

A STUDY ON TOTAL QUALITY MANAGEMENT ON FERRON STEELS

Submitted in partial fulfillment of the requirements for the award of

Master of Business Administration

by

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Register No. 39410078



SCHOOL OF BUSINESS ADMINISTRATION

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
Jeppiaar Nagar, RAJIV GANDHI SALAI, CHENNAI - 600 119**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **A. JEFFY FRANK (39410078)** who have done the Project work entitled “**A STUDY ON TOTAL QUALITY MANAGEMENT ON FERRON STEELS**” under my supervision from **January 2021 to February 2021**.

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TO WHOM SO EVER IT MAY CONCERN

We wish him all the best for his upcoming career.

For V.V Iron & Steel Company Pvt Ltd.,

 26/3/21
Authorized Signatory



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DECLARATION

I **A. Jeffy Frank (39410078)** hereby declare that the Project Report entitled **A Study on Total Quality Management on Ferron Steels**, Tuticorin done by me under the guidance of **Ms. KAVITHA RAJAYOGAN** and **Ms. JEYARAM KUMAR** at **FERRON STEELS, VISCO INDUSTRIAL ESTATE, THANOOTHU VILLAGE, ANIARPARANALLUR, THOOTHUKUDI – 628851** is submitted in partial fulfillment of the requirements for the award of Master of Business Administration degree.

DATE: 10/04/2021

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

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I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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A. JEFFY FRANK

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ABSTRACT

The objective of this study is to implement Total Quality Management in an organization, Innovation can be created from changing small things in our daily routine. Seiri, Seiton, Seiso, Seiketsu, and Shitsuke are the five Japanese words which helps in improving the efficiency of the company. Total Quality Management helps management to improve the quality of the product, improve discipline, reduce waste and increase productivity. Ferron Steels is a steel manufacturing company that follows the quality control which partake significantly to the implementation 5S, Swot Analysis and Brainstorming. This study made the innovation of TQM implementation which refers to 5S that applied on the production floor. Direct observation will take place on the basis of the methodology of this study. Without any record detail activity of 5S that should be done by the workers as a habit in their daily work. The SWOT analysis is a strategic planning tool which can be used to evaluate the Strengths, Weaknesses, Opportunities and Threats which are involved in an industry. It will be used to identify some areas of action which industry and policy-makers need to take to maintain the steel industry's competitiveness. This study aims to investigate all the possible way to improve the OEE of the company equipment facing theoretical aspects and reality issues. The tools involved in the process are part of the content, ought to support a company for the organizational changes required for improving effectiveness and performance.

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LIST OF ABBREVIATIONS

ABBREVIATION	EXPLANATION
MS	Mild Steel
TMT	Thermo-Mechanically Treated steel
TQM	Total Quality Management
CRI	Corrosion Resistance Index
CRS	Corrosion Resistance Steel
OEE	Overall Equipment Effectiveness

1. INTRODUCTION

1.1 INTRODUCTION ABOUT THE STUDY

The project titled “A STUDY ON TOTAL QUALITY MANAGEMENT” has been undertaken in FERRON STEELS, TUTICORIN. TMT bars or Thermo-Mechanically Treated bars are high-strength rebars having a tough outer core and a soft inner core. Thermo-Mechanically Treated bars are widely used for different construction projects. Made from high strength steel, TMT bars possess several qualities which is mostly preferred material for various construction projects. It has a unique metallurgical process which combines work hardening along with heat-treatment from low-carbon steel to create robust and high strength bars, TMT bars have a great demand.

Total quality management (TQM) is a Firm-wide management philosophy of continuously improving the quality of products/services/processes through aiming customer's needs prospects to enhance customer satisfaction and Firm performance. The study is used in different methods, TQM variables, and performance measures in their research models. And it is performed in different contexts such as different nations and different trades. Research will take place appropriately analytical methodologies and measuring tools which can be significantly put into the investigating work on total quality management which analyzed reasons of relationship between TQM practices and performance. Aims of work are finding the impact of total quality management practices on various firm performances, investigating reasons and difficulties of implementing TQM practices, and using appropriate analytical techniques and statistical analysis methods to investigate relationship between TQM practices and performances in an organization.

In a ‘Total Quality Management’ (TQM) concept, the word quality which means quality of output of every department and by every employee, cleanliness, orderliness, punctuality, customer service, standardization of works and continuous efforts for their improvement are also part of the TQM. Here the needs of the customer are monitored to improve the products and processes to meet their requirements.

The organization should represent alternate approaches to improving the effectiveness and efficiency of an organization's operation function and it is used to track the effectiveness of the TQM process, quality improvement projects, and provide cost justification to pessimists. It has easily assembled costs of review, inspection, testing, scrap, and rework, one can convince management and others of the need for quality.

1.2 INDUSTRY PROFILE



Fig 1.2 Indian Steel Industry

India is 100 years old in the steel industry. The first steel ingot was rolled on 16th February 1912 is a momentous day in the history of industrial India. Steel is the backbone of human civilization which is crucial to the development of any modern economy. The level of capita consumption of steel is the main indicator of socio-economic development and living standards in any country. It is a product of the technological industry having forward and backward linkages in the form of material flow and income generation. Mostly all industrial economies are characterized by a strong steel industry and the growth of the economies has been largely shaped by the steel industries in initial stages of development.

India is the 2nd largest steel producing country in the world, employing over 1/2 million people directly with a cumulative capital investment of around Rs.1 lakh crore. It is

the main sector essential for economic and social development of the nation and it is crucial for its defence. The Indian iron and steel industry partakes about Rs.8,000 crore to the national exchequer in the form of exercise and custom duties, which is apart from earning foreign exchange of approximately Rs. 3,000 crore through exports. Consumption of finished steel products grew by 5.9 % and increased to 24.9 million tons. Steel consumption is used to increase at a rapid pace in future due to large investments planned in infrastructure development, increased urbanization and growth in key steel sectors i.e, automobile, construction and capital goods. Indian steel industry has for-come as one of the core sectors of the Indian economy with significantly impact on economic growth. India with its existing availability of high grade iron ore and cheap skilled labour used in well placed for the development of steel industry and to provide a strong manufacturing base for the metallurgical industries. Over the last couple of years the industry has been witnessing unprecedented growth. In 2020 the landmark year in global steel production- it crossed the 1000 million tons mark for the first time. The major steel producing countries are listed below.

Table 1.2 Major Steel Production

Country	Rank	Steel Production (MTPA)
China	1	1053.3
India	2	99.6
Japan	3	83.2
Russia	4	73.4
United States	5	72.7
South Korea	6	67.1
Turkey	7	35.8
Germany	8	35.7
Brazil	9	31.0
Iran	10	29.1
Total		1580.9

Though India holding its second place, its production fell by **10.6%** in 2020 to **99.6 MT** from **111.4 MT**.

The total production of finished goods of steel from April 2019 to March 2020 which has been estimated to 102.059 tons as against the production of 369.57 lakh tons during the same period last year showing an increase of 3.7 %.

However, it has been recorded in export performance. Steel has so far proved to be the single key factor responsible for industrial production for economical growth and it is also growing with newer developments within steel making practice, which ask for more usage of steel. Accordingly, many enterprises adopt and implement a set of management practices them to improve the efficiency of organizational operations and the most popular and effective management practices is TQM. Steel production is greater than any other man-made material in the world except concrete. Steel is dominant in the manufacturing sector today. In today's ecology steel is the most recycled material, which makes sustainable growth. The liberalization of the economy in the early 90's accompanied by concerted efforts made by the government to stimulate the steel industry have not only prompted government investment, but also encouraged many private firms to get into steel.

1.2.1 IRON AND STEEL INDUSTRY IN INDIA

In India Iron and Steel Industry is over 125 years old. India is the ninth largest producer of crude steel in the world with a production of 33 million MT and investment of over Rs.1,000 billion. In 2003-2004 the country produced 32.6 million MT finished steel, compared to a meagre one million MT in 1947. And this 21 million MT came from the secondary producers while the main producers accounted for 15.18 million MT. After the policy reforms since 1991 the steel industry in India is placed in a totally new environment. Price regulation for iron and steel was found on 16/1/1992. The Indian Government, like others, has realigned these policies to adjust to the reorganization and reorientation of the forces of economic development. Hence the competitions from imports and market opportunities for exports which becomes normal features for iron and steel industry. Nowadays the demand for finished steel has been forecast to reach the following levels.

Table 1.2.1 Demand for Steel

Year	Demand for Steel (Million Ton)
2000-01	29.916
2006-07	48.290
2012-13	75.580
2018-19	106.56

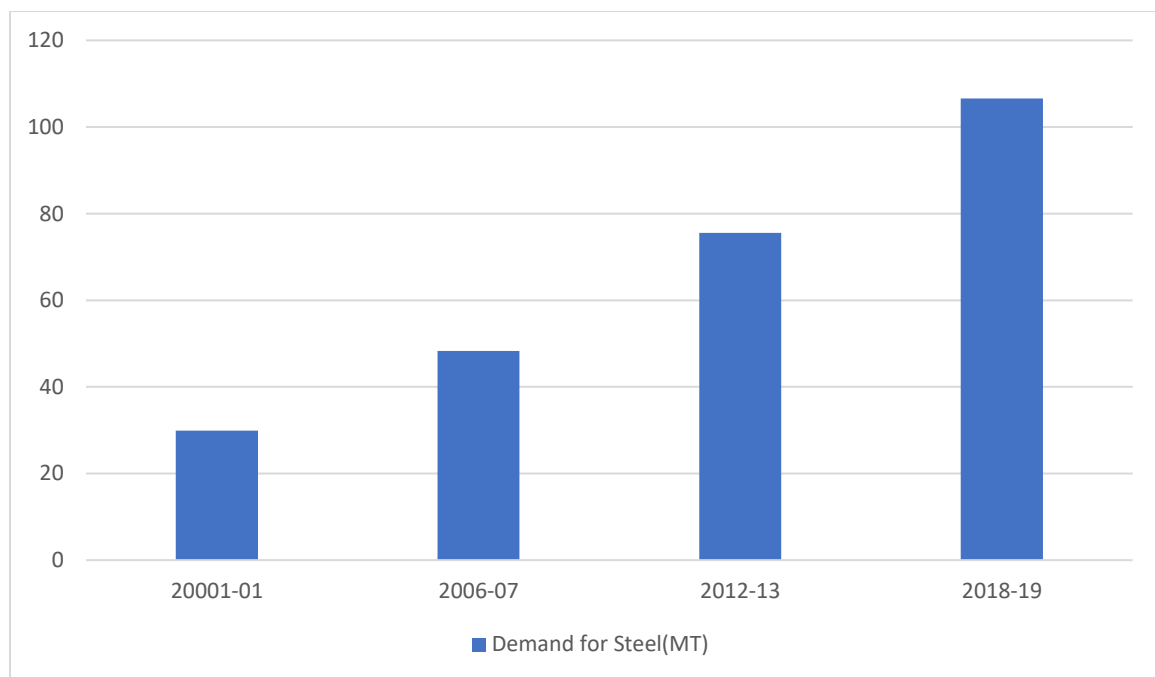


Fig 1.2.1 Demand for Steel

1.2.2 RE-ROLLING INDUSTRY IN INDIA

There were 1192 Re-rolling units with a total installed capacity of 23.82 million MT per annum. In the year 1999-2000 these units produced 6.57 million MT. The same went up to over 8 million MT. Out of the total production of the secondary share of steel producer in India finished steel has been assessed at 59% which itself proves the achievement of this sector.

The secondary industry has been considered by the government and the steel experts as a compliment to the steel industry. The industry has produced thousand

and thousand MT of its products to core projects, dams, State Electricity Boards and other infrastructure projects in India. The steel re-rolling industry caters to the needs of the domestic field up to the tune of 68% of the total requirement, 80% of the total exports of rounds and bars has recorded.

Steel products are classified into two segments long products and flat products.

a) Long Products

Long products segment includes of bars, rod, angles, channels, structural and railway materials. Long products are available in straight length or cut length barring wire rods which are generally in irregularly wound coils. Long products in steel are those, whose length to cross section ratio is higher than 10. These finished steel goods are produced by hot rolling or forging of bloom/billets/pencil ingots into usable shapes or sizes. Bars are used in construction work as reinforcement for concrete.

b) Flat Products

Flat products include plates, sheets and CIS. Here, finished steel products that are produced from slabs or thin slabs in rolling mills using flat rolls. These are supplied in Hot Rolled, Cold Rolled or in coated condition depending upon the requirement.

Long and flats products in developing countries which around 60:40 but in developed countries the flat products dominate over long products. The wide range of activities making "Chulah" - an earthen oven widely used in Indian Villages to the construction of bridges across rivers and seas. Longs which are fabricated from building, housing, roofs, railway tracks so on. Long products requirement is predominantly used in any developing country. With the growth in industry, "Flat" products like plates and sheets have been used. In India we are using both flat and long products equally.

Generally long products can be classified into,

- Bars/ Rods
- Wire Rods

- Structural like angles, channels and beams
- Railway materials

Bars and rods are produced in straight lengths from 5m to 12m and the coils which weight is from 0.3 MT to 1.5 MT. The size is up to 12mm are in coils and higher sizes are in straight lengths. In both categories, they may be rebars for construction or plain rounds for engineering and other applications. The main producers in steel industry can able to be both rebars and plain rounds whereas re-rollers make rebars (TMT Bars).

Longs lack basically in its usage diversity. Infrastructure is capital intensive and consequently in developing or under developed countries, the growth is constrained for want of funds. Long needs should be come out of their conventional usage and find alternative usage. The long products in India during past period is given below.

Table 1.2.2.1 Percentage of Long Product

Long Products	2016	2017	2018	2019	Percentage (%)
TMT Bars	34383	33195	39935	48941	28.4
Angles	36952	34506	41533	52115	32.2
Channels	37135	34857	41558	51701	30.3

Table 1.2.2.2 Percentage of Flat Product

Flat Products	2016	2017	2018	2019	Percentage (%)
Gp sheets	49003	51158	59118	68074	18.1
Cold Rolled coils	41114	44279	50936	62072	26.9
Hot Rolled coils	36299	39546	46614	55859	25.3

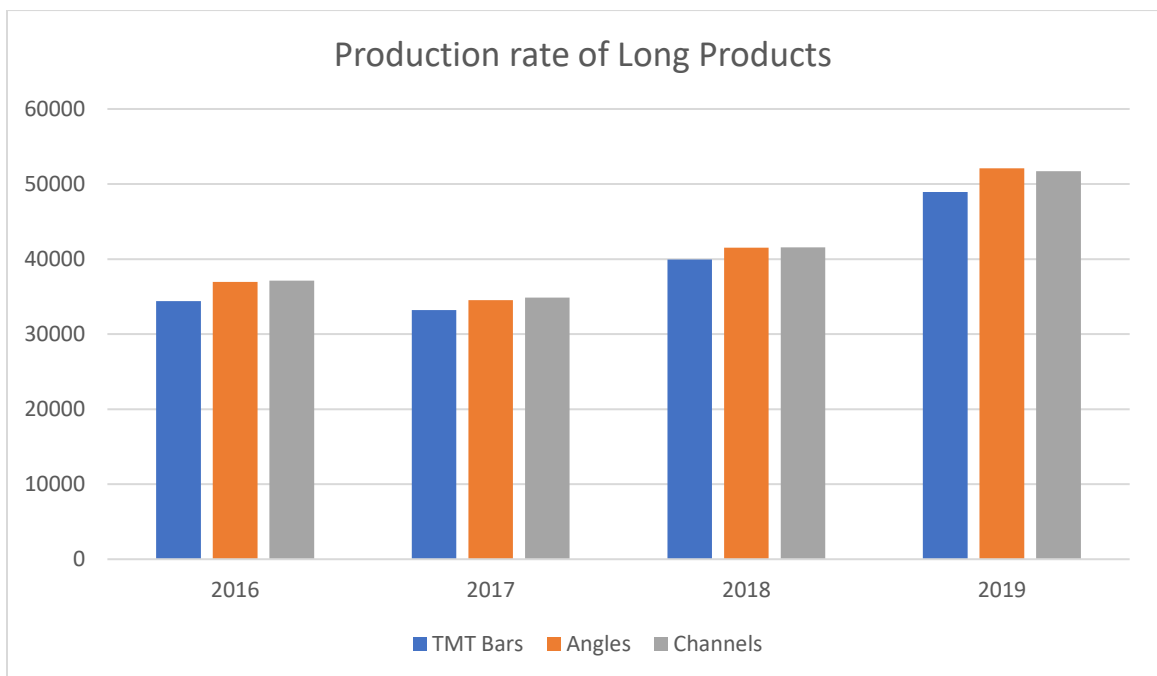


Fig 1.2.2.1 Production rate of long products

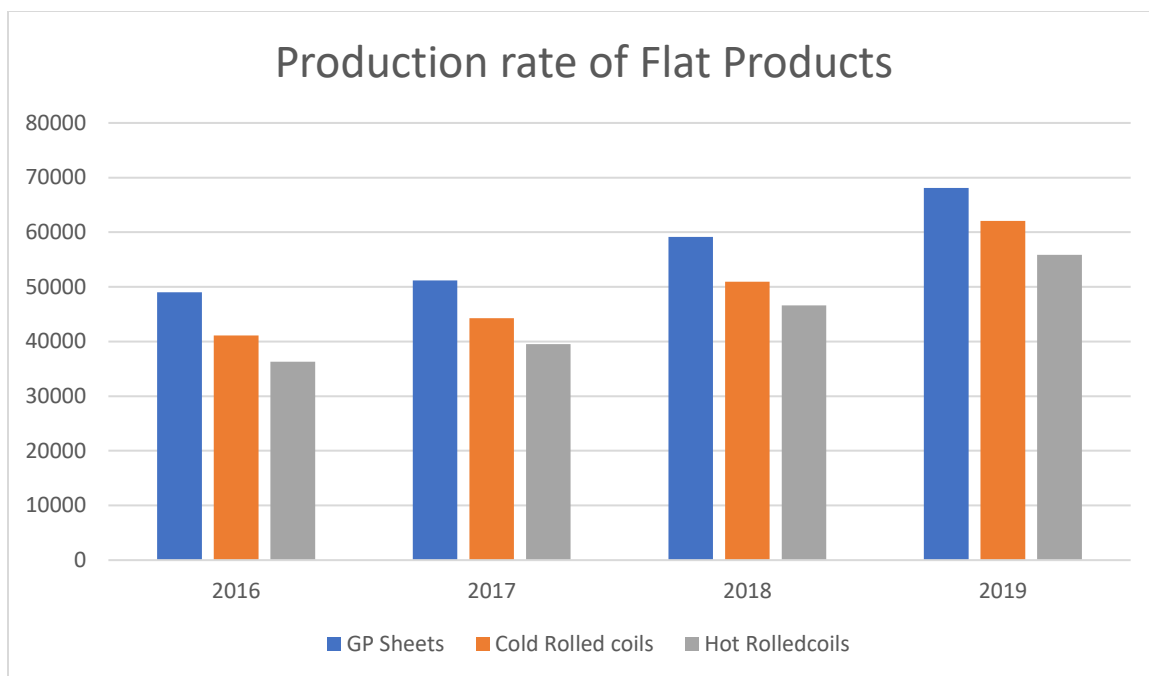


Fig 1.2.2.2 Production rate of Flat Products

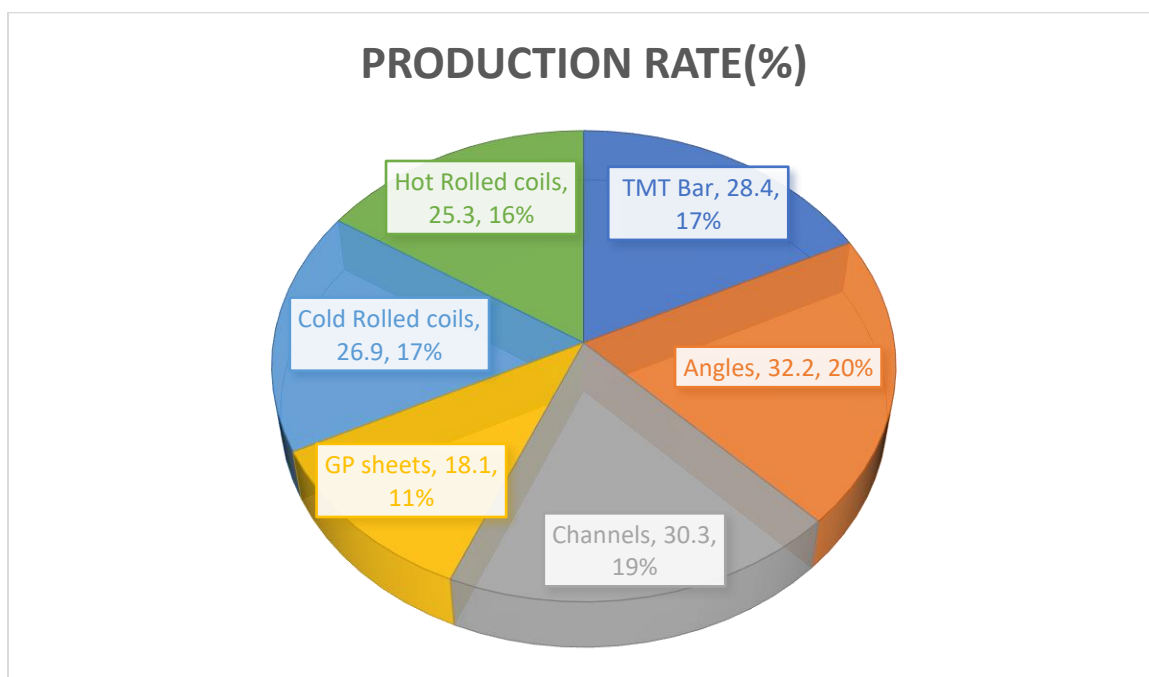


Fig 1.2.2 Production rate of Long and Flat Products

1.3 COMPANY PROFILE



Figure 1.3 Logo of Ferron Steels

- V.V. Iron & Steel Co. Pvt. Ltd. is part of the IMC Group. The company is in the business of manufacturing TMT Rebar of FE500 Grade and marketing the same under the brand name of FERRON TMT FE 500 in South Tamil Nadu and in the State of Kerala. This is the first integrated steel plant to be set up in the region. The Company has setup an induction furnace with CCM for casting high quality billets and a high speed sophisticated rolling mill with a production capacity of 10000MT per month. World class quenching technology is used to produce high quality TMT Rebar of international standards. The company has obtained BIS License for making billets (IS2830) and IS 1786 for TMT Rebar. Additionally, the company has also been accredited ISO 9001 Certification by Perry Johnson Certification Agency as a proof of quality systems being followed by the company. The Company's motto is High Quality, Timely Service, Right Price and correct weight.

- The company imports its raw material and after passing the most stringent tests for quality the raw materials are processed for production. At every stage of the production right from raw material to finished product stringent quality tests are conducted to ensure that the quality is maintained. The finished product is cut to 12m length and bent and staked for dispatch. Tags with details of size, date of production, lot no. are attached to every bundle and Test Certificate is issued with every consignment as proof of quality of the material.
- Ferron Steels TMT Rebars are earthquake proof and corrosion resistant. Ferron Steels TMT Rebar has a wide market presence across various infrastructure segments such as urban development, irrigation and it also used in various projects for rail, roads, bridges, ports, airports, defense and energy
- Ferron Steels about to invest in the most upgraded and advanced international technology of Electric Arc Furnace.
- Ferron Steels with superior design, engineering and quality manufacturing process provide the ideal strength and flexibility to the TMT steel bars that is required in today's construction industry

Types of Products

- TMT Rebar
- Billets

1.3.1 TMT Rebar

1.3.1.1 High Strength for Critical Applications

Ferron Steels Re-bars Fe 500D is the grade of TMT Re-bars produced under the process resulting in increased strength unlike other grades of TMT Rebars. Fe 500D Rebars are ideal for applications in heavy load RCC structures like flyovers, dams, bridges and other critical structures where high yield load. Yield load is required without compromising on the ductility. In addition to the features of Ferron Steels TMT Re-bars exhibit the following characteristics

1.3.1.2 Special Weldability

Ferron Steels TMT Re-bars do not require pre or post welding treatment as they have low carbon content and are produced under controlled thermomechanical treatment.

1.3.1.3 Higher Corrosion Resistance

Thermomechanical treatment which also results in a uniform and thick tempered martensitic rim and completely free from internal stress. This martensitic rim helps to improve the corrosion resistance as well as fatigue strength of the Ferron Steels TMT Re-bars Fe 500D when compared to other TMT Re-bars.

1.3.2 CRS TMT REBAR

Worldwide demand for Micro alloyed low alloyed Rebars generates mostly from industries like power, oil and gas extraction, road & bridge and port development. This is due to the improved strength of ductility, corrosion properties as well as increased toughness.

Ferron Steels corrosion resistance steel TMT Re-bars have been tested in rigorous corrosion media and evaluated for various corrosion resistance properties as per ASTM standards viz. Alternate immersion test, salt spray test, atmosphere exposure test, Sulphur Di Oxide test and Potentio-dynamic test. Thus, the corrosion test in Ferron Steels CRS TMT Rebars more corrosion resistant than normal TMT Rebars available in the market.

1.3.3 Corrosion Resistance Index (CRI)

Table 1.3.3 Test between Non CRS and CRS TMT Re-Bar

Type of Test	Non CRS TMT Re-bars	CRS TMT Re-bars
Potentio Dynamic Test	1.0	2.35
Salt Spray Test	1.0	1.59
Sulphur Dioxide Test	1.0	1.68
Alternate Immersion Test	1.0	1.92

1.3.3.1 Mechanical Properties

- Tensile strength- $630N/mm^2$
- Yield Strength- $520N/mm^2$
- Elongation-22%

1.3.3.2 Alloying Elements

- Sulphur
- Phosphorus
- Manganese
- Carbon

1.3.3.3 Properties

1. High strength
2. High tensile strain
3. Good bond to the concrete
4. Thermal compatibility
5. Durability in the concrete environment

1.3.3.4 Applications

General purpose concrete re-enforcement structures

- Bridges
- Flyovers
- Dams
- High rise buildings
- Industrial structures
- Concrete roads

1.3.4 Billets

Ferron Steels produces a wide range of Continuously casted Billets in its Integrated Steel Plant. The state-of-art technology of continuous casting AG Zurich imparts international quality standards and ensures smooth and defect-free casting of billets.

The Billets produced by the company can be broadly divided into Two main types i.e.

- M.S. Billets.
 - Low Alloy Steel Billets (CRS Billets)
1. M.S. Billets are used for rolling of TMT Rebars and various other structural steel products.
 2. Low Alloy Steel Billets are used from rolling of CRS TMT Rebars

Table 1.3 Test between IS2830 and Ferron Steels

Description	IS2830	FERRON STEELS
Bend	5mm/m	$\geq 5\text{mm/m}$
Camber	3mm/m	$\geq 3\text{mm/m}$
Length	3mt – 13mt	3mt – 9mt



Figure 1.3.1 Fe500



Figure 1.3.2 Fe500D



Figure 1.3.3 Billets



Figure 1.3.4 Furnace

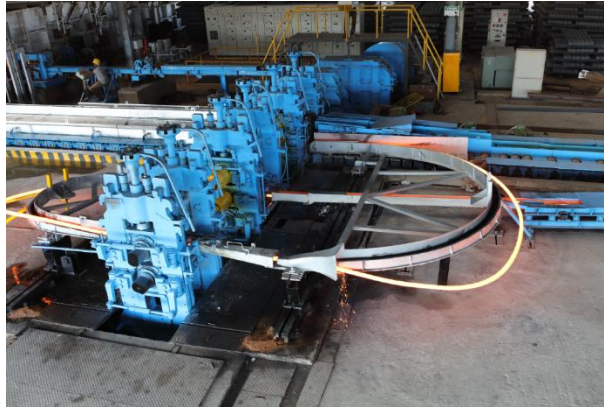


Figure 1.3.5 Hot Rolling Mill



Figure 1.3.6 MS- Scrap

1.4 Need for Study

Project is important for the organization, because it will helps to identify the performance undergoing in the manufacturing process. Further this study will help you to understand the improvement of overall efficiency of the firm.

The TQM is used here to improve the quality of the products and reducing the wastages at the same time. Thus, TQM helps to eliminate waste of the organization and increase the efficiency by ensuring that the production process of the organization's finished products. The study helps in analyzing strategic planning in firm, from identifying the Strength, Weakness, Opportunities and Threats involved in a business. By ensuring the problem arises in the company during manufacturing process should be encountered with quality management of the study. Then the equipment effectiveness will analyzed through

OEE. The overall production rate of the company per day is needed for the study to analyze the overall effectiveness of the company .

1.5 Scope of the Study

The study is used to improve the production rate and the overall efficiency.

The reason of implementing TQM in the organization is to increase the quality and the performance of the product. The scope of the study encompassed working steel industry, iron and steel firms, Total Quality Management, Implementation, Organizational Effectiveness, Respondents of all the firms. It also included the environment and ecosystem of steel industry in particular.

The study is confined to the implementation performance of the FERRON STEELS.

- This study aims at analyzing with help of tools of the quality performance of the company that are,
 - 5S
 - SWAT Analysis
 - OEE

1.6 Objectives of the Study

1.6.1 Primary Objectives

- To study the Total Quality Management in an organization.

1.6.2 Secondary Objectives

- To reduce and control the overall defects of the products.
- To improve the quality of the product.
- To increase the efficiencies by ensuring that the production process of the organization's finished products.

1.7 Limitation of the Study

- The study provides an insight into the quality and performance aspects of FERRON STEELS.
- The data collected for the study has been limited from January 2021 to February 2021.
- Opinions of the external guide of the organization were taken into consideration.
- Most of the information and data has been kept confidential.

2.REVIEW OF LITERATURE

- **Rahman and Bullock (2005)** explored the relationship between TQM practices and organizational performance. Their study utilized data from 261 Australian manufacturing companies. They created a model with 10 TQM elements: workforce commitment, shared vision, customer focus, use of teams, personnel training, cooperative supplier relations, computer-based technologies, just-in-time principles, technology utilization, and continuous improvement enablers. The first six elements were considered as the soft elements and the remaining four elements as the hard elements of TQM.
- **Dean and Bowen (1994)** TQM is a management idea, or a methodology characterized by principles, practices, and techniques. They confirmed that three principles, that most quality frameworks, had following commonality - customer focus, continuous improvement, and teamwork. Each principle is applied through established practices, and these practices, in turn, are reinforced by a wide set of techniques.
- **Terziovski and Samson (1999)** established that there were noteworthy differences in the relationship between TQM and organizational performance when the size of the organization was taken into consideration, specifically impacting the new product development. Larger companies were likely to benefit more from TQM than smaller firms. These findings are consistent with some other studies as well.
- **Ahire and Golhar (2001)** showed that there were no operational differences in TQM implementation which could be attributed to firm size and that small and large firms that produced high-quality products implemented TQM likewise.
- **Haar and Spell (2008)** in their study concluded that firms with higher level of workplace independence, use of performance standards, use of teams, and use

of group problem solving were more likely to adopt TQM, and this was more expected for larger companies than smaller companies

- **Ahire and Golhar (1996)** found no differences between experienced TQM firms and less experienced TQM firms in the rigor of TQM implementation, with the exception of employee involvement and concludes that it is possible for a firm to achieve a high operational performance within a shorter TQM time frame compared to firms that had longer TQM experience.
- **Abusa (2011)** anticipated that the extent of TQM implementation among large companies would be more innovative and better established than among the S&M companies, but the outcomes were not in line with is the expectation. His results indicated that there was no significant difference between the S&M companies and large companies' mean of TQM elements at the 0.05 significant levels. In addition, the mean of TQM elements in S&M sized companies is, on average, a bit better than the mean of TQM elements among large company.
- **Shahryar Sorooshian etal. (2012)** They have experienced of implementing a 5S program and paper involves presentation of a real case study, specifically the influence of 5S on some basic work environment problems and the compensation power on the choice of implementation of 5S. This paper is simply representation of basic information with all problems and compensation about the concept of 5S.
- **Derya Sevim Korkut etal. (2009)** This study involves 5S system for ensuring order and discipline in the companies and ensuring the supervision of both simple and even the smallest details, has been reviewed in full details and they have been taken under the content of the research through selecting the assembly department as pilot department for 5S activities which is applied at a yacht manufacturing company. 5S approach is not a study covering a certain period of time rather it is a method defending the requirement of the standardization and continuation of all improvements need to be perform.

- **J. Michalska et al. (2007)** In this paper 5S implementation results in increasing of an efficiency, safety and reduction of the industry pollution. The proceedings to research clearly show that training of workers about the 5S rules is very essential. The important task is to divide activities on some main steps and to maintain the continuous improvement. It is also important to understand the need of executing the routine inspections of usage the 5S rule. This inspection is executed by helping of so-called check list and created on its basis the radar graph of the 5S, which serves to estimation of the workplace.
- **Ravinder Kumar Panchal et al. (2012)** This paper focus on the methodology adopted in 5S and implementation of the same in the production industry. The 5S rules bring the great changes in the company, for example: process improvement by costs" reduction, increasing of effectiveness and efficiency in the processes, maintenance and improvement of the machines" efficiency, safety increasing and reduction of the industry pollution and waste.
- **Marko Milosevic et al (2013)** This paper explain the methods and techniques of lean concept which uses to increase the efficiency of all processes in the company. Also show the results of the level of implementation this method in international and domestic production companies. It can conclude that large companies pay much attention to "lean" concept, both because productivity, and the satisfaction of their employees.
- **Harsha Lingareddy et al. (2013)** This paper involves the study and change in the work place of a manufacturing industry to implementation of 5S. This strategy helps in minimizing the time of manufacturing and also increases the area of work place. The solution found by 5S approach solely minimizes several kinds of wastes in the production process and which finally helps in the development of the organization. An Inspection process has been executed on the basis of 5S check

lists and the results analyzed to confirm great changes like increasing efficiency in production and quality, improves safety.

- **Arash Ghodrati et al. (2013)** This paper is aimed to determine performance factors and characteristics in industrial organizations and identifying the effectiveness of 5S implementation on organizational performance as well. Surveying method is used and data collection is carried out by distributing questionnaire among five target organizations which have implemented 5S techniques. The target organizations are chosen from different industries and diverse field of work. The results of this research obtained from a comparative measurement of organizational performance before and after 5S implementation. The results show that 5S is an effective tool for improvement of organizational performance, regardless of organization type, size, its production or its service. Consequently, 5S techniques would strongly support the objectives of organization to achieve continuous improvement and higher performance, identifying effectiveness of 5S implementation on the organization performance. Finally it is concluded that 5S has positive effect on overall performance and could improve the quality, efficiency and productivity of industrial organizations
- **Prof. S. B. Khedkar et al. (2012)** This research is dealt with the implementation of 5S methodology in the S. P. Plastic Industry MIDC, Hingna Road, Nagpur 16. 5S implementation impacts the instructors and workman of industry that work within the selected place. By following the 5S methodology, this research effort shows significant improvements to safety, productivity, efficiency, morale and housekeeping.
- **P. M. Rojasra et al. (2012)** This paper explain the implementation of 5S methodology in the Krishna Plastic Company, Udhyognagar, Amreli, Gujarat. Out of the available various lean manufacturing techniques, 5S offers good potential for required improvement. Ten weeks study is carried out in the company. The

results after the 5S implementations states that production system efficiency is improved from 67% to 88.8% in the successive week.

- **Mohammad Rasouli Dizaji et al. (2013)** This paper includes research conducted at Tabriz- IDEM company in the Iran. For gathering required data, they have used three kinds of questionnaires that each one investigates the related area. The result shows that the company has successful actions in employing and implementation of 5S, Ergonomics and executing TQM and also their relations are meaningful.
- **R.T. Salunkhe et al. (2011)** In this paper, the objective of spare part management is to ensure the availability of spares for maintenance in minimum time with the help of different management techniques like 5s system, Kanban system and different Kaizens. The 5s system helps to understand the actual condition of spares in store department. It also helps to manage the spare parts effectively giving satisfactory results. The result shows that the improvement in reduction of searching time and also control the cost of inventory significantly accomplished through 5s, Kanban and kaizen systems. The searching time is reduced from 10 - 15 min. to 6 - 8 min.
- **Gheorghe Dulhai et al. (2008)** This paper presents a continuous improvement strategy, process oriented and aiming to improve manufacturing at auto car exhaust. The improvement of auto car exhausts quality, using the “5S” rules, is accomplished at the initiative of the inferior levels of the organization coordinated and helped by the superior management. The efficient implementation of the „5S” strategy leads to a subsequent improvement of the exhaust’s quality.
- **Kaushik Kumar et al. (2012)** In this paper, the steps undertaken for the implementation of the 5S emphasizing on the benefits to the organization. The successful implementation of 5S requires that everyone understand why it is being

used and what the expected results are, as the removal of familiar (although unneeded) items and the reorganization of processes can be extremely unsettling.

- **Jose H. Ablanedo-Rosas et al. (2010)** In this paper results of an empirical study applied to some Mexican organizations with the aim of understanding their implementation experience, empirical relationships, and ongoing challenges associated with the 5S practice are elaborated. The 5S practice is used as the basis for advanced quality and continuous improvement philosophies and the organization measures the benefits from 5S implementation such as quality improvement. The 5S practice is worthwhile for production and service organizations and is universal to all organizations. The big challenge is how to incorporate the 5S practice in employee's life.
- **Shahabi et al., (2014)** SWOT analysis is a frequently used tool in the strategy development process. In this way, organizations can conduct the analyses of internal and external environments, such as identifying existing strengths and weaknesses, opportunities, and threats in the foreign market, and they can also determine their actual position and competitiveness within the sector from Hill and Westbrook, 1997.
- **Yuksel and Dagdeviren, (2007)** SWOT analysis aims to develop plans and strategies for individuals or organizations to obtain maximum advantage of existing strengths and opportunities while minimizing the impact of potential threats and weaknesses by considering internal and external factors.
- **Shinno (2006)** has conducted SWOT analysis to create effective industrial strategy planning for the machine tool industry which can be carried out by applying the proposed method. The SWOT key words were collected from the related research reports published on the machine tool industry in Japan. In order to proposed quantitative SWOT analysis, the AHP method is combined into weighted score stage in SWOT analysis.

- **Terblanche (2008)** used SWOT analysis to provide an overview of the pressures experienced by the pharmaceutical industry in producing new drugs. SWOT analysis was used to analyze factors with regard to the ability of pharmaceutical industry to produce new drugs.
- **Milosevic (2010)** has conducted SWOT analysis to identify potential risks for both the investor and the contractor that are facing current market economy, and when private interests provide significant financing, also time and budget limitation on construction. This research showed each SWOT Analysis components from the point of view of both investor and the contractor in the planning, contracting, and construction phases of a project.
- **Dharmaraj (2011)** has conducted SWOT analysis on car industry. This study aims to cover the important pre-purchase and post-purchase behavior of consumers relating to the car buying decisions. The method used was SWOT analysis through Test Analysis of Friedman to find the more influencing factors towards the car manufacturers and service provided by the dealers to determine the perceptual ranking. The identification of SWOT component was limited to the pre-purchase and post-purchase behavior of consumers in car buying decision.
- **Lee (2011)** has used SWOT analysis to assess the comprehensive strategic of the overall conditions around the Korean Automobile Industry by analyzing its key areas. While, the Porter's Five Forces model has used to competitive analysis of the Korean Auto Parts Industry. This research aims to give some suggestions for Korean automobile industry continuous growth in the global markets.
- **Zardeini and Aghdaie (2011)** the aim of this research is to analyze the export of Persian handmade carpet which is facing decrease the share of Persian handmade carpet in foreign markets in recent decade by using the SWOT matrix.

The Opportunities, Threats, Strengths and Weaknesses analysis was limited to the available empirical and library studies about handmade carpet industry.

- **Saghaei (2012)** has been used SWOT analysis and QSPM models. This research aims to methodize an appropriate strategy for a steel manufacturing company. The SWOT identification process was regarding technological innovation, feasibility study regarding application of current and potential production of company by customers, and the ability of company in production.
- **According to Prof. J. Oakland (1993, 1991)**, TQM is a way of managing to improve the effectiveness, flexibility and competitiveness of a business as a whole. It applies just as much to service industries as it does to manufacturing. It involves whole companies getting organized in every department, every activity and every single person at every level.
- **According to Cullen and Hollingum (1987)**, TQM is a zero defects in products leaving the factory and in the services
.
- **According to David (1992)**, TQM is the process which seeks to meet and satisfy customer requirements throughout the whole chain of internal and external customers and suppliers.
- **According to Department of Defense, USA (1988)**, “TQM is the application of quantitative methods of human resources to improve the materials and services, supplies to an organization, all the processes within an organization and the degree to which the needs of the customers are at present and in future”
- **Huang et al. [2003]** report that the concept of OEE has been widely used as a quantitative tool essential for the measurement of productivity in manufacturing operations, because of extreme capacity constrained facility investment. They state that traditional metrics for measuring productivity and utilization, are

insufficient for identifying the problems and underlying improvements needed to increase productivity.

- **Iqbal and Asrar-ul-Haq (2018)** revealed that employee change readiness brings an inclusive impact, to the level of organizational change in software houses of Pakistan. Furthermore, the results of this study found that TQM practices and ICR provide noteworthy provision to quantify the mediating role of ICR and employee performance.
- **AlMaamar et al. (2017)** studied the role of TQM application in the Oil Unit in Yemen. They also analyzed the impact of TQM practices concerning human resources readiness to change and thereby improved efficiency and overall productivity and performance in the organization.
- **Haffar et al. (2014)** found that "individual change readiness" is strongly related to TQM and, have stated that the presence of "individual change readiness" in the organizational culture, would lead organization to the better execution and, implementation of TQM practices.
- **Mahanti and Antony (2009)** concluded that TQM practices are the critical success factor in the Indian software industry. TQM is an essential approach for the betterment of the industry in terms of product quality, service, a satisfaction of the customer and, profitability.

3. RESEARCH METHODOLOGY

Research methodology is the specific procedures or techniques used to identify, select, process, and analyze information about a topic. In a research paper, the methodology section allows the reader to critically evaluate a study's overall validity and reliability. It is a scientific and systematic way to solve the research problem. It helps to understand the study how the research is done scientifically. It will give the work plan of research. It provides training in choosing methods materials, scientific tools and techniques relevant to the solution of the problem.

3.1 Research Design

The study carried several methods to improve the performance of the organization. Research design used in this project is purely and simply the framework or systematic plan for concerned with describing the characteristics of organization.

The research design used in this study is Total Quality Management and the procedure is use the researcher gather information already available, and analyze these to make an improvement of the performance.

The research design helps to describes the phenomenon as it exists and effective production rate in the firm. It is undertaken in order to take necessary measures to reduce the defective product by increasing the quality.

3.2 Tools used in the Study

1. 5S
2. SWOT Analysis
3. OEE

3.2.1 5S

5S is useful approach for giving valuable foundation for the organization and help to improve communication, lead time, downtime, defect, inventory, injury and costs associated with them. Order, neatness and cleanliness are considered to give a continuous improvement. 5S is able to link total productive maintenance and other

approaches also. There is no difference between ISO 9001 guidelines and formalities of 5S. From implementation of 5S, majority of routine problems can be resolved easily.

3.2.1.1 Methodology.



Figure 3.2.1.1 5S Methodology

3.2.1.2 Sort (Seiri)

First of 5S is to clean workplace for perfect operations. Company collected every item; it determined whether it would be useful, and then distinguishing items into categories based on their usage: Low, Medium and High. Nobody in the organization can notice what items should kept and what items should throw-away, so keep all unsure items for some weeks to make sure of a waste. Unsure items kept place where frequency of movement of people is low.

- Eliminate all unnecessary tools, parts and instructions.
- Keep only essential items and eliminate what is not required.
- Prioritizing things per requirements and keeping them in easily-accessibility places.

3.2.1.3 Set in order (Seiso)

It is the way to make items look neat and reduce the time for hunting of tools and components. Second S keeps every item set in an order. Putting name tags over box and item should be kept according to its name. Company got varieties of tools and components, so set in order helps the workers to save time and to gather the required items.

- There should be a place for everything and everything should be in its places
- The place for each items should be clearly labelled or demarcated.
- Items should be arranged in a manner that promotes efficient work flow, with equipment used most often being the most easily accessible.

3.2.1.4 Shine (Seiton)

The common idea is to clean, shine and neat everything in the workplace. In order to make things have much longer usage life and have perfect environment, Company asked their workers to clean their work-place before leaving the company.

- Clean the workspace and all equipment and keep it clean, tidy and organized.
- At the end of each shift, clean the work area and be sure everything is restored to its place.
- Maintaining cleanliness should be part of the daily work – not an occasional activity initiated when things get too messy.

3.2.1.5 Standardize (Seiketsu)

After implementing successfully all three above steps, the supervisors will ask their workers to maintain everything same as it was organized.

- All work station for a particular job should be identical.
- All employees doing the same job should be able to work in any station with the same tools that are in the same location in every station.

- Everyone should know exactly what his or her responsibilities are for adhering to the first 3S's.

3.2.1.6 Sustain (Shitsuke)

Final step and hardest step of 5S implementation, asks the managers to keep everything same going every day. Company make a checklist for helping managers to make sure everything is fine. Making workers do sorting, set in order, shine, and standardize, daily, means that they are sustained.

- Maintaining and review standards.
- Maintaining focus on this new way and do not allow a gradual decline back to the old ways.
- While thinking about the new way, also be thinking about yet better ways.

3.2.2 SWOT Analysis

Availability of power and raw material with skilled persons are the lacuna found in the firm. Even though there are enough labours available, the temperature effects due to high heating and melting process people are reluctant to work.

Another important negative impact is lack of chemical and labs for the material testing. Availability of cheap labour and facilities for the expansion is good. Hence cost of production may be less in TMT products. Since number of steel industries are coming up the local competition is a threat to this field. Many industries are using the raw materials as scrap steels. When it melts in induction furnaces the product qualities may reduce. In order to compensate this additives and other ingredients have to be added while it is melting after the lab verifications of the components of the molten mild steel (MS). The MS rods malleability, ductility, resistance to corrossions are very important. These properties can only be achieved by the lab testing only.

Transportation of the finished and raw material are another problem faced by the firm. There may be a shortage of infra structure too. Research and development wings performance may also be poor.

Strength, weakness, opportunities and threats of Ferron Steels

3.2.2.1 Strength

- 1) Cheap
- 2) Good Malleability & ductility properties
- 3) Good Advertisement & publicity
- 4) Customer trust & faith is good
- 5) Good in sales technique & ability to customize
- 6) Flexibility for expansion
- 7) Availability of international market
- 8) Good in share market
- 9) Mechanical strength is good
- 10) Scrap availability and ease of scrap transportation

3.2.2.2 Weakness

- 1) Poor network in rural area
- 2) Poor R&D wing
- 3) International shares
- 4) Lab facility
- 5) Preparation is from its scrap
- 6) Failure in furnace

3.2.2.3 Opportunities

- 1) Good internal market
- 2) High demand in Public sectors
- 3) Expansion facility

- 4) Flexibility in future expansion
- 5) Good distribution network
- 6) Resource Building capacity

3.2.2.4 Threats

- 1) Good competition
- 2) Availability of raw materials
- 3) Availability of skilled person
- 4) Internal market
- 5) Dumping by competitors.
- 6) Poor lab facility

3.2.3 OEE

OEE stands for Overall Equipment Effectiveness which that identifies the percentage of planned production time that is truly productive. An OEE score of 100% is perfect production. The OEE of World Class is 85%

3.2.4 Calculating the Overall Equipment Efficiency

To measure the OEE which will gives an indication of where we may find the error or the weakness point. The study was taking during 10 days for the data collection.

As there are no. shifts/day with number working hours per shift There was a stoppage of for each shift,

Available operating time = no. of days * no. of shift/day * no. of hours/shift

.

3.2.5 Availability Factor

The percentage of time that a machine to be available for production.

Total time consumption to produce the batch for total no. of days = Available operating time – Downtime

3.2.6 Performance Factors

The percentage of the actual operational speed or the number of units produced in a certain timeframe, compared to the standard speed.

Performance rate = $[(\text{Design cycle time} \times \text{Total Output}) / \text{Operating time}]$

3.2.7 Quality Factors

The percentage of non defective products produced

Quality rate = $(\text{production input} - \text{quality defects}) / (\text{production input})$

The Overall equipment effectiveness

OEE = $\text{Availability} \times \text{Performance rate} \times \text{Quality rate}$

And the World Class OEE is 85%.

3.3 Sources of Data Collection

This research consist of both primary data and secondary data.

3.3.1 Primary Data

The process of collecting data can be long and tedious. In an effort to collect all the necessary, relevant information available at one time, professionals often lose sight of the purpose of the data collection process. The production rate, quality rate of the product, efficiency of the product data were collected from Ferron Steels.

3.3.2 Secondary Data

In this process of data collections of sources are taken from the firm for the study and analysis. The source of the world class, international brands and standard values are taken from the INTERNET, which helps the study to analyze with Ferron Steels for improving the performance and efficiency

4. DATA ANALYSIS AND INTERPRETATION

Here the data is collected to analyze. The data is classified into purposeful and usable category. The analysis can be done by means of various statistical measures. For representation of the data used in Pie Charts and Bar Chart. After data analysis is done, the obtained information is interpreted and various inferences are made and also conclusions are drawn related to the objectives, which have been listed, in the beginning of project.

- This study will follow the analytical type. In analytical research, the research has to use facts or information available, and analyze these to make critical evaluation of material like in this project.
- This project is based on both primary and secondary data, some statistical tools are used: - Tables, Graphs and charts etc

Table 4.1 Demand Forecast of Steel Rebar

Financial Year	Quantity (MT)
2011-12	21.77
2012-13	22.04
2013-14	23.91
2014-15	25.90
2015-16	28.05
2016-17	30.39
2017-18	32.91
2018-19	35.65
2019-20	38.61
2020-21	41.82

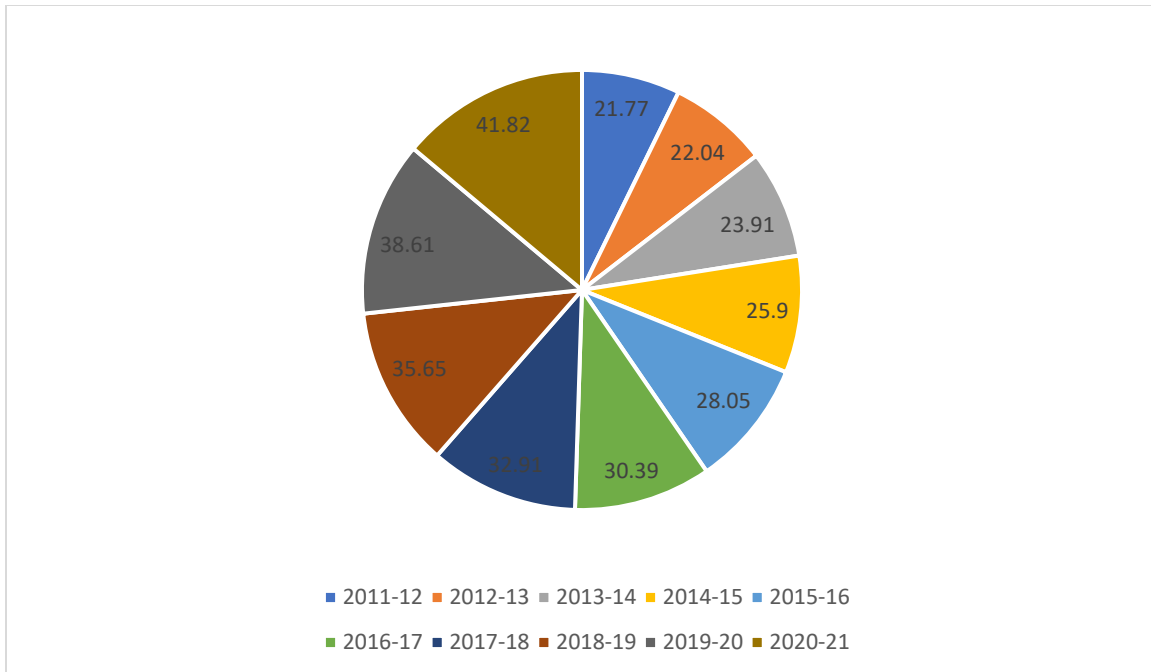


Fig 4.1 Demand Forecast of Steel Rebar

Methodology used in the analysis

1. 5S
2. SWOT Analysis
3. OEE analysis

4.1 5S

4.1.1 1st S Seiri (Sort)

❖ Availability of material

1 mark will be given if fully available otherwise 0.

❖ Defective finished goods

If there are A items which contains B items as defective then marks will be, $[1 - (B/A)]$

❖ Operating condition

If there is a proper flow of material, then the value 1 is given otherwise 0.

❖ Relative information

Information about process guidelines, working conditions, material information, tool information takes place. 1 mark for full information otherwise 0

❖ **Waste elimination**

Let total C be number of wastage list, but only D number was removed, then marks will be as follows, $[1-(D/C)]$.

Table 4.1.1 Seiri rating table

Weeks	Average of material	Operating condition	Defective finished goods	Relative information	Waste elimination	Total rating S1
1	1	1	0.15	1	0.15	3.3
2	1	1	0.2	1	0.2	3.4
3	1	1	0.3	1	0.35	3.65
4	1	1	0.45	1	0.4	3.85
5	1	1	0.5	1	0.55	4.05

Interpretation

From the above table 4.1.1 the Seiri rating data is calculated which is taken from Ferron Steels through 5S process. It gives the working condition of the firm by analyzing the defective finished goods. Thus, the relative information the fished goods are also been collected. The wastage of the process are also noted for the study. These data are taken for 5 weeks from Ferron Steels.

4.1.2 2nd S Seiton (Set in order)

Second S deals with arrangement of equipment and tools

❖ **Sequence rating**

Let M number of total tools and N number which aren't in sequence, then the rating will be $[1-(N/M)]$.

❖ **Material arrangement**

Let X be the lack of material and Y be material required,

then rating will be $[1-(X/Y)]$.

❖ **Process arrangement**

Let G be the number of total processes and H be number of irregular processes, rating $[(1-H/G)]$

❖ **Material arrangement consistency**

Let U be arrangement of material and V be number that fails to achieve exact position. Then rating would be: $[1-(V/U)]$.

❖ **Working efficiency**= total allotted time to process / working time for processing

Table 4.1.2 Seiton rating table

Weeks	Sequence rating	Material arrangement	Material arrangement consistency	Process arrangement	Working efficiency	Total rating S2
1	0.3	0.5	0.5	0.4	0.85	2.55
2	0.3	0.5	0.5	0.4	0.85	2.55
3	0.35	0.5	0.5	0.5	0.85	2.7
4	0.4	0.5	0.5	0.5	0.85	2.75
5	0.5	0.85	0.8	0.6	0.85	3.6

Interpretation

From the above table 4.1.2 the Seiton rating data is calculated which is taken from the Ferron Steels through 5S process. The process needs the material arrangement and the consistency. And the working efficiency of the firm are also calculated. These data are taken for 5 weeks from Ferron Steels.

4.1.3 3rd S Seiso (Shine)

Third S deals in order to do work in a clean environment.

❖ **Cleaning workplace**

Machine gets 1 for clean and 0 for unclean.

❖ **Working conditions**

Let J be number of wrong arrangement and I be the total number of favorable conditions, then rating would be $[1-(J/I)]$

❖ **Safety**

Safety is given on scale means if there is chance rating will be 0 and if they feel safe, rating will be 1.

❖ **Cleaning consistency**

Let Q be the total no. of time cleaning required and R be number of times the cleaning not done, so consistency rate will be $[1-(R/Q)]$.

❖ **Path for movement of material**

Let J is the total no. of times hindrance and K be the total no. of movements. Then rating will be: $[1-(K/J)]$.

Table 4.1.3 Seiso rating table

Weeks	Cleaning workplace	Machine Cleanliness	People Working conditions	Safety	Cleaning consistency	Total rating S3
1	1	1	0.4	0.9	0.4	3.7
2	1	1	0.4	0.9	0.4	3.7
3	1	1	0.65	0.9	0.4	3.95
4	1	1	0.65	0.9	0.4	3.95
5	1	1	0.8	0.9	0.6	4.3

Interpretation

From the above table 4.1.3 the Seiso rating data is calculated which is taken from Ferron Steels through 5S process. Thus, the cleanliness of machines are executed before the process starts and the working conditions were also noted. The safety measures are also used and the cleaning consistency data were taken. These data are taken for 5 weeks from Ferron Steels.

4.1.4 4th S Seiketsu (Standardize)

By taking average of last three S, because standards of any system will fall & rise by factors of mean rate.

Rating of Seiketsu = (Rating of Seiri + Rating of Seiton + Rating of Seiso)/3

4.1.4 Seiketsu rating table

Weeks	Total S4 = (S1+S2+S3)/3
1	3.1833
2	3.2167
3	3.4333
4	3.5167
5	3.9833

Interpretation

From the above table 4.1.4 the Seiketsu rating data is calculated which is taken from Ferron Steels through 5S process. The summation 5 weeks average rating data of Seiri, Seiton and Seiso is calculated.

4.1.5 5th S Shitsuke (Sustain)

Shitsuke rating can be calculated by last four S because without that regularity will not maintain.

Shitsuke Rating = (Rating of Seiri + Rating of Seiton + Rating of Seiso + Rating of Seiketsu)/4

Rating of this table is shown in results.

4.1.5 Shitsuke rating table

Weeks	Total S5 = $\left[\frac{(S1+S2+S3+S4)}{4} \times 100/5\right]$
1	63.6665
2	64.3333
3	68.6667
4	70.3333
5	79.6667

Interpretation

From the above table 4.1.5 the Shitsuke rating data is calculated which is taken from Ferron Steels through 5S process. The summation 5 weeks average rating data of Seiri, Seiton, Seiso and Seiketsu is calculated. And the average percentage of data is calculated.

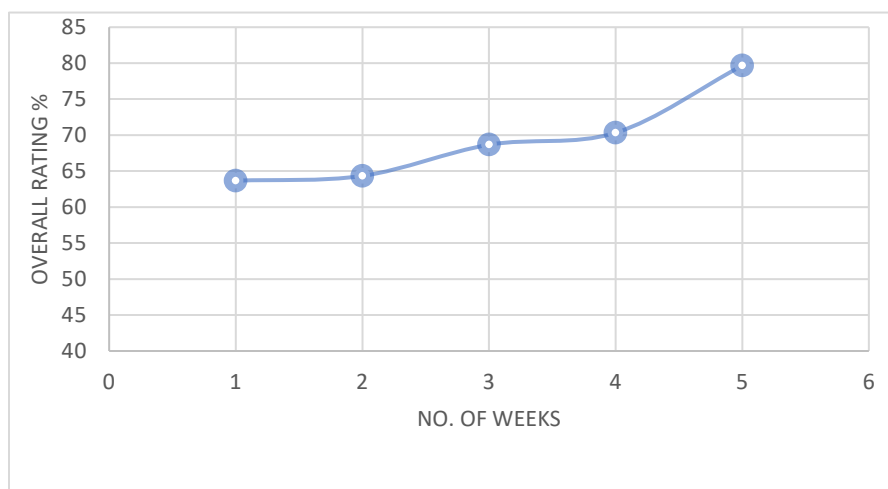


Fig 4.1.1 Efficiency of 5S rating system

4.2 SWOT Analysis

Percentage wise analysis of Ferron Steels

4.2.1 Strength

- Cheap - 7%
- Good Malleability & ductility properties - 11%
- Good Advertisement & publicity - 15%

- Customer trust & faith is good - 9%
- Good in sales technique & ability to customize - 12%
- Flexibility for expansion - 13%
- Availability of international market - 5%
- Good in share market - 12%
- Mechanical strength is good - 9%
- Scrap availability and ease of scrap transportation- 7%

Table 4.2.1 Percentagewise split up of factor Strength

S.No	Strength	%
1	7	1.75
2	11	2.75
3	15	3.75
4	9	2.25
5	12	3
6	13	3.25
7	5	1.25
8	12	3
9	9	2.25
10	7	1.75
Total	100	25

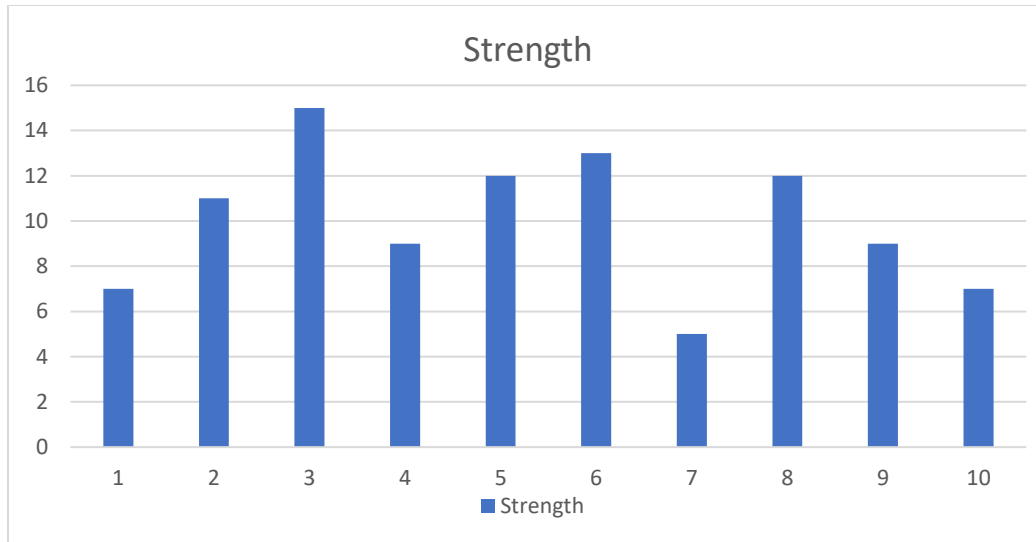


Fig 4.2.1 Relationship of Strength

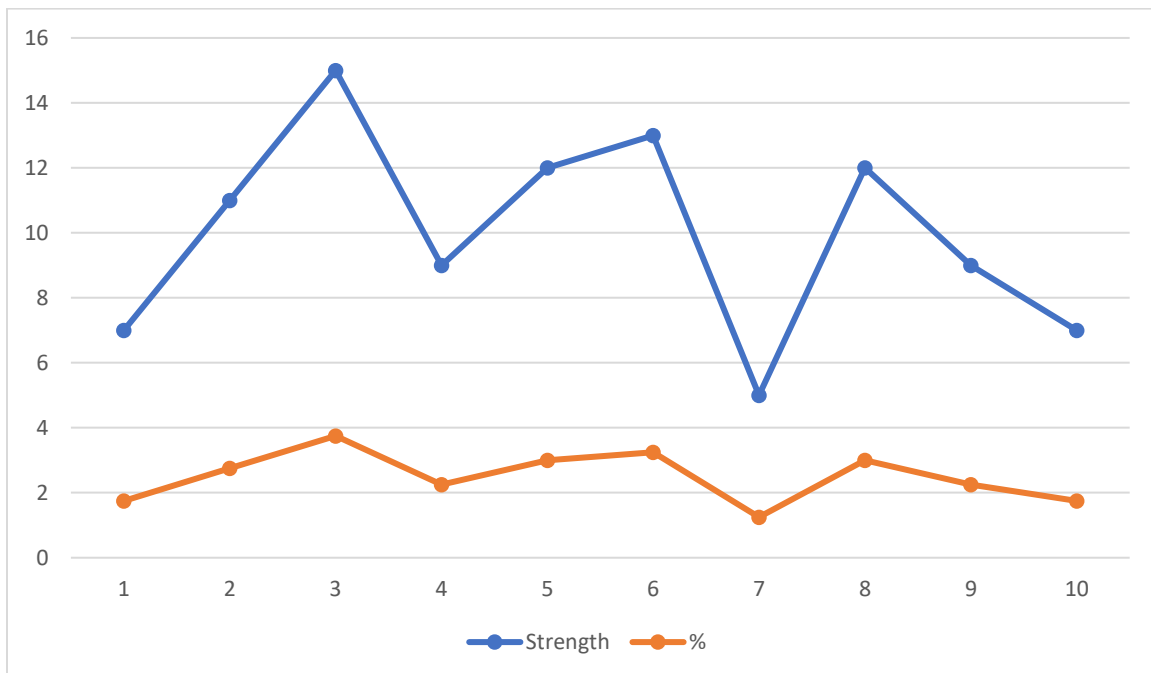


Fig 4.2.1.1 Relationship between the Strength and its overall percentage

Interpretation

From the above table 4.2.5 the percentage of Strength of the Ferron Steel is calculated which are taken from the firm through SWOT Analysis process. And the fig 4.2.5 shows relationship of Strength and fig 4.2.5.1 denotes the relationship between the Strength and its overall percentage of Ferron Steels.

4.2.2 Weakness

- Poor network in rural area - 1.75
- Poor R & D wing - 2.75
- International shares - 5.25
- Lab facility - 3
- Preparation is from its scrap - 4.5
- Failure in furnace - 5.75

4.2.2 Percentagewise split up of factor Weakness

S.No.	Weakness	%
1	15	1.75
2	11	2.75
3	21	5.25
4	12	3
5	18	4.5
6	23	5.75
Total	100	25



Fig 4.2.2 Relationship of Weakness

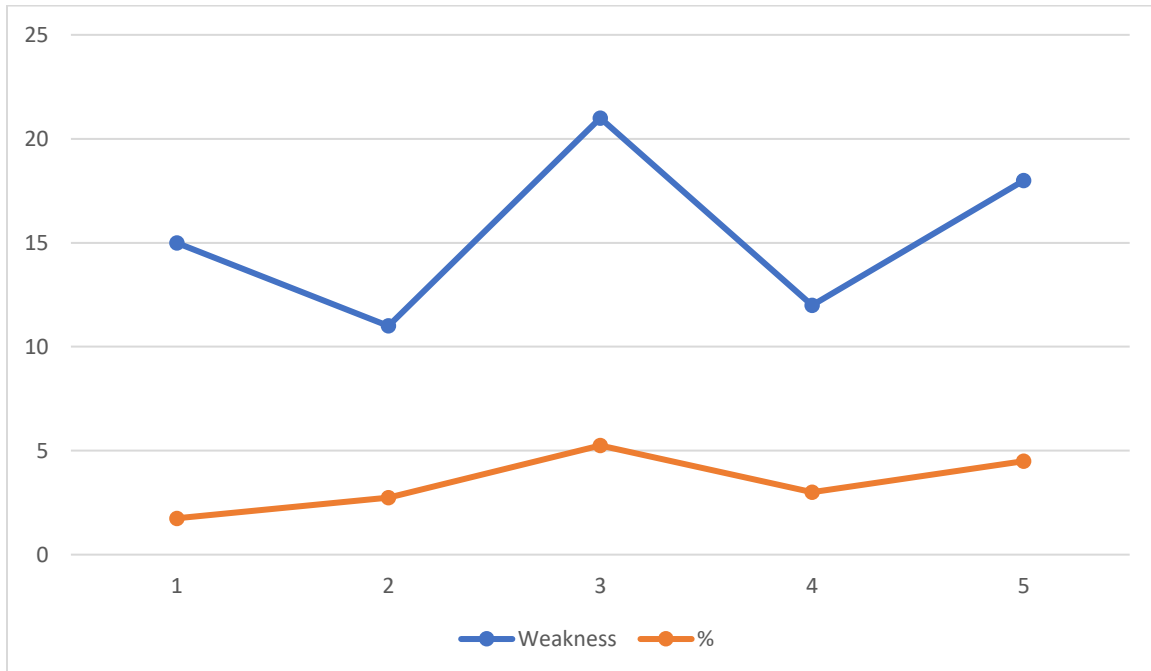


Fig 4.2.2.1 Relationship between the Weakness and its overall percentage

Interpretation

From the above table 4.2.6 the percentage of Weakness of the Ferron Steel is calculated which are taken from the firm through SWOT Analysis process. And the fig 4.2.6 shows relationship of Weakness and fig 4.2.6.1 denotes the relationship between the Weakness and its overall percentage of Ferron Steels.

4.2.3 Opportunities

- Good internal market - 5
- High demand in Public sectors - 4
- Expansion facility - 3.25
- Flexibility in future expansion - 4
- Good distribution network - 4.5
- Resource Building capacity - 3.25

4.2.3 Percentagewise split up of factor Opportunities

S.No.	Opportunities	%
1	22	5.5
2	16	4
3	13	3.25
4	16	4
5	18	4.5
6	13	3.25
Total	100	25



Fig 4.2.3 Relationship of Opportunities

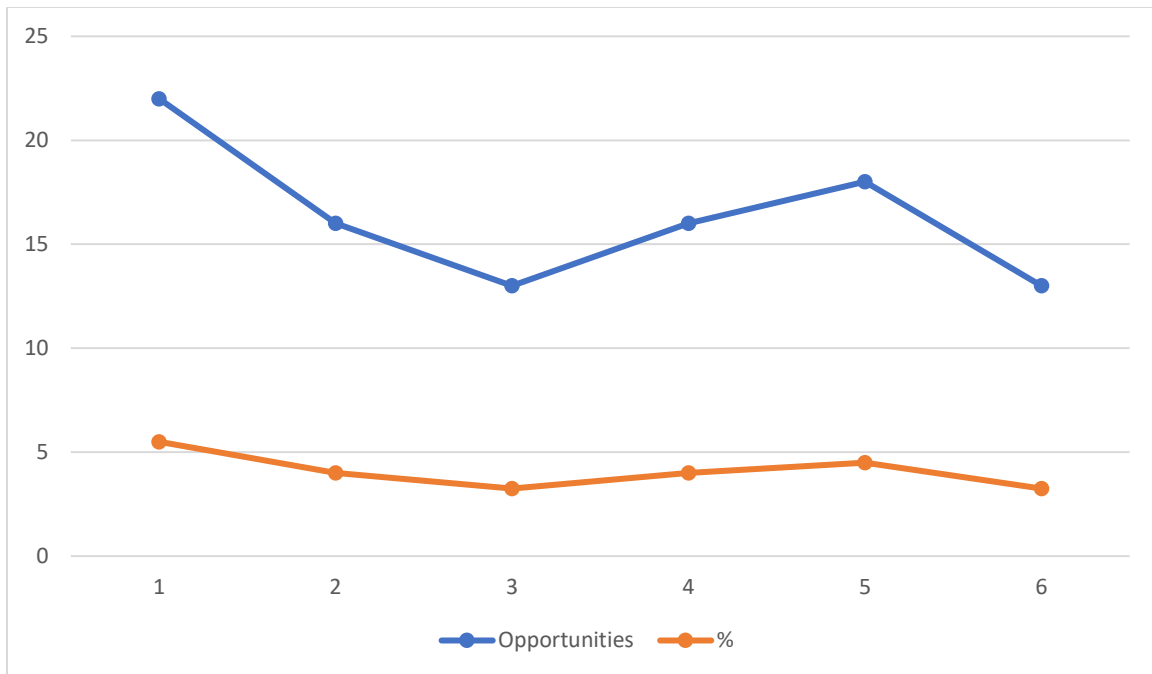


Fig 4.2.3.1 Relationship between the Opportunities and its overall percentage

Interpretation

From the above table 4.2.7 the percentage of Opportunities of the Ferron Steel is calculated which are taken from the firm through SWOT Analysis process. And the fig 4.2.7 shows relationship of Opportunities and fig 4.2.7.1 denotes the relationship between the Opportunities and its overall percentage of Ferron Steels.

4.2.4 Threats

- Global competition
- Availability of raw materials
- Availability of skilled person
- Internal market
- Dumping by competitors.
- Poor lab facility

4.2.4 Percentagewise split up of factor Threats

S.No.	Threats	%
1	19	4.75
2	17	4.25
3	16	4
4	16	4
5	18	4.5
6	14	3.5
Total	100	25

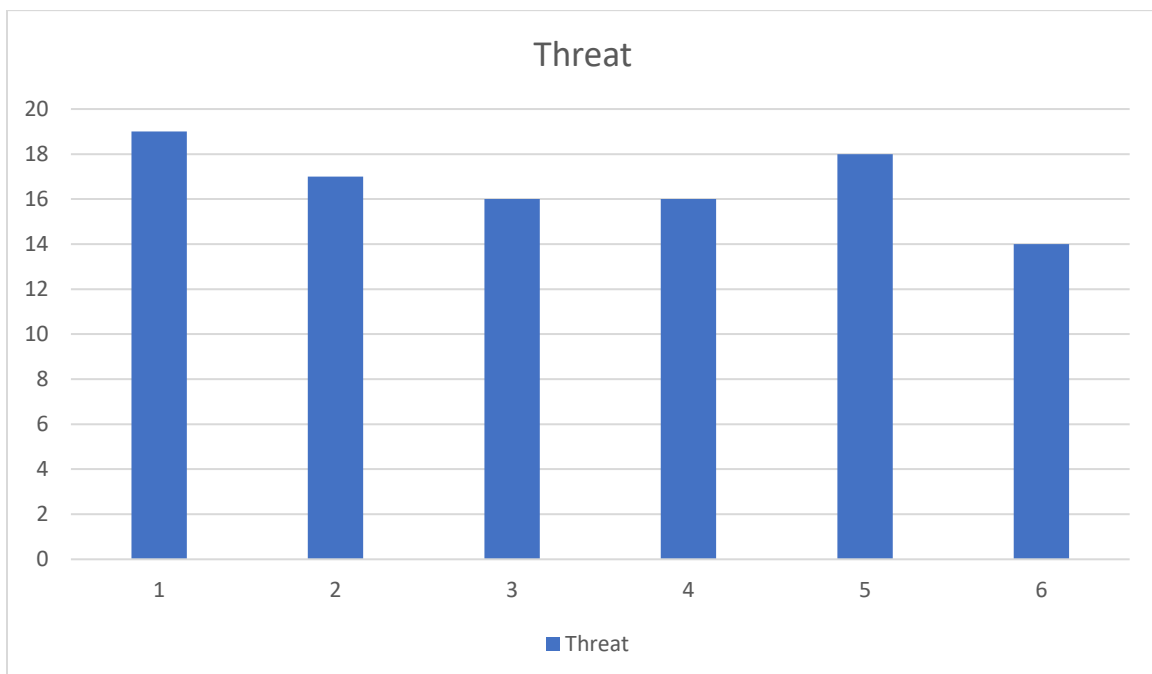


Fig 4.2.4 Relationship of Threats

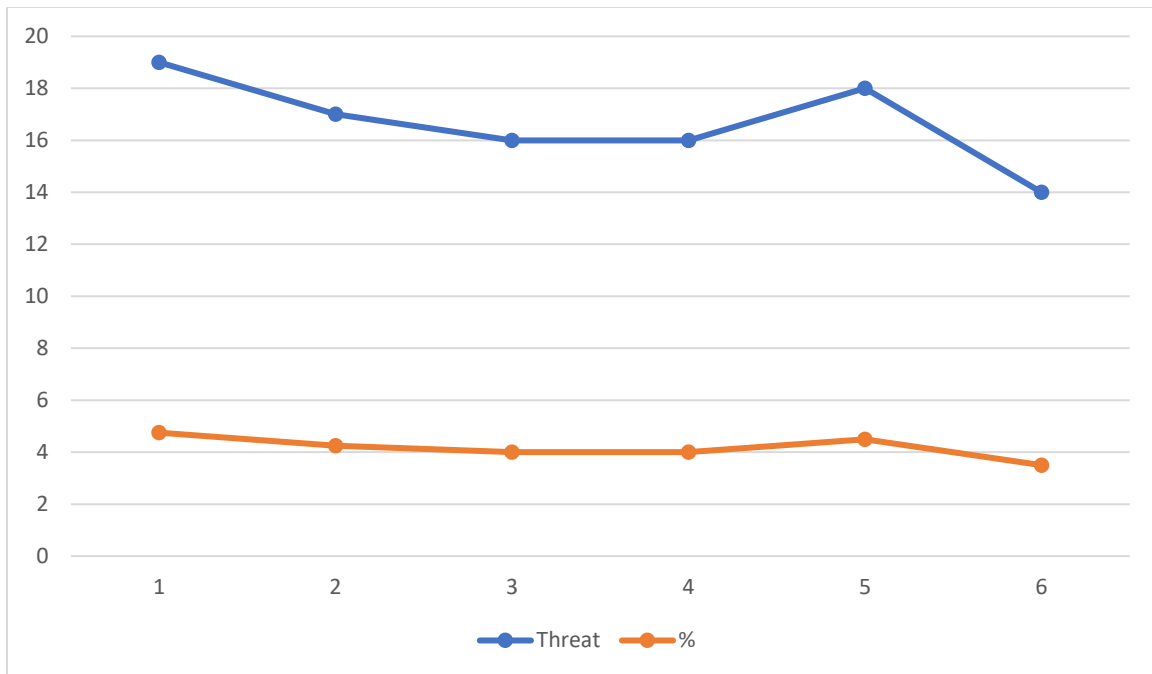


Fig 4.2.4.1 Relationship between the Threat and its overall percentage

4.3 OEE - Overall Equipment Efficiency

4.3.1 Problems Identify

Major industry losses were identify which are shut down, production adjustment, equipment failure, process failure, normal production loss, abnormal production loss, quality defect and reprocessing. Following are some of the losses listed which occurs during the production process:

1. Miss roll of TMT Bar.
2. Cooling Bed jam.
3. Jamming of material in the furnace.
4. Reduction Gear Box Problem (due to oil contamination, teeth damage).
5. Ejector jam.
6. Sprocket and chain fails.
7. V belts fail.
8. Guiding and transportation system.

Table 4.3.1 The Total Downtime and the amount of Scrap, Batch size and production/day for 10 operating days

Days	Downtime (Min)	Scrap (Ton)	Batch Size (Ton)	Production/Day (Ton)
1	140	13.45	119.7	117.3
2	350	11.12	80.15	78.56
3	200	13.8	92.85	90.67
4	420	15.31	78.52	75.5
5	260	12.13	85.83	83.06
6	220	15.43	92.77	90.1
7	180	11.1	111.02	109.49
8	230	10.05	89.12	87.67
9	310	12.17	82.45	81.6
10	480	13.86	77.16	75.87
Total	2570	128.42	909.57	889.82

4.3.2 Calculating the Overall Equipment Efficiency

To measure the OEE which will gives an indication of where we may find the error or the weakness point. The study was taking during 10 days for the data collection.

As there are 3 shifts/day with 8 working hours per shift There was a stoppage of 30 min for each shift, Therefore for 10days

Available operating time = 10 days * 3 shift/day * 8 hours/shift = 240 hours.

which gives in total 22.30 hours, 240-22.30=217.7 hours.

The target for production of TMT Bar for each day is 120 tons and for each shift is equal to 40 tons.

4.3.3 Availability Factor

Total time consumption to produce the batch for 10 days = Available operating time – Downtime

Therefore, downtime = 2570/60 = 42.833

$$= 217.7 - 42.833$$

$$= 174.867 \text{ hours}$$

Therefore, the valuable operating time is 174.867 hours.

$$\text{Availability} = \text{valuable operating time} / \text{available operating time}$$

$$= 174.867 / 217.7 = 0.803$$

Availability factor = 80.3%

4.3.4 Performance Factors

Therefore, the main factors Designed cycle time = $40 / 7.5 = 5.33$ ton / hour

Total output = 889.82 ton

$$\text{Performance rate} = [(\text{Design cycle time} * \text{Total Output}) / \text{Operating time}]$$

$$= [(60 / 5.33) * 889.82] / (174.867 * 60) = 0.9547$$

Performance factors = 95.47%

4.3.5 Quality Factors

For calculating the quality factors we need

Total amount of defect = 128.42 ton

Production input, Total batch size = 909.57 ton

$$\text{Quality rate} = (\text{production input} - \text{quality defects}) / (\text{production input})$$

$$= (909.57 - 128.42) / (909.57)$$

$$= 0.8588 \text{ Quality rate} = 85.88 \%$$

The Overall equipment effectiveness

$$\text{OEE} = \text{Availability} * \text{Performance rate} * \text{Quality rate}$$

$$= 0.803 * 0.9547 * 0.8588 = 0.6583$$

Therefore, the Overall equipment effectiveness is 65.83 %

It can be seen from the table 4.3.2 that the performance of the company as overall equipment effectiveness is 65.83%, where the availability of the line was 80.3% of the production time and the performance was 95.47% while the quality factor is 85.88%. And the World Class OEE is 85%.

Table 4.3.2 Comparison between OEE of Ferron Steels and OEE World Class

OEE Factors	OEE of Ferron Steels (%)	OEE World Class (%)
Availability	80.3	90
Quality	85.88	95
Performance	95.47	99
OEE	65.83	85

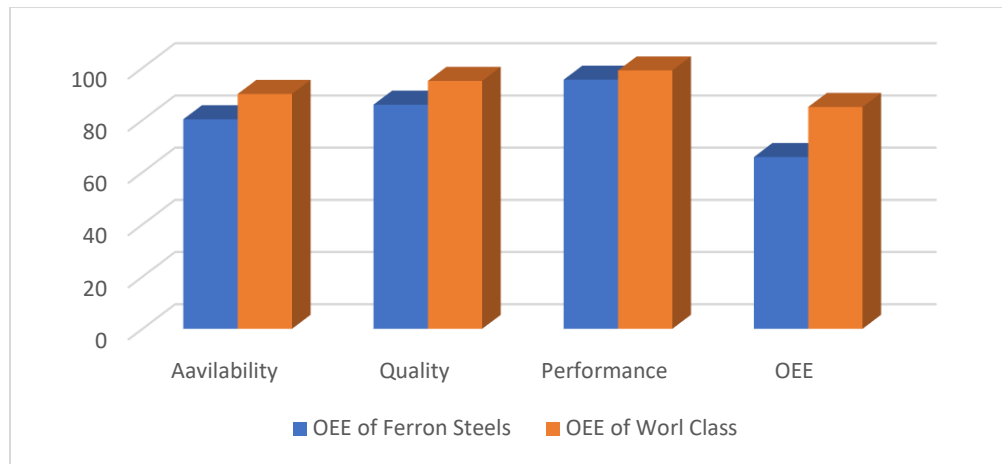


Fig 4.3 Comparison between the OEE of company and the World standard

Interpretation

From the above Table 4.3.2 comparison between Overall Equipment Effectiveness of Ferron Steels and Overall Equipment Effectiveness OF World Class. Thus, the total production time, performance and quality rate is calculated for 10days. And the data is collected from Ferron Steels to calculate the Overall Equipment Effectiveness of the firm. And the Overall Equipment Effectiveness of World Class is also taken from firm. Therefore, the Overall equipment effectiveness is 65.83 %

5. FINDINGS, SUGGESTIONS & CONCLUSION

5.1 FINDINGS

- From the 5S process the wastage of the process, working efficiency, cleaning consistency is calculated which helps in improvement of the quality of the product.
- And the overall efficiency is calculated for five weeks.
- In SWOT Analysis process the percentage of Strength, Weakness, Opportunities and Threats are collected for Ferron Steels.
- Finding the problems during the process is also analyzed.
- Overall Equipment Efficiency is calculated and the performance of the Ferron Steels as overall equipment effectiveness is 65.83%, where the availability of the line was 80.3% of the production time and the performance was 95.47% while the quality factor is 85.88%.

5.2 SUGESSTIONS

The study guides the workers to improve their work by reducing the defective goods through Total Quality Management.

- The OEE process helps to increase the efficiency of the organization with increase in quality and performance.
- 5S will helps the firm to improve the quality of the product and the reduces the wastages of the firm.
- SWOT Analysis helps to find the percentage of Strength, Weakness, Opportunities and Threats of the company.

5.3 CONCLUSION

Thus, the study shows the implementing the Total Quality Management in the firm through 5S, SWOT Analysis and Overall Equipment Effectiveness helps in improving the quality of the product, performance of the process and increase in the production of the firm. The wastages are also reduced by using 5S. The project has done in Ferron Steels for 2months and the data were taken from the firm. The employees were instructed keep workplace in a proper arrangement and clean.

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APPENDIX

A Study on Total Quality Management on Steel Industry

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ABSTRACT

The objective of this study is to implement Total Quality Management in an organization, Innovation can be created from changing small things in our daily routine. Seiri, Seiton, Seiso, Seiketsu, and Shitsuke are the five Japanese words which helps in improving the efficiency of the company. Total Quality Management helps management to improve the quality of the product, improve discipline, reduce waste and increase productivity. Ferron Steels is a steel manufacturing company that follows the quality control which partake significantly to the implementation 5S, Swot Analysis and Brainstorming. This study made the innovation of TQM implementation which refers to 5S that applied on the production floor. Direct observation will take place on the basis of the methodology of this study. Without any record detail activity of 5S that should be done by the workers as a habit in their daily work. The SWOT

analysis is a strategic planning tool which can be used to evaluate the Strengths, Weaknesses, Opportunities and Threats which are involved in an industry. It will be used to identify some areas of action which industry and policy-makers need to take to maintain the steel industry's competitiveness. This study aims to investigate all the possible way to improve the OEE of the company equipment facing theoretical aspects and reality issues. The tools involved in the process are part of the content, ought to support a company for the organizational changes required for improving effectiveness and performance.

Keywords: Total Quality Management, Quality, 5S, SWOT Analysis Overall Equipment Effectiveness, Availability, Performance.

1. INTRODUCTION

In a 'Total Quality Management' (TQM) concept, the word quality which means quality of output of every department and by every employee, cleanliness, orderliness, punctuality, customer service, standardization of works and continuous efforts for their improvement are also part of the TQM. The needs of the customer are monitored to improve the products and processes to meet their requirements [1]. Thus, 5S will be used in the company to reduce the defective products [2]. And the wastage of the company can be reduced from SWOT Analysis to improve the quality of the product [3]. The organization should represent alternate approaches to improving the effectiveness and efficiency of an organization from OEE of the equipment of the company [4]. TQM process, quality improvement projects, and provide cost justification to pessimists [5]. It has easily assembled costs of review, inspection, testing, scrap, and rework, one can convince management and others of the need for quality [6].

1.1 RESEARCH OBJECTIVES

1.1.1 PRIMARY OBJECTIVES

- To study the Total Quality Management in an organization.

1.1.2 SECONDARY OBJECTIVES

- To reduce and control the overall defects of the products.
- To improve the quality of the product.

- To increase the efficiencies by ensuring that the production process of the organization's finished products.

2. REVIEW OF LITERATURE

- **Dean and Bowen (1994)** TQM is a management idea, or a methodology characterized by principles, practices, and techniques. They confirmed that three principles, that most quality frameworks, had following commonality - customer focus, continuous improvement, and teamwork. Each principle is applied through established practices, and these practices, in turn, are reinforced by a wide set of techniques.
- **Ravinder Kumar Panchal (2012)** This study is focused on the implementation of 5S in the steel manufacturing industry. The 5S rules bring the great changes in the company, for example: process improvement by reduce in cost or increasing of effectiveness and efficiency of the process or maintenance and improvement of the equipment efficiency, safety increasing and reduction of the industry pollution and waste.
- **Yuksel and Dagdeviren, (2007)** SWOT analysis aims to develop plans and strategies for individuals or organizations to obtain maximum advantage of existing strengths and opportunities while minimizing the impact of potential threats and weaknesses by considering internal and external factors.
- **Huang et al.(2003)** report that the concept of OEE has been widely used as a quantitative tool essential for the measurement of productivity in manufacturing operations, because of extreme capacity constrained facility investment. They state that traditional metrics for measuring productivity and utilization, are insufficient for identifying the problems and underlying improvements needed to increase productivity.
- **According to Cullen and Hollingum (1987)**, TQM is a zero defects in products leaving the factory and in the services
- **According to Prof. J. Oakland (1993, 1991)**, TQM is a way of managing to improve the effectiveness, flexibility and competitiveness of a business as a whole. It applies just as much to service industries as it does to manufacturing. It involves whole companies getting organized in every department, every activity and every single person at every level.
- **Saghaei (2012)** has been used SWOT analysis and QSPM models. This research aims to methodize an appropriate strategy for a steel manufacturing company. The SWOT identification process was regarding technological innovation, feasibility study regarding

application of current and potential production of company by customers, and the ability of company in production.

- **According to David (1992)**, TQM is the process which seeks to meet and satisfy customer requirements throughout the whole chain of internal and external customers and suppliers.
- **AlMaamar et al. (2017)** studied the role of TQM application in the Oil Unit in Yemen. They also analyzed the impact of TQM practices concerning human resources readiness to change and thereby improved efficiency and overall productivity and performance in the organization.
- **Mahanti and Antony (2009)** concluded that TQM practices are the critical success factor in the Indian software industry. TQM is an essential approach for the betterment of the industry in terms of product quality, service, a satisfaction of the customer and, profitability.

3. RESEARCH METHODOLOGY

Research methodology is a techniques which helps to identify, select, process, and analyze information about the study. In a research paper, the methodology section explains and critically evaluate a study's overall validity and reliability. It helps to understand the study. It will helps to identify how the research has been done.

5S is useful approach for giving valuable foundation for the organization and help to improve communication, lead time, downtime, defect, inventory, injury and costs associated with them. Order, neatness and cleanliness are considered to give a continuous improvement. 5S is able to link total productive maintenance and other approaches also. There is no difference between ISO 9001 guidelines and formalities of 5S. From implementation of 5S, majority of routine problems can be resolved easily.

3.1 RESEARCH DESIGN

The research design used in this study is Total Quality Management and the procedure is use the researcher gather information already available, and analyze these to make an improvement of the performance.

3.2 SAMPLING TECHNIQUE

1. 5S
2. SWOT ANALYSIS
3. OEE

3.2.1 5S

5S stands for Sort, Set in Order, Shine, Standardize, Sustain which is useful approach for giving valuable foundation for the organization and help to improve communication, lead time, downtime, defect, inventory, injury and costs associated with them. Order, neatness and cleanliness are considered to give a continuous improvement.

3.2.2 SWOT ANALYSIS

SWOT analysis stands for Strengths, Weaknesses, Opportunities, and Threats is a framework used to evaluate a company's competitive position and to develop strategic planning and also assesses internal and external factors, as well as current and future potential.

3.2.3 OEE

OEE stands for Overall Equipment Effectiveness which that identifies the percentage of planned production time that is truly productive. An OEE score of 100% is perfect production.

3.3 SOURCE OF DATA COLLECTION

This research consist of both primary data and secondary data.

3.3.1 PRIMARY DATA

The process of collecting data can be long and tedious. In an effort to collect all the necessary, relevant information available at one time, professionals often lose sight of the purpose of the data collection process.

3.3.2 SECONDARY DATA

Data collections of sources are taken from the firm for the study and analysis. The source of the world class, international brands and standard values are taken from the INTERNET.

4 DATA COLLECTION INTERPRETATION

The analysis can be done by various statistical measures. For representation of the data used in Pie Charts and Bar Chart. After data analysis is done, the obtained information is interpreted and inferences are made and also conclusions are drawn related to the objectives.

4.1 5S

4.1.1 SEIRI (SORT)

Availability of material

1 mark will be given if fully available otherwise 0.

Defective finished goods

Consider A items which contains B items as defective then marks will be, $[1-(B/A)]$

Operating condition

If there is a proper flow, then the value 1 is given otherwise 0.

Relative information

Information about process guidelines, working conditions, material information, tool information takes place. 1 mark for full information otherwise 0

Waste elimination

Let total C be number of wastage list, but only D number was removed, then marks will be as follows, $[1-(D/C)]$.

Table 4.1.1 Seiri rating table

Weeks	Average of material	Operating condition	Defective finished goods	Relative information	Waste elimination	Total rating S1
1	1	1	0.15	1	0.15	3.3
2	1	1	0.2	1	0.2	3.4
3	1	1	0.3	1	0.35	3.65
4	1	1	0.45	1	0.4	3.85
5	1	1	0.5	1	0.55	4.05

4.1.2 SEITON (SET IN ORDER)

Sequence rating

Let M number of total tools and N number which aren't in sequence, then the rating will be $[1-(N/M)]$.

Material arrangement

Let X be the lack of material and Y for material required, then rating will be $[1-(X/Y)]$.

Process arrangement

Let G be the number of total processes and H be number of irregular processes, rating $[(1-H/G)]$

Material arrangement consistency

Let U be arrangement of material and V be number that fails to achieve exact position. Then rating would be: $[1-(V/U)]$.

Efficiency of work= total allotted time to process / working time for processing.

Table 4.1.2 Seiton rating table

Weeks	Seque nce rating	Material arrangem ent	Material arrangeme nt consistenc y	Process arrangement	Working efficiency	Total rating S2
1	0.3	0.5	0.5	0.4	0.85	2.55
2	0.3	0.5	0.5	0.4	0.85	2.55
3	0.35	0.5	0.5	0.5	0.85	2.7
4	0.4	0.5	0.5	0.5	0.85	2.75
5	0.5	0.85	0.8	0.6	0.85	3.6

4.1.3 SEISO (SHINE)

Cleaning workplace

Give 1 for cleaned machine and 0 for uncleaned.

Working conditions

Let J be the wrong arrangement and I for the total number of proper conditions, then rating would be $[1-(J/I)]$

Safety

Safety is given on scale means if there is chance rating will be 0 and if they feel safe, rating will be 1.

Cleaning consistency

Let Q be the total no. of time cleaning required and R be number of times the uncleaning, consistency rate will be $[1-(R/Q)]$.

Path for movement of material

Let J be the total number of times hindrance and K be the total no. of movements. Then rating will be: $[1-(K/J)]$.

Table 4.1.3 Seiso rating table

Weeks	Cleaning workplace	Machine Cleanliness	People Working conditions	Safety	Cleaning consistency	Total rating S3
1	1	1	0.4	0.9	0.4	3.7
2	1	1	0.4	0.9	0.4	3.7
3	1	1	0.65	0.9	0.4	3.95
4	1	1	0.65	0.9	0.4	3.95
5	1	1	0.8	0.9	0.6	4.3

4.1.4 SEIKETSU (STANDARDIZE)

By taking average of S1, S2 and S3, because standards of any system will fall & rise by factors of mean rate.

Rating of Seiketsu = (Rating of Seiri + Rating of Seiton + Rating of Seiso)/3

Table 4.1.4 Seiketsu rating table

Weeks	Total S4 = (S1+S2+S3)/3
1	3.1833
2	3.2167
3	3.4333
4	3.5167
5	3.9833

4.1.5 SHITSUKE (SUSTAIN)

Shitsuke rating can be calculated by S1, S2, S3 and S4 because without that regularity will not maintain.

Shitsuke Rating = (Rating of Seiri + Rating of Seiton + Rating of Seiso + Rating of Seiketsu)/4

Table 4.1.5 Shitsuke rating table

Weeks	Total S4 = $\left[\frac{(S1+S2+S3+S4)}{4}\right]*100/5$
1	63.6665
2	64.3333
3	68.6667
4	70.3333
5	79.6667

4.2 SWOT Analysis

Here the calculation can be done percentage wise by analyzing the Strength, Weakness, Opportunities and Threats of the organization. Thus, it helps to improve the strategic planning in order to improving the quality of the product of the organization as well.

4.2.1 Strength

- Cheap
- Good Malleability & ductility properties
- Good Advertisement & publicity
- Customer trust & faith is good
- Good in sales technique & ability to customize
- Flexibility for expansion
- Availability of international market
- Good in share market
- Mechanical strength is good
- Scrap availability and ease of scrap transportation

Table 4.2.1 Percentage wise split up of factor Strength

S.No.	Strength	%
1	7	1.75
2	11	2.75
3	15	3.75
4	9	2.25
5	12	3
6	13	3.25
7	5	1.25
8	12	3
9	9	2.25
10	7	1.75
Total	100	25

4.2.2 Weakness

- Poor network in rural area
- Poor R & D wing
- International shares
- Lab facility
- Preparation is from its scrap
- Failure in furnace

Table 4.2.2 Percentage wise split up of factor Weakness

S.No.	Weakness	%
1	15	1.75
2	11	2.75
3	21	5.25
4	12	3
5	18	4.5
6	23	5.75
Total	100	25

4.2.3 Opportunities

- Good internal market
- High demand in Public sectors
- Expansion facility
- Flexibility in future expansion
- Good distribution network
- Resource Building capacity

Table 4.2.3 Percentage wise split up of factor Opportunities

S.No.	Opportunities	%
1	22	5.5
2	16	4
3	13	3.25
4	16	4
5	18	4.5
6	13	3.25
Total	100	25

4.2.4 Threats

- Global competition
- Availability of raw materials
- Availability of skilled person
- Internal market
- Dumping by competitors.
- Poor lab facility

Table 4.2.4 Percentage wise split up of factor Threats

S.No.	Threats	%
1	19	4.75
2	17	4.25
3	16	4
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6	14	3.5
Total	100	25

4.3 OEE - Overall Equipment Efficiency

Most of the industry losses were identify which are shut down, production adjustment, equipment failure, process failure, normal production loss, abnormal production loss, quality defect and reprocessing. Find the losses in the industry which occurs during the production process like,

1. Miss roll of TMT Bar.
2. Cooling Bed jam.
3. Jamming of material in the furnace.
4. Reduction Gear Box Problem (due to, oil contamination, low oil level, teeth damage).
5. Ejector jam.
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8. Guiding and transportation system.

Table 4.3.1 The Total Downtime and the amount of Scrap, Batch size and production/day

Days	Downtime (Min)	Scrap (Ton)	Batch Size (Ton)	Production/Day (Ton)
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Total	2570	128.42	909.57	889.82

4.3.2 Calculating the Overall Equipment Efficiency

To measure the OEE which will give an indication of where we may find the error or the weakness point. The study was taking during 10 days for the data collection.

As there are 3 shifts/day with 8 working hours per shift There was a stoppage of 30 min for each shift, Therefore for 10days

Available operating time = 10 days * 3 shift/day * 8 hours/shift = 240 hours.

which gives in total 22.30 hours, 240-22.30=217.7 hours.

The target for production of TMT Bar for each day is 120 tons and for each shift is equal to 40 tons

4.3.3 Availability Factor

Total time consumption to produce the batch for 10 days = Available operating time – Downtime

$$\begin{aligned}\text{Therefore, downtime} &= 2570/60 = 42.833 \\ &= 217.7-42.833 \\ &= 174.867 \text{ hours}\end{aligned}$$

Therefore, the valuable operating time is 174.867 hours.

$$\begin{aligned}\text{Availability} &= \text{valuable operating time} / \text{available operating time} \\ &= 174.867 / 217.7 = 0.803\end{aligned}$$

Availability factor = 80.3%

4.3.4 Performance Factors

Therefore, the main factors Designed cycle time = 40/7.5 = 5.33 ton / hour

Total output = 889.82 ton

$$\begin{aligned}\text{Performance rate} &= [(\text{Design cycle time} * \text{Total Output}) / \text{Operating time}] \\ &= [(60 / 5.33) * 889.82] / (174.867 * 60) = 0.9547\end{aligned}$$

Performance factors = 95.47%

4.3.5 Quality Factors

For calculating the quality factors we need

Total amount of defect = 128.42 ton

Production input, Total batch size = 909.57 ton

$$\begin{aligned}\text{Quality rate} &= (\text{production input} - \text{quality defects}) / (\text{production input}) \\ &= (909.57 - 128.42) / (909.57) \\ &= 0.8588 \text{ Quality rate} = 85.88 \%\end{aligned}$$

The Overall equipment effectiveness

OEE= Availability*Performance rate*Quality rate

$$= 0.803 \times 0.9547 \times 0.8588 = 0.6583$$

Therefore, the Overall equipment effectiveness is 65.83 %

It can be seen from table 4.3.2 that the performance of the company as overall equipment effectiveness is 65.83%, where the availability of the line was 80.3% of the production time and the performance was 95.47% while the quality factor is 85.88%. And the World Class OEE is 85%.

Table 4.3.2 Comparison between OEE of Company and OEE World Class

OEE Factors	OEE of Company (%)	OEE World Class (%)
Availability	80.3	90
Quality	85.88	95
Performance	95.47	99
OEE	65.83	85

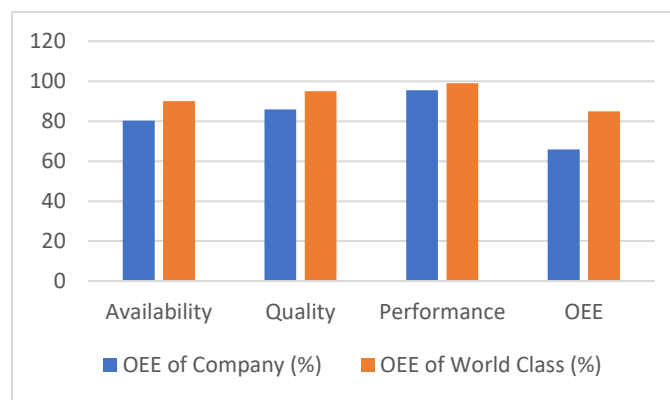


Fig 4.3.2 Comparison between OEE of Company and OEE World Class

5.CONCLUSION

Thus, the study shows the implementing the Total Quality Management in the firm through 5S, SWOT Analysis and Overall Equipment Effectiveness helps in improving the quality of the product, performance of the process and increase in the production of the firm. The wastages are also reduced by using 5S. The project has been done in Ferron Steels for 2 months and the data were taken from the firm. The employees were instructed to keep workplace in a proper arrangement and clean.

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