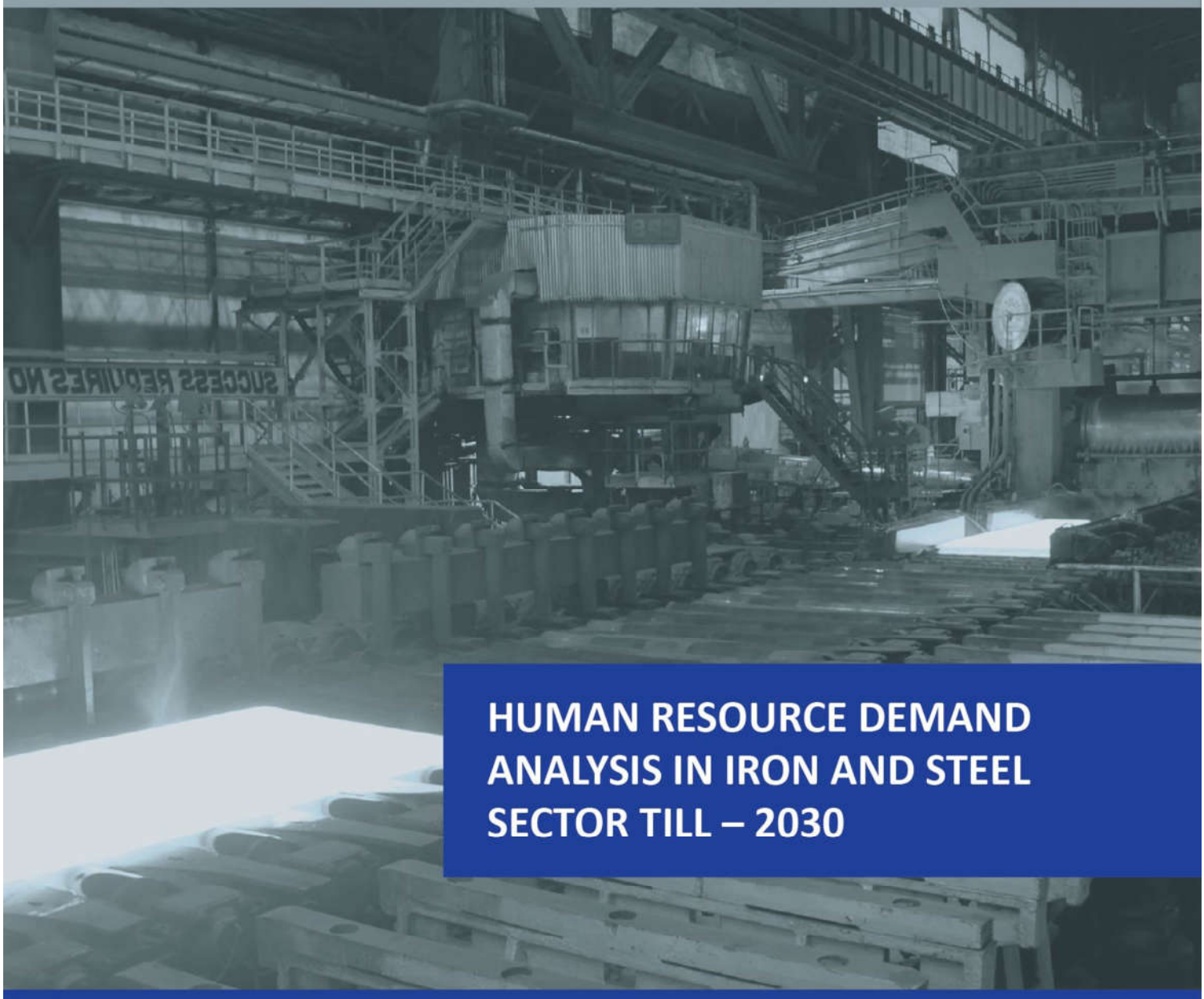
SKILL GAP STUDY CUM LABOUR MARKET SURVEY IN IRON AND STEEL SECTOR



HUMAN RESOURCE DEMAND ANALYSIS IN IRON AND STEEL SECTOR TILL – 2030

National Institute of Secondary Steel Technology (NISST)

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Index:

1.0 Acknowledgement

Industry:

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16. Balaji Steel
17. Shyam Steel Industries Ltd, Durgapur, Odisha

The detailed list is a part of annexure

Industry Associations supported the Study

1. Steel Rolling Mills Association - SRMA
2. The Institute of Indian Foundrymen - IIF
3. All India Steel Re-rollers Association - AISRA
4. Pellets Manufacturers Association of India – PMAI
5. Chhattisgarh Steel Re-rollers Association - CSRA
6. Chhattisgarh Mini Steel Plant Association
7. Chhattisgarh Sponge iron Manufacturers Association
8. Chhattisgarh Steel Chamber
9. Raigarh Ispat Udyog Sangh
10. Department of Steel & Mines, Govt of Odisha
11. Utkal Chamber of Commerce
12. Odisha Sponge Iron Association
13. Giridih Chamber of Commerce
14. Adityapur Small Industries Association
15. Singhbhum Chamber of Commerce
16. West Bengal Sponge Iron Manufacturers Association
17. West Bengal Small Manufacturers Association
18. Bengal Chamber of Commerce and Industry

Educational Institutions:

1. Pradhan Mantri Kaushal Kendras – PMKKs
2. Industrial Training Institutes
3. Technical Colleges – Both Degree and Diploma

2.0 Executive Summary

Indian Iron and Steel Industry

Steel is a product of large and technologically complex industry having strong forward and backward linkages in terms of material flows and income generation. It is also one of the most important products of the modern world and of strategic importance to any industrial nation. From construction, industrial machinery to consumer products, steel finds its way into a wide variety of applications. It is also an industry with diverse technologies based on the nature and extent of raw materials used.

India is currently the second -largest producer of steel after China, leaving behind Japan and the US. Rising domestic demand by sectors such as infrastructure, real estate and automobiles has put the Indian steel industry on the world map. Growth in the private sector is expected to be boosted by new policies on Make in India, import of foreign technology and foreign direct investment (FDI). The Government has mooted a perspective plan to boost domestic steel capacity to 300mt per annum by 2030. In tandem, with a strong economic outlook and plans to expand steel production, it is likely that India may hold this position for years to come.

There are a number of critical success factors, enablers and building blocks that can support competitive growth of the steel industry in India, including the following. The contributions required by different stakeholders are outlined with a few global examples of similar initiatives.

- Government support and regulatory framework
- Infrastructure and logistics
- Raw materials security
- Capital
- Sustainability and environmental reforms
- Trade agreements and barriers — ensuring a level playing field
- Technological innovation
- Supply chain optimization
- War for Talent – Need for Skilled manpower for operations, projects and maintenance
- Hedging through financial derivatives

India's competitive advantage in steel production is driven, to a large extent, from the indigenous availability of high grade iron ore and non-coking coal –the two critical inputs of steel production. In addition, it also has a vast and rapidly growing market for steel, strong MSME sector and a relatively young work force with competitive labour costs.

Government support and regulatory framework

The steel sector has often been supported by favourable regulatory frameworks, not only during initial phases of development but also during times of economic downturn. These benefits range from cheap loans, tax incentives and subsidized land availability to tariff protection measures.

With an intention for strengthening the support to industry, Government has created National Steel Policy 2017 with following objectives:

a. Build a globally competitive industry
b. Increase per Capita Steel Consumption to 160 Kgs by 2030-31
c. To domestically meet entire demand of high-grade automotive steel, electrical steel, special steel and alloys for strategic applications by 2030-31
d. Increase domestic availability of washed coking coal so as to reduce import dependence on coking coal from ~85% to ~65% by 2030-31
e. To have a wider presence globally in value added/ high grade steel
f. Encourage industry to be a world leader in energy efficient steel production in an environmentally sustainable manner
g. Establish domestic industry as a cost-effective and quality steel producer
h. Attain global standards in Industrial Safety and Health
i. To substantially reduce the carbon footprint of the steel industry

The future of sector determined by the related sectors such as automotive, capital goods, infrastructure and shipping industry and inevitable impact created by 3 key trends of:

a. Manufacturing Trends : Exponential technologies are touching each element of the value chain in the iron and steel sector. Industry 4.0 technologies such as autonomous robots, 3D printing, industrial IOT, machine learning and artificial intelligence started to These technologies have dramatically driven industrial productivity. In India, the impact of one specific Industry 4.0 technology that is being felt is industrial IoT. The system is promoting the rise of connected factories wherein the machines can interact with one another, configure themselves and adapt to changes. Industrial IoT along with other technologies are integrating entire automotive value chain bringing significant productivity gains. The impact has been inform of greater automation, displacement of lower skilled human resource and requirement of higher-skilled labor for managing these exponential technologies.

b. Policy Initiatives with NSP 2017 on mission mode:

a. Self-sufficiency in steel production by providing policy support & guidance to private manufacturers, MSME steel producers, CPSEs & encourage adequate capacity additions.
b. Development of globally competitive steel manufacturing capabilities
c. Cost-efficient production and domestic availability of iron ore, coking coal and natural gas
d. Facilitate investment in overseas asset acquisitions of raw materials
e. Enhance domestic steel demand.

c. Changing Market Demand and dynamics: The end product demand is ever changing and in near future is also expected and even promoted that tieup with other sector partners like automotive, capital goods to have a joint plant which shall support the sector with specific needs as per end user or customer.

These trends are expected to give way to changes in the production process, emergence of new business models, newer sales and service delivery models along with reconfiguration of workforce strategies. Further, there is a lot of negative sentiment in the market around the jobs loses because of adoption of Industry 4.0. Towards this it is necessary to remind ourselves that there is a distinction between the potential of Industry 4.0 automation and actual adoption of Industry 4.0. While a significant share of iron and steel production process has the potential to be automated, the actual adoption will depend upon on the interplay of a host of complex factors including the supply of cheap labour in the Indian market, skill level of current and future workforce, policy intervention for automation and associated job losses, labour laws, availability of ancillary infrastructure and societies' perception towards technological innovations etc.

It is believed that there will a net increase in the number of jobs in the sector on account for following reasons:

a) Cost of Automation
b) Existing market conditions
c) Jobs emerging from the enhancement of production capacities
d) Human resource for maintenance

Major concern of the industry is currently focused on the skill shortage and the ability of the current workforce to adapt to the changing industry dynamics. The pace of change in technology and changing consumer demand patterns are leading to potential skill gaps. Our interaction with the industry executives

suggested that apprenticeship can be a robust program in meeting the qualified workforce requirements.

However, a deeper investigation suggested that the current practice of implementing apprenticeship programs in the iron and steel sector is prevalent only among the large integrated steel plants and some of secondary steel units only. Discussion with the employers suggested that as apprenticeship is driven by employer demand the chances of mismatch between skills taught and skills demanded in the work place are less likely to occur than when training is provided in school, Industrial Training Institute (ITI) or polytechnic-based course and other short duration programs offered presently. However, within the aforesaid segments too apprenticeship programs are initiated and managed exclusively by the sectors players and are disassociated with apprenticeship promotions schemes of the government like National Apprenticeship Promotion Scheme (NAPS), National Employment Enhancement Mission (NEEM), Employability Enhancement Training Program (EETP) among others. It is important to expand the scale of apprenticeship training within these segments and provide more workers to enter formal employment routes.

Further, with the nature of manufacturing continuously changing across the automotive value chain, sector players have highlighted their critical focus on re-skilling of the current talent and paving the way forward for their skills upgrade. The sector is seeing a renewed interest in up- skilling and re-skilling of the current workforce across the sector with multiple initiatives aimed at building a learning culture within their workforce.

Our analysis on the supply side of the spectrum of the iron and steel sector suggested that the sector players mainly meet their workforce demand through higher education sector, technical and vocational education segment

An analysis of the other two segments, viz: higher education and Technical training (including vocational) suggested that these segments differ in many ways, particularly in learning approach and student profiles, whereas Technical Training (including vocational) learning is competency based and the higher education is knowledge based. The sector's learning and instruction modes are closely linked to the desired employment outcomes for each sector's graduates. Due to this reason the students coming out of these modes are mainly aspiring for jobs

This makes a compelling case for the policy makers, industry players and the IISSSC to develop skilling capacity for the NEET segment also as it is forming

the major supply base for Capital Goods, Infrastructure, Construction, Rural Sector, Ship building and automotive

Therefore, given the above background there is an immediate requirement to skill/upskill/reskill the workforce for the industry and of the industry with a motto of ***"Better Steel and Better Skill"***

In this report, NISST brings together:

NISST, an Institute under Ministry of Steel, Government of India, having diversified experience in Iron and Steel sector adds its experience in:

1. Primary research through extensive interactions with industry personnel for 4 major steel producing states
2. Secondary research through detailed review of industry reports, news articles and expert opinions.
3. Numerical evidence through rigorous analysis by internal team of experts, to present a comprehensive report on the skill gaps in the Indian Steel Industry
4. NISST is in this field of manpower training for steel industry and development of manpower since 31 years and is fully dedicated to growth and development of this sector.
5. Has been extensively involved in nation-wide survey on Requirement and Availability of technical manpower for steel industry in India under the aegis of IIT Kanpur in 2015 conducted by Ministry of Steel, Government of India

Summary of Recommendations to stakeholders

a. To the Government

1. Support the competitiveness-enhancing initiatives of corporates to spur growth in the sector and employment
2. Support in the workforce capacity building by linking it to the Skill India Mission
3. Promote the Recognition of Prior Learning (RPL) route to create alternative career pathways
4. Support skilling of industry workforce on skilling on Industry 4.0
5. Collaborate with and incentivize industry for skilling on Industry 4.0

b. To the Industry

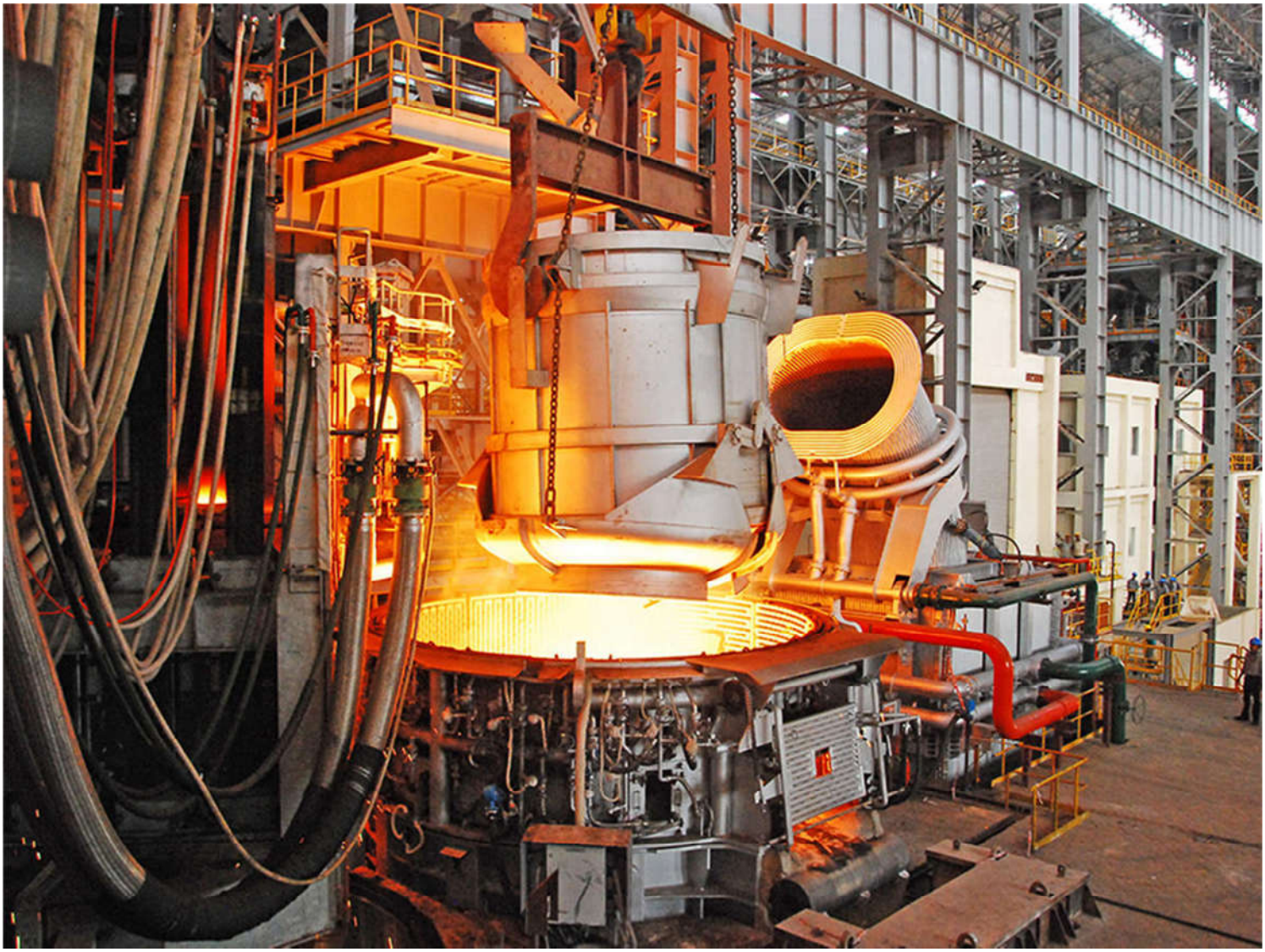
1. Create collaborative learning ecosystems
2. IISSSC, in collaboration with industry players and institutional partners, must forge an integrated framework to meet the imminent future that skill demand encompasses.
3. Develop workforce re-training programs across organization levels
4. Industry needs to contribute towards the goal of creating future ready skilled manpower
5. Work closely with Government to ensure inclusive growth through Skill India Missions
6. Industry—academia collaboration for better demand- supply matching
7. Industry led upgradation of Qualification Packs

Report Structure:

The report is structured in the following manner

Acknowledgements

1. Part I - About the Iron and Steel Sector, India
2. Part II - Manpower Categorization, Demand and supply ecosystem
3. Part III - Recommendations for Industry and Academia
4. Part IV – Annexures,
    a. Approach and Methodology
    b. Questionnaires,
    c. Others



Part – 1 About the Iron and Steel Sector in India

Introduction to Indian Iron and Steel Industry:

In terms of metallic products which are used, iron and steel holds the maximum usage as metal. The products are made from different process according to the usage and industry. The three major classification of production can be termed as:

i. Crude Steel and finished steel – Products received from this process are basically has a very usage starting from Infrastructure, Construction, Automobile, Railways, Defence, Capital Goods etc. The production is continuous production process in Integrated Steel Plants.

ii. Foundry - Metal casting is a modern process with ancient roots. In the metal casting process, metal shapes are formed by pouring molten metal into a mould cavity, where it is cooled and later extracted from the mould. Metal casting is arguably the earliest and most influential industrial process in history. It's used to make many of the metal objects used in our daily lives: automotive parts, train wheels, lamp posts, school bus pedals, and much more. Foundry sector is largely unorganised sector and manpower are recruited on contract basis and educational level of workers is very low as the production processes are still not modernised

iii. Ferro-Alloys - Ferroalloys have been developed to improve the properties of steels and alloy steel by introducing specific alloying elements in desirable quantities in the most feasible technical and economic way. Ferroalloys are namely alloys of one or more alloying elements with iron, employed to add chemical elements into molten steel. Not a single steel grade is produced without ferroalloys. Ferroalloy production is an important part of the manufacturing chain between the mining and steels and alloy steel

1.0 STEEL INDUSTRY SCENARIO

1.1 International Steel Scenario

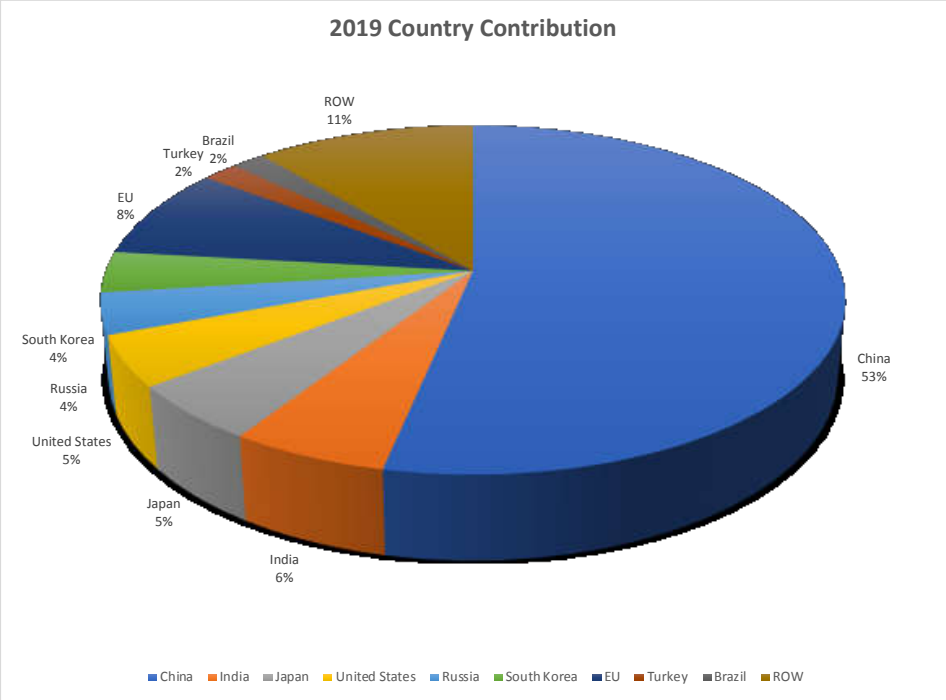
The world has produced more than 1870 million tonnes of steel in year 2019 up by 3.4% compared in 2018. Major contribution to steel production is from China with more than 50% of steel production.

India's crude steel production for 2019 was 111.2 Mt, up by 1.8% on 2018. Japan produced 99.3 Mt in 2019, down 4.8% compared to 2018. South Korea produced 71.4 Mt of crude steel in 2019, a decrease of 1.4% compared to 2018

Top 10 steel-producing countries			
Rank	**Country**	**2019 (Mt)**	**2018 (Mt)**
1	China	996.3	920.0
2	India	111.2	109.3
3	Japan	99.3	104.3
4	United States	87.9	86.6
5	Russia (e)	71.6	72.0
6	South Korea	71.4	72.5
7	Germany (e)	39.7	42.4
8	Turkey	33.7	37.3
9	Brazil	32.2	35.4
10	Iran	31.9	24.5

Source - World Steel Association Yearly reports

In terms of percentage of crude steel production in 2019, contribution of major countries are as follows



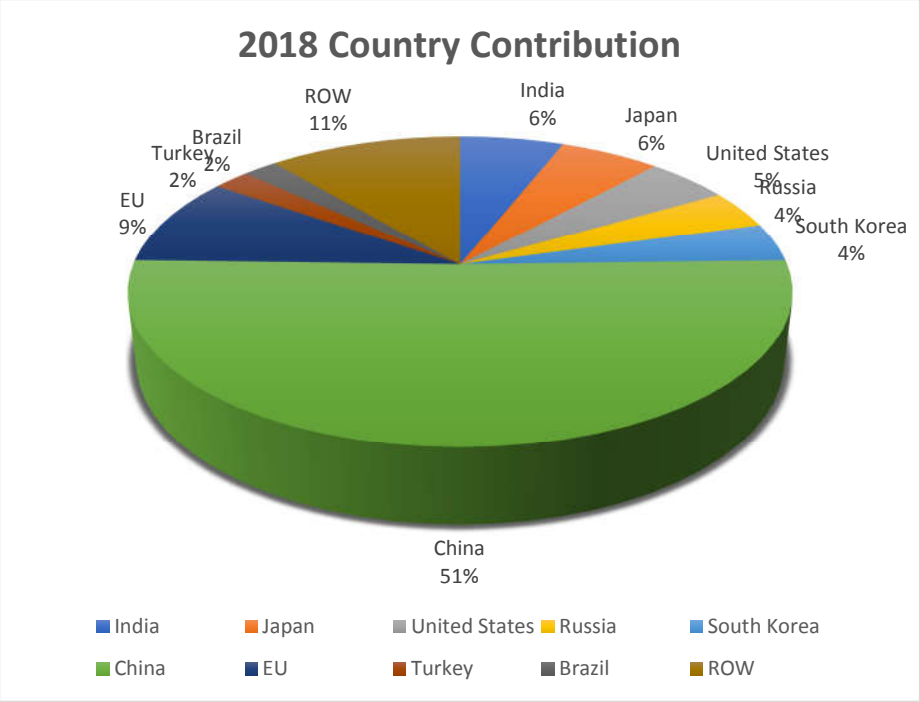


Figure 1 - Source - World Steel Association

1.2 Scenario of Iron and Steel in India

India is currently the world's second largest steel producer with crude steel production capacity of 142.42 MT in the year 2018-19. This is expected to increase further, reaching a figure of about 300 MTPA by the year 2030-31 (As per National Steel Policy 2017)

The Government has taken various steps to boost the sector including the introduction of National Steel Policy 2017 and allowing 100 per cent Foreign Direct Investment (FDI) in the steel sector under the automatic route. Consolidation of NPAs has also initiated and giving a chance for production enhancement and also increase in production capacity in long run. The production and capacity of crude steel in India in 2018-19 by different routes of steel production are represented:… ..

Production Route	No of Units	Working Units	Inst Cap, mT	Working Cap, mT	Prod, mT
BOF	17	17	56.795	56.795	49.455
EAF	54	48	41.69	41.464	28.476
IF	1074	912	48.801	43.977	32.99
Total			147.286	142.236	110.921

Route wise Crude Steel production contribution

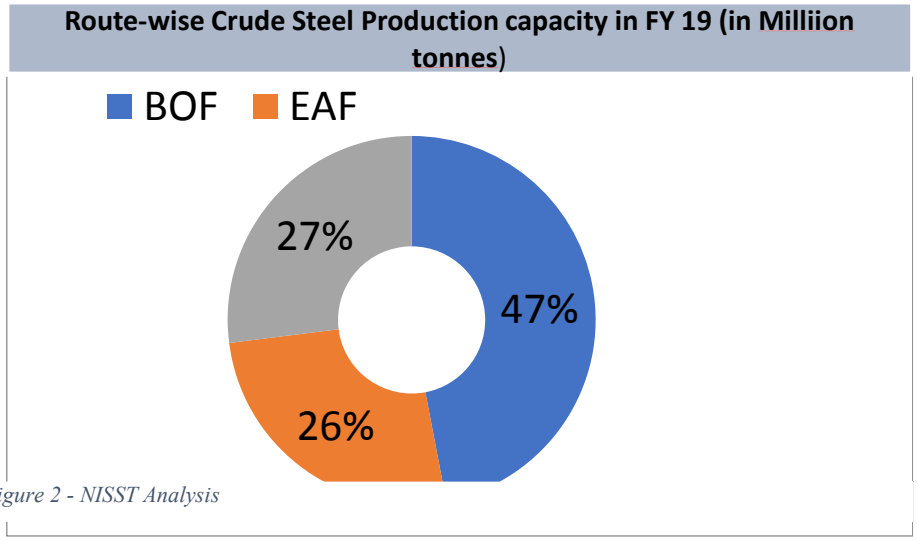


Figure 2 - NISST Analysis

1.3 Steel Industry in India:

The steel industry categorised as:

a. A form of Steel
b. Composition of Steel

c. End Use

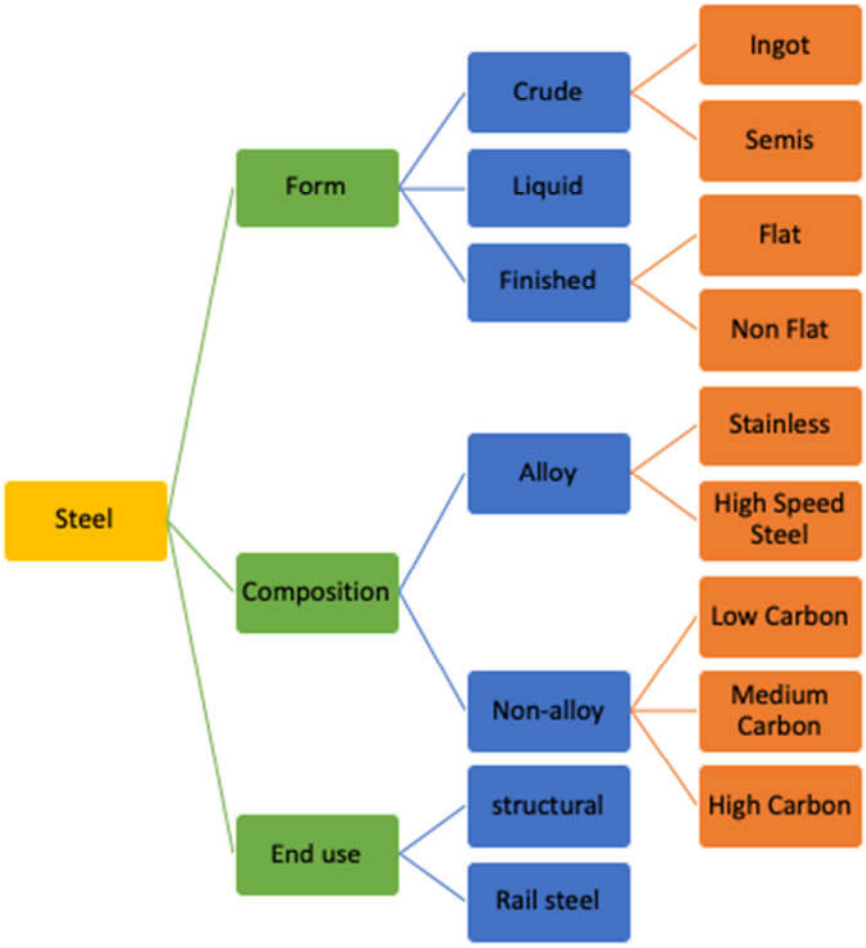


Figure 3 - NISST Analysis

Indian Iron and Steel Sector mainly comprises of Primary Steel Sector (Integrated Steel Plants) and Secondary Steel Sector (EAF, IF Route) with sub sectors such Sponge Iron, Rerolling etc. The sectors and subsectors are:

1. Integrated steel plants
2. Electric Arc Furnace based Plant
3. Induction furnace based plants
4. Sponge iron making units
5. Rerolling mills
6. Foundry
7. Ferro-Alloys

2.0 Steel Making Process Routes:

2.1 Steelmaking Process & Key Components in Steel Industry

Steelmaking is the process of producing steel from iron ore and/or scrap. In steelmaking, impurities such as nitrogen, silicon, phosphorus, sulphur and excess carbon (most important impurity) are removed from the sourced iron, and alloying elements such as manganese, nickel, chromium and vanadium are added to produce different grades of steel. Limiting dissolved gases such as nitrogen and oxygen and entrained impurities (termed as "inclusions") in the steel are also important to ensure the quality of the products cast from the liquid steel

Modern steelmaking processes can be divided into two categories:

a. **Primary steel making route**: Primary steelmaking route involves converting liquid iron from a blast furnace and steel scrap into steel via basic oxygen steelmaking.
b. **Secondary steel making route**: Secondary steelmaking route involves electric arc furnaces and induction furnaces

Steel is manufactured from iron ore in two steps – Iron making and Steel making. Iron making by the Blast furnace route is most common around the world. In India also, most of the iron produced is by Blast furnace route. The Raw materials required by the Blast furnace are Iron ore, Sinter, Pellet, Coke, Pulverised coal and Fluxes.

2.2 Ironmaking Process in Integrated Steel Plants (ISP) in India

An integrated steel mill has all the functions for primary steel production:

- Iron making (conversion of ore to liquid iron),
- Steelmaking (conversion of liquid iron to liquid steel),
- Casting (solidification of the liquid steel),
- Rolling

The present Iron Making process in ISPs are:

Blast Furnace Route : In the Blast Furnaces(BF)liquid iron (popularly termed as 'Hot Metal') is produced by the process of reduction at high temperature from raw materials like iron ore, base mix, sinter, coke, fluxes (limestone / quartzite), etc. &also air blast / O2. In blast furnace solid raw material is being charged from the top and hot air is being blown from Tayers. During the process the impurities are removed in the form of slag and hot metal is produced. Coal is being injected to reduce consumption of main fuel coke as cost reduction measure.

The below image shows the process of iron and steel making through Blast Furnace route. Most of the large Integrated Steel Plants in India do have BF route of iron making

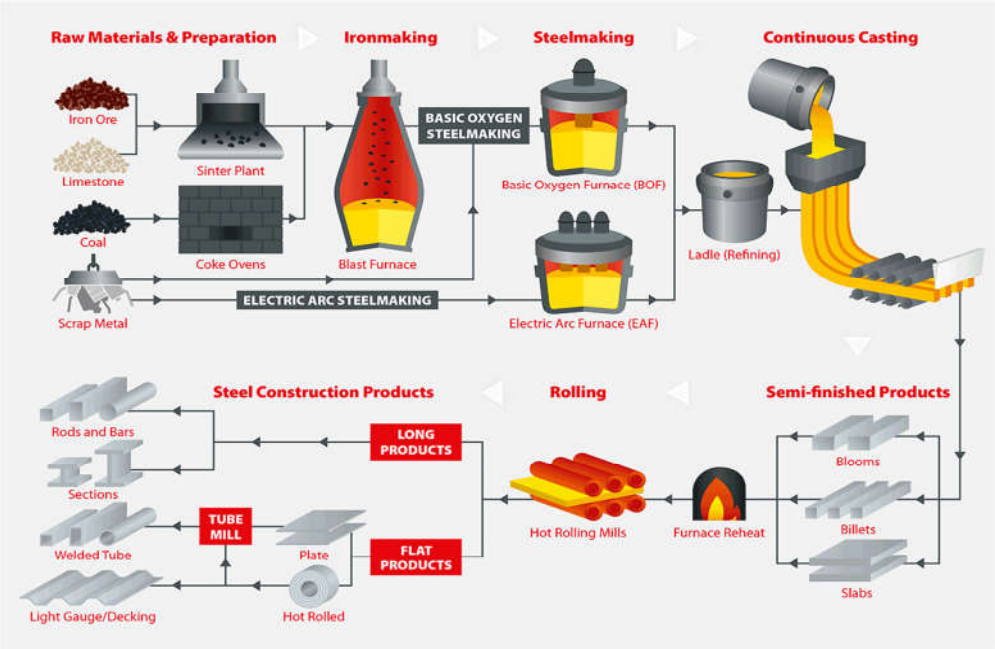


Figure 4 Steel Making through Blast Furnace Route

c. Alternate Method of Iron Making:

Some of the plants have adopted Corex route of Ironmaking. Corex is a smelting-reduction process developed by Voist Alpine India (VAI), for cost-efficient and environmentally friendly production of hot metal from iron ore and low grade coal. The process differs from the conventional blast furnace route in that low grade coal can be directly used for ore reduction and melting work, eliminating the need for coke making units.

All metallurgical work is carried out in two separate process reactors - the reduction shaft and the melter gasifier. Lump ore, pellets or a mixture are charged into a reduction shaft where they are reduced to direct-reduced iron (DRI) by a reduction gas. Discharge screws convey the DRI from the reduction shaft into the melter gasifier where final reduction and melting takes place in addition to all other metallurgical and slag reactions.

2.3 Direct Reduced Iron (Sponge Iron)

Sponge- iron is a metallic product produced through direct reduction of iron ore and iron- ore pellets in the solid state as such it is also known as Direct Reduced Iron (D.R.I.) Hematite iron ore is used for reduction. After reduction of iron ore the product resembles sponge because of pores left behind after removal of oxides. As such it is called sponge iron. Sponge iron is a substitute of scrap in steel melting.

Direct Reduced Iron can be manufactured by two routes:-

a) Gas based,

b) Coal based.

The gas based route is preferred where availability of gas is assured. There are only three Gas based DRI plants in India.
Process flow of gas based DRI plants is shown below:

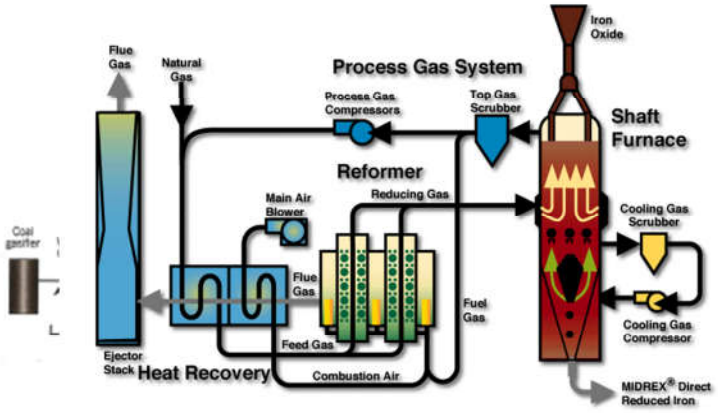
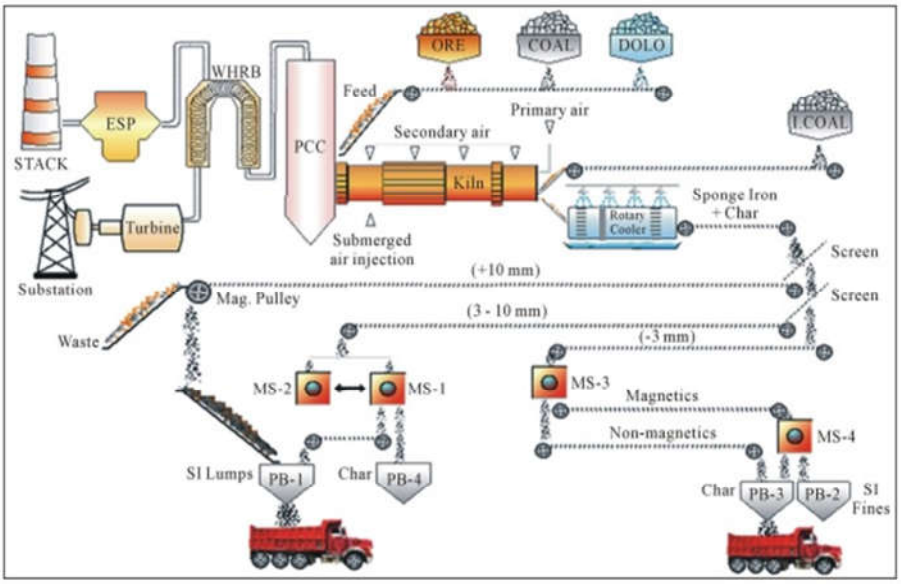


Figure 5 - DRI Process – Gas Based

Gas based DRI, though superior in quality as compared to coal based one, requires huge amount of natural gas, which is already in short supply in India. The Gas based plants in India are facing shortage of natural gas supply. Moreover, Iron ore resources are available in Odisha, Jharkhand, Chhattisgarh and Karnataka. In these states and nearby areas, natural gas supply is not available. Taking the advantage of availability of iron ore and coal, there are more than 300 coal based DRI plants in India well spread in Eastern, Central and Southern part of India.

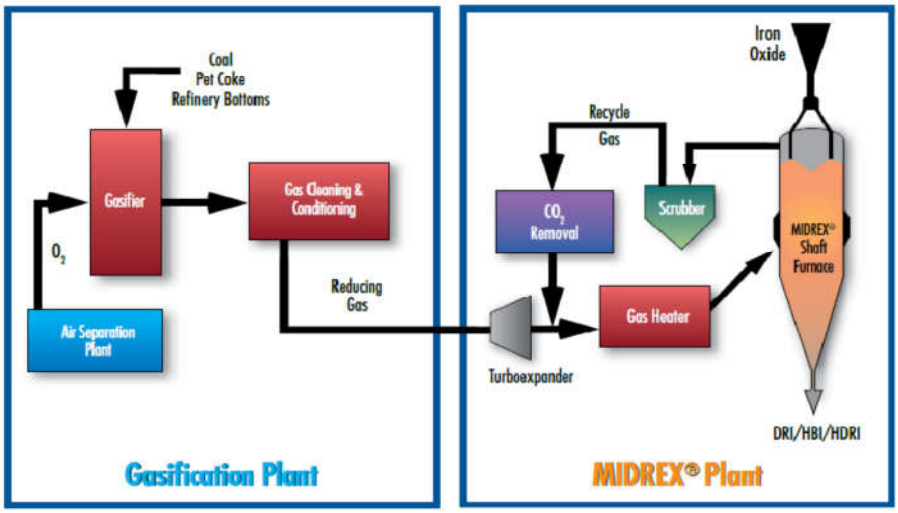
The process flow of coal based DRI plant is shown below:



2.4 Innovative Processes of Sponge Iron Making

Considering the quality advantages of Gas based DRI over coal based but short supply of natural gas, an entirely new innovative process has now emerged. This is producing DRI by Gas based route but using coal without using natural gas. The gas required for producing DRI is generated by coal gasification. The DRI is produced as per the following scheme.

Figure



2.5 Steelmaking in Primary Steel Sector (Large Integrated Steel Plants):

Presently, almost all the world's steel is produced via one of two routes- BOF and EAF. About 65% of total world steel production is by BOF route. This route utilizes about 75 - 90 % of Hot metal from Blast Furnace with balance recycled scrap and / or DRI (Sponge Iron). The steel is produced in this sector by Basic Oxygen Furnace (BOF route). The process flow of BOF steelmaking is depicted below:

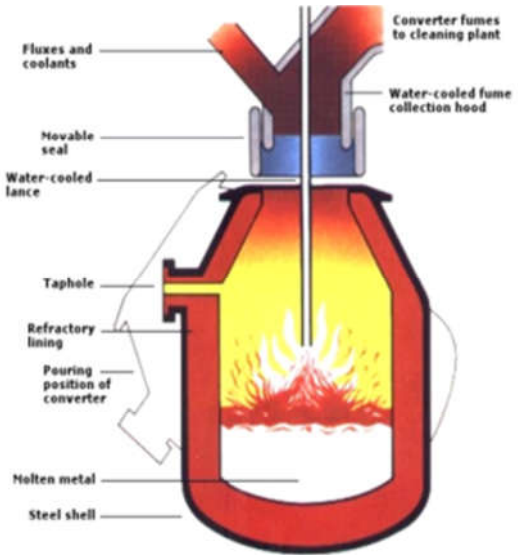


Figure 7 - BOF Process for Steel Making

2.6 Steelmaking In Secondary Steel Sector:

Steel making in secondary steel sector is either by EAF route or by EIF route. EAF and EIF uses steel scrap and DRI as raw materials for production of steel. Some of EAF Plants uses hot metal as metallic input as well

About 35 % of the world steel is produced by EAF route. This route of steelmaking has flexibility of using raw material like- recycled scrap and sponge iron in any proportion. For the last 20 years, use of hot metal in EAF has gained importance.

Electric Arc Furnace (EAF) is a steel making furnace, in which steel scrap is heated and melted by heat of electric arcs striking between the furnace electrodes and the metal.

The main advantage of the Electric Arc Furnaces over the Basic Oxygen Furnaces (BOF) is their capability to treat charges containing up to 100% of scrap. About 35% of the crude steel in the world is made in the Electric Arc Furnaces (EAF).

2.8 Steel making by Induction Furnace:

In India, steel making by IF route is quite prevalent due to some inherent advantages and contributes more than 25% of the total steel production. Since the production capacity of one Induction Furnace is quite low as

compared to other routes as BOF and EAF, manpower requirement is also more comparatively.

In Induction Furnace, raw material used is steel scrap, Sponge Iron, Pig Iron and some other metallic charges like cast iron. Steel is produced by melting of the solid charge by electric power.

The Induction Furnace steel making process is depicted below:

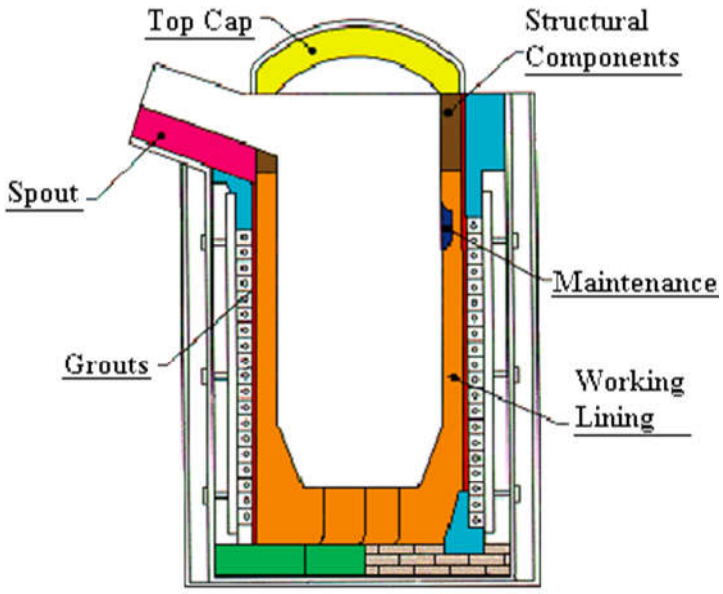


Figure 8 - Induction Furnace

2.9 Casting Of Steel:

The liquid steel is cast on continuous casting machines. Very few plants in India still cast the steel in Ingot moulds and hence called Ingot casting. However, most of the Ingot casting has been replaced by Continuous casting practice.

2.10 Rolling Of Steel:

The continuous cast products as Billets, Blooms, Slabs, Thin slabs, Beam blanks are rolled to finish products as Bars, Rods, Wire rods, Angles, Channels, Rails, Beams, Rounds, Plates, HR Coils, CR Coils and other products. There are different types of Rolling mills like Bar Mill, Wire rod mill, Plate Mill, Structural Mill, Rail Mill, Hot strip Mill, Cold Rolling Mill etc. The continuous cast products as Billets, Blooms, Slabs, Thin slabs, Beam blanks are first heated in Reheating furnaces and then rolled for specific section in a particular rolling mill.

3.0 Foundry (Metal Casting) Process

Metal casting is a modern process with ancient roots. In the metal casting process, metal shapes are formed by pouring molten metal into a mould cavity, where it is cooled and later extracted from the mould. Metal casting is arguably the earliest and most influential industrial process in history. It's used to make many of the metal objects used in our daily lives: automotive parts, train wheels, lamp posts, school bus pedals, and much more.

Steps involved in Metal Casting Process :

1. **Patternmaking** – A pattern is a replica of the exterior of the casting. Patterns are typically made of wood, metal, plastic, or plaster. Patternmaking is incredibly important for industrial part-making, where precise calculations are needed to make pieces fit and work together.

2. **Core making –** If a casting is hollow, an additional piece of sand or metal (called a core) shapes the internal form to make it hollow. Cores are typically strong yet collapsible so they can be easily removed from the finished casting.

3. **Moulding –** To visualize the metal casting process so far, imagine yourself walking on the beach toward the ocean. Look at a footprint you leave behind in the wet sand. Your foot would be the core, and the impression left in the sand is a mould of your foot. Moulding is a multistep process that will form a cast around the pattern using moulding sand. In casting, a mould is contained in a frame called a flask. Green sand, or moulding sand, is packed into the flask around the pattern. This is known as metal sand casting. Once the sand is packed tight, the pattern can be removed, and the cast will remain. Alternatively, a two-piece, non-destructible metal mould can be created so that the mould can be used repeatedly to cast identical parts for industrial applications.

4. **Melting and Pouring Molten Metal –** After metal is melted, it is poured into the cavity of the mould and left to solidify. Once solidified, the shakeout process begins: the moulds undergo vibration to remove sand from the casting. In industrial applications, equipment are available to keep production output high because of their efficient and smooth performance. Removed sand is typically collected, cooled, and reclaimed to be used once more in future castings. The Sand Casting Conditioner improves this process of sand separation from castings by removing and cooling sand and castings and evaporating moisture, while alleviating the casting damage that

is common during this point of the process. The end results are a clean cast and sand ready for the reclamation process.

5. **Cleaning –** In this final step, the cast metal object is removed from the mould and then fettled. During the fettling, the object is cleaned of any moulding material, and rough edges are removed.

Process flow in metal casting process is depicted below:

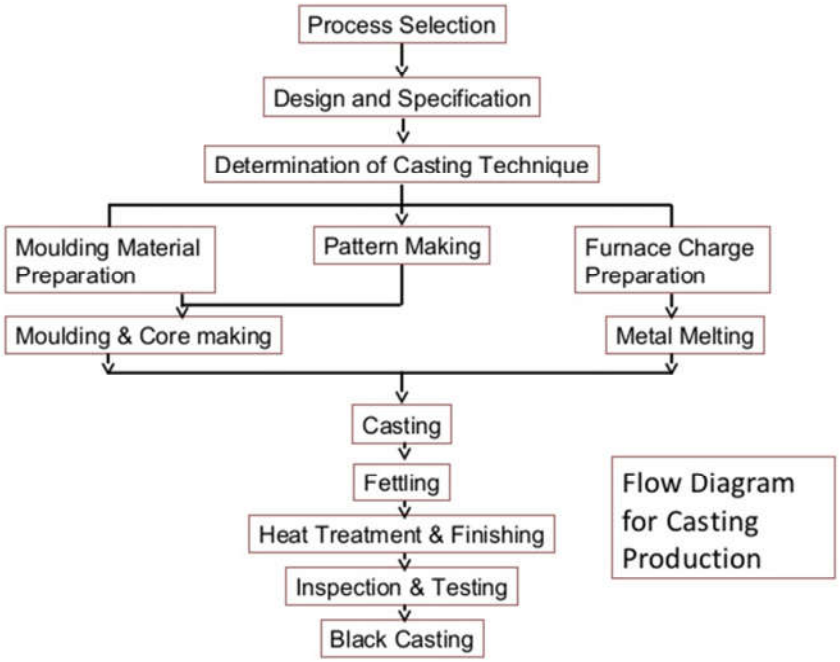


Figure 9 Metal Casting Process

4.0 Ferro Alloys:

Ferroalloys have been developed to improve the properties of steels and alloy steels by introducing specific alloying elements in desirable quantities in the most feasible technical and economic way. Ferroalloys are namely alloys of one or more alloying elements with iron, employed to add chemical elements into molten metal. Not a single steel grade is produced without ferroalloys. Ferroalloys production is an important part of the manufacturing chain between the mining and steel and alloys. Main task of the ferroalloys industry is the primary recovery (reduction) of needed metals from natural minerals. As ores also include non-metallic minerals (gangue),

they have to be dressed (beneficiated, enriched) by one or several successive methods (gravitational, magnetic, electric, and flotation separation, or in some cases by chemical means) to produce useful mineral concentrates in which the leading content of the metal is much higher in comparison with the original ore. This allows the production of higher-grade ferroalloys with a higher content of leading elements and a lower content of impurity elements (usually phosphorus, sulfur, and nonferrous metals), and it significantly reduces specific energy consumption and production costs.

Ferro-alloys are usually classified in two groups: bulk (major) ferroalloys (produced in large quantities) and minor ferroalloys (produced in smaller quantities, but of a high importance). Bulk ferroalloys are used in steelmaking and steel or iron foundries exclusively, whereas the use of special ferroalloys is far more varied. About 85% to 90% of all ferroalloys are used in steelmaking; the remaining ferroalloys are used for nonferrous alloys and by the chemicals industry.

Production of Ferro Alloys:

Continuous and Batch Processes

Ferroalloy processes are divided into continuous and periodic. Continuous processes are characterized by continuous loading of the charge and periodic (or continuous) slag and ferroalloy tapping. The charge is in the furnace at a certain level throughout the process. The electrodes are immersed in a charge continuously. The furnaces used for these processes usually have high power (>9 MVA) and the reducing agents are carbon materials (coke, char, charcoal, anthracite coal).

Batch processes use a certain amount of charge material for the same heat. The charge loaded into the furnace is completely melt, leading to the reduction of the elements. The products are released periodically (metal and slag tapping), most often at the same time.

Submerged Electric Arc Process :

In most cases, the submerged electric arc furnace produces the desired product directly. It may produce an intermediate product that is subsequently used in additional processing methods. The submerged arc process is a reduction smelting operation. Raw materials are crushed, sized, and, in some cases, dried, and then conveyed to a mix house for weighing and blending. Conveyors, buckets, skip hoists, or cars transport the processed material to hoppers above the furnace. At high temperatures in the reaction zone, the carbon source reacts with metal oxides to form carbon monoxide and to reduce the ores to base metal.

Submerged Arc Furnace for manufacturing of Ferro Alloys is shown below:

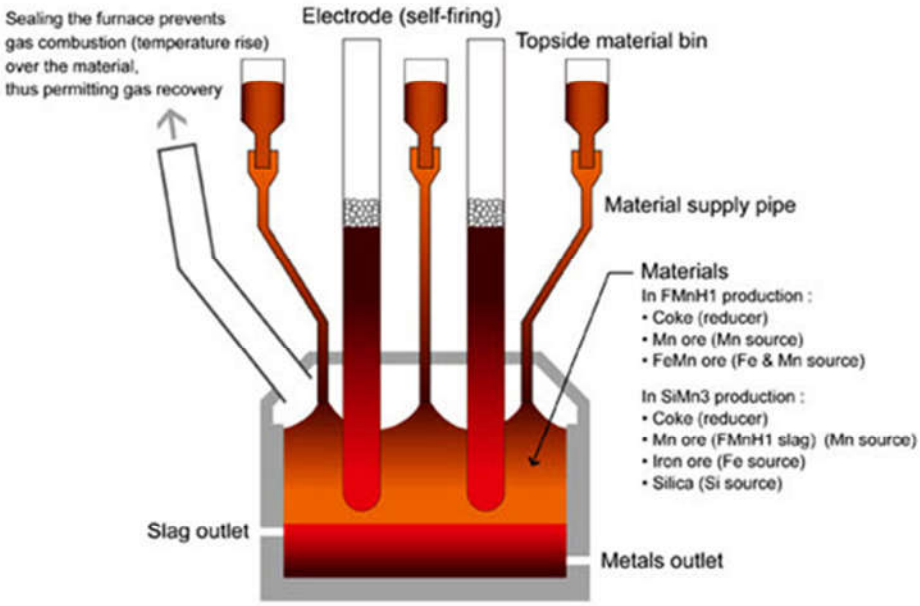


Figure 10 - Ferro Alloys through Submerged Arc Furnace

5.0 GOVERNMENT POLICY SUPPORT FOR STEEL SECTOR IN INDIA

The Government has launched the National Steel Policy 2017 that aims to increase the per capita steel consumption to 160 kgs by 2030-31. The government has also promoted Policy which provides a minimum value addition of 15 per cent in notified steel products which are covered under preferential procurement.

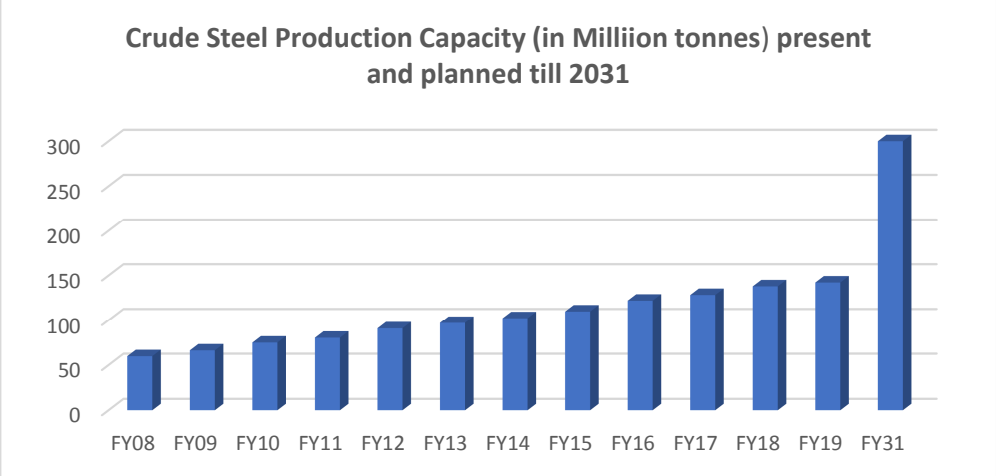
Policy Support:

National Steel Policy 2017	▪ New National Steel Policy has been formulated by the Ministry of Steel in 2016, which will retain the objectives included in National Steel Policy (NSP) 2005. It aims at covering broader aspects of steel sector across the country including environment and facilitation of new steel projects, growth of steel demand in India and raw materials ▪ Under the policy, the central government stated that all the government tenders will give preference to domestically manufactured steel and iron products. Moreover, Indian steel makers importing intermediate products or raw materials can claim benefits of domestic procurement provision by adding minimum of 15 per cent value to the product. ▪ The National steel policy, 2017 aspires to achieve 300MT of steel making capacity by 2030-31. This would translate into additional investments of Rs 10 lakh crore (US$ 156.08 billion). ▪ Further, it aims to increase in per capita steel consumption to 160 kgs by 2030-31.
R&D and innovation	▪ 'The scheme for the promotion of R&D in the iron and steel sector' has been continued under the 14th Finance Commission (2019-20). Under the scheme, 26 projects have been approved with financial assistance of Rs 161 crore (US$ 24.98 million) from Ministry of Steel. ▪ The Ministry of Steel is also actively participating in the Impacting Research Innovation & Technology (IMPRINT) & Uchchatar Avishkar Yojana (UAY) Schemes launched by Ministry of Human Resource Development. IMPRINT scheme aims to solve major engineering and technology challenges and UAY is promoting industry sponsored, outcome-oriented research projects. ▪ Ministry of Steel is setting up an industry driven institutional mechanism - Steel Research & Technology Mission of India (SRTMI) – with an initial corpus of US$ 30.89 million. The institute will facilitate joint collaborative research projects in the sector.

Rise in export duty	▪ The government hiked the export duty on iron ore to 30 per cent ad valorem on all varieties of iron ore (except pellets)
Reduction in custom duty on plants and equipment	▪ The government has reduced the basic custom duty on the plants and equipment required for initial set up or expansion of iron ore pellets plants and iron ore beneficiation plants from 7.5/5 per cent to 2.5 per cent ▪ Customs duty on imported flat-rolled stainless steel products has been increased to 10 per cent from 7.5 per cent ▪ Basic customs duty on steel grade dolomite and steel grade limestone is being reduced from 5 per cent to 2.5 per cent. Basic customs duty is being reduced from 10 per cent to 5 per cent on forged steel rings used in the manufacture of bearings of wind-operated electricity generators
Push due to Make in India initiative	▪ Going forward, the Make in India initiative and policy decisions taken under it are expected to augment the country's steel production capacity and resolve issues related to the mining industry
Foreign Direct Investment	▪ 100 per cent FDI through the automatic route is allowed in the Indian steel sector

Figure 11 - Source Ministry of Steel

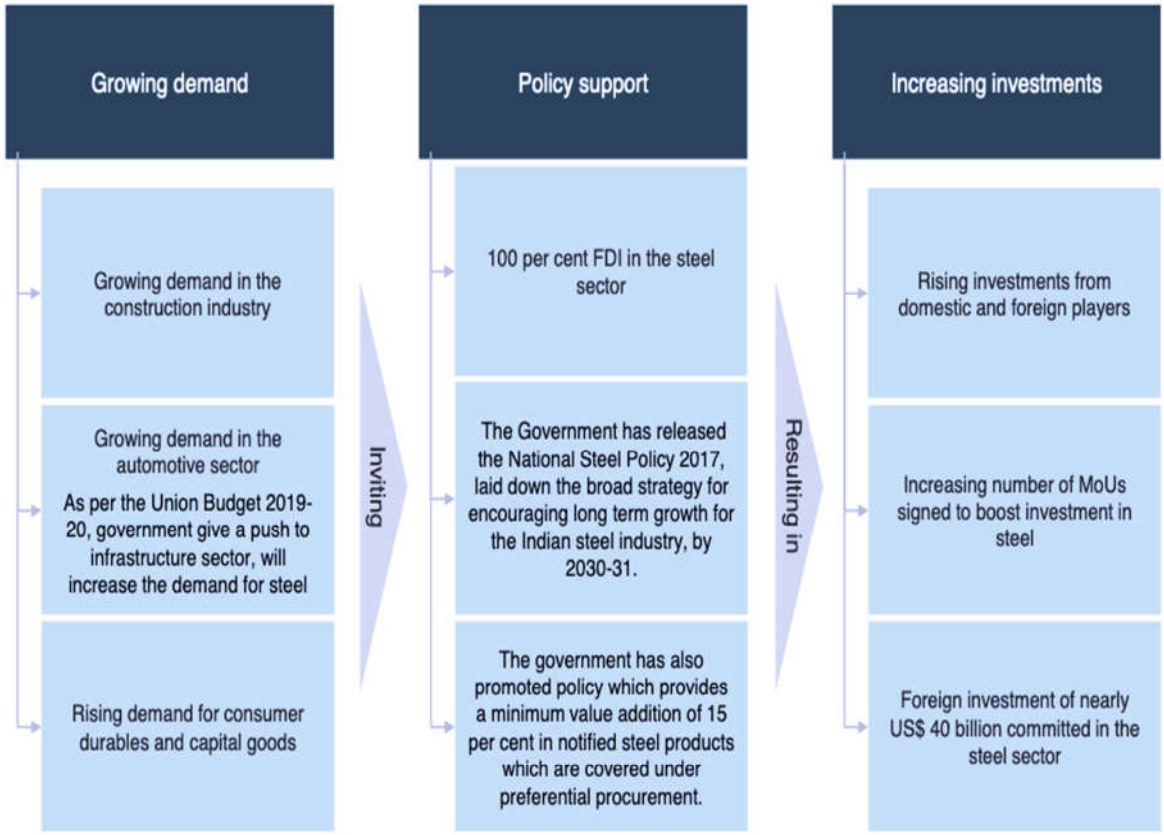
Steel Production Capacity – From 2008 to till date



The iron and steel industry is also witnessing technological developments and challenges. One such challenge is to reduce specific energy consumption by about 35% by 2030 based on 2005 levels. This is a herculean task and lot of innovative energy saving technologies would be required to be implemented,

requiring new set of skilled manpower. This necessitates setting up of new energy and emission efficient steel plants, capacity enhancement of existing mills and adoption of new technology and removal of obsolescent technologies from existing plants and so on.

Strong Demand And Policy Support Driving Investments



Opportunities for growth for Iron and Steel Sector:

Automotive

- The automotive industry is forecasted to grow in size to US$ 260-300 billion by 2026
- The industry accounts for around 10 per cent of demand of steel in India.
- With increasing capacity addition in the automotive industry, demand for steel from the sector is expected to be robust

Capital goods

- The capital goods sector accounts for 11 per cent of steel consumption and expected to increase 14/15 per cent by 2025-26 and has the potential to increase in tonnage and market share
- Corporate India's capex is expected to grow and generate greater demand for steel

Infrastructure

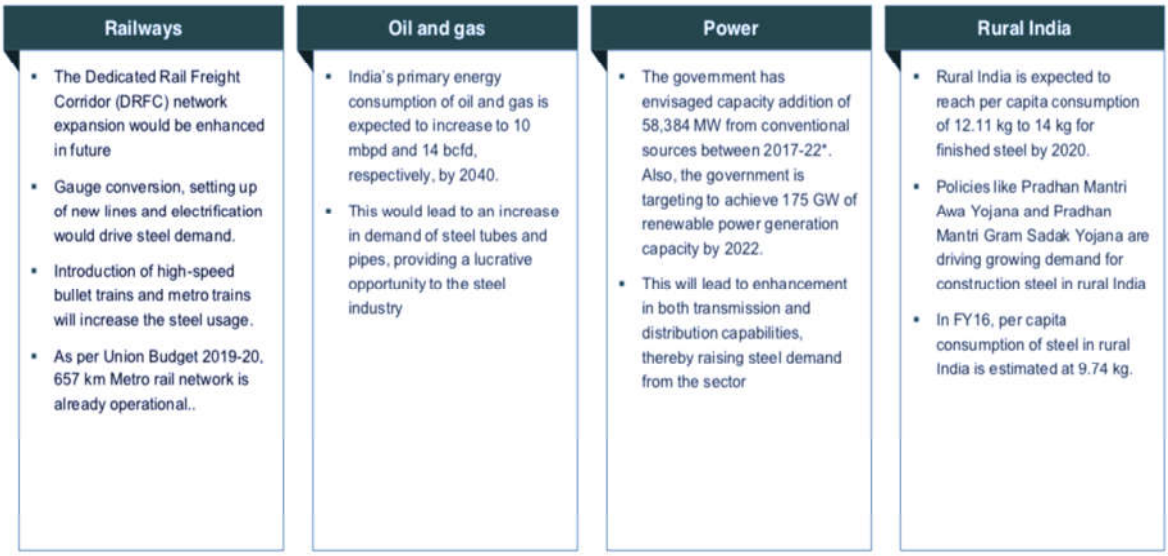
- The infrastructure sector accounts for 9 per cent of steel consumption and expected to increase 11 per cent by 2025-26.
- Due to rising investments in infrastructure the demand for long steel products would increase in the years ahead
- Seventy per cent of the country's infrastructure estimated at Rs 6 lakh crore (US$ 89.50 billion) is yet to come up. Thus, a significant growth potential for steel sector is present.*
- For various infrastructure sectors, including real estate and power, Ministry of Finance planning to set up a stress fund.

Airports

- More and more modern and private airports are expected to be set up
- In FY19, passenger traffic at Indian airports stood at 344.69 million
- The number of operational airports stood at 110 as on 31 March 2018.
- Development of Tier-II city airports would sustain consumption growth
- Estimated steel consumption in airport building is likely to grow more than 20 per cent over next few years

Major Steel Producing States In India

The major location of steel clusters in the country are on the basis of various raw materials and resources. This industry needs efficient raw material base with enough supportive infrastructures. India today enjoys a leading position due to its raw material base but unless other related sectors show an equally and much needed growth; this



advantage will slowly turn down of the steel sector growth.

Major input resources to be considered are:

1. Iron ore and other mineral needed in iron making
2. Coking Coal
3. Power
4. Labour
5. Infrastructure

Iron Ore:
India has got an initial advantage of having huge resources of iron ore the main raw material required in the production of steel. The estimates for long term predict the resources to last for 20 to 40 years as per different estimates. Also the production is more in from of fine than in lumps while the technology used in our country uses lumps, thereby creating a mismatch. The exports consequently are more in form of fines.

Coking coal:

The quality of coking coal input in the steel industry is quite poor for our domestic production and we have very less reserve of good quality of coal

We have major dependence issues on imported coal. The suppliers have a strong bargaining advantage; hence industry end up paying higher prices. High import volumes need good ports, rail and road infrastructure which need to be developed.

Power:
Electric steel making is curbed due to very high rates of electricity in this country; but things look better with a huge number of power projects underway currently Also technology that use the power efficiently need to be developed for lower input costs

Labour:
A source of major competitive advantage when it comes to cheap labour availability lies in favour of India. The productivity of older plants has been a major problem due to high number of workers being employed in peripheral activities. But these are being resolved through schemes like voluntary retirement. Further training and development are need to reduce the low productivity. Though most of the newer plants have overcome these problems, our nation is yet to come up with own solution.

Infrastructure:
The infrastructure is grossly short of what is needed by the steel industry. The costs of transportation are humongous and hit at both the ends; carrying in input and carting out outputs. Ports need to be further developed and the turnaround time must be decreased .

Hence, from above it is quite evident that the above factors play a very crucial role in setting of steel manufacturing industries and mostly located in the vicinity of mineral belt. Added to that in India coal and iron ore mines are located nearby only hence it makes a scientific approach for having steel plants.

The large steel plants are located to near to these locations while there may be cases that small and medium plants may exist where rail infrastructure is available apart from these locations as well such as Uttar Pradesh, Punjab, Gujarat etc.

Below mentioned map shows the location of main industrial areas for steel manufacturing according to terms of production:

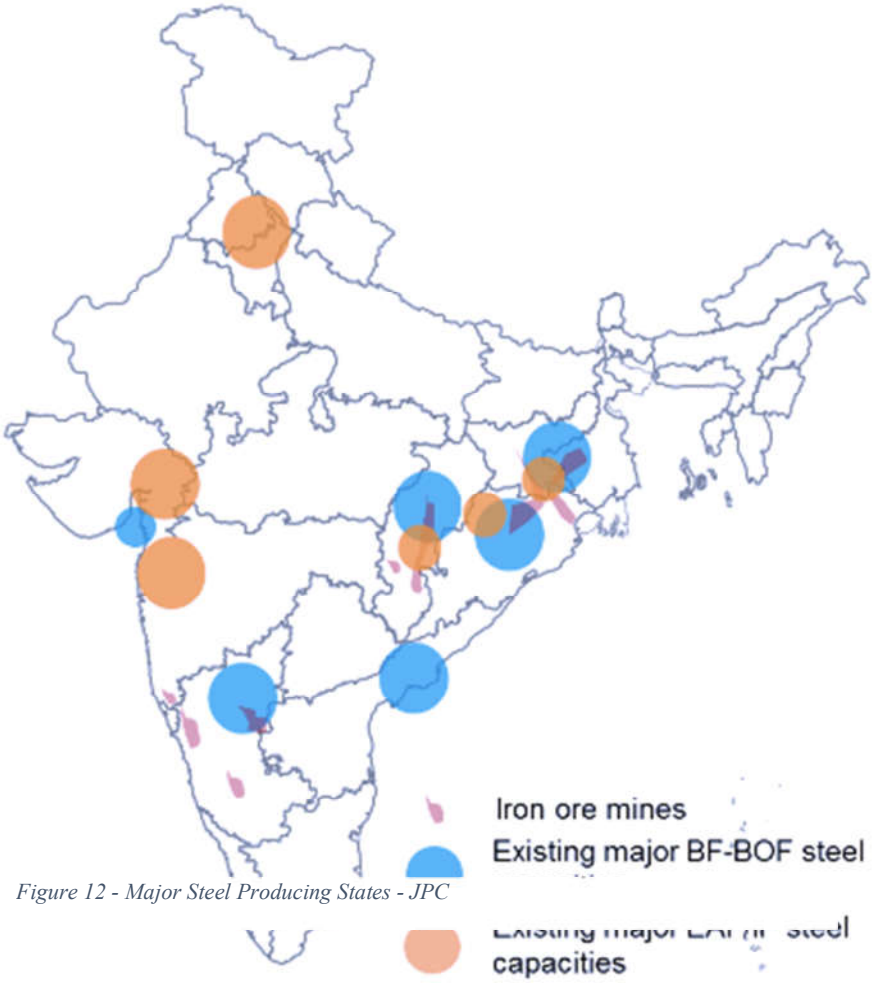


Figure 12 - Major Steel Producing States - JPC

From the above map it can be easily made out that the major steel processing and producing states in the country are:

a) Odisha
b) Chhattisgarh
c) Jharkhand
d) West Bengal

The mentioned 4 states contribute to more than half of steel production in the country and the other major locations are Karnataka specifically Bellary and Gujarat Hazira, and some locations in Western Maharashtra such as Dolvi. Apart

from these there are location in Punjab, Western UP largely confined to foundry and other allied metal processing such as scrap and small rolling mills The manufacturing capacities and production in the year 2018-19 of identified 4 states are:

Steel Production Capacity - Odisha						
	No of Units	**Number Working units**	**Inst Cap, mT**	**Working Cap, mT**	**Prod., mT**	**Instal Cap. Planned by 2030, MT**
BOF	4	4	11.4			58.10
EAF	9	8	11.394			
IF	61	51	4.493			
Total	74	63	27.287	26.42	19.30	
Steel Production Capacity - Chhattisgarh						
	No of Units	Number of Working units	Inst Cap, mT	Working Cap, mT	Prod., mT	**Instal Cap. Planned by 2030, MT**
BOF	1	1	5.5			39.60
EAF	6	5	6.327			
IF	84	70	6.774			
Total	91	76	18.601	18.064	13.164	
Steel Production Capacity - Jharkhand						
	No of Units	**Number of Working units**	**Inst Cap, mT**	**Working Cap, mT**	**Prod., mT**	**Instal Cap. Planned by 2030, MT**
BOF	3	3	16.477			41.70
EAF	3	2	1.024			
IF	74	60	2.086			
Total	80	65	19.587	19.415	17.238	
Steel Production Capacity - West Bengal						
	No of Units	**Number of Working units**	**Inst Cap, mT**	**Working Cap, mT**	**Prod., mT**	**Instal Cap. Planned by 2030, MT**
BOF	2	2	4.7			24.29
EAF	8	8	1.014			
IF	69	41	5.696			
Total	79	51	11.41	10.82	7.471	

*The installed capacity of these 4 states is 77 MT approximately half of total,installed capacity and the expected increment in installed capacity the total installed capacity by 2030 to be 163.00 MT if the industry grows at a rate of 6.5% as per National Steel Policy 2017. Same has been taken as bench mark for across the country while extrapolating the data

SWOT Analysis of Present Indian Steel Industry:

STRENGTHS

1. Abundant raw material like Iron ore, limestone and Coal
2. Availability of huge man power
3. Low Labour wages
4. Developed production base .

WEAKNESSES

1. Poor mining technology Dependence on other countries for coking coal
2. Low R&D investment Inadequate Infrastructure in the country
3. High cost of capital
4. Labour productivity in India is still very low.

OPPORTUNITIES

1. Huge and growing domestic demand
2. Consolidation of small players into a big producer
3. Exports
4. Unexplored Rural market which provides a huge platform for production as well as consumption.

THREATS

1. Demand Volatility
2. Threats of substitute (Plastic, Aluminium etc.)
3. Technological changes
4. Price war
5. Tough competition from China
6. Protection policies in Western countries

Part – 2 – Manpower Categorisation, Demand and Supply

Approach & Methodology

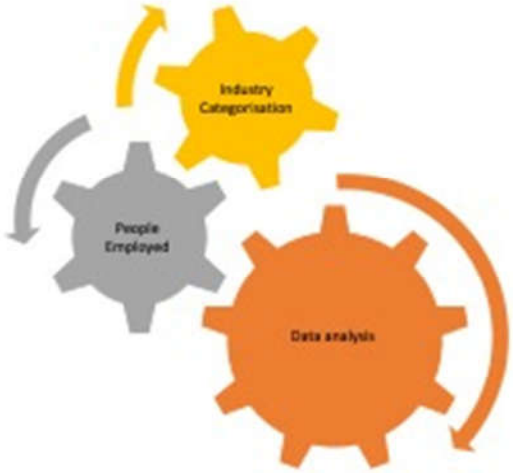
National Institute of Secondary Steel Technology (NISST) was set up as a registered society on 18th August, 1987 under the Chairmanship of the then Development Commissioner of Iron & Steel under Ministry of Steel. NISST brings to the table extensive experience gathered across industry segments and has been in the forefront of new technology and steel business evolution in India.

The approach to the study:

1. **Industry Categorisation** - Efforts were made to study the structure of the industry - including information on the universe of companies present and its categorization into steel making routes. The manpower employed in each of the process route would differ from one another

2. **People Employed** – Technical job roles - Norms for the number of people employed in the industry were established by linking it to high-level metrics such as manpower needed in per Million Tonne steel production under various steel making routes

3. The established norms were superimposed on the data for universe of companies in the segment to arrive at a realistic estimate for the number of people employed in the respective segment. The consideration of National Steel Policy (Ministry of Steel) and JPC data is also taken into account for arriving the estimated numbers



Principle of Estimation

NISST adopted a strategic "Norms"- driven approach for the estimation of the employment figures in each of the segments. Norms helped link the required data point i.e. the number of employees with high-level statistics in production which could be used to extrapolate and generate estimate for the entire segment or sub-segment. The norms were based on analysis carried out on the data collected from a wide variety of sources – representatives of companies active in the segment, industry experts and targeted research reports.

Data sources used for this study

- National Steel Policy 2017
- JPC, Reports
- Industry Feedback and outcomes of Focus Group Studies

Approach to current job estimation

NISST approach to evaluate `current' and `projected Job requirements going forward' involved a systematic 'Norms-driven' approach. The various steps undertaken included: An estimate of the number of jobs per Sector was then validated through different sources.

These included:

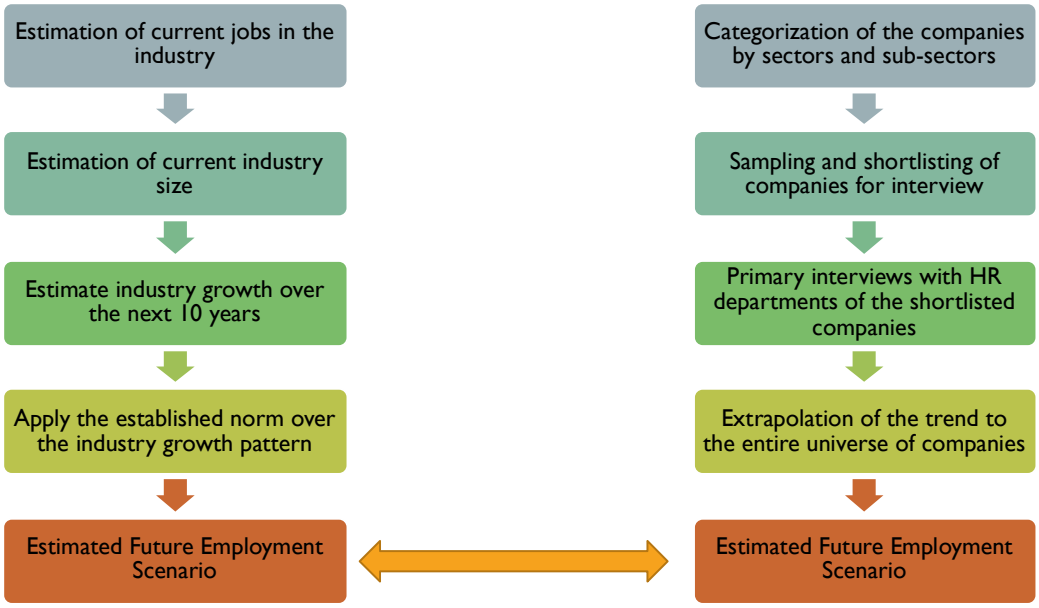
1. Validation through published news reports and industry as well as ministry reports
2. Validation post interviews and verifications by Industry leaders, Industry Associations and major players.

Data points were collated regarding their views on the likely trends and employment possibilities going forward.

1. Collection of primary data: on the number of jobs required at different levels across the board

2. These norms were then substantiated across different companies in various sub-sectors, to arrive at a common estimation numbers

3. Projected growth of the industry was then evaluated and `considered' to arrive at the estimated job requirements using these Norms



4. The manpower based on study and industry interaction for per MT of steel produced is:

S. No	Production Process/Route	Present Technical Manpower/MT
1	Integrated Steel Plant	3500
2	EAF-LF-CC – Steel Plants	400
3	IF-CC based Steel Plants	2000
4	Sponge Iron Plants	700
5	Re-rolling	3000

Figure 13 – NISST - Manpower Analysis

Manpower Distribution and requirement : Principle and Procedure

Major Regions of Employment Concentration in the steel production would be obviously the states and regions producing major steel in the country, we see that for over 57% of the total production happens in the following states of :

1. Jharkhand
2. Odisha
3. West Bengal
4. Chhattisgarh

Basis on the various study done with various industries and other stakeholders (both primary and secondary research) the broad technical manpower hired under various steel making processes is as illustrated below

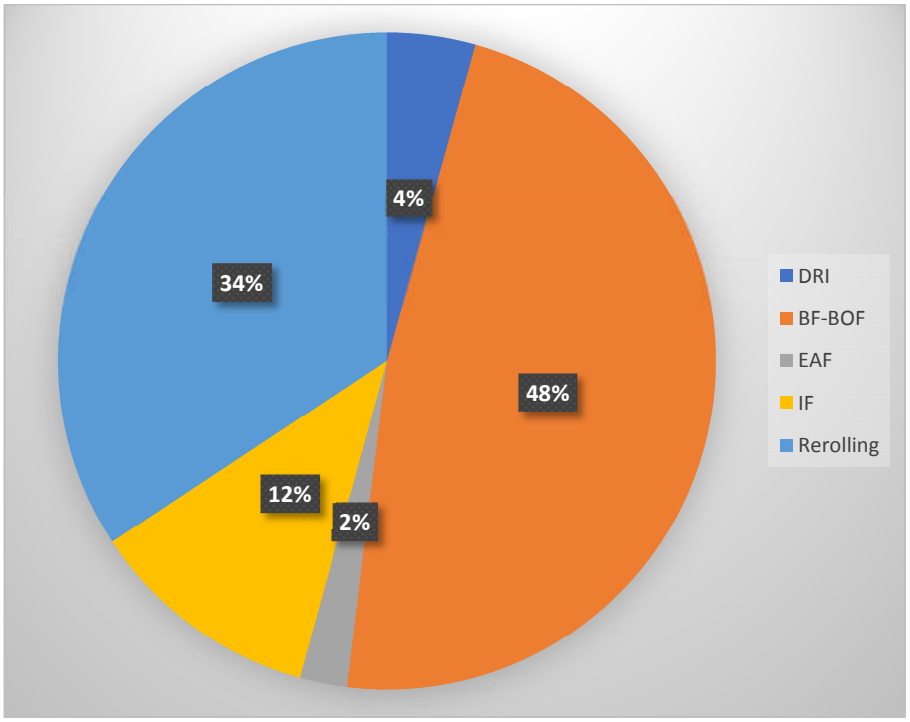


Figure 14 - NISST – Manpower allocation analysis

Process Route	Present Technical Manpower/MT	Working Cap, mT	Consolidated Manpower
DRI	700	46.5	33000
BOF	3500	56.8	199000
EAF	400	41.5	17000
IF	2000	44.0	88000
Rerolling	3000	73.6	220000
Total			557000

The typical distribution manpower in various occupations are as indicated below according to IIT – Kanpur Study, supported by Ministry of Steel in 2017

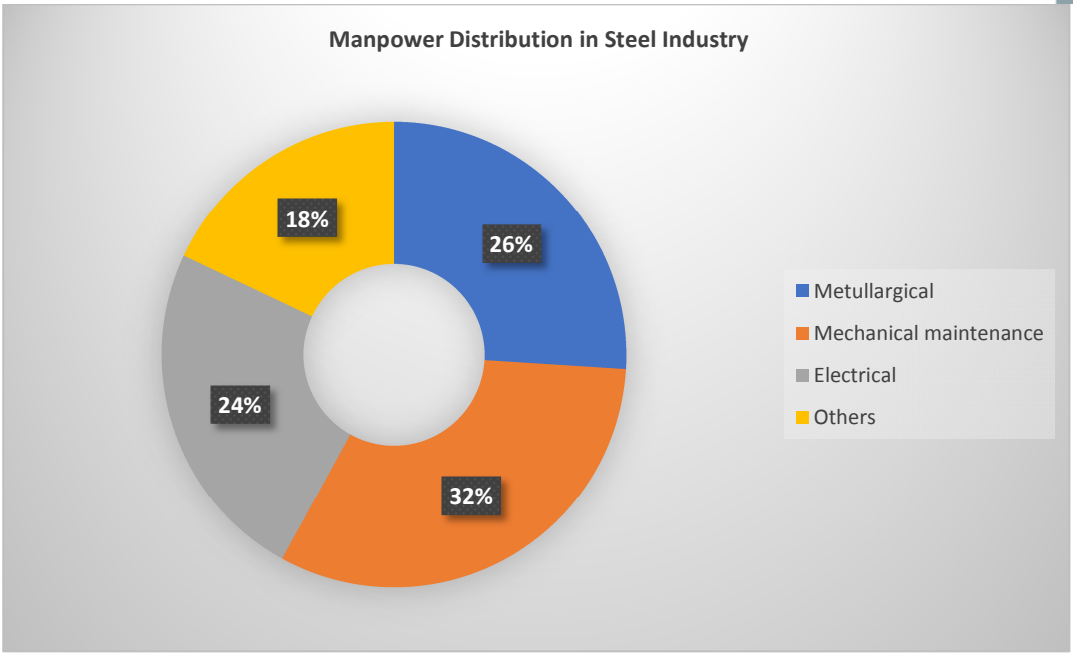


Figure 15 IIT Kanpur Report – Supported by Ministry of Steel, Analysis by NISST

The manpower projection techniques used by human resource teams in this sector has a relation to the company size and maturity of other workforce development practices. Large size companies typically assess future manpower needs based on their business needs and strategic goals (the planning horizon may itself vary between 1-3 years). Medium and small companies normally focus on upsizing / downsizing manpower based on their order book and hence are

likely to typically employ a higher share of temporary manpower. Companies with a clearer vision for the future and better manpower forecasting techniques may be more likely to have a better workforce management strategy which enables them to work closely with the education and training systems for better recruitment, retention and continuous training interventions for the employed manpower. The majority of the expansion in the sub-sector in next decade is expected to come mainly through capacity expansion at existing or new locations. On skill front, it can be inferred that the demand for manpower will primarily increase for existing job-roles. While, there would be minimal requirement which would be needed for new and futuristic technologies.

The present manpower engaged in Iron and Steel Sector in India is calculated broadly on the basis of steel production route

The manpower prediction is done on basis as per steel production and incremental as per demand of steel based on the assumptions as per NSP 2017:

a) Industry growth from now onwards is considered so as to achieve production capacity of 300MTA by 2030-31 at a gross rate of 6.50%
b) Contribution of BF-BOF route is taken as 60%, EAF as 15% and IF as 25%

The projections based on assumptions for incremental steel production capacity by 2030-31:

Incremental Crude Steel Growth (in MT – Million Tonne)					
			Incremental Capacity Sector wise in MT		
Projected year	Proj. capacity in year, MT	Incremental capacity, MT	BF-BOF	EAF	IF
19-20	151.23	9.23	5.54	1.38	2.31
20-21	161.06	9.83	5.90	1.47	2.46
21-22	171.53	10.47	6.28	1.57	2.62
22-23	182.68	11.15	6.69	1.67	2.79
23-24	194.55	11.87	7.12	1.78	2.97
24-25	207.20	12.65	7.59	1.90	3.16
25-26	220.67	13.47	8.08	2.02	3.37
26-27	235.01	14.34	8.61	2.15	3.59
27-28	250.28	15.28	9.17	2.29	3.82
28-29	266.55	16.27	9.76	2.44	4.07
29-30	283.88	17.33	10.40	2.60	4.33
30-31	300.00	18.45	11.07	2.77	4.61

The crude steel production from Integrated Steel Plants comprises right from Raw Material to finished products. The crude production from Electric Arc Furnaces and Induction Furnaces are taken upto to the steel making stage only.

The manpower required for finished products (through rolling) has been computed separately for steel produced from EAF and IF Route

Further, since Sponge Iron (DRI) is a subsector of Iron and Steel Industry and is Raw Material for Steel Making from EAF and IF Route, the manpower required has been computed separately

Future manpower estimation in industry

The need for technical manpower in the next decade would highly be dependent on new technology, increased automation, Industry 4.0, Artificial Intelligence etc., and innovative practices in steel plant operation, latest management strategies that would

emphasise higher productivity, efficiency and sustainability while reducing the manpower needed in production and maintenance of steel plants.

Capacities of existing plants and new plants are envisaged to be much higher as compared to the existing average capacities due to the reasons mentioned above and the need for manpower would be reduced per MT of steel produced.

Accounting all the conditions the changes are envisaged in manpower requirement in future and the same is tabulated below:

S. No	Production Route	Present Technical Manpower/MT	Future Technical Manpower/MT
1	Integrated Steel Plant	3500	1500
2	EAF-LF-CC – Steel Plants	400	300
3	IF-CC based Steel Plants	2000	1400
4	Sponge Iron Plants	700	500
5	Re-rolling	3000	2500

On the basis of estimated incremental production capacity the prediction of the incremental manpower demand is as calculated:

Incremental Manpower Demand								
Projected year	Proj capacity in year,MT	Incremental capacity, MT	**BF-BOF**	**EAF**	**IF**	**Rolling**	**DRI**	**Incremental manpower**
19-20	151.23	9.23	8307	415	3231	9230	1530	22713
20-21	161.06	9.83	8847	442	3440	9830	1668	24227
21-22	171.53	10.47	9422	471	3664	10469	1818	25844
22-23	182.68	11.15	10034	502	3902	11149	1981	27569
23-24	194.55	11.87	10687	534	4156	11874	2160	29411
24-25	207.20	12.65	11381	569	4426	12646	2354	31376
25-26	220.67	13.47	12121	606	4714	13468	2566	33475
26-27	235.01	14.34	12909	645	5020	14343	2797	35715
27-28	250.28	15.28	12832	687	5346	15276	3049	37190
28-29	266.55	16.27	14642	732	5694	16269	3323	40659
29-30	283.88	17.33	15593	780	6064	17326	3622	43385
30-31	302.33	18.45	16607	830	6458	18452	3948	46296
Total Incremental manpower required								**397860**

Manpower needed for Foundry Sector

1. As per the Foundry Informatics Centre, Indian Institute of Foundryman, the total Manpower in Foundry Sector is approx. 500,000 directly & 1,500,000 indirectly.
2. The foundry sector is highly labour intensive & currently generates employment for 2 Million directly & indirectly mainly from socially & economically weaker sections of society.
3. It has potential to generate additional employment of 2 Million in next 10 years.
4. Considering this, direct manpower requirement in Foundry sector upto 2030-31 is estimated as 5,00,000.

Ferro-Alloys

1. Present production 5.15 MT and approximately 2500 technical persons are required for 1 MT ferro alloys production and hence present employment in ferro alloys directly and indirectly is 12875. The installed production capacity is more than that of the demand of ferro alloys
2. The production of Ferro Alloys sector as per NSP 2017. is estimated at 4.0 MT by 2030-31
3. There is envisaged 2.5 MT requirement for exports, total requirement expected is 6.5 MT.
4. Capacity needed would be 7.65 MT at 85% capacity utilization
5. New Capacity needed would be 2.50 MT
6. Additional technical Manpower needed would be 6250 for additional 2.5 MT

The total incremental manpower requirement in Iron and Steel Sector by 2030

S. No	Sectoral	Number
1	Crude Steel Production	3,97,860
2	Foundry	5,00,000
3	Ferro Alloys	6,250
4	Requirement of Overseas for skilled jobs in Iron and Steel related Trades (Welder, fitter, machinist etc.)	1,50,000
	TOTAL	**10,54,110**

Considering the total incremental manpower need training and certification to the to present production processes the training requirement would be:

1	Fresh Trainings and hiring under various employment models and apprenticeships	Crude Steel Production	3,97,860
		Foundry	5,00,000
		Ferro Alloys	6250
		Over Seas	1,50,000
			10, 54, 110

With the change in technologies, innovative production processes and changing industrial working conditions as interacted with industry it is assumed that 50% of the existing manpower will be needed to undergo a skill upgradation process to enhance their skills and acquire multiskilling

Hence, the total manpower need to undergo skill upgradation/reskilling by 2030 is estimated as:

S. No	Manpower	Areas	Number
1	Skill upgradation and reskilling	Crude Steel Production including Rerolling and DRI	5,57,000
		Foundry	5,00,000
		Ferro Alloys	12,875
	Total existing manpower in industry		10,69,875
	Estimation of 50% for Skill upgradation		5,35,000

The total fresh training and reskilling for Iron and Steel Industry would be

S. No	Manpower	Number
1	Fresh skilling	10, 54, 110
2	Reskilling/upskilling	5,35,000
	Total skilling requirements	**15, 89, 110**

Occupations, Job Roles and Trades in Iron & Steel Industry

The technical jobs can be categorised in following occupations:

a) Raw material Handling including mining of ore
b) Plant Operations
c) Mechanical Maintenance
d) Electrical, Electronics & Instrumentation Maintenance

The identified representation of trades/ job roles and occupations in iron and steel industry are:

Job Roles, Trades, Occupations	BF-BOF	EAF	IF	Re - Rolling	DRI
Raw material handling					
Mobile Equipment Operations and Maintenance	✔	✔	✔	✔	✔
Dumper Operator	✔	✔	✔	✔	✔
Locomotive Driver	✔	✔	✔	✔	✔
Stacker and Reclaimer	✔	✔	✔	✔	✔
Excavator Operator	✔	✔	✔	✔	✔
Shunting Operator	✔	✔	✔	✔	✔
Wagon Loading and Unloading	✔	✔	✔	✔	✔
Screen & Crusher Operator	✔	✔	✔	✔	✔
Marker & Signage Painter	✔	✔	✔	✔	✔
Marking and Packaging	✔	✔	✔	✔	✔
Housekeeping	✔	✔	✔	✔	✔
Refractory Brick Layer	✔	✔	✔	✔	✔
Conveyor Belt Operations and Maintenance	✔	✔	✔	✔	✔

Job Roles, Trades, Occupations	BF-BOF	EAF	IF	Re - Rolling	DRI
Mechanical Maintenance					
Bearing Maintenance	✔	✔	✔	✔	✔
Mechanical Maintenance Technician	✔	✔	✔	✔	✔
Fitter – Levelling alignment and balancing	✔	✔	✔	✔	✔
Conveyor Belt Operations and Maintenance	✔	✔	✔	✔	✔
Fitter – Hydraulic and Pneumatics Technician	✔	✔	✔	✔	✔
Rigger: Rigging of Heavy Material	✔	✔	✔	✔	✔
Welding and Fabrication	✔	✔	✔	✔	✔
Machinist	✔	✔	✔	✔	✔
Fitter – Maintenance	✔	✔	✔	✔	✔
High Pressure Welder	✔	✔	✔	✔	✔
Safety Supervisor	✔	✔	✔	✔	✔
CNC Machine operator	✔	✔	✔	✔	✔
Process operator for hydraulic equipment	✔	✔	✔	✔	✔

Job Roles, Trades, Occupations	BF-BOF	EAF	IF	Re - Rolling	DRI
Electrical, Electronics & Instrumentation Maintenance					
Electrical Supervisor	✔	✔	✔	✔	✔
Electrical Fitter	✔	✔	✔	✔	✔
Electronics Fitter	✔	✔	✔	✔	✔
Instrumentation Fitter	✔	✔	✔	✔	✔

Cable Jointer	✔	✔	✔	✔	✔
Optical fibre cable jointer	✔	✔	✔	✔	✔
PLC operator and Drives control with Automation systems	✔	✔	✔	✔	✔
Drives operation and Maintenance(focus on HV and MV drives)	✔	✔	✔	✔	✔
Motor winding	✔	✔	✔	✔	✔
Safety Supervisor	✔	✔	✔	✔	✔

Job Roles, Trades, Occupations	BF-BOF	EAF	IF	Re - Rolling	DRI
Plant Operation	✔	✔	✔	✔	✔
Process Operator – CR and HR	✔	✔	✔	✔	✔
Process Operator Pellet Plant	✔	✔	✔	✔	✔
EOT Overhead Crane Operator	✔	✔	✔	✔	✔
Coil Packaging Machine Operator: Rolling Mills	✔	✔	✔	✔	✔
Heating Regulator	✔	✔	✔	✔	✔
Control Room Operator	✔	✔	✔	✔	✔
Battery Anchorage Regulator	✔	✔	✔	✔	✔
Heating Regulator	✔	✔	✔	✔	✔
Control Room Operator for Agglomeration	✔	✔	✔	✔	✔
Cast House Operations	✔	✔	✔	✔	✔
Operator Rolling Mills	✔	✔	✔	✔	✔
Process Operator Blast Furnace	✔	✔	✔	✔	✔
Process operator for BOF operation	✔	✔	✔	✔	✔
Reheating furnace operator	✔	✔	✔	✔	✔
Process operator for Sinter plant	✔	✔	✔	✔	✔
Boiler Operator	✔	✔	✔	✔	✔
Process Operator Sponge Iron (Coal based)	✔	✔	✔	✔	✔
Process operator for Induction Furnaces	✔	✔	✔	✔	✔
Ladle Operations	✔	✔	✔	✔	✔
Mould Operator	✔	✔	✔	✔	✔

Impact of Disruptive Technologies and Opportunities for Skill Development in new Job-Roles :

While interacting with industries during visits and verbal discussions, it was apparent that industry foresees impact of some disruptive technologies in the steel sector. Some of these may alter the requirement of manpower in conventional process routes and practices and also require new job-roles .

Some of the disruptive technologies as indicated are :

1. Higher level of Automation
2. New emerging process
3. Increase use of Robotics in processes, maintenance, and handling systems
4. Increased use of non-coke/coal material in Blast Furnaces
5. Oxygenated Blast Furnaces
6. Extensive use of hydrogen in Blast Furnaces
7. Increased use of gas-based sponge iron as the gas availability is likely to increase.
8. Use of PNG (Piped Natural Gas) and CBM (Coal Bed Methane) replacing conventional fuels
9. Extensive use of Thin slab casting with direct rolling
10. Increased use of EAF route of steel making compared to BF-BOF route due to increased supply of steel scrap.
11. Direct Steel making process
12. New alloy developments requiring new processes for stringent quality control
13. Twin roll casting process for strip production
14. Emerging Agglomeration technique which could replace Sinter and Pellets
15. Advancements in material science with development of new products which pose a challenge to consumption of steel
16. Digital technologies for improving efficiency and supply chain management
17. Digital developments taking place outside steel industry like steel consuming sector and supply chain systems
18. Shifting transportation from a personal property- based to a service-based feature of society. As vehicle sharing increases, demand for new vehicles will weaken.
19. Once driverless cars become a widespread reality, the reduction in accidents could eventually obviate the need for crash –protecting vehicle bodies. This potentially renders the steel versus aluminium issue obsolete, as a variety of other materials could fit the need.
20. Future growth in emerging economics will be much less steel intensive.
21. Circular economy principles and practices in all parts of the economy, as well as ongoing advances in the other areas.
22. On-line monitoring and diagnostic systems.

These disruptive technologies, on the one hand has adverse effect on conventional process of iron and steel making, and on the other are good for reducing the overall cost of steelmaking. They also offer exciting opportunities for development of new specific job-roles and newer opportunities for training and skill development.

Qualitative Aspects of trades and workforce:

To further analyse the qualitative requirements of relevant trade roles, it is important to comprehensively understand the skill related requirements of the sub-sector for various trade roles. In this context, following important areas would be analysed to understand the various demand side requirements:

- Desired Skill
- Preferred skill recruitment channels
- Employees up-skilling practices

Desired Skills

While on quantitative front, different sub-sectors and companies would have different requirements; on qualitative front, the key expectations from a particular trade role across sectors remain similar. The key qualitative expectations of company from its manpower are as follows:

Technical competency

On this part, companies expect employees to be skill ful on following key aspects:

Technical knowledge of trade: Employee is expected to have a sound practical knowledge of the trade. And this requirement of practical knowledge is even more important in case of small to medium size companies. SMEs are typically more constrained than large players to allocate capital and time for manpower training and hence they have a tendency to rely more on manpower that is readily skilled and fully productive in operations.

Sensitivity to quality assurance and High Productivity: With a rapid growth in manufacturing and competition from imported machineries, sensitivity to quality assurance and higher productivity has become all the more important. Iron and Steel industries are expected to deliver products not only of high quality but also under very tight timelines. And given the competition from foreign counterparts, Iron and Steel industries cannot afford any batch rejection or delay in project execution.

Good technical aptitude: Good technical aptitude among employees is primarily sought for two reasons: easy up- skilling and reduction of downtime. With rapid advancements in manufacturing, Iron and Steel maker are also required to adopt newer technologies. And with such technological advancements, re-skilling/up-skilling the existing employees has become all the more important. However, to be able to quickly learn new technologies employees should have good technical aptitude to quickly grasp the learning. If not so, the partially trained employees remain a bottleneck in quickly expanding on new technology. Secondly, an employee with good technical aptitude is able to understand and resolve day-

to-day technical glitches relatively quickly. This helps companies in reducing downtime and thereby increasing productivity.

Soft Skills

Good communication skills: A part of the trade job roles includes understanding and communicating the machine related instructions. Hence, a good communication skill is one of the important requirements of the various trade roles.

Professional attitude: The manufacturing process requires an employee to demonstrate important professional traits such good team worker, adherence to guidelines, disciplined etc to ensure quality and productive production process.

Employee up-skilling practices

Medium to large companies follow more methodological approach in managing the skills of employees on rolls. And from time to time relevant training programs are facilitated to employees to up-kill. However, small companies largely remain unstructured in their approach to train the employees. And a very minimal capital and time is earmarked to provide employees an exposure to essential training programs.

As far as the preferred mode is concerned, on-the-job training remains the unanimous choice for the shop floor roles. On-the-job training has been attributed to maximum learning adoption as compare to classroom based or computer based training programs

Supply Side through Skill Ecosystem, Hiring Methods and Origination of Skill Gaps

Present Skill Supply Ecosystem:

a. ITI Ecosystem
b. PMKVYs and PMKKs

The State wise ecosystem of ITI according to 2018 are:

These institutions have been the essential providers of skilled manpower for the sector. The programs undertaken at ITIs are essentially categorized as long-term trainings, typically spanning more than six months. Following is the current outlook at ITIs, mapped trade wise and sub-sector wise for the Iron and Steel sector:

Total ITIs in India	13,105
Government ITIs:	2,293
Private ITIs	10,812
Total trades in ITIs	150+
Number of trades which can be aligned under the iron and steel sector:	40
Total seat count in ITIs for all trades:	3.4 million
Total seat count for manufacturing trades	1.4 million
1. Seat count for Iron and Steel Sector trades	0.20 million
2. Seat count for other manufacturing trades (relevant to the Iron and Steel Industry industry)	1.18 million

State wise number of ITIs

S.No.	State	Total	Government			Private		
			General	Women	Others	General	Women	Others
1	Andaman and Nicobar Island	2	2	0	0	0	0	0
2	Andhra Pradesh	788	101	21	4	653	4	5
3	Arunachal Pradesh	4	3	0	0	1	0	0
4	Assam	31	24	3	1	3	0	0
5	Bihar	575	23	7	1	541	0	3
6	Chandigarh	2	1	1	0	0	0	0
7	Chhatisgarh	171	70	8	4	89	0	0
8	Daman and Diu	2	2	0	0	0	0	0
9	Delhi	77	5	3	7	36	23	3
10	Dadra and Nagar Haweli	1	1	0	0	0	0	0
11	Goa	18	12	0	0	6	0	0
12	Gujarat	417	158	5	3	248	2	1
13	Himachal Pradesh	204	59	17	1	126	0	1
14	Haryana	197	55	45	1	85	10	0
15	Jharkhand	174	13	2	0	157	0	2

16	Jammu and Kashmir	39	33	1	4	1	0	0
17	Kerala	613	58	9	9	527	2	8
18	Karnataka	1470	123	13	13	1294	7	20
19	Lakshadweep	1	1	0	0	0	0	0
20	Meghalaya	7	4	1	0	2	0	0
21	Maharashtra	884	375	14	2	484	9	0
22	Manipur	7	6	1	0	0	0	0
23	Madhya Pradesh	291	108	12	1	169	1	0
24	Mizoram	2	2	0	0	0	0	0
25	Nagaland	2	2	0	0	0	0	0
26	Orissa	627	20	8	4	557	3	35
27	Punjab	342	61	50	3	217	10	1
28	Pondicherry	18	6	2	0	10	0	0
29	Rajasthan	826	94	8	7	711	2	4
30	Sikkim	3	2	0	0	1	0	0
31	Tamil Nadu	733	62	8	5	649	6	3
32	Tripura	8	6	1	0	1	0	0
33	Uttranchal	114	54	4	5	50	0	1
34	Uttar Pradesh	1554	109	40	4	1391	10	0
35	West Bengal	110	41	2	2	63	2	0

Trade Units and No of ITIs associated with Trades aligned with iron and steel sector

S.No	Trade		Number of ITIs	
		Number of Units	Government	Private
1	Attendant Operator (Chemical Plant)	72	42	10
2	Attendant Operator (Chemical Plant)	7	4	0
3	Mechanic Communication Equipment Maintenance	4	1	2
4	Carpenter	563	379	91
5	Driver Cum Mechanic (Light Motor Vehicle)	238	111	76
6	Draughtsman (Mechanical)	976	285	337
7	Draughtsman (Civil)	2243	504	882
8	Electrician	25609	1686	9526
9	Electroplater	30	22	1
10	Foundaryman	180	117	6
11	Farm Mech. Agri. Mechanic	5	4	0
12	Fitter	21196	1722	8443
13	Instrument Mechanic (Chemical Plant)	41	16	6
14	Instrument Mechanic (Chemical Plant)	15	10	2
15	Instrument Mechanic	372	178	56
16	Information Technology & Electronics System Maint.	573	281	126
17	Mechanic Repair & Maintenance of Light Vehicle	21	8	7
18	Mechanic Auto Electrical & Electronics	61	18	29
19	Mechanic Agricultural Machinery	25	21	1
20	Machinist (Grinder)	251	110	18
21	Machinist 1263	1263	442	84
22	MCP	134	33	59
23	Mechanic-cum-Operator Electronic Communication System	22	5	7
24	Mechanic (General Electronics)	15	4	3
25	Moulder	87	54	2
26	Mechanic Maintenance (Chemical Plant)	38	21	6
27	Mechanic (Marine Diesel)	11	2	2
28	Mechanic (Motor Vehicle) 3224	3224	888	945
29	Mechanic Mechatronics 9	9	4	0
30	Mechanic Machine Tool Maintenance	114	70	6
31	Operator Advanced Machine Tool	5	4	1
32	Pump Operator-Cum-Mechanic	115	95	10
33	Painter (General)	272	166	69
34	Plastic Processing Operator	159	117	10
35	Pattern Maker	71	55	1
36	Sheet Metal Worker	357	235	49
37	Tool & Die Maker (Dies & Moulds)	32	18	6
38	Tool & Die Maker (Press Tools, Jig & Fixture)	66	35	7
39	Tool & Die Maker	72	35	10
40	Turner	1925	586	236
41	Welder (Gas & Electric)	1749	662	421
42	Welder	2097	647	823
43	Wireless Mechanic cum Operator	20	14	1
44	Wireman	2476	1021	589

Short term Trainings STT

These centers have been setup under the Skill India initiative of the government. These centers have contributed towards enhancing reach of training for basic level roles. This section will only discuss the capacity created by the NSDC scheme Pradhan Mantri Kaushal Kendra (PMKK).

Total PMKKs (2019)	611
Total PMKKs with manufacturing job roles	85
Total training capacity for all job roles in 611 PMKK	13,05,600

S.No	Name Of Project	Name Of State	Total Centre PMKK	Total Centre PMKVY	PMKVY -PMKK =Total
1	PMKVY	Chhattisgarh	48	27	21
2		Jharkhand	53	22	31
3		West Bengal	55	41	14
4		Odisha	98	25	73
	Total		**254**	**115**	**139**

Present Hiring Patterns:

The recruitment channels employed by the companies have a large bearing on its skill related competitiveness. The companies taking more methodological approach to hiring new manpower are able to access better trained employees as compare to companies following unstructured approach. In this context, there are three key channels of recruitments employed by companies across the sectors:

a. **Formal Training programs**: The large companies primarily rely on hiring manpower from training programs either running in-house or in good institutions. The hiring percentage of large companies from such programs is close to 70-80 percent. However, for SMEs this has only a minor source of new hiring. The primary reason being that typically SMEs are more constrained in their approach to manpower planning since they rely on more immediate project wins and have to accordingly upscale or downscale manpower count.

b. **From open source hiring and competitions**: The other major source of hiring a trade worker is from competitors from within or outside the sector. This mode of

sourcing new employment constitutes approximately 60-70 percent in SMEs hiring. However, for large companies the percentage remains low in 10-20 percent range.

c. **Internal job rotations or promotions:** This mode of new skill sourcing constitutes minority percentage among both large companies and SMEs. The reliance on channels of recruitment other than fresher recruitment from education and training institutions

Potential Sources of Manpower

New talent acquisition has been deemed to be one of the top priorities by companies of all sizes and sectors. The potential sources of manpower play an important role in determining the availability of adequate skill in requisite quantity. The most important recruitment channels employed by companies in various sectors are as follows:

- **Industrial Training Institutions**: The industrial training institutions (ITIs/ ITCs) facilitate the major percentage of new manpower requirement. This channel has been observed to be accessed more by medium to large companies as against smaller size companies. One of the reasons for such a trend is low employability of new trainees on shop floors. Large companies further train new joinee for typically three to six months before employing them on shop floors, even as smaller companies find that such a practice of further training fresh recruits from training institutions is often difficult given their business visibility is more short to medium term and also because investing in such training is often found to increase attrition in the experience of SMEs.

- **Experienced hires from competitors**: This involves hiring from competitors within subsector or companies in other sectors. This is a very important source of manpower for small companies as against large companies. The preference of lateral hiring among the small companies is, as already discussed, due to the paucity of time and capital to train its new manpower. SMEs generally prefer to hire manpower which is readily employable and can start giving shop floor output from day one without much additional training.

- **Confirming Apprentices to jobs:** Any industry under the Apprenticeship act 1961 amendment to 2015 has been mandated to take 2.5% of its workforce as trade apprentices and certain portion has to be given employment post training programs. This method is easy for SMEs for hire candidates having apprenticeship certificates

- **Others**: Other channels of new manpower include internal hiring through promotions and rotations. Job rotations are more frequently employed by SMEs which tend to prefer multi-skill employees who can be seamlessly employed across functions/ roles depending on project requirements. In some cases, companies also promote contractual employees to permanent role based upon performance to not only fill the vacancies but also to incentivize contract workers for good performance. However, on a whole, this mode has been relatively less utilized by small and large companies alike.

Training Requirements of Employees:

Constant up-skilling of the employees has been deemed as a critical area of workforce management by participating employers. The important insights on the training requirements of existing employees as gathered from the primary interviews are as follows:

- Most preferred mode: For most of the trades, on-the-job training has been a preferred mode over classroom or computer based training. Industry players prefer on-the-job training for its high learning adoption in minimal time. However, classroom based training or offline training through simulation also play an important complementary role in imparting the requisite knowledge. And in most cases, considering factors such as material cost, safety etc brief offline training precedes on-the-job training.

- Training content: Apart from training on the core activities of the work trade, following areas have been indicated by employers to be the important areas of training: quality control aspects including concepts like six sigma, JIT etc; personal safety on the job; environmental aspects of production operations etc.

- Training expenditure and hours: Expected training expenditure required to up-skill the existing employees was indicated to typically lie in the range of ten to fifteen percent of annual salary of workforce. While on duration front, the training requirement varies from as three/four months to as high as 2 years for new joinees to a week- month for up-skilling the existing employees.

Current Skill Gaps, Future Industry aspirations

The Iron and Steel sector has its associated skill ecosystem which is a self-sustaining network of workforce skills and knowledge. This eco-system is constituted by four main stakeholder groups, i.e.:

1. The individuals who get trained for employment

2. The present education and vocational training system leading to skilled jobs and employment
3. Industry concentrating on skilled manpower for getting work done.

The present skill gap can be defined as following in terms inputs and outputs of industry and education ecosystem

a) Due to gap between Industry and academia

When there is a void between industry policy makers, candidate is there skill gap arises when the education and training system is not responsive to the changing needs of the industry requirements or expectations and is slow to adopt training curricula, courses or delivery methodologies that are required for current and future manpower profile of the industry. Another void can be the lack of responsiveness to the candidate need and aspirations in investing in skills which can lead to over expectation for the value of training perceived by individuals and hence the emergence of non-formal ways for the candidates to enter the industry without going through the education and training system. Regularly, such an education and training system suffers from poor industry linkages and associated issues such as lack of infrastructure and resource constraints and poor teacher quality.

Some of the potential issues are:

1. Non responsiveness from academia to industry needs
2. Courses not aligned to candidate expectation and job needs
3. Trainer Quality
4. Training infrastructure Quality

b) On the job trainings

Workforce management strategies adopted by firms in the industry sector. Workforce management includes both workforce development, or the activities related to improving the workforce to bridge the gap between current workforce and desired workforce and workforce planning, or activities that are future focused to manage the supply and demand of labour. Workforce development activities include job design recruitment, performance management, skill development, retention strategies etc. Workforce planning activities include forecasting of staffing needs, succession planning and industry / technology developments which impact workforce. Key issues leading to type II skill gap include improper job design which mismatches the education skills required with those available from formal education and training channels, insufficient interaction with education and training system leading to inadequate communication of the industry expectations on skills required.

Some of the potential issues are:

1. Planning of workforce for expansions and projects
2. On the job trainings and skill identification

3. Job designing by industry
4. Working issues with industry and academia
5. Industry reluctant to offer recognition and incentivise the skilled manpower

c) Individual entering into the industry without being skilled

It is a situation arisen due to the commonalities due to the above two conditions, where individual needs a job for sustainability but does find a value to skills. it is the rational response chosen by individuals to either an education and training system that makes the training investment unattractive, or firms' workforce management policies which dilute the requirement for education and training. The above skill gaps as observed in the Iron and Steel Industry and largely in SME industry and the recommendations for the industry is on policy responses that can facilitate the alignment between of industry, individual and the education and training system.

Underlying issues due to skill gaps

- **Low employability due to technical incompetency**: Industry participants highlighted the concern of low employability of new entrants into the workforce due to technical incompetency. The situation becomes more burdensome for small to medium sized players which have to invest capital and time to train the employees to desirable level. The originating points for this skill gap are twofold.
    - The ITIs from which the industries source this category of manpower suffer from a curriculum and content that is not relevant to the current or future industry needs. While this is being partly addressed by the scheme for company adoption of ITIs, not all companies can afford the resources and bandwidth to follow this approach. Hence the ITI ecosystem very slow responsive to the employer needs.

    - For a large number of small to medium industries whose workforce management strategies are not evolved or absent, investing in capacity building initiatives for education and training is not a rational response. This leads to poor communication of requirements and collaboration with ITIs. Further lack of tight inter-firm linkages in similar sectors makes factors such as attrition a significant deterrent to employee skill development.

- **Lack of employee attitude/ inclination for a career in engineering**: The tough competition from imported machineries requires the Indian manufacturers to adopt newer technology to remain competitive. However employees with a little

experience do not possess the right attitude / inclination to stay invested in a career in engineering through up-skilling themselves which can support those business needs of technology up gradation. The key reason for this issue is many of the manpower pursuing entry level jobs in the sector live on subsistence level. And therefore, to earn a salary to live is understandably the primary objective of such people. An attitude to make a conscious effort to train oneself in latest technology is lost to the need for receiving a better salary on a more immediate term basis.

- **Dependence on informal channels for manpower sourcing and temporary manpower**: An adhoc workforce management approach is typical of many small and mid-size manufacturers. Majority of SMEs participants did not cite any formal method of manpower planning " which is mostly the basis of orders inflow and leads to reliance on informal channels for recruitment of semi-skilled manpower and increased share of temporary labour. This adds complexities to the skills ecosystem and the labor market information as it is difficult to categorize and plan interventions for temporary manpower whose future availability and contribution to the sector are not reliable.

Skills gaps at Training ecosystem:

A survey of training institutions in identified 4 states of CG, Jharkhand, Odisha and West Bengals in conjunction with an industry survey of effectiveness of the training institutions revealed the following skill gaps and their originating causes. The training institutions profiled were ITIs, PMKK, PMKVYs, Polytechnics and their equivalents (both private and government managed) offering skills training on specific trades. The issues identified with the education and training institutions' resulting in skill gaps are as follows:

1. **Poor employment selection by industry** : One of the key reasons acknowledged by both training institutions and firms is that the placements are an indicator of the quality of training provided. Industry is still showing reluctance in hiring fresh candidates. Both stakeholders felt that poor quality of training was arising from the fact that the training provided was not responsive to the needs of the industry. Apart from citing outdated technology on which training was provided, lack of effective communication and other professional skills training were vital missing links typical of training institutions with low placement records

2. **Training Drop outs:** Various training institutions experience the cases of student drop- out. Such incidents actually lead to a sub-optimal usage of institution's capacity. While the percentage of such drop outs may vary, an

understanding of primary reasons behind the student's discontinuation of training invariable pointed to the factors

- Financial issues
- Some quick job opportunity elsewhere
- Admission in some poly technical course or engineering course
- Difficulty in understanding the course
- Disinterest in the trade

3. **Underutilization of capacity due to poor perception of trades** - Growing inclination towards other sector jobs such as this in malls, financial services, and IT which are financially more lucrative, have better working environment or have better social standing have made it difficult to fully utilize the existing seat capacity for some of the trades. This is seen to be a very strong factor leading to the quantitative skills gaps in this sector.

4. **Unavailability of sufficient funds**: Availability of funds has been cited as another major hindrance in planning aggressively for the capacity expansion. Training infrastructure for engineering trades is asset intensive and requires significant capital allocation compared to most other sectors' training. On an operating cost basis also, good private training institutions are forced to innovate on delivery methods that will lower costs, in order to maintain profitability in a market that does not typically allow them pricing power

5. **Good Trainers**: Poor trainers' quality or lack of an adequate number of good trainers, has been felt to be one of the key reasons for poor quality of training leading to poor employment outcomes. And it has been strongly recommended by various participants to start the ‚Train the trainer' course on full scale to meet the demand of different institutions

Trainer Assessment

On qualitative front, the most important expectations from trainers, in order to ensure an effective training delivery are as follows:

a. Qualification, Knowledge of subject matter, industry experience, commitment to learning, teaching ability and interpersonal skills.
b. It has been observed from the primary discussions that while the trainers have an adequate knowledge of subject matter they relatively lack on two critical softer aspects- teaching ability and commitment to learning.
c. While the weaker teaching skill reduces the effectiveness of knowledge transfer, weakness on further learning has its impact on keeping one's technical knowledge abreast with industry. On the

profile part, access to trainers with good amount of industry experience has been felt to be a challenging area.

d. Experienced trainers are sought after for their better ability to bring the requisite the practical perspective to the training and to motivate the trainees to pursue a long-term career in manufacturing.

Over and above the qualitative aspect, availability of sufficient number of trainers is critical to achieve the targeted growth in training capacity. This is of specific importance, when the requirement of trainers increases in proportion with number of trainees trained. Due to practical component of the training, the Student: Trainer ratio should be ideally around 20:1

Future Industry requirements

Participants of the study indicated following manpower requirements to become important in order to remain competitive in future. These will have an impact for the overall workforce management strategies of the sector:

- **Multi-skilled employees**:
  - Convergence in technologies like mechanical electronics hardware and electrical will require candidates with greater conceptual knowledge on these technologies and be able to deploy such equipment/devices as well.
  - Due to convergence of these technologies the requirement of technicians with multi-disciplinary technical knowledge and skill will become important.
  - The multi-skilling training becomes very important especially for SMEs employers who require their employees to perform more multi-tasking.
  - Multi-skilling includes training the employees across the traditional trade roles.
  - The primary benefit from multi-skilling is that a particular job which would have required more than single trade- however not more than one person " can now be performed by just one person.
  - This could be further understood with an example of changing out a motor.

    Typically, changing a motor would require an electrician to disconnect the motor leads and a millwright or mechanic to disconnect the coupling, physically replace the motor, and perform the alignment. The electrician would then return to the job, reconnect the motor leads, check and possibly change rotation. The mechanic or millwright would, at this point, be able to connect the coupling halves to complete the job. However, a multi-skilled trade worker would have replaced electrician and mechanic. Such a trade worker would have been trained in the proper disconnecting and reconnecting of the motor leads, as well as how to change motor rotation.

- **Operator and Maintenance Technician**: With growing multiskilling the requirement of operator and maintenance Technician is going to grow more

- Computer skills based job-roles to increase: With technological advancement application of IT in various roles will start taking considerable importance.

- Demand for Innovation and design roles to increase: For Indian companies to remain competitive against imported machineries, a strong foothold on

innovation and design is critical. More so when the manufacturing sector itself is expected to embrace quickly many technological advancements in near future.

- Demand for competent managers to increase: The sector is expected to see a double digit growth in the next decade. However, as small to medium sized companies expand; demand for effective managers will increase. In such a phase of expansion, a manager's role is expected to become important to not only ensure strict adherence to quality guidelines but also keep motivated the manpower to ensure high productivity.

Availability of cross-trained employees helps increasing the productivity and reduces labour costs through following benefits:

a. **Flexibility**: Cross-trained employees are flexible to play multiple roles and are able to fill in for absent employees and work in any area of the business that requires increased manpower at any time, and for any duration. This allows the steel industry to maintain production levels under many circumstance that would otherwise leave workers idled or profits left on the table

b. **Decrease labor costs**: A steel industry with multi-skilled labor can operate with a reduced number of employees. A multi-skilled workforce moves with the workload instead of waiting for the work to come to them. This results in fewer idle work hours, which reduces the cost to the industry.

c. **Flexible and motivated Employees**: Multi-skilled workers are more flexible to learning new skills and to consistently adapt to changes in production. Employee satisfaction improves morale in a business, which leads to increases in productivity and employee retention rates.

The productive areas which can be identified for multi-skilling would be those which require two or more crafts to complete the job, but only one or two individuals to do the work. In the context of capital goods sector following areas could be considered for cross-training of the employees:

- Jobs which can combine electrical and mechanical skills
- Jobs which require electrical/mechanical and simple welding skills

Part – 3 Recommendations for Industry and Academia

Recommendations for Bridging the Skill Gaps

Now since the critical issues affecting the manpower development of the Iron and Steel are established industry were identified and categorized according to their associated skill gaps ecosystem. Further, the recommended solutions can also be identified actionable items for the relevant stakeholders in the skills ecosystem as discussed below:

- **Recommendations for the Academia (IISSSC):**
  1. **Collaborate with industries**: To prepare the labour maker in the country for future challenges, it is necessary for the academic setup to be rejuvenated. The major issues plaguing the educational system in the country include poor infrastructure, outdated curriculum, lack of qualified and trained teaching staff and absence of connect with industry. Addressing the entire gamut of these issues is out of the scope of the present study; however, developing a healthy partnership between academia and industry will help in addressing many of these fundamental constraints.
  2. **Strengthening the industry-training system linkages** – Critical to the success of developing an industry responsive training program is the clarity of inputs and information exchanged between the training system and industry. The SSC as a platform should function as the gateway of information exchange that will form the basis for all skill development initiatives
  3. **Trainer and Assessor framework and Network**:
     1. One of the key tasks of the IISSC will be to develop trainer training programs and run pilots of these programs to test the potential for cultivating a large pool of current and past employees of the sector with significant experience into certified trainers.
     2. The IISSSC could develop a database of retired and current employees of the industries who could be developed to conduct accredited training programs.
     3. IISSSC can also target Diploma colleges trainers as they have adequate knowledge and with right industry exposure can be better resources as trainers
     4. When combined with periodic feedback, trainer training and mentoring of these industry veterans based on their performance, an trainer training certification may also be given to such trainers to increase their marketability as a trainer
  4. **Developing a labour market information system** (LMIS) that reflects the dynamic status of industry's manpower profile and needs – A labour market information system is critical at various levels and definitely so for policy

makers who need to plan for skills development needs which are reflecting the industry's workforce priorities

5. **Job Roles/National Occupational Standards and training curricula as per industry need** – National occupation standards hold the key to defining training curricula that are relevant to changing industry needs. The SSC's core task would be to develop these standards and setup a mechanism where these can be periodically reviewed and updated for industry relevance.
6. **Industry associations to increase membership and participation in the SSC activities** – Given the nature of the industry where there a few dominant large players and a number of medium to MSME, the IISSSC should try to enlist the support of all the large players and key players in the medium to small segment represented in their respective associations and are active in pursuing the cause of skill development for their industry. Industry Associations need to be made more active in terms of attaining skill targets as large representation is from MSME Segment
7. **Identification of target manpower** (e.g. rural population) sources to whom a career in steel sector is aspirational – Many parts of eastern India and mainly rural areas have been observed by training providers and firms to be a source of manpower who could be trained and developed into skilled manpower. The IISSSC, as part of its labour market information system could identify typical demographic profile of people who are likely to enter the industry and support the development training programs suited to these profiles
8. IISSSC can support the industry towards meeting its demand for skilled manpower. A way forward in this direction is apprenticeship. IISSSC can convince sector players to offer apprenticeship and hire candidatesfrom Government's skilling initiatives such as PMKVY, DDU-GKY , etc. Further, IISSSC can motivate and aggregate the demand from the sector players and offer apprenticeship.

- **Recommendations for industry:**
  - **Create collaborative learning ecosystems:** Industry in India have faced a regular criticism on their lack of participation in the social cause of skilling and reskilling. Individual companies within the Iron and Steel sector can work toward towards creating a collaborative learning ecosystem in their respective sectors to skill workforce/ students. These models will be more effective as these will be pioneered by the industry members who are in the best position to ascertain the demands of the sector. Sector players collaborate to pool resources and effectively meet the training demand of the sector. Standardized curriculum could be developed with the support from educational institutes and can be made available through PMKKs, ITIs, universities etc.

  - IISSSC, in collaboration with technologically advanced industry partners and reputed partners, must forge an integrated framework to meet the imminent future skill demand encompassing:
    - Identification of enhanced and market-relevant job role with key focus on following areas:
      - Advanced robotics and automation
      - Artificial intelligence and machine learning
      - Cloud computing and remote solutions
      - Industrial Internet of Things
      - 3D printing and digital fabrication mediums, etc.
      - Other industry 4.0 related job roles
      - Data analytics

  - Support IISSSC in creation of additional relevant NOSs/ QPs and training modules to support the new job roles that are emerging as a result of enhanced market-relevant jobs

  - Support IISSSC upgradation of existing NOSs for current job roles that will undergo a change due to the evolving context

  - Support IISSSC Design of curriculum and content development to address the needs of adopting newer technologies and processes for existing and new job role training, wherein certain imperatives are:
    - Rapid content updation capabilities
    - Enhanced learner experience through interactive content
    - Co-creating content with industry
    - Benchmarking curriculum and content to international standards, to leverage international employment potential

- Develop workforce re-training programs across organizational levels: For the existing workforce, there needs to be large-scale re-skilling on exponential technologies and their potential applications. We are beginning to see this in sectors beyond service sectors, such as traditional manufacturing sectors. The expectation is that even shop floor workers with their experience would able to suggest innovative process improvement solutions if they are aware of the technology possibilities. At the supervisory and mid management levels, the training focus is on awareness and process improvement programs using these technologies. Finally, at the senior management levels, the focus is on strategic implications, new products and business models.

- Work in close partnership with the government to ensure success of its efforts to take advantage of Skill India Mission: The need for a partnership between sector and Government has never been more important than today, when disruptive forces are expected to have large-scale impact. Through the Skill India Mission Government is providing the much-needed impetus to vocational education in India. Industry associations and leading companies need to support the Government by providing inputs on how the Indian society, workforce and education systems should be and look like going forward, enthusiastically participate in all engagement platforms and support the implementation efforts (typical weak link in large-scale government initiatives) through resources, knowhow and well-designed PPP models.

- **Industry needs to contribute towards the goal of creating future ready skilled manpower:**
  Since this is a critical success factor for their sustained growth. Some of the areas that need to be worked upon are:
  - Partner in revamping PMKKs, PMKVYs, ITIs and other skill development institutions infrastructure
  - Partnering with respective government department and agencies towards a more conducive skill policy and deployment planning.
  - Enhanced adoption of ITIs, with contribution by way of training through line functionaries, content enhancement and exposure to R&D facilities.
  - Conduct faculty immersion programs to provide faculty with shop-floor experience.
  - Deploy robust apprentice programs, with focus on learning outcomes during apprenticeship.

- Industry to extend similar support to polytechnics and engineering colleges to develop resource pool at different levels along the value-chain.
- Implement job rotation: Job rotation is the systematic movement of employees from job to job within the organization. Rotating employees within the organization into different roles helps broaden their skill sets, especially for entry-level employees. Job rotation also helps organization in driving flexibility in operating with employees who are well rounded and can fill different roles. Job rotation is especially helpful in preparing employees for leadership roles because as they move into senior leadership positions, by breaking out of the functional silos. The need for job rotation is more important today as organizations are getting disrupted from forces not only within the industry but occasionally outside. Job rotation will help in continuous learning and refreshing of knowledge of business operations at a more strategic level.

Part – IV –Annexures

Workshops conducted for Study and Questionnaire Approach

Geographical Location:

Four States to be covered:

1. West Bengal
2. Jharkhand
3. Odisha
4. Chhattisgarh

These States have been selected as most of the iron and steel activities are covered in these 4 states. These states can be treated as representative of iron and steel sector throughout India as these states comprises Integrated steel plants with capacities ranging from 1-10 million tonnes, Mini Steel plants with all alternatives as EAF, Induction Furnaces, Sponge Iron units, Rolling Mills-stand alone and coupled with steel making facilities in all capacity ranges.

Categorisation of Industries of study

Industries to be categorized based on the following system:

1. Large Integrated Steel Plants with capacity > 1 million tonnes (BF-BOF route)
2. Medium scale Steel Plants with capacity 0.2 – 1.0 million tonnes (BF-BOF/BF-EAF/ DRI-EAF/ DRI-IF) (Composite Units, with or without Rolling Mills)
3. Small scale steel plants with capacity < 0.2 million tonnes

9. **Large Scale** (1.0 million tonne and above)
   a. In Major steel plants category only SAIL-BSP, Tata Steel, JSPL – Angul, Raigarh, JSPL Raigarh and Jayaswal NECO have responded. Other major steel plants have not yet responded due to different reasons. Efforts are still on to get the desired response. We are expecting positive response from Tata Steel, SAIL plants and JSPL plant at Angul. We expect to include the response in final report.

   b. Separations and Recruitments: SAIL has policy of 25% replacement against superannuation and separation. But that is also not implemented

   c. Contractual workers, particularly in Durgapur Steel Plant don't have safety training, which is must. Otherwise job permit not made. Special safety training for working at height needs to be provided

d. Many jobs are outsourced, particularly jobs related to Project work. Workers, as supplied by the contractor, must have work related certificates. But they are not certified for particular job contract.

e. IISCO steel plant is struggling to redeploy old manpower to new system

f. In IISCO Steel plant, Manpower as per technology providers plan, should be 5500

g. Since already excess manpower is reported in SAIL plants, scope of fresh recruitment is bleak

h. Tata has big expansion plans. Likely to be 25-30 mt by 2025-26. But manpower is not likely to increase. The skill level of existing manpower will be enhanced to make them suitable for the job-roles. So although the numbers are not increasing, but there is vast potential of skill development in specific areas. Presently unskilled persons (above 10^{th} pass) will be trained for skills in specific job-roles.

i. With the kind of automation, manpower requirement per T is decreasing. For ex, latest I-Blast Furnace is manned by only 62 operation people, who are manning the work station (excluding officers) in Tata Steel, Jamshedpur. On-line campus hiring systems are in place now. Digital assessment platform to identify talented employees. With this, recruitment process takes much less time.

j. As for Industry 4.0, IoT, Cloud computing, Analytics, Mobility, Robotics will be in place. However, the exact effect of Industry 4.0 on manpower can't be assessed.

k. Tata steel is of the view that existing few job-roles can be clubbed/ consolidated with focus on multi-skilling. As for job roles, tata steel says there is requirement of about 1.00 lakh welders.

l. For training on Automation, BSP has the practice of MOU with OEMs. For ex with Siemens and ABB for drives, SKF for Bearings and Vibration,, Bosh for Hydraulics. Later on it is expected that suitable faculties will be developed.

- **Medium Scale** (0.2 million tonne and above)
  - There are very few plants in medium scale category. Plants responded in this category are : Vandana Global, MSP Steel & Power, Godawari Power, Vandana Ispat, Balmukund Sponge, Shyam Steel and Super Smelters

- Most of the Plants have Sponge Iron, Induction Furnace and Rolling Mills

- This sector of the industry doesn't prefer to recruit engineers, as engineers don't like to work with this sector due to various reasons, few of them are locational disadvantages, limited career growth opportunities and less pay package.

- This sector of the industry wants to expand the capacity, but due to uncertain market condition, shortage on raw material front, stringent conditions of approvals from pollution control department, logistic issues, difficulty in getting loans, high rate of interest etc.

- **Small Scale** (less than 0.2 million tonne)
  - Large no. of plants are in small scale.

  - Most of the Plants have Sponge Iron, Induction Furnace and Rolling Mills. Quite a few plants have stand-alone Rolling Mill.

  - Practically all plants in this category don't have any expansion plans and hence manpower requirement for next 5 years are not available. The reason cited are uncertain market conditions.

  - As per the response received, almost all plants don't recruit Metallurgical engineers. Very few % of manpower is engineering graduates. Even diploma engineers are also very few. However, this sector recruits ITI holders. But most of the manpower is not formally skilled.

  - As per the analysis of response received and verbal discussions, it transpires that most of the manpower in on contractual basis. Since manpower on contractual basis is floating, plants take little interest in training and development of contractual manpower.

- This sector of industry refrains to recruit educated and skilled manpower due to high cost of hiring and low level of retention. This can be bridged by suitable training and skill development of manpower at various levels in the organization.

- **Foundry Units**
  - Persons targeted for obtaining the needing information
    a. HR Department of concerned industries
    b. Technology Group/Similar other groups concerned for capturing the required data

c. Principals, Placement Cell, HODs of various departments from educational institutions (Engineering colleges, Polytechnics, it is, Other training centres)

Methodology for data collection

The present study on the requirement and availability of technical manpower for domestic steel industry in four states has been carried out on two distinct parts i.e., requirement and availability. The exercise is initiated by framing set of appropriate questionnaires for various industries and educational institutes in targeted states in the country. Questionnaire for industries will capture details of work force at various levels. It is to be noted here that the questionnaires for the manufacturing sector are so formulated that information on the number and distribution of technical manpower engaged in iron and steel sector and sub-sectors can be gathered from each organization. The feedback to be provided by various organizations will form the starting point of calculations for requirement of technical manpower for iron and steel sector and sub-sectors.

Sets of questionnaires were framed for the educational institutes comprising Engineering colleges, Polytechnics, ITIs/ ITCs and Pradhan Mantri Kaushal Kendra and Pradhan Mantri Kaushal Vikas Yojna (PMKVY) training centers to seek data on intake capacity, number of pass outs and number of graduates/diploma holders taking up jobs with steel and allied industries.

The questionnaires formulated to execute the present study:

1. Questionnaires supported with letters from the IISSSC as well as from NISST were sent to all iron and steel sector and sub-sector units and educational institutions in targeted 4 states. The organizations were given sufficient time to respond to the questionnaire and option to provide feedback electronically as well as through post will be given. Almost simultaneously, some members of the team visited several industries under each sector so that reliable data could be gathered expeditiously.

2. Feedback from industries and educational institutes and local Associations related to iron and steel industry formed the basis of requirement and availability of technical manpower. On the basis of such, gap between the two, if any, is identified at each skill set as well for each individual stream/discipline.

3. The study finds out net additional technical manpower requirement for steel plants. On the basis of this, discipline-wise requirements are

estimated for each skill set viz., graduate and diploma engineers, ITI certificate holders as well as BSc./M.Sc. To this end, data provided by industries for each discipline from the basis to deduce the corresponding requirement for the given future capacity. In this way, requirements of technical manpower for each skill set are obtained for different disciplines.

4. Parallel to the above, an extensive exercise was undertaken to assess the availability of graduate engineers, diploma holders and ITI trained personnel across the 4 states in the country through interactions with engineering institutions, polytechnics as well as industrial training institutes. On the basis of such, discipline wise (Mechanical, Electrical, metallurgical etc.) availability of technical manpower for different skill set (engineers and diploma holders) are obtained. Similarly, number of yearly pass outs from different ITI's across the country are also estimated.

1. Questionnaires with covering letter were sent to targeted industries
2. Response to the questionnaires through email, personal contacts through phone, support from industry associations and IISSSC
3. Separate communication to industries through respective Associations in states as SRMA.
4. Visit to few selected industries in each state, so that in total about 5 Large, 15 medium and 30 small scale units, spared over selected four states, are covered.

Industries have been contacted as per the following plan:

- Through iron and steel Associations. Associations sent them mails with Questionnaires
- Direct contact by NISST by mails with Questionnaires
- Through direct contact over phone
- Information sent prior to Workshops conducted
- In the Workshops. Awareness about objectives and distribution of Questionnaires

Involvement of Associations/ Agencies

States	Associations/ Agencies involved
Chhattisgarh	1. Chhattisgarh Steel Rerollers Association 2. Chhattisgarh Mini Steel Plant Association 3. Chhattisgarh Sponge iron Manufacturers Association 4. Chhattisgarh Steel Chamber 5. Raigarh Ispat Udyog Sangh
Odisha	1. Department of Steel & Mines, Govt of Odisha

	2. Utkal Chamber of Commerce 3. Odisha Sponge Iron Association
Jharkhand	1. Giridih Chamber of Commerce 2. Adityapur Small Industries Association 3. Singhbhum Chamber of Commerce 4. Management Studies Research Centre
West Bengal	1. West Bengal Sponge Iron Manufacturers Association 2. Steel Rolling Mills Association 3. West Bengal Small Manufacturers Association 4. Bengal Chamber of Commerce 5. Indian Foundry Association

Summary of Workshops conducted:

State	Venue and Location	Date	Salient points
Chhattisgarh	Hotel Vennington Court, Raipur	May 10, 2019	Associations participated: CSRA, CMSPA, CSIMA,CSC No. of participants: 40 Presentations: IISSSC and NISST
West Bengal	BCCI, Kolkata	May 14, 2019	Associations participated: SRMA, WBSIMA No. of participants: 25 Presentations: IISSSC and NISST
Odisha	Hotel May fair Convention, Bhubaneswar	2nd July, 2019	Associations participated: Utkal Chamber, Odisha Sponge iron No. of participants: 44 Presentations: IISSSC

Workshops and Outcomes

There Workshops were conducted one each in West Bengal, Odisha and Chhattisgarh.

Structure of Workshops were as follows:

1. These were about 3 hours duration with selected invitees, participants from local industries Institutional including local Associations.
2. NISST and IISSSC made presentations on suitable theme as desired by IISSSC

Overall Outcome of workshops

1. Awareness to the participants and industry (demand side) as a whole about the fruitfulness of the ongoing survey and ensure full support of the industry. IISSSC explained objectives of this survey and key terms associated with the survey.
2. Awareness to the participants and educational institutions (supply side) as a whole about the fruitfulness of the ongoing survey and ensure full support of educational institutions and training providers.
3. Get ideas for few job specific QPs in various disciplines from industry
4. Marketing of RPL 4.0, RPL 2.0
5. Industry and Educational institutes got a feel of the objectives of the study and they were influenced to participate in the endeavour. The message was spread throughout the particular cluster and the state. This has also created awareness among the steel industry about activities of IISSSC and its objectives. Stakeholders got appraised on opportunities available for skill development of existing manpower.

Workshop at Raipur:

Workshop at Raipur was conducted on 10th May, 2019 at Hotel Vennington Court, Raipur.

Following Associations were actively involved in the Workshop:

1. Chhattisgarh Steel Re-rollers Association
2. Chhattisgarh Mini Steel Plant Association
3. Chhattisgarh Sponge iron Manufacturers Association
4. Chhattisgarh Steel Chamber

Outcome of the Workshop:

Industry and Educational Institutes got a feel of the objectives of the study and they were influenced to participate in the endeavour. The message was spread throughout the particular cluster and the state. This has also created awareness among the steel industry about activities of IISSSC and its objectives. Stakeholders got appraised on opportunities available for skill development of existing manpower.

Awareness to the participants and industry (demand side) as a whole about the fruitfulness of the ongoing survey and ensure full support of the industry. IISSSC explained objectives of this survey and key terms associated with the survey.

Awareness to the participants and educational institutions (supply side) as a whole about the fruitfulness of the ongoing survey and ensure full support of educational institutions and training providers.

Kolkata Workshop:

Workshop at Kolkata was conducted on 14th May, 2019 at BCCI, Kolkata. Following Associations were actively involved in the Workshop:

1. West Bengal Sponge Iron Manufacturers Association
2. Steel Rolling Mills Association
3. West Bengal Small Manufacturers Association
4. Bengal Chamber of Commerce
5. Indian Foundry Association

In the inaugural session, Mr Sushim Banerjee, DG, INSDAG and CEO, IISSSC informed about the theme of the workshop. Mr KV Ramaraju, SAIL- IISCO, Burnpur, appreciated the objectives of the study and emphasized active response from the industries and institutions as well.

Outcome of the Workshop :

Industry and Educational institutes got a feel of the objectives of the study and they were influenced to participate in the endeavour. The message was spread throughout the particular cluster and the state. This has also created awareness among the steel industry about activities of IISSSC and its objectives. Stakeholders got appraised on opportunities available for skill development of existing manpower.

Awareness to the participants and industry (demand side) as a whole about the fruitfulness of the ongoing survey and ensure full support of the industry. IISSSC explained objectives of this survey and key terms associated with the survey.

Awareness to the participants and educational institutions (supply side) as a whole about the fruitfulness of the ongoing survey and ensure full support of educational institutions and training providers.

Bhubaneshwar Workshop:

Technical Workshop and Skill Gap Assessment in Iron and Steel Sector was organized jointly with Biju Patnaik National Steel Institute with support of Department of Steel and Mines, Govt of Odisha on 2nd July, 2019 at Hotel Mayfair, Bhubaneswar.

The chief guest was Mr R K Sharma, IAS, Addl Chief Secretary, Deptt of Steel & Mines, Govt of Odisha.

The entire session was very dynamic and very interactive. Representatives of various industries and institutions discussed about various options of technologies available in iron and steel sector. They all appreciated the efforts of NISST, BPNSI and IISSSC for this study and assured to give required data for the success of this study.

Outcome of the Workshop:

Industry and Educational institutes got a feel of the objectives of the study and they were influenced to participate in the endeavour. The message was spread throughout the particular cluster and the state. This has also created awareness among the steel industry about activities of IISSSC and its objectives. Stakeholders got appraised on opportunities available for skill development of existing manpower.

Awareness to the participants and industry (demand side) as a whole about the fruitfulness of the ongoing survey and ensure full support of the industry. IISSSC explained objectives of this survey and key terms associated with the survey.

Awareness to the participants and educational institutions (supply side) as a whole about the fruitfulness of the ongoing survey and ensure full support of educational institutions and training providers.

Questionnaire for Integrated Steel Plant

SKILL GAP STUDY CUM LABOUR MARKET SURVEY FOR IRON & STEEL SECTOR
(On behalf of Indian Iron & Steel Sector Skill Council (IISSSC))
Questionnaire for steel industry

Foundry				
Ferro Alloys				
Refractory				
Mechanical Maintenance				
Electrical, Electronics, Instrumentation				

G. Yearly data of technical personnel (Estimated demand vs. recruited)

Category	FY 2017-18		FY 2016-17		FY 2015-16	
	Estimated demand	Recruited	Estimated demand	Recruited	Estimated demand	Recruited
Metallurgical Engineers						
Metallurgical Engineering Diploma holders						
Mech. Engineers						
Metallurgical Engineering Diploma holders						
Electrical Engineers						
Electrical Engineering Diploma holders						
Other Engineers (all combined)						
Other diploma holders (all combined)						
B.Sc./M.Sc.						
ITIs						

SKILL GAP STUDY CUM LABOUR MARKET SURVEY FOR IRON & STEEL SECTOR
(On behalf of Indian Iron & Steel Sector Skill Council (IISSSC))
Questionnaire for steel industry

H. Apprenticeship yearly data of technical personnel

Category	FY 2017-18		FY 2016-17		FY 2015-16	
	Estimated demand	Recruited	Estimated demand	Recruited	Estimated demand	Recruited
Metallurgical Engineers						
Metallurgical Engineering Diploma holders						
Mech. Engineers						
Metallurgical Engineering Diploma holders						
Electrical Engineers						
Electrical Engineering Diploma holders						
Other Engineers (all combined)						
Other diploma holders (all combined)						
B.Sc./M.Sc.						
ITIs						
Any other specialized training courses						

*** Reasons for difference between both**

SKILL GAP STUDY CUM LABOUR MARKET SURVEY FOR IRON & STEEL SECTOR
(On behalf of Indian Iron & Steel Sector Skill Council (IISSSC))
Questionnaire for steel industry

I. Growth pattern of past five years

Year	FY 2013-14	FY 2014-15	FY 2015-16	FY 2016-17	FY 2017-18
Total Technical Manpower					
Total Production in Million Tons					
Installed Capacity (Million Tons)					
Turnover (Rs. In Cr.)					
CSR Contributions (In Rs.)					

J. Technical Manpower Demand for next seven years

Category	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25
Metallurgical/Material Science Engineering Graduates						
Metallurgical Engineering Diploma holders						
Mechanical Engineering graduates						
Electrical, Electronic and Instrumentation Engineering graduates						
Diploma Mechanical						

SKILL GAP STUDY CUM LABOUR MARKET SURVEY FOR IRON & STEEL SECTOR
(On behalf of Indian Iron & Steel Sector Skill Council (IISSSC))
Questionnaire for steel industry

Diploma Electrical						
Other diploma holders (all combined)						
B.Sc./M.Sc.						
ITI/Equivalent						
Any other specialized training courses						
Informal Sector Skilled Candidates						

K. Future Plans for capacity enhancement

Year	Up to 2020	Between 2020-2025
Projected Capacity in Million Tons Hot Metal/Pig Iron Sponge Iron Steel making Rolling Castings (Foundry) Ferro Alloys Refractory		
Projected Technology Up-gradation/ New Technologies planned to be adopted (Create extra sheet)		
Implementation of Industry 4.0 (Like IOT, AI, Robotics)		

SKILL GAP STUDY CUM LABOUR MARKET SURVEY FOR IRON & STEEL SECTOR
(On behalf of Indian Iron & Steel Sector Skill Council (IISSSC))
Questionnaire for steel industry

HR Practices	At present	By 2020	By 2025	Comments

Recruitment Pattern (JOB ROLE WISE)

Hiring criteria	Job Roles													

NEED OF SKILL DEVELOPMENT:

IDENTIFICATION/REQUIREMENT OF NEW JOB ROLES EMERGING/LIKELY TO EMERGE

Impact of	New Job Roles required	Comments
Industry 4.0		
New Technologies		
Automation		
Robotics		
Artificial Intelligence		
Digitization		

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Questionnaire for steel industry

EXISTING JOB ROLES REQUIRE RE-SKILLING / UPSKILLING (2 – 10 days training programs)

Existing Job Role	Job roles for reskilling	Duration of training

EXISTING WORKFORCE AND WORK AREA:

Existing Job-Role	Work Area	Anticipated changes in job roles by	
		2020	2025

Questionnaire for Skill Development Institutes

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Questionnaire for Educational Institute

QUESTIONNAIRE FOR INDUSTRIAL TRAINING INSTITUTES OFFERING ITI CERTIFICATES AND SIMILAR COURSES

1. Name of Institute/ College/Training provider

2. Contact person, cell number and e-mail address

Contact person
Designation
Contact no.
Mobile no.
Email id

3. **EXISTING DISCIPLINES , SEAT DISTRIBUTIONS AND PASS OUT CANDIDATES (2017-18) IN ITI**

Trades Offered	Duration	No of seats sanctioned	No of seats filled up	No of pass out students	No of students Placed in industries
Electrician					
Electrical Maintenance					
Wireman					
Fitter					
Turner					
Machinist					
Mechanic-Diesel					
Mechanic-Instrumentation					
Mechanic-Electronics					
Mechanic-Motor Vehicles					
Mechanic-Refrigeration & Air Conditioning					
Mechanic-Mechatronics					
Welder					
Advanced Welder					
Driver-cum-Mechanic					
Pump operator-cum-Mechanic					
Sheet Metal					
Foundryman					

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Pattern maker					
Information Technology					
Plumber					
Mason					
Moulder					
Draughtsman					
Fireman					
Any other (pl specify)					

4. EXISTING DISCIPLINES , SEAT DISTRIBUTIONS AND PASS OUT CANDIDATES (2017-18) IN EXCELLENCE CENTRE/SPECIALIZED TRAINING

Trades Offered (pl name the course/Trade/Specialized discipline	Duration	No of seats sanctioned	No of seats filled up	No of pass out students	No of students Placed in industries

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Questionnaire for Educational Institute

7. TRADE WISE INTAKE, PASS OUT AND EMPLOYEMENT IN PAST 3 YEARS

Trades Offered	Intake sanctioned 2016/2017/2018	No of seats filled up 2016/2017/2018	No of pass out students 2016/2017/2018	No of students Placed in industries 2016/2017/2018
Electrician				
Electrical Maintenance				
Wireman				
Fitter				
Turner				
Machinist				
Mechanic-Diesel				
Mechanic-Instrumentation				
Mechanic-Electronics				
Mechanic-Motor Vehicles				
Mechanic-Refrigeration & Air Conditioning				
Mechanic-Mechatronics				
Welder				
Advanced Welder				
Driver-cum-Mechanic				
Pump operator-cum-Mechanic				
Sheet Metal				
Foundryman				
Pattern maker				
Information Technology				
Plumber				
Mason				
Moulder				
Draughtsman				
Fireman				
Any other (pl specify)				

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Questionnaire for Educational Institute

8. FUTURE PLAN OF TRADES WITH INTAKE CAPACITY:

Trades Offered	No of seats sanctioned 2018	No of seats planned in 2020	No of seats planned in 2025	
Electrician				
Electrical Maintenance				
Wireman				
Fitter				
Turner				
Machinist				
Mechanic-Diesel				
Mechanic-Instrumentation				
Mechanic-Electronics				
Mechanic-Motor Vehicles				
Mechanic-Refrigeration & Air Conditioning				
Mechanic-Mechatronics				
Welder				
Advanced Welder				
Driver-cum-Mechanic				
Pump operator-cum-Mechanic				
Sheet Metal				
Foundryman				
Pattern maker				
Information Technology				
Plumber				
Mason				
Moulder				

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Questionnaire for Educational Institute

Draughtsman				
Fireman				
Any other (pl specify)				

9. TRAINING PRGRAMS:

a) Academic level (list training programs being conducted in last 3 years)

Area of Training	Duration	No of Students passed	No of Students Employed in Industries	No of Students Employed in Iron & Steel sector

b) Vocational Training (list training programs being conducted in last 3 years)

Area of Training	Duration	No of Students passed	No of Students Employed in Industries	No of Students Employed in Iron & Steel sector

List of Industries those supported the Study

Jharkhnad

1. Allied India Iron & Steel (P) Ltd,
2. Atibir Hi-Tech (P) Ltd,
3. Atibir Industries Co Ltd
4. B M C Metalcast Pvt Ltd
5. Balmukund Sponge & Iron (P) Ltd,
6. Bir Steels Pvt. Ltd,
7. Blue Star Casting Pvt. Ltd,
8. Blue Star Casting Pvt. Ltd,
9. Blue Star Malleable Pvt Ltd
10. BMC Ferrocast Pvt. Ltd
11. Eefco Metals & Powers (P) Ltd,
12. ESH Ispat Pvt. Ltd.
13. Ganpati Wire Industries
14. Indrani Steels Pvt Ltd,
15. Saluja Steel & Power (P) Ltd
16. Santipuria Alloys (P) Ltd,
17. Swati Concast (P) Ltd.
18. Union Enterprises,

Chhatisgarh

1. Adarsh Ispat Udyog (P) Ltd,
2. Agrawal Sponge Pvt. Ltd,
3. Ashirwad Ispat Udyog,
4. Ashok Ispat Udyog,
5. Avani Ferro Alloy Pvt. Ltd,
6. Balajee Loha Ltd,
7. Balajee Loha Ltd, (TMT Division)
8. Balajee Loha Ltd, (TMT Division)
9. Bhagwati Power & Steel Limited,
10. C G Ispat Pvt. Ltd,
11. Godawari Power & Inspat Ltd,
12. Hanuman Ispat Pvt. Ltd,
13. Jayaswal NECO Industries Ltd,
14. Karni Steels (P) Ltd,
15. Laxmi Kripa Ispat Pvt. Ltd
16. Mahendra Sponge &
17. MSP Steel & Power Ltd,
18. Rashmi Sponge Iron & Power Ind. Ltd,
19. Shivali Udyog (I) Limited
20. Shree Hanuman Loha Ltd
21. Vandana Global Limited
22. Vandana Ispat Limited,

23. Vandana Rolling Mills Ltd,
24. Maa Kudargarhi Steels Private ltd.

Odisha

1. Ardent Steel Limited
2. Aryan Ispat & Power Pvt. Ltd,
3. Kashvi International Pvt ltd
4. Sharda Rerollers Pvt. Ltd
5. Surendra Mining Industries Pvt. Ltd.,
6. Vikram Private Limited
7. VISA Steel LTD
8. Aarti Steels Limited
9. Neelachal Ispat Nigam ltd
10. Jindal steel &power limited
11. Narbheram Power and Steel Pvt.Ltd
12. SAIL, Rourkela Steel Plant,
13. Tata Steel Limited – Kalinganagar

West Bengal

1. B D Castings P Ltd.,
2. Balaji Steel,
3. Jawala Steels Limited
4. Mackeil Ispat & Forging Ltd,
5. Rashmi Group of Industries
6. Ritesh Tradefin Ltd,
7. Shree Parasnath Re-Rolling Mills Ltd,
8. Shyam Steel Industries Ltd
9. Super Smelters Ltd,
10. Sri Vaishanavi Ispat Ltd.,
11. SAIL – Durgapur Plant
12. SAIL – ISP - Burnapur