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A Study on the Impact of Covid-19 Lockdown in Manapparai Steel Factory

[1]Dr. S. Kumar,
Assistant Professor (T), Department of Disaster Management,
Alagappa University, Karaikudi, Tamilnadu, India.
Email id : kumarspm2013@gmail.com
ORCID id: https://orcid.org/0000-0003-2355-8886
Corresponding Author: *[1]Dr. S. Kumar*

Abstract

COVID-19 put an immediate halt to many business activities across the globe, as several countries had shut down their ports, airports and domestic transportation while imposing nation-wide lockdowns, leading to a disturbance in business and civil life. The lockdown in India impacted manufacturing activities across the globe. India took special measures to control the spread by imposing one of the longest lockdowns in the world, to cushion the scarce availability of healthcare resources. The enormity of the lockdown affected manufacturing activities and supply chains alike, disrupting the overall economy. While India recovered fairly from the first wave, the second wave has hit the country the hardest in terms of fatalities. The second wave has led to further State-imposed lockdowns, impacting the economy while putting several restrictions in place on key businesses. The aim of the study is to study about the economical losses of steel factory due to covid-19 lockdown, to study about the production and sales of steel factory before and after covid-19 lockdown, to study about the economic impact of covid-19 lockdown on steel factor. The availability of cheap steel allowed larger bridges, railroads, skyscrapers, and ships. Other important steel products were steel cable, steel rod, and sheet steel, which enabled large, high-pressure boilers and high-tensile strength steel for machinery. Military equipment also improved significantly. The iron and steel industry is the bottom line producer industry. This industry is the mother of all industries as it helps other secondary industries and also helps in national development. It is one of the vital aspects of stable growth and economic development.

Keywords: Steel, Factory, Workers, Industry, Development.

Introduction:

COVID-19 put an immediate halt to many business activities across the globe, as several countries had shut down their ports, airports and domestic transportation while imposing nation-wide lockdowns, leading to a disturbance in business and civil life. The lockdown in India impacted manufacturing activities across the globe. India took special measures to control the spread by imposing one of the longest lockdowns in the world, to cushion the scarce availability of healthcare resources. The enormity of the lockdown affected manufacturing activities and supply chains alike, disrupting the overall economy.

While India recovered fairly from the first wave, the second wave has hit the country the hardest in terms of fatalities. The second wave has led to further State-imposed lockdowns, impacting the economy while putting several restrictions in place on key businesses. This was followed by a slowdown in labor-intensive industries involving manufacturing, real estate, construction, and infrastructure, on account of the reduced labor availability during this period. With learnings from the first wave, the country used its experience to combat the effects of the second wave. Strategic lockdowns and easing up of the same have helped numerous States curb the spread of infection while providing the industry with considerable regulatory initiative to restore normalcy. With proactive measures, the country is slowly and steadily fighting against the insurgent second wave. India's role in the post-COVID-19, particularly in the industrial sector, is a subject of great interest, hope, and speculation to the rest of the world. In large scale production, even small changes in using raw materials and in energy can significantly improve process efficiency. The steel industry is continuously looking for new ways to improve resource efficiency and sustainability due to high dependence on resources like energy, raw materials and utilities. There are general tools and methodologies available and applicable for a wide range of production processes. The general tools and methodologies have similar characteristics as the domain specific tools needed or already utilized in the steel industry. Indian steel industry is one of the fastest growing industries in the whole world. Steel is the backbone of any modern human civilization or it can be said steel is essential for the development of any economy. Consumption of volume of steel is the barometer for measuring the economic growth and progress of the country. The history of steel making in India can be traced back to 400 BC when the Greek emperors used to recruit Indian Archers for their army who used arrows tipped with steel. Many more evidences are there of Indian's perfect knowledge of steel making long before the advent of Christ. Archeological finds in Mesopotamia and Egypt testify to the fact that use of iron and steel was known to mankind for more than six thousand years and that some of the best products were made in India. Among the widely known relics is the Iron Pillar near Qutub Minar in Delhi. The Pillar, built between 350 and 380 AD, did not rust so far an engineering marvel that Baffles the scientists even today. Yet another engineering feat is the famous Sun temple at Konark in Orissa, built around 1200 AD, where steel structurals were used for the first time in the world. Steel is crucial to the development of any modern economy and is considered being the Backbone of human civilisation. The level of per capita consumption of steel is treated as an important index of the level of socioeconomic development and living standards of the people in any country.

Statement of the problem:

Covid-19 lockdown has affected the manufacturing activities and supply chains alike, disrupting the overall economy. While India recovered fairly from the first wave, the second wave has hit the country the hardest in terms of fatalities. The second wave has led to further State-imposed lockdowns, impacting the economy while putting several restrictions in place on key businesses. The problems that confront Indian steel industry in the age of globalization are complex in nature. The secret of sustainable turnaround lies in how Indian steel industry faces the problems and develops combative and anticipatory prowess. Lower consumption in domestic market, high cost of capital, low labor productivity, poor quality of

infrastructure like road and port, lack of expenditure, high cost of basic inputs and services, loss in production and sales of steel. Lack of technology, Low productivity, Inefficiency of public sector units, Low productivity, Inefficiency of public sector units, low potential utilisation, Heavy demand, Shortage of metallurgical coal, Inferior quality of products are the Major problems faced by Iron and steel industry. Indian steel industry is facing an interesting scenario. First, the domestic flat category prices that increased around 47% during the last six months are still at a discount of minimum 10% with global prices. From mid-April to May, the major auto manufacturers have announced production cut down at their plants. During April ’21, sales of passenger cars were expectedly lower by 10% compared to March ’21 and more de-growth in sales were observed with regard to sales of two- and three-wheelers. These plants and their OEMS are also supplying liquid medical oxygen in this crisis period. The consumer durable segment is cutting down production of ACs and refrigerators as household expenditure is on hold to cope with sudden surge of Covid. . These projects under PPP would be implemented by EPC or by HAM module which have got majority acceptance. Building roads at the rate of 40 km per day has been aimed during the current fiscal. These steel factories face economical losses and huge fall in the production and sales of steel. This Covid-19 lockdown made a great impact in the economy of steel industry.

Scope of the study:

Huge scope of growth is offered by India’s comparatively low per capita steel consumption and the expected rise in consumption due to increased infrastructure construction and the thriving automobile and railway sectors. The performance of Indian steel industry registered an impressive growth over the recent few years. The industry got all the essential ingredients required for dynamic growth like strong domestic demand, infrastructural development, demand from automotive sector, etc. Industrial reform also extended its help for development of the industry. Indian steel industry was contributing around 2 percent to Gross Domestic Product (GDP) and its weight in the Index of Industrial Production (IIP) is 6.2 percent. With an impressive track record India became a reputed name in the world steel industry. Even during the tough times of recession, the industry was succeeded of recoding the positive growth rate. Global giants from all over the world has shown their interest in the industry because of its phenomenal performance.

Objective of the study:

To study about the economical losses of steel factory due to covid-19 lockdown

To study about the production and sales of steel factory before and after covid-19 lockdown

To study about the economic impact of covid-19 lockdown on steel factory

Manikandam Block

Nagamangalam is a Village in Manikandam Block in Tiruchirappalli District of Tamil Nadu State, India. It is located 16 KM towards South from District head quarters Tiruchirapalli. 4 KM from Manikandam. 369 KM from State capital Chennai. The Manikandam block is a revenue block in the Tiruchirapalli district of Tamil Nadu, India. It has a total of 22 panchayat villages. Located in urban part of Tamil Nadu, it is one of the

15 blocks of Tiruchirappalli district. According to the administration records, the block number of Manikandam is 164. The block has 26 villages and there is total 26515 houses in this block. As per Census 2011, Manikandam's population is 107526. Out of this, 53312 are males whereas the females count 54214 here. Literacy rate in Manikandam block is 69%. 75242 out of total 107526 population is educated here. In males the literacy rate is 76% as 40796 males out of total 53312 are educated whereas female literacy rate is 63% as 34446 out of total 54214 females are literate in this block. The dark portion is that illiteracy rate of Manikandam block is 30%. Here 32284 out of total 107526 individuals are illiterate. Male illiteracy rate here is 23% as 12516 males out of total 53312 are uneducated. In females the illiteracy rate is 36% and 19768 out of total 54214 females are illiterate in this block.

Data collection

Steelmaking is the process of producing steel from iron ore and/or scrap. In steelmaking, impurities such as nitrogen, silicon, phosphorus, sulfur and excess carbon are removed from the sourced iron, and alloying elements such as manganese, nickel, chromium, carbon and vanadium are added to produce different grades of steel. Limiting dissolved gases such as nitrogen and oxygen and entrained impurities in the steel is also important to ensure the quality of the products cast from the liquid steel. [Deo, et al. (1993)]. Steelmaking has existed for millennia, but it was not commercialized on a massive scale until the late 14^{th} century. An ancient process of steelmaking was the crucible process. In the 1850s and 1860s, the Bessemer process and the Siemens-Martin process turned steelmaking into a heavy industry. Today there are two major commercial processes for making steel, namely basic oxygen steelmaking, which has liquid pig-iron from the blast furnace and scrap steel as the main feed materials, and electric arc furnance (EAF) steelmaking, which uses scrap steel or direct reduced iron (DRI) as the main feed materials. Oxygen steelmaking is fuel predominantly by the exothermic nature of the reactions inside the vessel; in contrast, in EAF steelmaking, electrical energy is used to melt the solid scrap and/or DRI materials. In recent times, EAF steelmaking technology has evolved closer to oxygen steelmaking as more chemical energy is introduced into the process. [Turkdogan, E.T. (1996)]. Steelmaking is one of the most carbon emission intensive industries in the world. As of 2020, steelmaking is estimated to be responsible for 7 to 9 per cent of all direct fossil fuel greenhouse gas emission. [Pooler, Michael, 2020] In order to mitigate global warming, the industry will need to find reductions in emissions. [Mckinsey, 2021]. In 2020, Mckinsey identified a number of technologies for decarbonization including hydrogen usage, carbon capture and reuse, and maximizing use of electric arc furnaces powered by clean energy. Steelmaking has played a crucial role in the development of ancient, medieval, and modern technological societies. Early processes of steel making were made during the classical era in Ancient Iran, Ancient China, India, and Rome. Cast iron is a hard, brittle material that is difficult to work, whereas steel is malleable, relatively easily formed and a versatile material. For much of human history, steel has only been made in small quantities. Since the invention of the Bessemer process in 19th century Britain and subsequent technological developments in injection technology and process control, mass production of steel has

become an integral part of the global economy and a key indicator of modern technological development. [Sass, Stephen L. (2011)] The earliest means of producing steel was in a bloomery. Early modern methods of producing steel were often labour-intensive and highly skilled arts. See:

- Finery forge, in which the German finery process could be managed to produce steel
- Blister steel and crucible steel

An important aspect of the Industrial Revolution was the development of large-scale methods of producing forgeable metal (bar iron or steel). The puddling furnace was initially a means of producing wrought iron but was later applied to steel production. The real revolution in modern steelmaking only began at the end of the 1850s when the Bessemer process became the first successful method of steelmaking in high quantity followed by the open-hearth furnace. Modern steelmaking processes can be divided into three steps: primary, secondary and tertiary. Primary steelmaking involves smelting iron into steel. Secondary steelmaking involves adding or removing other elements such as alloying agents and dissolved gases. Tertiary steelmaking involves casting into sheets, rolls or other forms. Multiple techniques are available for each step [Ghosh, Ahindra, 2000]. Yet the results of the internationalization process have been mixed, and many players have found it difficult to adapt their business models to foreign markets. In any case, the international presence of construction companies is expected to continue broadening in the coming years as supply of services exceeds construction demand in domestic markets. Furthermore, profit margins in the construction business are traditionally lower than in other (interrelated) businesses operated by the larger construction companies, while operating risks are higher. As a result, most construction groups have diversified their portfolio to perform activities throughout the entire infrastructure cycle. This allows construction groups to increase synergies and harness their competitive advantages and knowledge of the sector, resulting in higher profitability. Beyond the immediate economic volatility currently experienced by the global economy, there are a number of underlying trends driving the future demand for steel in the building and construction sector. At the heart of many of these trends is progressive urbanization and the growth of so-called megacities that have a population of more than 10 million inhabitants. A recent example is the proposed greenfield Neom megacity development in Saudi Arabia, with a planned size 33 times that of New York City. [Ghosh, Ahindra,(2000)] In order to counter the potential negative effects of urbanization (high energy usage, safety and security, and environmental pollution, among others), there is an increasing focus on the development of smart buildings—that is, structures that use technology-driven processes to automatically control a building's various operations and functions within an integrated management system. These developments create a significant opportunity for steel producers to evolve their thinking of how steel materials can play a role in the buildings and cities of the future. It is no longer sufficient to think in isolation about the basic material requirements. The material must embrace full, end-to-end lifecycle thinking, starting with the architect's vision and design thinking through to the end-of-life or perhaps re-purposing of a building many years in the future. In principle, steelmaking is a melting, purifying, and alloying process carried out at approximately 1,600° C (2,900° F) in molten conditions. Various

chemical reactions are initiated, either in sequence or simultaneously, in order to arrive at specified chemical compositions and temperatures. Indeed, many of the reactions interfere with one another, requiring the use of process models to help in analyzing options, optimizing competing reactions, and designing efficient commercial practices. In the steelmaking process that uses an electric arc furnance, the primary raw material is scrap metal. The scrap metal is melted and refined using electrical energy. During melting, oxidation of phosphorus, silicon, manganese, carbon, and other materials occurs, and a slag containing some of these oxidation products forms on top of the molten metal. Oxygen is used to decarburize the molten steel and provide thermal energy. This is a batch process with a cycle time of about two to three hours. Since scrap metal is used instead of molten iron, no coke making or iron making operations are associated with steel production using an EAF. Steel production is a 24-hour-a-day, 365-day-a-year process, dependent on a consistent supply of raw materials and huge amounts of energy. According to the World Steel Association, world crude steel production has increased from 851 million tonnes (Mt) in 2001 to 1,606 Mt in 2013 and world average steel use per capita has steadily increased from 150kg in 2001 to 225 kg in 2013. High demand for iron ore, coke and scrap steel, increasing energy costs, and industry consolidation have prompted steel producers to develop new methods for gaining efficiency to remain competitive. The production methods using raw materials have improved significantly over the past decade, and scrap-based production is accounting for a larger portion of the total steel supply.

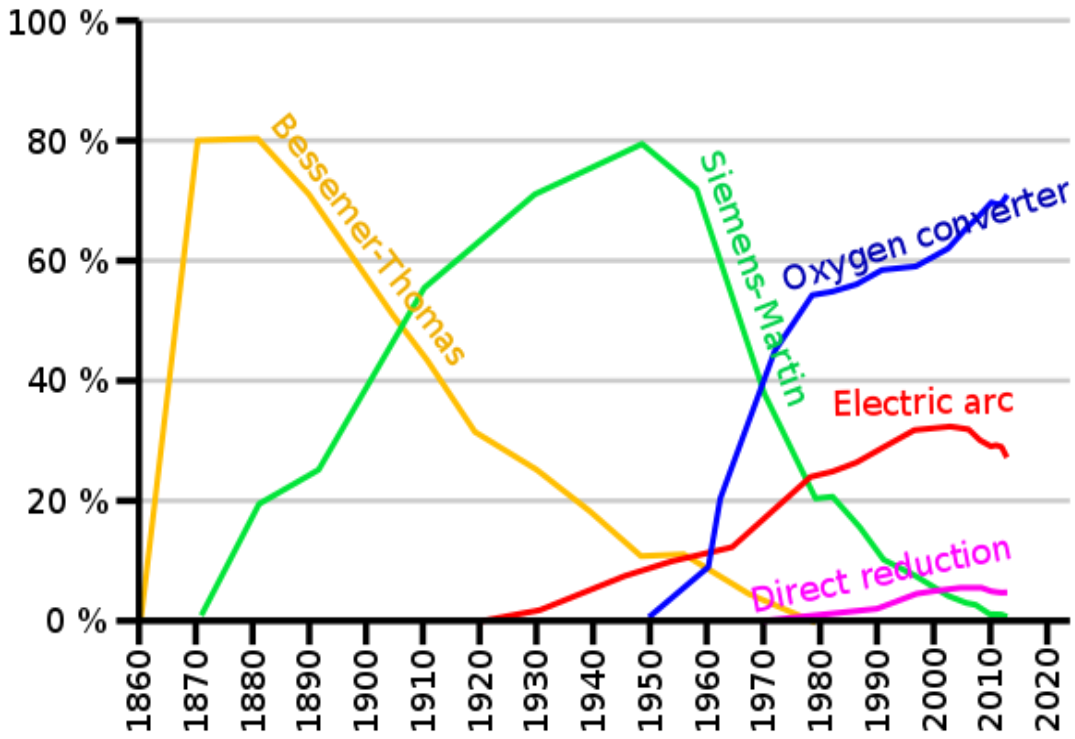

Figure 4.1 Distribution of world steel production by methods

Figure 4.2 Steel mill with two arc furnaces

Figure 4.3 Metal smelting furnance in steel mills

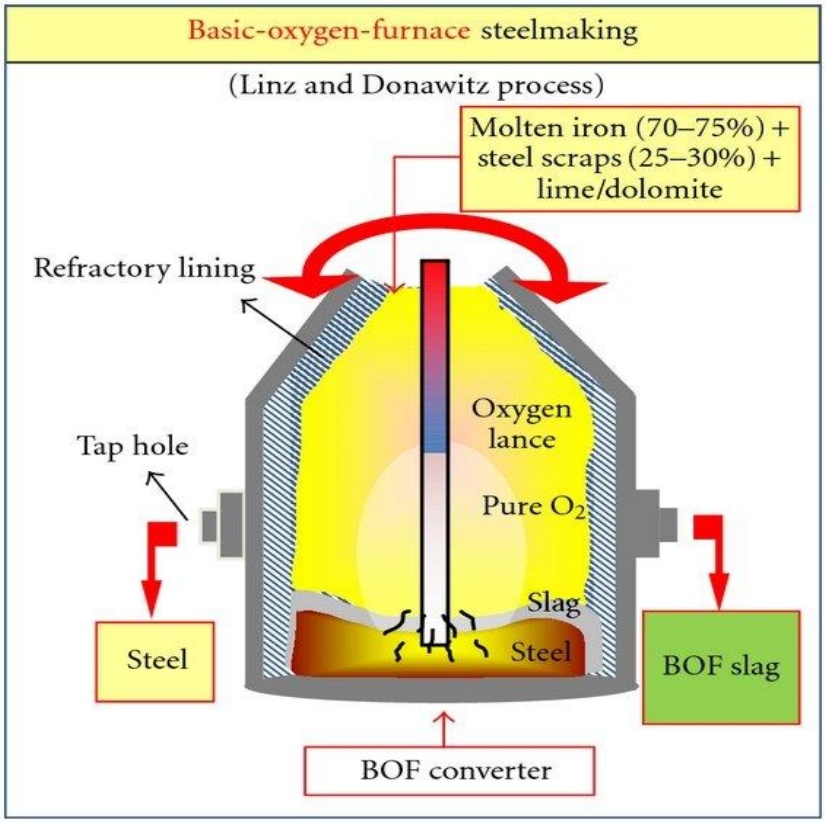

Figure 4.4 Basic oxygen furnance process

Basic oxygen steelmaking is a method of primary steelmaking in which carbon-rich pig iron is melted and converted into steel. Blowing oxygen through molten pig iron converts some of the carbon in the iron into CO and CO_2 turning it into steel. Refractories—calcium oxide and magnesium oxide—line the smelting vessel to withstand the high temperature and corrosive nature of the molten metal and slag The chemistry of the process is controlled to ensure that impurities such as silicon and phosphorus are removed from the metal. The modern process was developed in 1948 by Robert Durrer, as a refinement of the Bessemer converter that replaced air with more efficient oxygen. It reduced the capital cost of the plants and smelting time, and increased labor productivity. Between 1920 and 2000, labour requirements in the industry decreased by a factor of 1000, to just 0.003 man-hours per tonne. in 2011, 70% of global steel output was produced using the basic oxygen furnace. Furnaces can convert up to 350 tons of iron into steel in less than 40 minutes compared to 10–12 hours in an open hearth furnance. [Fruehan, Richard J.,ed. (1998)] Electric arc furnance steelmaking is the manufacture of steel from scrap or direct reduced iron melted by electric arcs. In an electric arc furnace, a batch ("heat") of iron is loaded into the furnace, sometimes with a "hot heel" (molten steel from a previous heat). Gas burners may be used to assist with the melt. As in basic oxygen steelmaking, fluxes are also added to protect the lining of the vessel and help improve the removal of impurities. Electric arc furnace steelmaking typically uses furnaces of capacity around 100 tonnes that produce steel every 40 to 50 minutes. [Fruehan, Richard J.,ed. (1998)] This process allows larger alloy additions than the basic oxygen method. In

HIsarna ironmaking process, iron ore is processed almost directly into liquid iron or hot metal. The process is based around a type of blast furnace called a cyclone converter furnance, which makes it possible to skip the process of manufacturing pig iron pellets that is necessary for the basic oxygen steelmaking process. Without the necessity of this preparatory step, the HIsarna process is more energy-efficient and has a lower carbon footprint than traditional steelmaking processes. Steel can be produced from direct-reduced iron, which in turn can be produced from iron ore as it undergoes chemical reduction with hydrogen. Renewable hydrogen allows steelmaking without the use of fossil fuels. In 2021, a pilot plant in Sweden tested this process. Direct reduction occurs at 1,500 °F (820 °C). The iron is infused with carbon (from coal) in an electric arc furnance. Hydrogen produced by electrolysis requires approximately 2600 kWh. Costs are estimated to be 20-30% higher than conventional methods. [Hutson, Matthew 2021]. However, the cost of CO_2-emissions adds to the price of basic oxygen production, and a 2018 study of science magazine estimates that the prices will break even when that price is 68 € per tonne CO_2, which is expected to be reached in the 2030's. Secondary steelmaking is most commonly performed in ladles. Some of the operations performed in ladles include de-oxidation (or "killing"), vacuum degassing, alloy addition, inclusion removal, inclusion chemistry modification, de-sulphurisation, and homogenisation. It is now common to perform ladle metallurgical operations in gas-stirred ladles with electric arc heating in the lid of the furnace. Tight control of ladle metallurgy is associated with producing high grades of steel in which the tolerances in chemistry and consistency are narrow. Steelmaking is estimated to be responsible for 7 to 9% of the global emissions of carbon dioxide. Making 1 ton of steel produces about 1.8 tons of carbon dioxide. The bulk of these emissions results from the industrial process in which coal is used as the source of carbon that removes oxygen from iron ore in the following chemical reaction, which occurs in a blast furnance Additional carbon dioxide emissions result from basic oxygen steelmaking, calcination, and the hot blast. Carbon capture and utilization or carbon capture and storage are proposed techniques to reduce the carbon dioxide emissions in the steel industry and reduction of iron ore using green hydrogen rather than carbon to make pure steel, iron and carbon are needed. On its own, iron is not very strong, but a low concentration of carbon - less than 1 percent, depending on the kind of steel, gives the steel its important properties. The carbon in steel is obtained from coal and the iron from iron ore. However, iron ore is a mixture of iron and oxygen, and other trace elements. To make steel, the iron needs to be separated from the oxygen and a tiny amount of carbon needs to be added. Both are accomplished by melting the iron ore at a very high temperature (1,700 degrees Celsius or over 3,000 degrees Fahrenheit) in the presence of oxygen (from the air) and a type of coal called coke. At those temperatures, the iron ore releases its oxygen, which is carried away by the carbon from the coke in the form of carbon dioxide.

$Fe_2O_3(s) + 3\ CO(g) \rightarrow 2\ Fe(s) + 3\ CO_2(g)$

The reaction occurs due to the lower (favorable) energy state of carbon dioxide compared to iron oxide, and the high temperatures are needed to achieve the activation energy for this reaction. A small amount of carbon bonds with the iron, forming pig iron, which is an intermediary before steel, as it has carbon content that is too high - around 4%. [Camp, James Mcintyre, Franchis, Charles Blaine (1920)]. To reduce the carbon content in

pig iron and obtain the desired carbon content of steel, the pig iron is re-melted and oxygen is blown through in a process called basic oxygen steelmaking, which occurs in a ladle. In this step, the oxygen binds with the undesired carbon, carrying it away in the form of carbon dioxide gas, an additional source of emissions. After this step, the carbon content in the pig iron is lowered sufficiently and steel is obtained. Further carbon dioxide emissions result from the use of limestone, which is melted at high temperatures in a reaction called calcination, which has the following chemical reaction:

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

Carbon dioxide is an additional source of emissions in this reaction. Modern industry has introduced calcium oxide (CaO, quicklime) as an replacement. It acts as a chemical flux, removing impurities (such as Sulfur or Phosphorus (e.g. apatite, fluorapatite) [Pereira, Antonio Clareti Et al. (1920)] in the form of slag and keeps emissions of CO_2 low. For example, the calcium oxide can react to remove silicon oxide impurities

$SiO_2 + CaO \rightarrow CaSiO_3$

This use of limestone to provide a flux occurs both in the blast furnace (to obtain pig iron) and in the basic oxygen steel making (to obtain steel). Further carbon dioxide emissions result from the hot blast, which is used to increase the heat of the blast furnace. The hot blast pumps hot air into the blast furnace where the iron ore is reduced to pig iron, helping to achieve the high activation energy. The hot blast temperature can be from 900 °C to 1300 °C (1600 °F to 2300 °F) depending on the stove design and condition. Oil, tar, natural gas, powdered coal and oxygen can also be injected into the furnace to combine with the coke to release additional energy and increase the percentage of reducing gases present, increasing productivity. If the air in the hot blast is heated by burning fossil fuels, which often is the case, this is an additional source of carbon dioxide emissions [American iron and steel institute (2005)]

RESULT AND DISCUSSION

Before covid-19 the production and sales of the factory seems to be good, at that time the production of steels range between 2500 – 3600 metric ton and the sales of steel range between 2300 – 3800 metric ton along with the previous month stocks. At the time of covid-19 lockdown, it has been a biggest blow to the world economy after the great depression of 1930. During the time of severe 21-day full lockdown, the steel factory has faced a loss in the production and sales of steel stocks. In the month of April 2020, the production of steel was about 1508.39 metric ton and the sales was about 979.54 metric ton. During the covid-19 pandemic, the economy was much worse than 2008-2009 financial crisis. The fall out of the COVID-19 on Indian economy is going to be huge because of its own lockdown, which was necessary to contain the spread of coronavirus, and also because of India's integration with the rest of the world. There was a huge fall in the production and sales of steel which affects the factory economically. The lockdown has put a lot of strain on the manufacturing industry which contributes almost 20% of the GDP. Almost all the industries are badly hit by the lockdown, this comes as yet another blow for the windows and doors manufacturing industry. The lockdown has made the economy handicapped with the shutters closed and is also affecting the livelihood of many. The

manufacturing units have already suffered a huge loss. With it, the livelihood of those associated with the industry is at stake. In this uncertain time, 90 % of the workforce has gone back to their native places, leaving manufacturers in the lurch. Worker's exodus has come as a double whammy to many COVID-hit Indian sectors that were already reeling under a slowing economy. The ongoing COVID-19 pandemic is causing unprecedented disruptions to economic activities across countries, and India is no exception.

Table 5.1 Production and Sales of Steel Factory during Covid-19 Pandemic

Month	Production in Metric Ton	Sales in Metric ton
October 2019	2986.9	3193.449
November 2019	3545.92	3049.2
December 2019	3545.92	3437.72
January 2020	3644.27	3757.58
February 2020	2704.99	3029.76
March 2020	2844.42	2387.16
April 2020	1508.39	979.54
May 2020	1804.11	1171.58
June 2020	2043.99	1892.49
July 2020	2483.11	2681.89
August 2020	2984.47	3490
September 2020	3186.69	2801.44
October 2020	3506.82	3144.38

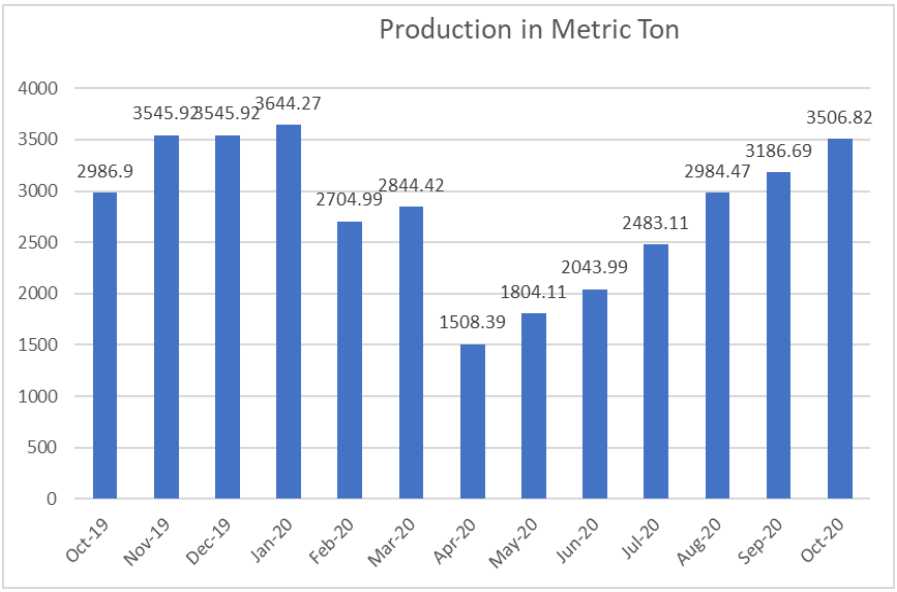

Figure 5.1 Production in Metric Ton

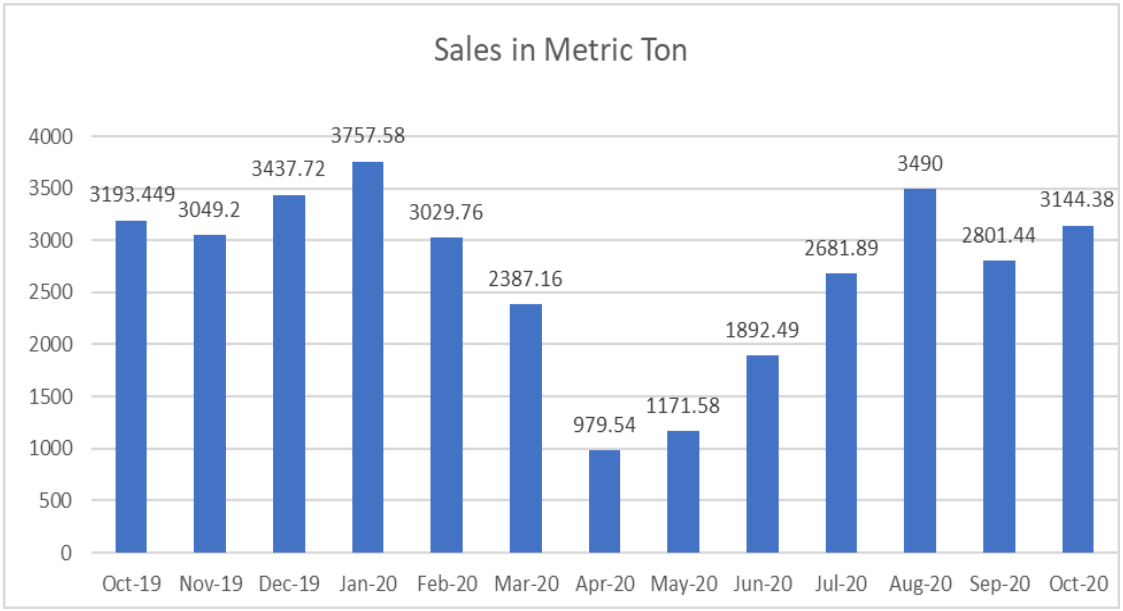

Figure 5.2 Sales in Metric Ton

The pandemic has severely affected and continues to disrupt global value chains (GVCs), domestic production network, trade, services and MSMEs thereby affecting overall growth and welfare. The current pandemic is working its way through a highly globalized world with interconnected financial markets and production networks. The complete lockdown and currently the ongoing partial lockdowns have both demand-side and supply-side effects on the Indian economy. On the supply side, the restrictions of movement of goods, services and personnel affects the production networks. The plunge in economic activities and overall output growth leads to employment loss. The supply shocks will further create demand-side effects by reducing the economy's disposable income, savings and giving rise to unwanted uncertainty. Steel demand in India is strong because the economy has shown robust growth in the past two quarters. The surge in Covid-19 cases is a concern if the situation doesn't plateau out by May-June. As a good hedge to the domestic sector, the large steel mills are also exporting a lot of semis due to high prices and increased demand from China and South East Asia," Nathani said. Many of India's top steel makers have reported their best ever performance for production or sales in their most recent results. State-owned Sail reported its highest-ever quarterly production and best-ever annual sales in its full-year results in April, while RINL reported its second-highest turnover since the company's inception in its latest full-year results. Based on different scenarios for the impact of COVID-19 on global GDP growth, the ILO estimates indicate a rise in global unemployment of between 5.3 million ("low" scenario) and 24.7 million ("high" scenario) from a base level of 188 million in 2019. By comparison, the 2008-9 global financial crisis increased global unemployment by 22 million. Underemployment is also expected to increase on a large scale, as the economic consequences of the virus outbreak translate into reductions in working hours and wages. Self-employment in developing countries, which often serves to cushion the impact of changes, may not do so this time because of restrictions on the movement of people (e.g.

service providers) and goods. Falls in employment also mean large income losses for workers. The study estimates these as being between USD 860 billion and USD 3.4 trillion by the end of 2020. This will translate into falls in consumption of goods and services, in turn affecting the prospects for businesses and economies.

5.2 Suggestions:

- Extend quality control orders on more steel products and introduce an effective monitoring mechanism to ensure standards.
- Increase value-addition norms in policy for preference to domestically-manufactured iron and steel products for Government procurement.
- Make trade actions more effective by removing the lesser duty rule (LDR) and imposing fixed duty in place of the reference price mechanism.
- Trade actions such as anti-dumping, countervailing duty and safeguards should be fast-tracked to arrest unfair exports being dumped into India.
- Raw Material Security

1) Scrap Policy: Implementation of the Scrap Policy is critical for the steel industry. Ferrous scrap is the main raw material for the secondary sector, but even the primary sector uses scrap in basic oxygen furnaces to the tune of 15% to improve efficiency, minimize cost of production, and save vital natural resources. 2)Coking Coal: Every year 45 million tonnes of coking coal are imported for manufacturing steel. Despite the shortage of coking coal, a duty of 2.5% is currently imposed on its import. The import duty of 2.5% on coking coal should be removed, to make this critical resource readily available.

- Liquidity

1) Create a dedicated Steel Fund, and broad-base funding sources to ensure availability of working capital.

2) Ensure adequate liquidity in the steel ecosystem.

- Steel Demand

Increase metal intensity in key sectors

1) Bring in robust building and construction standards to drive metal intensity in buildings (incentivize prefab buildings).

2) Incentivize the creation of SEZ parks linked to Indian primary metal producers with raw material connectivity and preferential allocation of resources.

3) Enhance the competitiveness of the domestic metal industry by rationalizing taxes. Currently, the cost of steel-making in India is $ 80-100 higher per tonne compared to other countries. Incentive auto companies for localization of key components, and for procuring domestic steel

- Increase raw material production (by leveraging Digitization in Mining) Promote domestic manufacturing and procurement of Capital Goods for steel. Promote a shift to an environmentally friendly steel sector. Promote R&D for the Indian steel sector
- Government’s focus on infrastructure and restarting road projects is aiding the boost in demand for steel. Also, further likely acceleration in rural economy and infrastructure is expected to lead to growth in demand for steel

Conclusion

The iron and steel industry are a very complex sector which is intrinsically linked with the rest of the world economy. Steelmaking is highly material and energy-intensive, which combined with the unequal geographical distribution of resources needed for manufacturing steel products and meeting final demand gives rise to significant trade flows. All those factors have a particular impact on supply and demand patterns, and on prices. There are two basic production methods that account for most of the production: (i)primary steelmaking (~72% of the global production) and (ii) secondary steelmaking (~28% of the global production). The first route requires the consumption of iron ore, coal, limestone, and scrap, plus the use of large facilities, while the second may rely on the use of scrap and electricity in smaller factories. Most steelmaking routes are energy-intensive and highly dependent on the use of solid fossil fuels. In 2006 world final energy consumption in the iron and steel industries amounted to 4.76% of global final energy consumption. Steelmaking is also a major source of greenhouse gas (GHG) emissions and air pollution. Global direct CO_2 emissions from final energy consumption in the iron and steel industry amounted to in 2006 to 3.70% of total CO_2 emissions from fuel combustion. Thus, steel-making is one of the industrial sectors most affected by the current efforts to fight global climate change (such as the European emission trading scheme). Steel prices depend on several variables, and there is not a single price for steel since there is a multitude of steel products. Those prices depend on supply and demand interaction (between steelmakers and consumers, but also on interaction with other industries competing for the same inputs), and on transport conditions. The raw material and energy costs of steel production are strongly interrelated, and closely linked with other technological variables and firm's know-how. World-wide consolidation of steelmaking firms has been taking place since the 70s in order to improve economies of scale, and also in order to reduce overcapacity. The current steel industry is made up of some large firms that operate globally and produce a significant output, and many small firms that operate at a smaller scale. The industry has been the subject of oligopolistic analyses since the 50s to date (not to mention the countless engineering-related studies). However, despite the historical consolidation trends towards multinational companies, rather than being world-wide those analyses focus on specific countries and regions. On the other hand, most analysts also expect that the industry will reach higher levels of consolidation in the forthcoming years. Therefore, any future mid or long-term analysis of the steel industry should take into account that trend and the global nature of the sector. Moreover, given the complexity of all the relationships outlined previously, exclusive reliance on expert analysis does not seem to guarantee the gaining of a proper and com-prehensive insight into the prospects of this key economic sector. The main conclusion of this overview is that any future analysis of the iron and steel industry should be based on quantitative modelling tools that: (i) properly capture the technological diversity of the industry and the key features of the supply chain, (ii) are able to consider the strategic behaviour of all the key players of the industry, and (iii) consider all those factors at the global scale. The Indian steel industry is among the upcoming industries of the world. It has a number of iron ores, which means that it has plenty of resources from which to draw its raw material. The rate of production of steel in India has been going up at a steady rate in the last few years. In

the recent times Orissa and Jharkhand have been identified as the potential steel destinations of India – the ones that would provide the Indian steel industry with its necessary raw material. There are also a number of steel companies in India like Tata and ArcelorMittal that are either coming up or have established themselves as prominent forces in the world steel scenario. In the recent times a lot of foreign direct investment is being made in the Indian steel industry. In fact, the rate of investment has increased in the last few years and, to a certain extent, this increase has been contributed to by the growth potential of the steel industry of India that is thought of as being impressive in the international steel circle. In the recent years a number of major steel corporations of the world have come flocking to India to avail the benefits of the flourishing steel industry of India. The number of steel projects in India has increased as well and this implies that the number of companies lining up to participate in these projects would be increasing too. There are certain challenges that are being faced by the Indian steel industry of late. There are certain issues regarding the condition of the infrastructural facilities available and the skill level of the members of the steel fraternity. The levels of skill of the various technical people associated with the steel industry has been found to be wanting and this has been a result of the inability of the Indian steel industry to attract the best people from the world of engineering and technology. The state of infrastructure needs to be improved so that the production of steel can be taken to the next level. India has traditionally been regarded as one of the top steel producers of the world. In 2004 it was ranked as the seventh largest producers of steel in the world, which is testimony to the standing of the Indian steel industry of the world. India is also supposed to have the best growth potential in the context of steel and is preceded only by China, which is a prominent steel producing and consuming country of the world. The availability of cheap steel allowed larger bridges, railroads, skyscrapers, and ships. Other important steel products were steel cable, steel rod, and sheet steel, which enabled large, high-pressure boilers and high-tensile strength steel for machinery. Military equipment also improved significantly. The iron and steel industry is the bottom line producer industry. This industry is the mother of all industries as it helps other secondary industries and also helps in national development. It is one of the vital aspects of stable growth and economic development.

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