Figure 3.14). As a learning from TQM Diagnosis, numerical analysis has been added as part of Know-Why for the SOPs and standards have been revised accordingly.

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)
2X2 Matrix		No	Yes
Stability of KPI			

Figure 3.14 Stability-Conformity Matrix

3.8 Cross Functional Management (referred to as CFM)

VJNR's complex value chain involves Raw Material Handling, Agglomeration, Iron Making, Steel Making and Rolling. While PM sets the direction for each vertical function and DM ensures management of routine KPIs, certain horizontal functions get left out (which require involvement of various functions at different levels).

The DM process identifies certain KPIs that are not under the direct control of respective individuals. Lack of collaborative approach between departments, higher interdependencies between processes for the attainment of common business objectives led VJNR to adopt CFM as an integral part of its system.

All the processes involving KPIs having cross functionality are mapped through MSCs (Management System Chart) that illustrate the detailed job flow involving various departments. MSCs help to clarify roles played by each department/function to attain their overall objectives.

A Memorandum of Understanding (MOU) is developed, agreed upon by respective departments/ functions involved in ensuring those processes are carried out for attainment of business objectives.

The KPIs identified through MSCs are tracked for deviations/ improvements and discussed in DM review meetings. The processes having KPIs from more than one department are discussed in DQC (Departmental Quality Council) Meetings. The Quality Board was formed after TQM Diagnosis to help clarify the creation and management of Cross Functional teams to address inter-departmental issues.

4. Employee Engagement

VJNR is India's largest (12 MMTPA) and the most productive (>1000 tons/man/year) Steel Plant. Through its signature employee engagement model "8S", it is focused on developing an engaged organization with a robust engagement process based on unique blend of *communication, capability building, empowerment* and *recognition*. Till 2012 (Pre-TQM period), VJNR had grown very fast, while struggling with following issues: 1) lack of basic infrastructure around VJNR due to its rural setup leading to difficulty in sourcing from outside, 2) scarcity of educated and skilled manpower amongst local population leading to sourcing issues from them, 3) large proportion of new employees causing skill and training related issues leading to lower manpower productivity. All the above resulted in low engagement, low satisfaction and high attrition.

In Pre-TQM period, VJNR made efforts to build **basic infrastructure and fundamental systems** like recruitment system, online payroll system, ensuring statutory compliances, basic training infrastructure. Also while adding equipment and plant for VASP production, it was required to develop technical and analytics capability in people for VASP.

4.1 Challenges and initiatives during TQM Implementation Period (FY13 to FY16)

In 2012, VJNR was struggling to enter into VASP and bring down its high Conversion Costs. *This wasn't possible without high levels of employee engagement.* By 2012, while the basic infrastructure had been built (Figure 4.1), there were no organised processes for building capability for organizational development. During this period, VJNR worked on 4 major things: 1) create a large scale training infrastructure, 2) design a people development framework, 3) create Development Forums for skill and competency improvement and 4) create more comprehensive employee engagement forums. During the period, the most noteworthy thing was developing the capability building framework as explained below.

Challenges	Pre TQM Period (FY12)	TQM Implementation Period (FY13-16)	Consolidation Period (FY17 onwards)
Building fundamental systems	<ul style="list-style-type: none"> Payroll Processing Statutory Compliances Recruitment System Training Infrastructure 	<ul style="list-style-type: none"> Online KRAs in SAP Online System for attendance Associates On-line bill processing Champion of the Quarter 	<ul style="list-style-type: none"> Integrated Employee Life Cycle Management (ELCM) in SAP-HCM ESI Success Factor for PMS
Building Capability for Organizational Development	<p><u>Basic Training Programs</u></p> <ul style="list-style-type: none"> Skill specific Technical training programs 	<p>1) <u>Infrastructure</u></p> <ul style="list-style-type: none"> Learning Centres in various depts. Centre of Excellence (CoE) for hands-on training <p>2) <u>Designing Development Framework</u></p> <ul style="list-style-type: none"> Comprehensive Capability Building Framework Tie-ups with Premier Institutes Graduate Engineering Trainee (GET) 100 day Induction Program MDP for Senior Management 	<p><u>Development programs</u></p> <ul style="list-style-type: none"> EDPs for Line Managers EDPs for Associate Managers GET Mentorship (Guru-Cool)
Adopting Strategic HR Management Practices	<p><u>Reward & Recognition Structure</u></p> <ul style="list-style-type: none"> Long Service Awards Best Employee Award 	<p>1) <u>Development Forums</u></p> <ul style="list-style-type: none"> Development Assessment Centre (DAC)- Utkarsh Skill Index Assessment <p>2) <u>Engagement Forums</u></p> <ul style="list-style-type: none"> Sampark, Samooh for Communication Sujhav for suggestions 	<p><u>Development cum engagement Forums</u></p> <ol style="list-style-type: none"> 8S concept (New) Individual Development Plan (IDP) Leadership Program (FFL) DMD Live, Executive Dialogue 5D Model (New) 4iJ3 Program (TQMD Feedback)

Figure 4.1.: Evolution of Employee Engagement

4.1.1 Developing a comprehensive Capability Building Framework

While many initiatives for technical skill and competency development started running concurrently, *employees were getting confused* and desired to understand the linkages of these initiatives to their individual development. Also, the Human Resource team required to understand the entire portfolio and scope of the training & development programs they needed to offer. Hence VJNR came up with a comprehensive "Capability Building Framework" that attempted to map

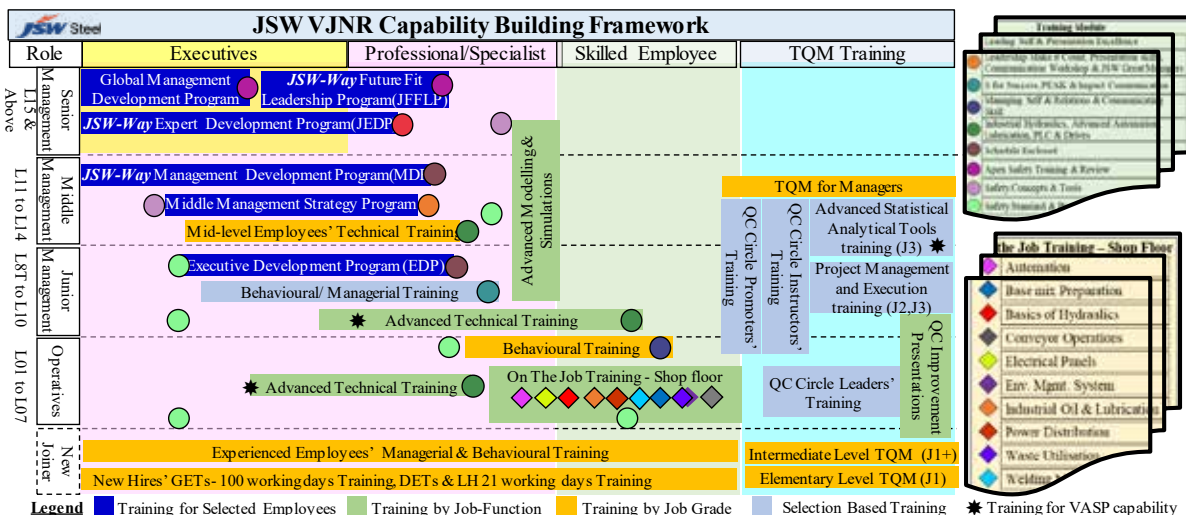


Figure 4.2: VJNR's Capability Building framework

training needs across levels to various programs that existed, and thus, *identify areas where improvement was required* (Figure 4.2). The framework took care of 5 issues – 1) the **scope of training** widened to cover all aspects: safety, TQM, technical, On-the-job, behavioural, 2) special focus was laid on **new recruits' training** including fresh engineers and technicians, 3) **competency development** assessment centres were designed for middle and senior managers, 4) **leadership development** programs started, and 5) department specific skill enhancement training started.

The framework helped a) employees build perspective of self-development, b) managers do Training Need Identification (TNI) for specific training for their employees, and c) HR department offer a training calendar. During the implementation period, engagement of employees through training went up significantly.

For the Mission of VASP, special initiatives were started to improve the capability of employees working in departments associated with VASP. While the Technical Training with JFE started, specialists program was also initiated for creating modelling & Simulation experts along with Advanced Statistical & Analytical tools courses. One of the Learning Centres was dedicated to training of experts for Product Design & Quality Control (PDQC) department.

Apart from improving the training & development model, other things like communication, rewards & recognition, QC and Kaizen culture played a vital role in improving attrition and needed to be improved.

Remaining Problems: VJNR concentrated on *building capability* with a focus on improving quality of training with IT enablement. However, while individual development forums (DAC) and communication forums helped reach grass-root level employees, the 2 elements of Communication and individual development still remained disjointed.

4.2 TQM Consolidation Period (FY17 ~)

In the TQM consolidation period, the focus shifted to develop Strategic HR Management Practices with an emphasis on 1) leadership development, 2) creation of change agents having problem solving skills along with leadership capabilities, 3) improving engagement at entry level and, 4) large scale behavioural training across all levels.

For above, VJNR took 6 actions to create development-cum-engagement forums – a) **8S**: an integrated model for Employee Engagement to engage-develop employees, b) a **multi-level communication structure** to connect senior leadership to grass-root (DMD Live, Executive Dialogue), c) **IDP**: Individual Development Plan (IDP) for co-creating development plans for individuals, d) **FFL** (Future Fit Leadership): a Leadership Development Program to identify and coach leaders for future, e) Leadership Pipeline Management model **5D Model** to evaluate 5 dimensions of leadership attributes and map and compare for development, f) **4i-J3** Program to integrate the process of leadership development into management of improvement projects (*TQM Diagnosis Feedback*).

As a result of improving the processes around employee engagement during TQM implementation, the employee satisfaction has improved by 22% in 5 years. Also, higher engagement, higher satisfaction and lowered attrition along with improved skill and capabilities during the period has resulted in improved Manpower productivity of >1000 Tons / man / year which is the highest in the Indian Steel industry (reference Ministry of Steel, Government of India).

5. Quality Assurance (QA)

While reducing its conversion costs, it was imperative for VJNR to design and implement a robust QA system to deliver customer satisfaction while the critical cost elements are under control. The QA system of VJNR focuses on integration of work processes across value chain for exceeding customer requirements by preventing process inefficiencies and generation of defects.

VJNR Operations has 2 parts: Iron Zone (Upstream) and Steel & Mills Zone (Downstream). The management goal of Iron Zone is primarily to convert huge variation of input Raw Material to produce one quality of Hot Metal. Later, customer requirements get incorporated into Product in the Steel Zone. The Mills Zone (Downstream) aims at building Product & Service Quality.

5.1 Evolution of Quality Assurance System at VJNR

While working towards increasing volume of value added products to attain leadership position in VASP, the issues were: a) Products conforming to standards but failing to meet Customer specific requirements, b) Design Characteristics of New Grades limited to Steel Chemistry / Strength Parameters rather than performance parameters, c) Frequent Failures at Trial Stage leading to delay in Commercialization of New Products, d) Higher Rejection during scale up and mass production, e) Poor start up management causing repeated customer complaints.

Table 5.1: Evolution Phases in Time Scale

	Pre-TQM (FY12)	TQM Implementation (FY13 – FY16)	Consolidation (FY17~)
Approach	Quality Control	QA during NPD and Manufacturing	QA integrated with business
Focus of QA System	Containment and Corrective Actions	Preventive Actions and Developing system to build quality into Product	Customer Experience and Product Performance during end use.
Major Business Focus	<ul style="list-style-type: none"> • Inspection & Testing • Certification of products • Containment, Correction • Managing customer complaints, Feedbacks • IO Blend Optimization • Adjusting processes 	<ul style="list-style-type: none"> • Establishing new IO and coal sources • Process re-designs for poor RM • Understanding customer requirement • Strengthen internal Feedback systems • Develop SOPs for VASP grades • Learning from JFE collaboration • Fast Ramp up of New Products, 	<ul style="list-style-type: none"> • Establish VOC mechanisms • Improving packaging quality • Integrating customer to Value chain • Benchmarking Product Quality • Front End Loading in NPD • CFTs for customer complaints • Change control mechanisms
QA in NPD		<ul style="list-style-type: none"> • Usage of QFD for VOC • Product Design based on end application 	<ul style="list-style-type: none"> • Proactive customization of grades

		<ul style="list-style-type: none"> • Process Capability Study and FMEA • DOEs, pre-launch control plan introduced for stabilization of VASPs • CFT with manufacturing, QA, AE and NPD team upto commercial supply 	<ul style="list-style-type: none"> • Designing Products with narrow band of properties to support VA/VE projects of Customer • Adopting advanced technologies • Benchmark Product Quality • Design Reviews for NPDs
QA in Manufacturing	<ul style="list-style-type: none"> • Train Operators, Inspectors on SOPs, customer needs 	<ul style="list-style-type: none"> • Internal Process Control Strengthen with development and revision of PFMEA, Control Plans and usage of SPC tools • Maintenance System reliability • Quality Gates Introduced at input, process, output stages • Departmental Quality Councils formed 	<ul style="list-style-type: none"> • QA matrix, process stability and capability studies • Poka-Yoke systems • IT based checks and quality gates • Early Detection and control of defects • CFTs to own defects and work on elimination
QA in Inspection & Testing	<ul style="list-style-type: none"> • Training provided to inspectors and testing team on customer needs • Improvement in sampling system and test procedures 	<ul style="list-style-type: none"> • Trg: Measurement tools, typical defects • Visual SOPs and defect album prepared • Surface defects Online inspection • Simulating customer end use condition • Checklists for pre-dispatch physical damage inspection 	<ul style="list-style-type: none"> • Advanced Characterization to check new grade performance issues • Quality gates at critical locations • CCTV cameras installed to ensure proper covering of vehicles to avoid Rust and transit damage of VASP
QA in Service Quality		<ul style="list-style-type: none"> • Streamline AE support to address issues • Systems developed for faster commercial settlement of claims • Enquiry Management System developed to help customers select correct grades • DM systems established to respond to customer queries within 48 hours. 	<ul style="list-style-type: none"> • Catalogued order entry to avoid incorrect grade selection • IT based quality gates introduced to avoid errors in Test Certificates • Variable Configuration modification in ERP system to link customer requirements to order attributes

5.2 QA System of VJNR

The QA System chart acts as a deployment tool for managing quality across the value chain by integrating all functions (from mapping of customer requirement, market analysis to post sales-support to customer). The chart has 6 key life cycle stages of product in vertical direction and departments in horizontal direction. It has been instrumental in clarifying roles of various stakeholders (and their KPIs) to achieve customer satisfaction. The QA chart of Iron and Steel & Mills Zone are linked through MOUs (Memorandum of Understanding) on Hot Metal delivery parameters.

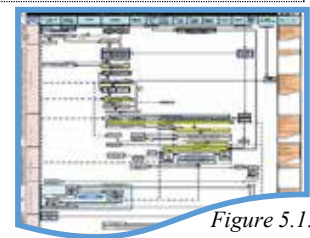


Figure 5.1: QA Chart

VJNR used **Integrated Quality Assurance Chain (iQAC)** to align activities of each part of value chain to final customer requirements. As a key mechanism to deploy customer needs to QA KPIs for each unit, iQAC defines the next process as the internal customer to the previous process. The quality of final product is defined in terms of **TDC (Technical Delivery Conditions)** agreed with customer. This is further drilled down to individual upstream work units to define the quality requirements at each stage in form of MOUs between various departments. Feedback on process deviations are received from the next process and necessary actions are taken. MOU compliance is reviewed in DQCs on a monthly basis and cross functional projects are taken to address chronic non-compliances. **iQAC as a Quality Deployment Tool** has resulted in reduction of internal rejection level and better coordination between departments.

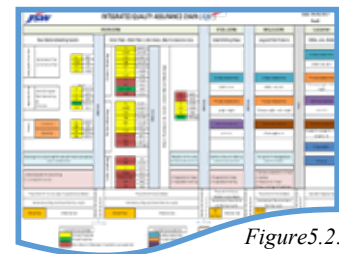


Figure 5.2: iQAC

5.3 QA Governance Structure

The QA Governance structure (Figure 5.3) at VJNR was developed by adopting best practices across industries. The JFE collaboration helped create and deploy a functional architecture for driving customer centricity. The Quality Board, introduced in FY17, acts as the apex governing body for promulgation of policies and guidelines to be deployed through divisional TQM Councils and DQCs. To promote CFM in VASP, SBU-A (Auto) and SBU-E (Electrical) CFMs were created. Project Appraisal Committee (PAC) checks for issues during early development stage of a Technology. Post diagnosis, a Central Quality Assurance (CQA) team was created to drive CFM better and guide divisional teams for effective QA deployment.

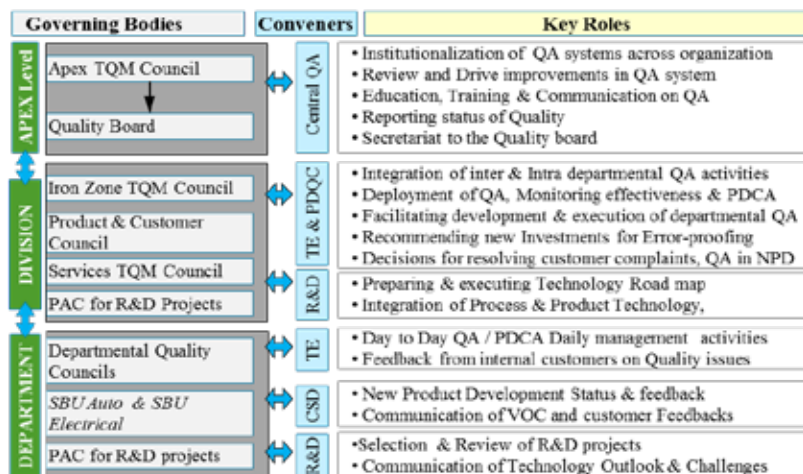


Figure 5.3: QA Governance Structure of VJNR

5.4 Benchmarking of Product Quality for Value Added Segments

Benchmarking on Critical to Quality (CTQ) parameters of key grade groups of VASP revealed that Cold Rolled grades have better properties than Competitors and Electrical steels are at par with the industry (Table 5.2).

Table 5.2: Benchmarking on CTQ parameter for key grade groups of VASP

Segment	Key Products	Key Characteristics	Competitor's level	VJNR's level	Remarks
Automotive	IF Grade	Tensile Strength,MPa	280-304 MPa	290-305 MPa	Products from VJNR have formability <u>better than competitors</u>
		Yield Strength,MPa	140-168 MPa	145-165 MPa	
		Elongation, %	43 - 48 %	49-55 %	
	Min n & r-bar value	0.2 & 1.90	0.22 & 2.2		
	HSLA	Tensile Strength,MPa	435-475 MPa	420-480 MPa	
Yield Strength, MPa		350-385 MPa	340 - 400 MPa		
Elongation,%		30 +/- 3 %	34 +/- 3%		
Electrical	50C800 Grade	Watt Loss, W/Kg	6.5	5.7	Properties of products from VJNR are <u>at par with competitors</u>
		B50 Value, Tesla	1.71	1.72	
	50C700 Grade	Watt Loss, W/Kg	6.0	5.0	
		B50 Value, Tesla	1.7	1.7	

5.5 Handling of Customer Complaints related to Product Quality

The process of handling customer complaint is explained in Figure 5.4. The action plan for elimination of each complaint is approved by a CFT called 'CAPA committee' that involves HoD of manufacturing, NPD, QA and Marketing & Sales teams. The rejections due to customer complaints have been brought down consistently from 0.52 % in FY12 to 0.14 % in FY18 despite increase in volume of VASP by implementing suitable corrective and preventive actions through QA system. Table 5.2 shows QA system response to major reasons for customer complaints.

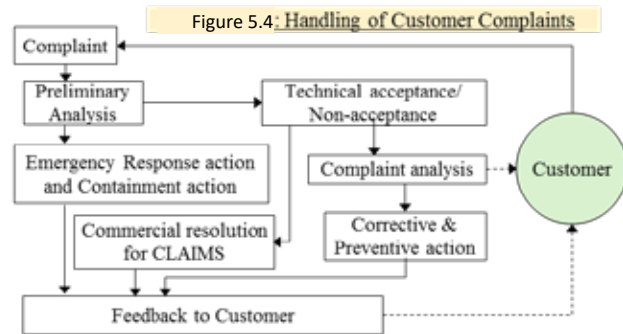
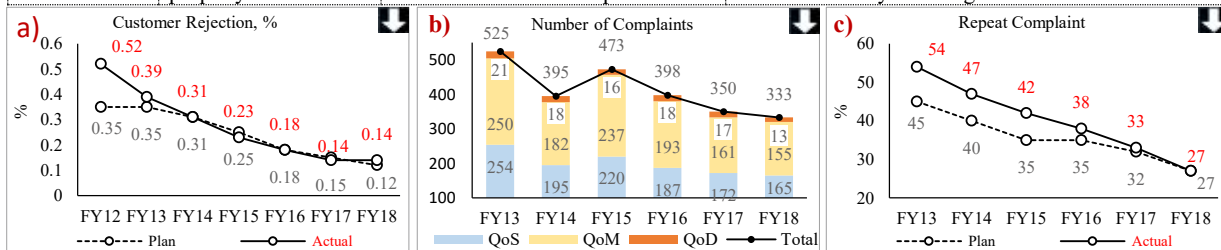


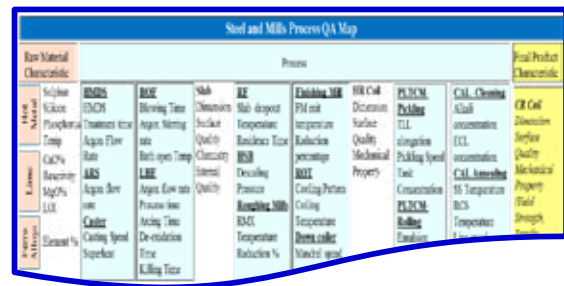
Table 5.2: QA system response to major reasons for customer complaints

Segments	Product Segment	Major reasons-Customer complaint	Key improvements in QA system done to address
Automotive	Cold Rolled	Rust and damage during transit	Standardization of packaging and logistics practices
	Hot Rolled & Pickled	Inconsistency in Surface Quality	Process Standard developed for Picking Lines
	Hot Rolled	Shape Defects: Waviness & Bow	Quality Gate introduced with offline bow checking
Electrical Steel	Standard grades	Poor punch-ability	Application methods adopted to capture for NPD
	High Magnetic property Grades	Magnetic properties are as per spec but not better than competition	Competitive Assessment of product characteristics made mandatory for design review of NPD



5.6 Strengthening Internal Control Mechanisms with FMEA, Control Plans, QA matrix, QA Map

During the TQM Implementation period, detailed PFDs were prepared for all units to identify process and product characteristics with incoming sources of variation. QA Matrices were improved with a) process specification limits derived from past data analysis and b) product characteristics based on customer requirements. FMEAs were periodically revised based on abnormalities arising out of product and process with better control plans. QA maps have been prepared to provide visibility of process control items together for effective control in order to achieve the desired characteristics of the intermediate and final product.



6. New Product Development (NPD)

For VJNR's Mission is to become the leader in VASP, market Segment wise demand analysis shows major growth in four key sectors: Automotive, Energy, Line pipe and Infrastructure. Also, each of these sectors are moving to higher share of VASP. In line with both of the above, VJNR has arrived at a Product portfolio of VASP in key segments This has been possible with superior NPD infrastructure backed by a robust QA process.

6.1 Challenges during Pre-TQM Period (FY 12)

VJNR was a late entrant to Automotive sector which already had evolved competitors with established NPD and Steel manufacturing expertise for VASP and supplying to majority of the Auto customers then. Thus, getting an approval for a new product was extremely difficult. Major challenges in FY12 are shown in Table 6.1.

#	Challenges of Pre-TQM	Strategies
1	Low Market Share in Automotive Segment due to lack of product offerings	-Strategic Collaboration with JFE -Enhancing product portfolio
2	Lack of NPD process and infrastructure	-Establishing a comprehensive NPD process (Formation of PDQC department to Drive NPD and Product Approval , Employee Capability Building)
3	Inadequate Manufacturing Facility for VASP	-Technology upgradation and adoption of manufacturing Facility for VASP

6.2 Strategies adopted during TQM Implementation Period (FY13-FY16)

To meet the stringent quality requirements from the target segment, product development at VJNR had to quickly undergo significant changes (technology, NPD process). The improvements started with developing the first draft of the NPD process to address aspects like a) customer requirement mapping and b) product and process design. To overcome the challenges mentioned, the following Strategies were developed:

1) Strategic Collaboration with JFE: The JFE Collaboration enabled VJNR to receive technological assistance in areas of a) equipment selection, b) technological knowhow on process and product, c) handholding for successful approval of grades. This helped in shortening the organizational learning curve for development, manufacturing and commercialization of VASP.

2) NPD System and Infrastructure development: During pre TQM period, VJNR's NPD process was primarily experience based product and process design. Lack of formal process of capturing customer requirements, process capability issues, lack of validation of product characteristics resulted into repeat trials during development. A comprehensive 7-step NPD process (Figure 6.1) was developed using learning from different NPD processes across industries. With this process, major improvements were made in the area of capturing VOC through QFD, Product design through regression and patent gap analysis and Process design through DOE or optimisers.

Formation of PDQC (Product Design & Quality Control) department helped VJNR centralize cross functional interactions

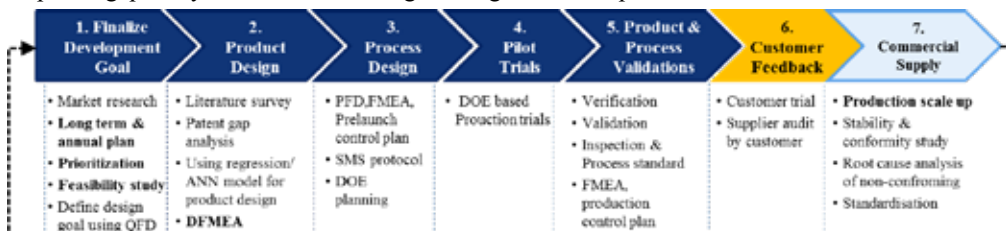


Figure 6.1: NPD Process Steps

related to NPD, while also driving joint product development with customers. Product approval process and commercialization was streamlined with strengthening of Application Engineering (AE) team. Training on Product and process technology, SPC, Advanced Statistical tool, Advanced Product Quality Planning (APQP) and Product part approval Process (PPAP), FMEA, IPR, ISO/TS16949 and Gleeble Simulation helped build employee capability on NPD.

3) Manufacturing Facility Enhancement

infrastructure development of VJNR's NPD is supported by parallel Upgradation in manufacturing facilities to improve VASP % (Table 6.1)

Result: Product portfolio Enhancement

VJNR's product portfolio has been diversified from general application grades (before FY12) to high end Automotive products having major enhancement in AHSS product. Figure 6.2 shows how VJNR has strategically moved from High Strength HR to AHSS in CR and Coated products.

#	Facility Upgraded	Unit	Utilization	FY
1	HSM upgradation	HSM 2	Develop in house HR Substrate to Produce Automotive	FY13
2	RH Degasser	SMS 2	Cleaner Automotive and Electrical steel Production	FY13
3	CAL1&2	CRM 2	Enter CRCA Automotive Products (Focus on AHSS)	FY14
4	CGL	CRM 2	Develop Coated products for Automotive, other VASP	FY14
5	KR Process	SMS 2	Develop VASP with Lower S%	FY15
6	ACL	CRM 1	Enter Electrical Steel segment (CRNO)	FY16
7	EMS	SMS 2	Inclusion control to improve Product Quality	FY17
8	Auto Scarfer	SMS 2	Improved quality of Auto Skin Panel Application	FY17

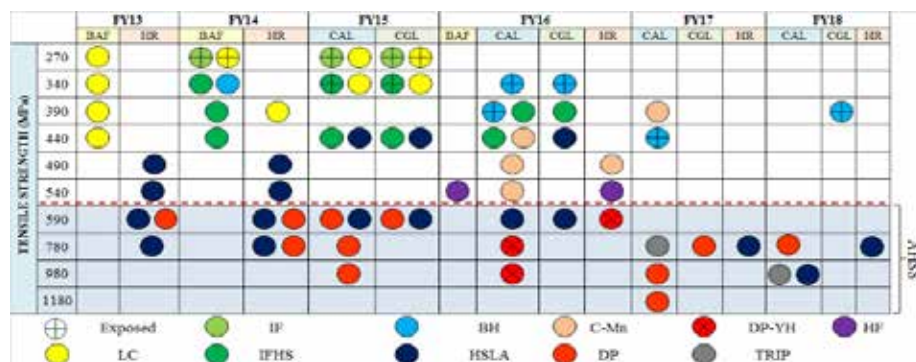


Figure 6.2: Automotive Product Portfolio Enhancement

6.3 Challenges during TQM Consolidation Period (FY17~)

The following major challenges remained: (Refer Table 6.2)

#	Challenges	Strategies
1	Inadequate Project Management System	IT based NPD Project management system with Cross functional linkage to Stakeholders
2	Sequential Product development Approach	Adoption of Concurrent Engineering Approach for NPD
3	Lack of Vertical Start-up	Adoption and Improving in DFMEA

1) Improving NPD Project Management: VJNR Improved its Cross functional management (CFM) through Management System Chart and incorporated it to IT based NPD project management system to link each stakeholder through IT based platform. Commercial feasibility through NPD ranking and prioritization incorporated in IT based NPD project management system to generate annual development plan.

2) Concurrent Engineering Approach: VJNR improved earlier sequential product development cycle (Figure 6.2) to concurrent engineering based parallel design approach.

Each cross functional sub-activity is defined as parallel or sequential previous sub-activity and assigned to responsible cross functional Team Member. Decision gate system at each stage divides the cross functional team effort into distinct stages separated by management decision gates. Sequential and parallel activities are also defined in IT based project management system. The approach is now utilized for proactive developments of steel Grades through IT platform.

3) Vertical Start up: As vertical start-up approach, VJNR improved upon the previously defined Design Failure Mode Effect Analysis (DFMEA). Improved DFMEA involves CFM and considers the potential failures and its effect at (i) Plant level (ii) component manufacturer level (iv) Final component level and (iv) end application level. Revised DFMEA also identifies effect of potential failure on statutory and regulatory requirements along with potential causes to develop counter measures for the same.

Production Technology Roadmap: In line with VJNR's objective to become a leading supplier of VASP, many systemic arrangements along with technology enhancements were done across the steel value chain during the period. Accordingly, VJNR evolved process for development of production technology roadmap based on vision and goals of the company (Figure 6.3). Looking at milestones, gaps are identified to derive the action plans. In line with this, product development and technology development plans are derived. Technology development is supported by central project team to meet the product development.

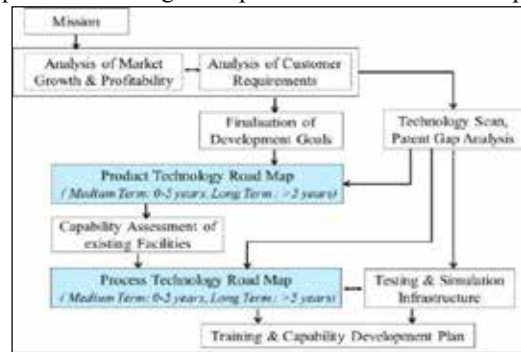


Figure 6.3 Process for Development Technology

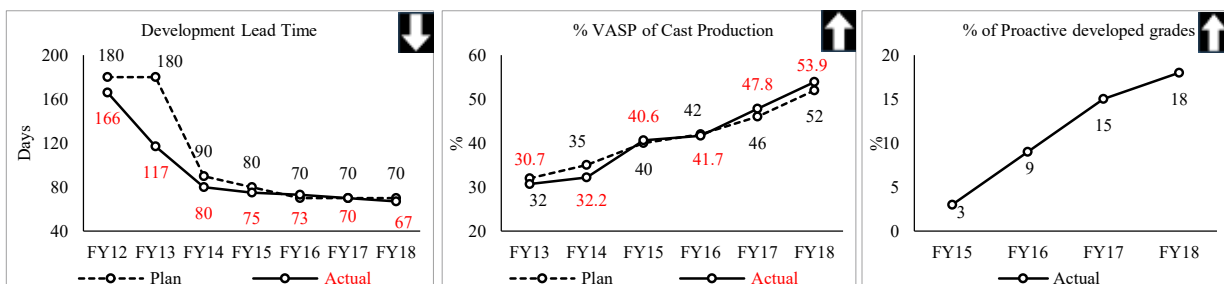
Proactive Development: In consolidation period VJNR's Product development approach has changed from customer requirement based development to developing products based on future requirements of customer and customised offering.

6.4 Key Effects: As a result of TQM deployment, NPD system development and utilization of enhanced production facility, VJNR is the only steel manufacturer to have produced advance high strength steel grades ranging up to 1180 MPa tensile strength in India. Proactive approach in identifying new business opportunities in high end application requirements from the consumers led to development of high strength 780TRIP steel resolving strength ductility trade off, UHSS 1180 grade for crash component, and AHSS coated 780DP steel with excellent surface property. Highlights of NPD in different product segment are shown in Figure 6.4.

Product Segment	New Product Development Highlights
Automotive	<ul style="list-style-type: none"> Dual Phase (DP) Steels of > 1180 MPa UTS TRIP Steel of > 780 MPa UTS (High Strength -High Formability) CRCA/COATED for Exposed Panel Coated DP > 780 MPa UTS (Surface Critical) Hot Rolled -700 MC and FB Grade (Wheel)
API Line pipe	<ul style="list-style-type: none"> API X65 (Sour Application) API X70 (For Gas and Petroleum Pipelines)
Electrical Steel	<ul style="list-style-type: none"> CRNO Grades with High Si (>2%) -Lower Watt Loss (<2.8 W/Kg)
Long Products	<ul style="list-style-type: none"> Fe 600 (High Toughness for large RCC construction) TMT -Seismic Resistant Grades (Fe500D & Fe500D) TMT -Corrosion Resistant Grades (Fe600CRS) High Carbon Wire Rods Electrode Application Grades

Figure 6.4: Segment wise NPD Highlights

VJNR one-stop solution Automotive and Other Value Added Products: Successful development and commercialization of AHSS, JSW received the prestigious **Steelie Award** from World Steel Association for **"Innovation of the year"** 2016 for development of AHSS for automotive sector. VJNR is considered a domestic pioneer in the field of AHSS by being the only Indian supplier capable to cater to the entire range of flat steel requirements from an automotive manufacturer.



7. Delivery Management

In line with its Mission to increase share in VASP market segments it was imperative for VJNR to create Service differentiation through efficient delivery management system that focuses on meeting Service expectations of customers. These segments require customised products and services, shorter lead time and careful handling of products. To meet these requirements, VJNR had to restructure various aspects of its delivery management process including sales order management, production planning, inventory management and logistics.

7.1 Evolution of Delivery Management process

Table 7.1: Evolution of Delivery Management process

	Pre – TQM (FY12)	TQM Implementation period (FY13 – FY16)	TQM consolidation period (FY17 ~)
Approach	Focus on capacity utilisation to maximise sales	SKU level Delivery compliance with respect to Quantity	Ensuring On Time in Full compliance (OTIF)
Focus areas	<ul style="list-style-type: none"> Sales plan based on production of crude steel and availability of resources Manual process for order management to validate customer requirements and order attributes Production planning based on priority and escalations Majority of dispatches through market vehicles 	<ul style="list-style-type: none"> Establishing Sales & operation planning process Segment demand mapping based Sales planning Capacity utilisation to meet sales plan Tracking SKU level compliance at each workstation IT enabled WIP visibility and capability check Part number based order capturing (Poka-yoke) Identify and address bottlenecks in VASP servicing Augmented Stock yards and service centre capacities to service large number of SKUs Introduction of customized vehicles and transportation methods 	<ul style="list-style-type: none"> Establish On Time in Full measurement system (OTIF) Customer wise sales plan based on history and projected demand. Establish process of capacity check for order promise date Expansion of logistics networks and fleets

7.2 Challenges during Pre-TQM Period (Pre-FY12)

During Pre-TQM period, the Delivery Management process of VJNR primarily focused on capacity utilisation to maximize sales. Since it was focused on volumes, it was failing to meet the specific Service requirements of VASP segments (*Lead time, customized sizes, specialized handling requirement, and SKU level compliance*). These limitations resulted in lower customer satisfaction.

Table 7.2 Challenges & Strategies of TQM Implementation Period

#	Challenges	Strategies
1	Lower Customer Satisfaction related to Order Serving, Delivery	Establish S&OP, Formation of CFU (customer facing units)
2	Unable to meet JIT requirement of customers for coils and CTL matl.	Setting up of service centres and stockyards near automotive hubs
3	Unable to execute small quantity orders (<50Tons) due to constraints in slab casting.	Installation of Slab sizing press at HSM 2 to facilitate aggregation of production orders
4	Transportation Damage of VASP	Building Logistics infrastructure

7.3 Challenges and strategies during TQM-Implementation Period (FY13 to FY16) (Table 7.2)

7.3.1 Establish Sales & Operation Planning Process (S&OP) and Formation of CFU

Analysis of results of customer satisfaction survey, inputs from senior management interaction with customers and ideas developed within the group resulted in developing a comprehensive S&OP process to maximize Delivery Compliance. The key process steps are mentioned Figure 7.1. During implementation of this process, the functional units of 1) Sales Planning, 2) Production Planning & Control (PPC), 3) Logistics and, 4) Customer Service (CSD) were united (through a Governance mechanism) to form Customer Facing Unit (CFU). This was done to improve Cross Functional Management across the organisation.

With formation of CFU, improvements were done in areas of a) sales order prioritisation, b) demand and supply planning, c) inventory management and logistics planning by defining necessary business rules.

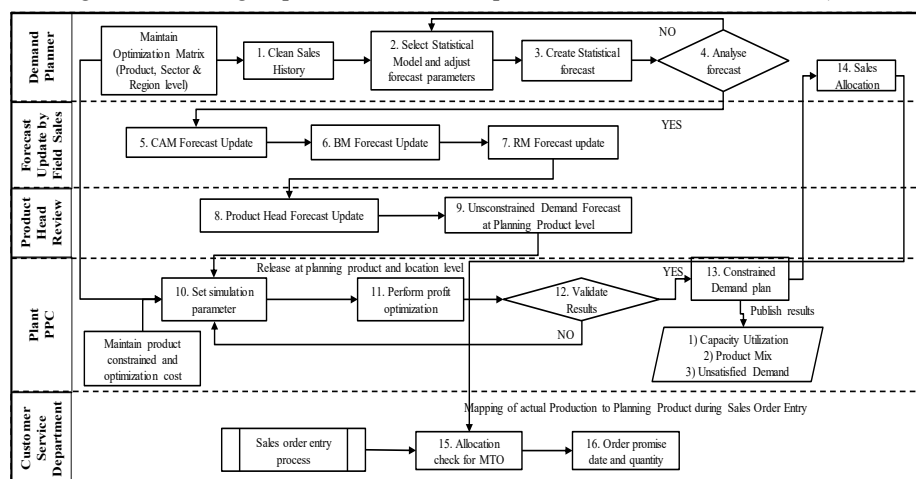


Figure 7.1 Integrated Sales and operation Planning

Better order management and coordination between departments through SNOP process has helped in increasing the unit weight (Usage of VJNR steel per Vehicle) with key automotive customers in addition to improving the overall delivery compliance.

8. Cost Management

8.1 Overview

Cost Management is a key CFM theme at VJNR that focuses on establishing a lean cost structure, controlling costs at element levels and continually reducing the overall cost by integrating efforts from all parts of the organisation including activities during planning stage like New Grade Development, Technology Selection and execution of expansion projects. VJNR strives to achieve cost leadership by working towards eliminating all wastes. The Annual cost management activities of VJNR includes ABP process, anticipating disruptions and preparing alternate plans to meet the ABP along with the related risk mitigation strategies. The high level cost elements are drilled down to element level information of techno economic parameters for each unit and are detailed for each product and market segment for further deployment.

8.2 Evolution of Cost Management in VJNR

	Cost Planning	Cost Control	Cost Improvement
Pre-TQM Period (FY12)	<ul style="list-style-type: none"> • Estimation of cost elements during ABP Planning process 	<ul style="list-style-type: none"> • Input consolidation for ABP • Controls at aggregate level, focus on major contributors • Monitoring of overall ROA 	<ul style="list-style-type: none"> • Reporting of deviations from budget provisions and sensitising the process owners to act.
TQM Implementation Period (FY13-FY16)	<ul style="list-style-type: none"> • Technologies to reduce RM cost • Investment to facilitate usage of low cost Iron ores (Micro Pellet Plant, MSBQ & SSRP) • VIU models for design of IO Blend before production of HM • Focus on high ROI at concept stage of capital projects 	<ul style="list-style-type: none"> • Defining Targets for various Cost Elements of ABP based on environment analysis • Frequent Multi-tier cost review structure to act on abnormalities • Debottlenecking critical resources to improve ROA. 	<ul style="list-style-type: none"> • Launch of cost reduction program” Deep Drive” • Cross functional projects to reduce rejections and improve yield • Techno-economic parameters as means to reduce cost • QC circles engaged in taking cost saving projects.
TQM Consolidation Period (FY17 onwards)	<ul style="list-style-type: none"> -Designing Grades with leaner and optimised chemistry -Decision on process routing for high end products -Development and Adoption of technology for waste utilisation (Waste to Wealth Plant) -Vertical start-up of new projects using source control 	<ul style="list-style-type: none"> Preparation of ABP with cost elements drilled down to product level & segment level • Tracking of important non-financial parameters having bigger impact on cost. • Monitoring of ROA asset by asset 	<ul style="list-style-type: none"> Institutionalising “Deep Drive” • Zero Waste Projects under 0757. • Reduction in delivery cost. • Maximisation of port utilisation to reduce logistics cost. • Product mix optimisation Cost reduction Using OPE loss tree • Maximising ROA

8.3 Cost Structure of VJNR and its key Levers

About 70 % of the total operating cost of VJNR is contributed by input Raw Materials. Conversion Cost comprising rest 30% of the Hot Rolled Coil (HRC) Cost has four major contributors. VJNR has a significant disadvantage due to lack of low cost captive Raw material (Iron Ore and Coal) leading to high RM Cost and tried to mitigate this disadvantage through a two pronged strategy along with an efficient cost Management System.

The **key Raw Material levers** used to manage Cost were:

- Maximising sourcing of RM from local sources (cheaper due to lower transportation cost)
- Long Term contracting with mineral and mining companies for uninterrupted supply of Raw materials to the plant without maintaining high stock levels in the Plant.

Similarly, **key Operations levers** used to manage Cost were:

- Beneficiation of low grade IO and Optimised blending of agglomerates. Optimised blending of various types of Raw Material and agglomeration designs have also helped deal with volatility in raw material prices.
- Recycling and reuse of waste from various processes by developing suitable technologies has resulted into lower specific consumption of prime minerals and also addressed environmental concerns related to waste disposal,
- Mathematical models and tools were adopted for optimised blend design. A VIU based ILOG model is used to estimate target chemical composition and cost of Hot Metal based on various combination of input raw materials.

8.4 Cost Planning

8.4.1 Designing Grades with leaner and optimised chemistry: Expensive alloying elements added during steel making process to achieve specific desired properties are a major contributor to the differential cost between various products. During new steel grade chemistry design, multiple combination of alloying elements for achieving the final product characteristics are evaluated. Depending on the metallurgical interaction between these alloying elements during steel melting, the most optimised combination in terms of alloy cost and grade chemistry are finalised. The process parameters in subsequent stages of rolling are also decided keeping in mind the optimised chemistry finalised during steel making.

8.4.2 Decision on process routing for high end products

With increase in requirement of specialised and value added grades, process routing has also become a critical element affecting the cost of the product. Finalisation of process route has been made an internal part of NPD, which ensures only the selected grades are routed through expensive treatment stations like RH degasser, thus avoiding additional process cost loaded onto low end grades.

Any additional consumption of reagents like calcium carbide during desulphurisation and aluminium during steel making required to achieve any special properties are also decided during the design stage. Based on the chemical composition and process routing decided, an estimated cost is calculated and vetted by central costing department followed by several iterations between the product design team (PDQC), manufacturing team and the marketing team before releasing the same for mass production. Figure 8.1 provides a schematic explanation of activities done to arrive at a lean alloy design of the steel grades.

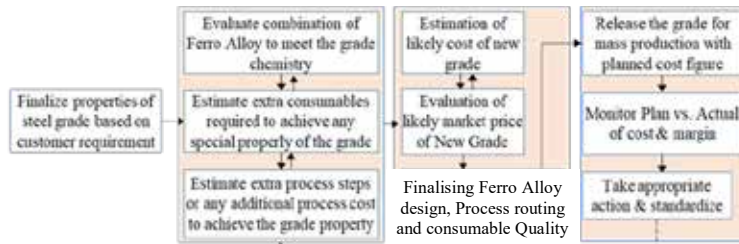


Figure 8.1: Planning Grade Cost during NPD stage at VJNR

8.4.3 Selection of Process Technology during expansion projects for Cost Leadership (Vertical start-up)

Planning the cost elements during the technology selection and process design stage of expansion projects has also contributed to maintain VJNR's cost leadership in the Indian Steel Industry. The unique beneficiation process enables the plant to use low cost iron ores from local sources. Designing processes with capabilities for recycling the waste and its usage in other processes in the plant through development and adoption of suitable technology has resulted into lowering the cost base of the agglomerates. Selection of state of the art and energy efficient systems and material flow design are considered as key cost planning aspects during conceptualisation of the expansion projects in VJNR.

8.5 Cost Control

8.5.1 Preparation of Annual business plan (ABP): VJNR operates on an annual cost planning cycle which starts with preparation of ABP for the organisation as a part of Policy Development cycle. Based on the global economic outlook, market demand, plant capability and the growth plan of VJNR, guidelines are issued to departments to prepare a draft of business plan for the coming year. 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 President, the senior management team, HoDs and the corporate office and finally the Annual Business Plan is finalised and approved by the board after several iterations. Targets on various techno economic parameters were derived considering the overall Cost and Production targets and are incorporated into the OSM sheets of HoDs.

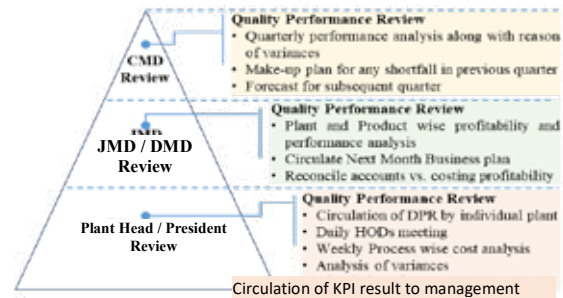


Figure 8.2: Cost Review Structure at VJNR

8.5.2 Cost Review Structure: A robust multi-level cost review structure (Figure 8.4) helps in tracking the variance against plan and taking necessary corrective actions. Higher deviations and any major impact due to external reasons are addressed through management by exception. The President conducts weekly cost review meeting to align and integrate the efforts of each department towards cost control and takes decision on any short term corrections. Daily cost Module also helps the HoDs to keep online track of Production cost. Realising importance of quality in managing cost, cost management review has been introduced in the Quality Board of VJNR from FY18.

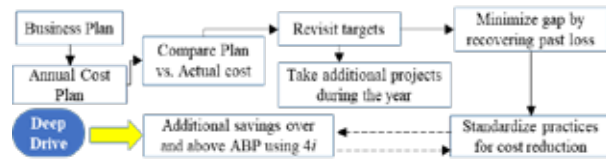


Figure 8.3: Deep Drive methodology of Cost Saving in VJNR

8.6 Cost Improvement Initiatives

8.6.1 Deep Drive

Cost improvements under the process of "Deep Drive" have been institutionalised since FY15 to explore opportunities for saving beyond the business plan by stretching the targets further. "Deep Drive" follows the signature 4i methodology of Identify-Ideate-Implement-Institutionalize to sweat out additional saving potentials in the system and triggers innovation. Figure 8.3 depicts the Deep Drive model of cost improvement. Deep Drive has been successful in stretching employees to explore new avenues to save cost.

8.6.2 Cost Reduction using OPE Loss Tree methodology

OPE loss tree has been introduced in FY18 in key production units to capture various loss elements due to lower availability, slower rate of production and poor quality rate. Specific cross functional projects were taken to address the major loss elements. Figure 8.4 shows OEE loss tree of sinter plant as a sample depicting various elements of cost loss. Improvement projects under the campaign of 0757 also being taken to reduce various types of waste to provide cost benefit.

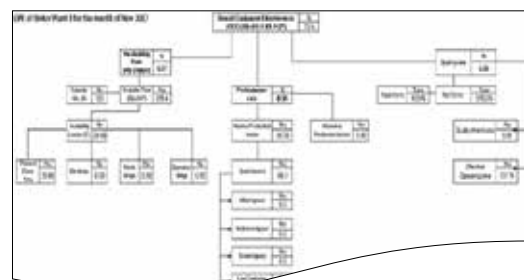


Figure 8.4: Sample OPE Tree

8.7 Maximising Return on Assets

To support the ambition of rapid growth in volume of VJNR, the company has invested heavily on building fixed assets related to plant and machinery. Return on Assets (ROA) is calculated at overall VJNR level and has been used for monitoring the overall financial health of business at VJNR along with EBITDA. While a good growth in the market and better operational controls has helped in getting desired returns on these investments on an overall level, with TQM implementation, post TQM Diagnosis, VJNR focussed on ensuring these returns asset by asset. ROI (Return on Investment) is now being used as a key indicator to identify opportunities for maximising returns from each assets, considering the investment and return promised during its concept stage. Non-financial parameters related to each asset are monitored and improved to maximise returns from that particular capital investment.

8.8 Strategic Cost Levers at VJNR

#	Major Cost Drivers	Key Cost Levers
1	Raw material cost	Blend Cost Optimisation, Use of VIU models, Beneficiation and Technology adoption
2	Logistics Cost	Rail to Road model shift, Port Optimisation, Reduction in Idle fright and demurrage
3	Recycling	Consumption of Micro Pellet, MSBQ, SSRP, WWP and Waste heat recovery
4	Conversion Cost	Hot metal Handling Loss, Energy Efficiency in Processes, Desulphurisation cost

9. Operational Excellence

9.1 Operating Model for VJNR

The converging-diverging value chain construct (shown in Fig 1.6 in Chapter 1) explained the challenges on both ends of the value chain. Due to this, the operating model of VJNR deals with 3 major constraints: **a)** handling Raw Materials from multiple sources (with wide variation in properties), homogenising and converting them into one consistent Quality of Hot Metal while keeping the cost low, **b)** improving the asset utilization despite lower yield due to poor Raw Material, **c)** manufacturing ~17500 types rolled steel products and servicing ~24500 SKUs with wide variety of product and service requirements (Fig 9.1)



Figure 9.1: Operating Model for VJNR

VJNR has strong Manufacturing & Maintenance practices supported ably by Project Management system. In its growth journey, VJNR has been able to grow both in capacity and capability while developing industry leading core competencies in Steel manufacturing. The following sections explain VJNR's specific approaches towards improving on above issues through Operations Excellence.

After the Iron Ore crisis in FY12, VJNR struggled with its manufacturing operations largely due to availability issues leading to lower equipment utilization and productivity. Also, sustaining operations with poor quality raw material was a major challenge. With TQM deployed to strengthen systems and process, VJNR took actions in the area of process control, majorly with a) Daily Management for KPI improvement, 2) IT for process control and maintenance improvement.

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9.2 Daily Management for KPI Improvement

SPC at VJNR took roots with pilot implementation of Daily Management practices in the manufacturing units. This started with identification of top 100 KPIs for VJNR. Teams at VJNR had been struggling to operate due to large variations in incoming raw material between batches. Gemba boards at shop-floor brought about visualization of the process in the employees, bolstering the manufacturing operations. Three-level Gemba boards and structured DM meetings helped tackle uncertainty and brought agility in responding to abnormalities or changes. Gap analysis of these DM KPIs is done using Stability vs. Conformity matrix, and appropriate actions are taken through various improvement forums.

9.2.1 Abnormality Handling

To help the KPI owners in identifying causes of the abnormalities, Apex DM council devised "Abnormality handling Framework" (Figure 9.2). It lays utmost importance on existence and adherence to SOPs. The process abnormalities are identified using control/run charts. When an abnormality occurs, it is captured, documented and corresponding adherence to SOP is checked. If SOP is inadequate or there is a change in 5M1E conditions, the KPI owner identifies the cause(s) through phenomenon observation and takes action on identified cause(s). The observations are summarised and reviewed at defined frequency to decide on the action and take corrective and preventive actions accordingly.

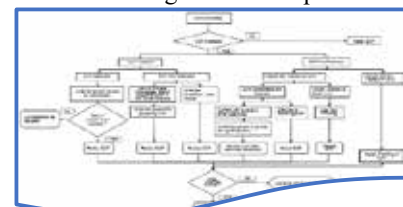


Figure 9.2: Abnormality Handling Framework

9.2.2 Recurrence Prevention

In routine operations, the KPIs are monitored on Gemba boards. For those KPIs having abnormalities, all causes leading to potential problems/non-conformities and undesirable situations are identified. Data pertaining to these causes are

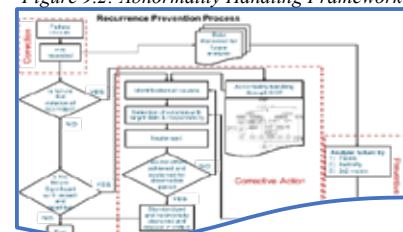


Figure 9.3: Recurrence Prevention Process

studied by means of charting in process data, usage of statistical tools to establish linkages and identify root causes.

These issues are further stratified and ranked based on their impact and resolved by developing a plan to prevent the occurrence (Figure 9.3). The plans implemented are reviewed under DM at Gemba board (daily and weekly).

9.3 Maintenance improvement

Being a manufacturing plant, it is imperative for VJNR to focus on its maintenance practices. The evolution of the Maintenance Management System is shown in Table 9.1. During the TQM Implementation period, VJNR developed its own system for Daily Management in Maintenance. The maintenance model of CERM® is the guiding Principle for maintenance activities at VJNR and revolves around three things: a) Equipment Tree: For equipment segmentation, b) Criticality Analysis: For equipment prioritization on process criticality, c) Maintenance Planning: For Equipment maintenance jobs Scheduling.

The maintenance prevention activities start from the working 'Shift' and include: a) CLITA checklists, b) shift logbook, c) prevention, correction and breakdown reports. The model is supported by an ERP module to plan and manage maintenance tasks and also act as repository for improvements made. As per master data, notifications are generated for maintenance jobs and refurbishment.

Table 9.1: Evolution of Maintenance Management at VJNR

Evolution	Pre-TQM	TQM Implementation Period	Consolidation Period
Basic Maintenance	<ul style="list-style-type: none"> Why-Why Analysis 	Criticality Assessment: Prioritize (Pareto), Visualise (Butterfly), Analyse (2x2 Matrix), FIR, RCFA Forms, Why-Why, C&E	KNOT chart, Event Timeline, Process Mapping, Fault Tree Analysis (FTA), Physical Phenomena Analysis
Planned Maintenance	Time Based Maintenance	Equipment Segmentation Tree, Real time Abnormality Detection (CBM), RCFA Analysis, OEE Analysis for Benchmarking, Cluster analysis (Spare Mgmt.)	OEE to identify Losses, Autonomous Maintenance, Framework for selection of maintenance (TBM, CBM, RTF) type based on equipment characteristic
Reliability centred Maintenance		E-FMEA	Categorization of equipment based on failure mode and consequences (Hidden/Evident), Weibull Analysis

IT at VJNR has been instrumental in enhancing plant productivity by use of automation system and Value Applications. Majorly for the upstream processes (for Iron and Steel Making), IT interventions in connecting the existing Manufacturing Execution System (in-house systems used in Pre-TQM period) with Level 2 and 3 Automation helped better process control through data visualization. These technology adoptions also aided large scale redesigning of Iron Making operations by enabling data based decision making.

9.4 Process Improvement

OEE is a managing KPI used across manufacturing units at VJNR. Improvements at VJNR manufacturing plants are mostly identified looking at OEE and 16 major losses. These losses are broadly divided into three parts as: a) Losses affecting OEE (8 losses), b) Losses affecting cost (5), c) Losses affecting worker efficiency (3). These losses then are undertaken for improvement at different improvement forums.

9.4.1 Target Setting

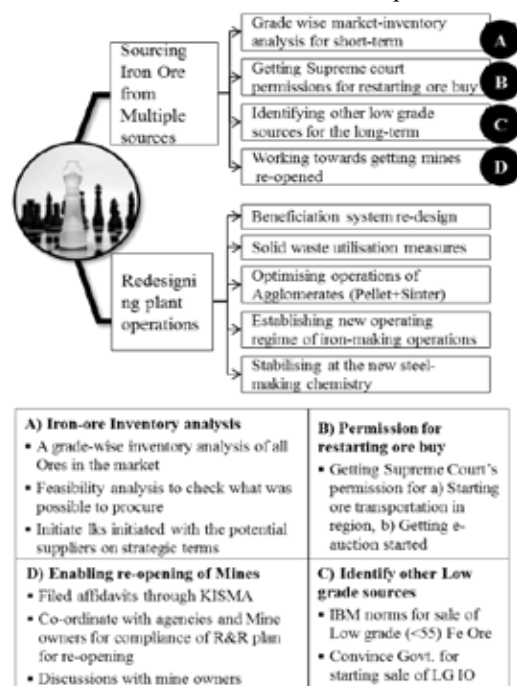
VJNR believes in taking stretched targets. However, the target setting process is based on a logical KPI drill-down methodology. Business KPIs are broken down into Operational KPIs which are further broken down into shop-floor KPIs and targets are set based on gap analysis.

9.5 Outstanding Story of overcoming the Iron Ore crisis with Operational Excellence

VJNR had proximity to Iron Ore (IO) sources in Karnataka State which helped in reliability of IO quantities and also consistency in Quality. In 2011, the Supreme Court of India banned Iron Ore mining in Karnataka due to large scale illegal mining prevalent then. Thus, the availability (Quantity) and Fe Grade (Quality) of IO for VJNR became a major challenge, leading to sharp rise in both RM Cost and Conversion Cost of Steel at VJNR. To take care of the issue, VJNR adopted a **two pronged strategy** on a) getting multiple IO sources and b) redesigning plant operations for the long term with available low grade IO. However, for short-term, VJNR rested heavily on policy advocacy with Govt. of India and local mine owners to restart operations. During this, operating with low grade IO (Fe<55%) was the only option for VJNR.

9.5.1 Challenges faced in getting Iron Ore due to the change in Govt. Policy: The policy advocacy with various governing and operating bodies resulted in more structured sourcing of IO through e-auction. However, the challenges to VJNR were different:

Seller's Market - Gearing up the internal infrastructure and people skills to the new market had challenges of building transport facilities, IT infrastructure, dealing with multiple mine owners with



heavy control, locals and other related liaising bodies. The IO thus received from so many unorganised sources had inconsistencies in properties due to Quality Control issues at mine head.

The e-Auction Challenge – The new system needed creation of basic infrastructure at seller's place like installation of weigh bridges, computers and printers. Mines were located in remote areas and internet connection from VJNR to Mines had to be provided through RF (Radio Frequency) connection. Co-ordination for deployment of forest officers in each mines for forest permit, building confidence and amicable relationships with mine owners & their staff became critical. VJNR had to get around 600 persons for movement of IO and release of rakes in time to avoid demurrages.

9.5.2 Overcoming Challenges through Operational Excellence by redesigning Operations

	Key Challenges (FY13)	Strategies deployed and Innovative Solutions
High conversion cost due to Poor Quality IO	<ul style="list-style-type: none"> Low Grade IO fines processing (Fe~ 46-48%) High slag rate operation Poor Quality HM (high Mn%) High Conversion Cost 	<ul style="list-style-type: none"> Installing Jigs and spirals at Beneficiation Plant Recycling of Intermediate tailings 3 tap hole operations (at BF3,4) Developed Slag Balance Model Increasing Scrap, Intermediate De-Slagging
Lower Throughput due to poor Quality IO	<ul style="list-style-type: none"> Hot metal Productivity SMS Productivity HSM Productivity CRM Productivity 	<ul style="list-style-type: none"> Tap-to-Tap time reduction Streamlining Hot metal flow CRM 2 Ramp up. Stabilizing automotive grades
Enhancing Value added products	<ul style="list-style-type: none"> Improving Quality rejections and Faster NPD with lower Quality Steel 	<ul style="list-style-type: none"> Strategic collaboration with JFE for NPD Online Surface inspection systems Auto Scarfing, KR, RH and EMS
Impact on Environment due to poor Quality IO	<ul style="list-style-type: none"> High Water consumption & impact on Zero effluent discharge, Control of Higher Fugitive Emission due to RM 	<ul style="list-style-type: none"> Reduction in specific Water consumption Recycling and sewage treatment Reduction in acid mist from Pickling lines Slag as replacement of aggregates for roads

After effective execution of the short-term strategies to get low grade IO, a concurrent challenge was to redesign plant operations for using this significantly Lower Grade IO; the comparison of which with our competitions is shown in the Figure 9.4. Specific strategies were deployed after capability analysis of entire Plant leading to several innovative practices in various departments.

Solid Waste Utilisation: A distinctive activity in



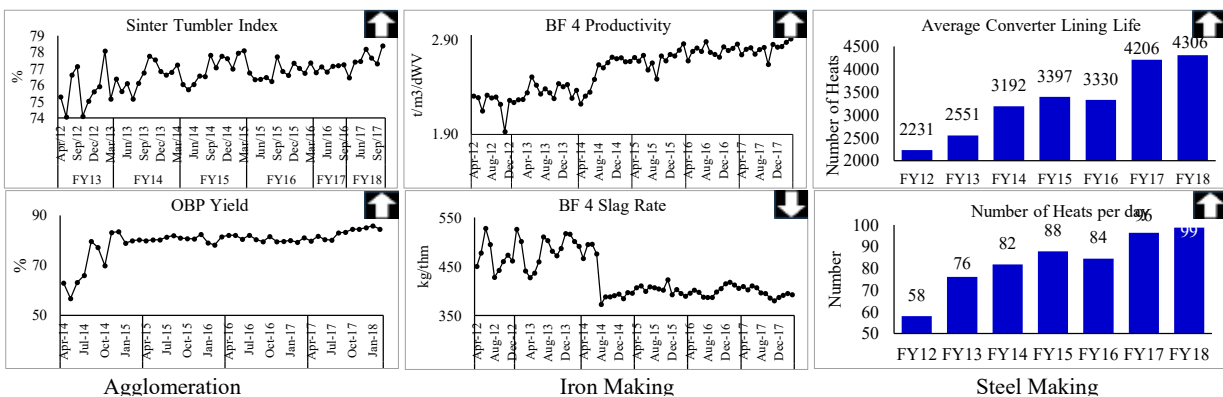
Figure 9.3: Innovations

redesigning the operations was utilizing solid wastes generated. Benchmarking exercise was done with best-in-class Steelmakers like POSCO, NSC and JFE and best practices were identified for suitability. Systematic approach led to development of many pioneering technologies first time in Indian steel industry as shown in Figure 9.3

Incoming IOF Qualities	JSW	TATA Steel	SAIL
No. of Sources	20 to 25	5 to 6	2 to 3
Fe grade, %	Fe:57 to 60 (25% of sources) Fe:51 to 64 (25% of sources)	> 63 (cost)	> 63 (cost)
Al2O3 % (max)	3.5 to 5%	< 2%	< 2%
SiO2 % (max)	4 to 8%	1.5 to 2.5	1.5 to 2.5

Figure 9.4: Competitor Comparison on RM Properties

Redesigning Operations: A three pronged approach to do this involved: a) Developing flexible raw material operation practices, b) throughput maximization with poor quality IO and c) cost reduction. As a result of systematic



deployment of these strategies and innovative solutions, the key KPIs of various department improved sustainably as shown in the graphs below:

9.5.3 Results: Establishing leadership in Indian Steel Industry

These strategic efforts taken to overcome the crisis helped VJNR develop two **distinct core competencies**:

A) Superior Capability in Operations (use of flexible Raw materials and **lowest Conversion Cost**): a) Utilising beneficiation to harmonise input chemistry of RM feed, b) Evaluating constraints in the system and having capability to de-bottleneck them fast, c) Lowering dependence on suppliers (Danielli, SVAI etc.), d) Developing technical solutions through innovative experimentation. **B) Establishing industry leadership:** a) Capability to run cost effective operations during such crisis (compared to peers) despite inconsistent and poor quality of RM and b) Showing the way in restarting the mining operations, restoring pace of industry, helping Indian Steel industry gain back the pace.

9.6 Outstanding Story of Project Management at VJNR

VJNR has grown from 0.8 MMTPA in the year 1999 to 12 MMTPA in past two decades due to its ability to execute projects faster and at lower cost compared to competitors. The growth journey of VJNR was in two phases; 1) capacity expansion and 2) capacity and capability building for VASP. The Project Management function has evolved over the TQM implementation period. VJNR has a very unique practice of the Operating team going into project management team to carry out the project. Upon completion of the projects, these members return to the plant operations team. This has helped in two ways: a) improve the quality of Project due to higher level of ownership as the same team has to operate it later and, b) helps impart project management skills to a large number of Operations team. VJNR improved its Project Management System and developed 3 distinctive capabilities of a) faster decision-making, b) faster execution process and c) faster learning and operationalization leading to its faster growth.

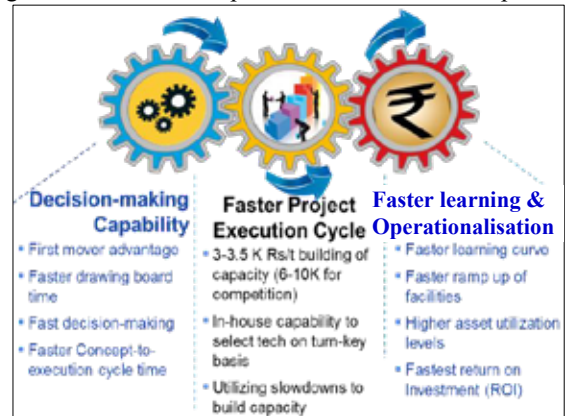


Figure 9.5: VJNR's Project Management Attributes

As a result of these distinctive Project Management attributes of VJNR it has been doing CAPEX projects faster and cheaper compared to competitors. VJNR undertook many large capacity enhancements and capability improvement projects. Series of upstream capability building projects and debottlenecking projects in the Steel zone resulted in increased sales volume for VJNR within a short period. Also capability improvement projects at Steel and downstream has helped VJNR become pioneer in Automotive segment.

9.6.2 Fast capacity and capability building for VASP

VJNR had been able to establish connect with larger OEMs for Automotive steel. However, VJNR was not able to further improve the SOB with Indian Automotive Customers, the primary reason for this was inability to serve small quantity orders from the customers. For large integrated steel plants like VJNR, servicing low quantity orders would mean taking a hit on plant productivity and yields and ultimately lower margins. Thus, VJNR was faced with this two-way problem of trying to aggressively grow capacities on one hand and trying to service customers with small quantity orders to capture the larger market share.

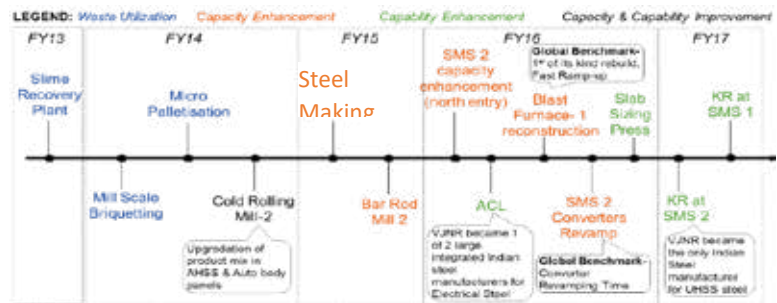
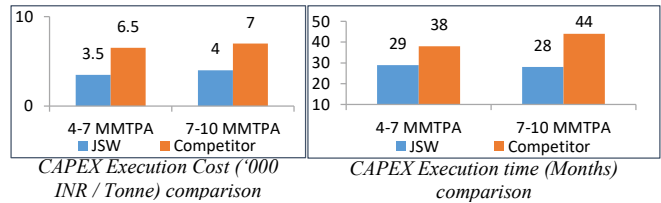
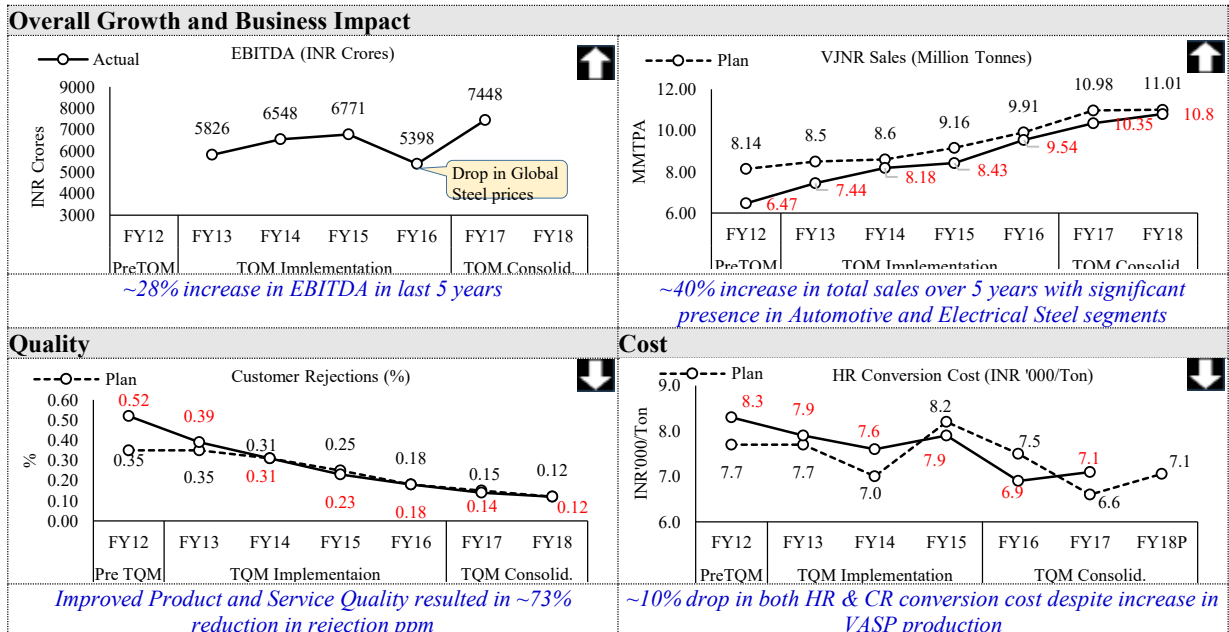
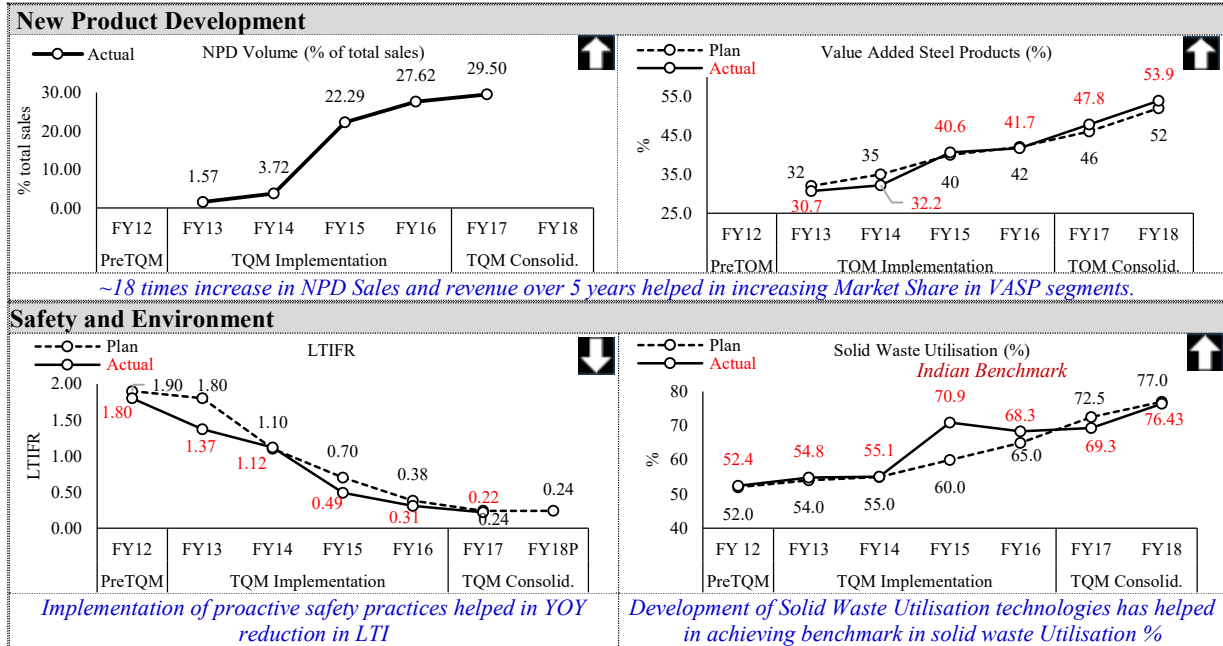


Figure 9.6: Major Projects in TOM Implementation period

10. Key Effects & Way Forward





Intangible benefits of TQM Deployment

VJNR has progressed well on its Mission of VASP and capacity and has also achieved cost competitiveness at global levels. These have helped it realize the business benefits of TQM deployment. However, there are certain intangible benefits that have also come along:

- Our employees take **pride** in VJNR becoming India's largest Steel plant, despite being a late entrant and it reflects in employees' commitment levels, their joy at work! Thus, our deeply engaged employees with empowerment for problem solving now have a deep sense of **ownership!**
- Fighting with the adversities of Iron Ore crisis through TQM has helped VJNR develop the **capability to convert threats into opportunities** and always be future-fit! This has also made VJNR a thought leader in the Indian Steel industry by showing an un-treaded path of a sustainable operating model with use of very low grade IO. This was otherwise considered unthinkable and **the competition today treats JSW and VJNR with respect.** We having created an ability to **develop waste & environment friendly technologies in-house** which are first time in India.
- Harmonious societal relations due to a structured and Mission based CSR approach has helped develop a pro-organization culture in employees who have loyalty and mutual faith. This has resulted in having uninterrupted operations with people from society around supporting and partaking all VJNR initiatives. The **local people behave as brand ambassadors of JSW.**
- The suppliers feel secure working with VJNR and as a result, lot of Ancillaries have developed in and around JSW. With TQM deployment, VJNR has tipped the import balance of the country. **Customers now have greater belief** in the quality and range of our products and services in line with international brands.
- The leadership drives TQM at VJNR. The program has helped create a rich pipeline of leaders who promote excellence and continuous improvement in the organization,
- The entire TQM deployment program has improved the overall **organizational energy and enthusiasm** and helped us DNA-ise our core strengths of Speed, Agility and Innovation!

Spreading TQM culture in India

With its rich TQM practices, VJNR is committed to spread and enrich TQM culture in India. In past, VJNR has been learning from TQM practicing companies like Mahindra Group, TVS and visited Ashok Leyland Hosur II Plant after their winning the Deming Prize in 2017. VJNR feels that its customised TQM approaches developed in context of Indian conditions can be suitably deployed across various manufacturing plants in India.

VJNR is spearheading the spread and deployment of TQM culture across the 6 companies over 17 locations of JSW Group., JSW Energy Ltd., JSW Steel's Salem and Dolvi Works are already progressing well in the TQM journey. JSW Energy Ltd. is likely to apply for TQM Diagnosis in 2019. Practices like 0757, 8S, 4i etc have been implemented across group companies and plants and customized TQM approaches are being developed.

VJNR participated in 14th ISQ Annual Conference (Indian Society for Quality) and won the 'Best Technical Paper Award' for 'Innovative methods of TQM promotion'. Participants from various organizations visited its stall and were enthused to know about the TQM practices like 'OSM', '4i-J3' and '0757'.

Frequently Used Terminology and Abbreviation	
Abbreviation or Terminology	Explanation
4i	A high-end Analytics program of VJNR, 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
Institutionalization	Institutionalization phase of 4i that focuses on standardization of solution and Knowledge Management
ABP	Annual Business Plan
AHSS	Advanced High Strength Steel
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.
BOF	Basic Oxygen Furnace: A Furnace lined with refractory bricks where Hot Metal is converted to Crude Steel by blowing oxygen to reduce excess Carbon, Si, Mn, P content. It is also called as Converter.
BRM	Bar Rod Mill: Unit that converts billets into Thermomechanically Treated Rebars
CAGR	Compounded Annual Growth Rate
CAPEX	Capital Expenditure
CDQ	Coke Dry Quenching: An alternative to traditional wet quenching of coke where red hot coke is cooled using an inert gas. During quenching process, sensible heat of the red hot coke is recovered and utilized for steam generation.
CFT	Cross Functional Team: A group of people with different functional expertise working towards a common goal.
CLITA	Cleaning, Lubrication, Inspection, Testing and Adjustment
Coils	A finished product of Hot Rolled or 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.
COPQ	Cost of Poor Quality
Corex	It is a two stage process where Iron Ore is reduced in one shaft (by non-coking coal) and melted in other to produce Hot Metal.
CQA	Central Quality Assurance: A Central Team to coordinate QA activities across the organizations, acts as secretariat to Quality Board.
CR	Cold Rolled: Product produced at Cold Rolling Mill by rolling of Hot Rolled Coils.
Cr.	Crore i.e. ten Million
CRCA	Cold Rolled Close Annealed: Controlled heating of Cold Rolled sheets in a closed atmosphere of nitrogen or other non-oxidizing gases to soften the sheet without oxidation. This product is used in Automotive application.
CRFH	Cold Rolled Full Hard: A highly work hardened steel with high resistance to denting. This steel can directly use for application that do not require any formability beyond limited bending.
CRGO	Cold Rolled Grain Oriented: An Electrical Steel grade steel that makes up the core of the transformers. The grain sizes are much larger than that of regular steel.
CRM	Cold Rolling Mill: A unit where thickness reduction of the Hot Rolled steel is carried out to the Customer's specifications.
CRNGO/CRNO	Cold Rolled Non Grain Oriented: An Electrical steel which is rolled in random directions so that the grains are elongated in different directions. Its electrical properties are isotropic in all directions and is used in motors, generators etc.
Crude Steel	First solid steel product upon solidification of liquid steel.
CSR	Corporate Social Responsibilities
CTL	Cut To Length: A downstream unit after Hot Strip Mill that uncoils the flat products, cuts them into desired length and stacks them.
EAF	Electric Arc Furnace: A Furnace lined with refractory bricks where Hot Metal is converted to Crude Steel by electric arcing and blowing oxygen
ERP	Enterprise Resource Portal
Fe	Iron
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
FP	Flat Products: Type of steel that have flat faces rather than groove or cut faces.
FY	Fiscal Year: Used for accounting purpose and preparing financial statement for e.g. FY18 means the period between 1 st April 2017 to 31 st Mar 2018.
GI	Galvanized (Zinc Coated Steel Sheets)
GA	Galvannealed: Cold Rolled product after galvanizing and annealing

gm/cc	gram per cubic centimeter
High End Products	End steel products with High tensile strength, better surface quality skin panel, and high ductility re-bars etc.
High Grade IOF	Iron Ore with Fe>55%
HM	Hot Metal: It is the molten Iron produced in Iron Making Units (Blast Furnace and Corex) and which is used by Steel Melting Shop to produce Steel
HoD	Head of Department
HR	Hot Rolled: Products produced by rolling of slabs at high temperature (above 1000 °C) in Hot Strip Mill which is used by Cold Rolling Mill to produce Cold Rolled Products.
HRPO	Hot Rolled Pickled and Oiled: A hot rolled sheet is pickled to remove any scale from the surface and oiled to prevent corrosion used in Automotive application.
Hrs.	Hours (Unit of Time)
IM	Iron Making
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
Kms	Kilometer (Unit of distance)
KNm3/Hr.	Thousand Normal Meter Cube Per Hour (used to represent gas flow rate)
KPI	Key Performance Indicator
KR	Kanbara Reactor: is a hot metal pre-treatment facility that can remove Sulphur in the Hot Metal to lower levels and at a cheaper cost than conventional processes.
LP	Long Products: It includes Billets, Rebars, Wire Rod etc.
LTIFR	Loss Time Injury Frequency Rate.
m/min	Meter Per Minute
m/s	Meter Per Second
mm	Millimeter
mm/s	Millimeter Per Second
MMT	Million Metric Ton
MSME	Micro Small Medium Enterprises
MT	Metric Ton
MMTPA	Million Metric Ton Per Annum
MPa	Mega Pascal: Unit of pressure
NCO	Non Conformed Orders
NPD	New Product Development
OEE	Overall Equipment Effectiveness
OPE	Overall Plant Effectiveness
OSM	Objective-Strategy-Means
OTIF	On Time In Full: A measurement of delivery performance
P,Q,C,D,S,M,E	Productivity, Quality, Cost, Delivery, Safety, Morale, Environment
Pellet	Spherical shaped agglomerates (Size 6-8mm) made of Iron Ore fines, fluxes, fuel and binder.
PFMEA	Process Failure Mode Effect Analysis
PM Analysis	Physical Phenomena Mechanism Analysis: A tool that helps develop a better understanding of the conditions, factors and the interacting elements of machining and processes
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.
RM	Raw Material
SBU	Strategic Business Unit
Sinter	Sinter is a porous irregular shape agglomerate (Size 5 to 40mm) of Iron Ore Fines, fluxes, coke fines and metallurgical wastes.
SKU	Stock Keeping Unit
Slabs	A semi-finished form of steel that is used for making Flat Products such as Hot Rolled Coils, Sheet and Plates.
SMS	Steel Making Shop: It uses Hot Metal to produce Molten Steel which is then cast into slabs and billets
TCS	Ton of Crude Steel
TPH	Ton Per Hour
TTT	Tap to Tap Time: Total cycle time of Basic Oxygen / Electric Arc Furnace
UHSS	Ultra High Strength Steel
UOM	Unit Of Measurement
UTS	Ultimate Tensile Strength: The maximum load which a material can withstand under tensile load
VA/VE	Value Addition/Value Enhancement
VASP	Value Added Special Products
VIU	Value In Use
VJNR	JSW Vijayanagar Works
VOC	Voice Of Customer
YoY	Year on Year