CHAPTER ONE

INTRODUCTION

1.1 Introduction

Industrial management one of tools uses to plan, schedule and control the production and solve the problems by the best scientific ways, these scientific ways were tested and gave satisfaction performance. The industrial management tools have updated to meet the development in steel industries.

Improve productivity makes steel industries prosperity therefor this reflected positively on national income and stability.

Steel industries are one of important industries to national economic, because of huge contribution in income. Variety products and widely using make this industry distinguish and unique. But there are many problems exposure improve productivity, illustrates these problems and find the solutions lead to optimize efficiency and this goal of factories and giving new investors trust and encouragement to start business in this industry.

1.2 Industrial management

Industrial management its unique tool to recognize important factor in any country's economic growth from last two centuries. The industrial management was established in eighteenth century when Adam Smith recognized the economics benefit of specialization of labor, he recommended breaking of jobs down into subtasks and recognizes workers to specialized tasks in which they would become highly skilled and efficient. In the early twentieth century, F.W. Taylor implemented Smith’s theories and developed scientific management. From then till 1930, there were many techniques developed prevailing the traditional view. (Limaa .*el at*, 2017).

Industrial Management deals with many factors effect on production process, these factors are:

1. The development.
2. Improvement.
3. Implementation and evaluation of integrated systems of people.
4. Money.
5. Knowledge.
6. Information.
7. Equipment.
8. Energy.
9. Materials.
10. Processes.
11. Designing new product prototypes.

There are three factors effect on industrial management performance, any production process must be taken these factors to reach to optimum operation. These factors were used to assess the performance because of direction effect on the production process. These criteria are:

1. Quality. More quality means more customers satisfaction.
2. Time lines. Less time using to do work means saving money and decrease of time machine consumption, therefore long time for life cycle machine.
3. Cost. When decrease the cost in production process, that means more productivity and of sure more profit a gain to the factory. (https://slideplayer.com/slide/5393476/ jun ,2018).

1.2.1 Concept of industrial management:

Industrial management term uses to highly organize modern methods of carrying on industrial, especially manufacturing and operations. Industrial management is a process of planning, organizing, directing, controlling and managing the activities of any industry. It combines and transforms various resources used in the system and subsystem of the organization into value added product in a controlled manner. Industrial management includes following for the effective management. Industrial Engineering and Management aims to uncover and solve organizational issues by attempting to establish a desirable allocation of management resources through the use of technologies. (https://slideplayer.com/slide/5393476/, jun, 2018).

1.2.2 Other Aspects of Industrial Management

Scientific management has principles, these principles have been gradually extended to every department of industry, including office work, financing, and marketing. Soon American firms established the First personnel departments, and eventually some of the larger companies took the lead in creating environments conducive to worker efficiency after 1910.

Safety devices, plant cafeterias, better sanitation and facilities for rest and recreation were provided to increase efficiency, adding to the welfare of employees and enhancing morale. Improvements were made at the insistence of employee groups, especially in labor unions. (Tamboli.*el at* ,2014).

1.2.3 Modern Trends of Industrial Management:

Modern technological devices have made automatic and semiautomatic machines a reality, particularly in the areas of computers, electronics, thermodynamics, and mechanics, the development of such Automation is bringing about a second industrial revolution and is causing

vast changes in commerce as well as the way of work is arranged. Such technological changes and the graduate need to improve productivity and quality of products in traditional factory systems also changed industrial management Practices. In the 1960s Swedish automobile companies recommended that they could improve productivity with a system of group assembly. In a contrast to older manufacturing techniques where workers were responsible for assembling only one part of the car, group assembly gave a group of workers the responsibility for assembling an entire car. This system was applied in Japan, where managers developed a number of other innovative systems to decrease costs and improve the quality of products. Allowed workers to contribute in management suggestions to make production more efficient and solving problems existed. if there is wrong in production process, workers were given the right to shot down the assembly line of production By carefully to controlling the manufacturing process, Japanese managers were able to decrease the waste, improve productivity, and reduce inventory, thus significantly reducing costs and improving quality. By the early 1980s, Japanese companies, which had once been criticized for producing for producing low-quality goods, had established a reputation for efficiently producing high-quality, high-tech products. In the 1980s and early 90s many U.S. companies looked to increase their competitiveness by adapting Japanese methods for improving manufacturing quality.

Industry represents the pulse of economic development of any nation. The goods and Services provided by industry directly influence the social, political, economic, and cultural structures of any population. Thus, successful industrial project management holds a key position in advancing local, regional, and national development.

A community that cannot institute and sustain industrial vitality will eventually become politically delinquent and economically retarded. Project management is the process of managing, allocating, and timing resources to achieve a given goal in an efficient and expeditious manner. The intrinsic benefits of this definition are even more pronounced in fast-paced and globally influenced industrial projects.

The objectives that constitute industrial project goals may be in terms of time, costs, or technical results. Projects can range from the very simple to the very complex.

Owing to its expanding utility and relevance, project management has emerged as a separate body of knowledge that is embraced by various disciplines ranging from engineering and business to social services.

Project management techniques are widely used in many endeavors, including construction management, banking, manufacturing, engineering management, marketing, health care delivery systems, transportation, research and development, defense, and public services. The application of project management is particularly of high value in industrial enterprises. In today's fast-changing and highly competitive global market, every industrial enterprise is constantly striving to get ahead. Integrative project management offers one avenue to achieve that goal. (Tamboli.*el at* ,2014).

1.2.4 Elements of industrial operations

Industrial development is one of important primary path to achieving national economic development. So industry is very vital to the development of any nation. Historical accounts abound on how the industrial revolution had a profound effect on world development. A sustainable industrial development has positively impacted the political, economic, cultural and social balance in a community. In order to achieve and sustain industrial

development both the technical and managerial aspects of industrial projects must come into play. The initiate goal of any industry is to plan operations ahead and allocate resources appropriately to improve industrial project efficiency, effectiveness, and productivity while reducing production waste (Lean) and improving product quality (Six Sigma).

Using a formal project management approach helps it possible to achieve this goal. (Bornemann, 1963).

For projects to be effectively managed in an industrial system, managers and analysis must understand the industrial operating environment. Any high-tech industrial project is a complex undertaking that crosses diverse areas of endeavors. Both technical and organizational issues must be addressed in order to avoid system-wide project failures.

Develop compromise or tradeoff strategies for cost, schedule, and performance constraints.

Manufacturing is the process of creating a product by processing raw materials from an initial point through to the end product. It encompasses several functions that must be strategically planned, organized, scheduled, controlled, and terminated. (Newton, 2015).

The functions of manufacturing cycle includes forecasting, inventory control, and process planning, machine sequencing, quality control, decision analysis, production planning, cost analysis, process control, facility layout, work analysis, and a host of others. All of these are functions that fall within the process of planning, organizing, scheduling, and control cycles of project management. Industrial projects can be characterized by a combination of the following attributes:

1- Large external stakeholders, customers, owners

2- Internal stakeholders

3- Short product life cycle (in high-tech industries)

4- Variable investment sources

5- Narrow margins for success.

Japan introduced the JIT (just in time) concept for the inventory management. Now a day's all industries uses automation, CAD/CAM, CIM, MRP, SCM & TQM. These are the industrial management techniques used in managing all phases of industry. (Oh, 2005).

Industrial management also involves studying the performance of machines as well as people. Specialists are employed to keep machines in good working condition and to ensure the quality of their production. The flow of materials through the plant is supervised to ensure that neither Workers nor machines are idle. Constant inspection is made to keep output up to standard. Charts are used for recording the accomplishment of both workers and machines and for comparing them with established standards. Careful accounts are kept of the cost of each operation. When a new article is to be manufactured it is given a design that will make it suitable for machine production, and each step in its manufacture is planned, including the machines and materials to be used. (Newton, 2015).

1.3 Productivity

1.3.1Concept and Definition

Productivity may be defined as the ratio between output and input. Output means the amount produced or the number of items produced and inputs are the various resources employed, land, building, equipment and machinery, materials, labors, etc. (Oh ,2005).

According to Peter Ducker, "Productivity means a balance between all factors of production that will give the maximum output with smallest efforts. (Tamboli. *el at* ,2014), ILO defines productivity as the ratio of

aggregate output to aggregate input. (Atfred H. Bornemann, 1963), Productivity could be calculated from this formula:

$$\text{productivity} = \frac{A}{B+C+D}$$

A=quantity at standard price

B=labor cost

C =material cost

D = overhead (Jhalani, 2010)

From this formula productivity calculated every day and it gives us prospective of production process to monitor the weakness points to take correct action and also provide us the total productivity to compare with the previous productivity and compares with the factory goals.

1.3.2 Factors Affecting Productivity

1.3.2.1.1Factors affecting National Productivity

1. Human Resources.
2. Technology and Capital Investment.
3. Government Regulation. (Kumar .*el at* ,2016).

1.3.2.2 Factors affecting Productivity in Manufacturing and Services Sectors

1. Product and System Design.
2. Machinery and Equipment.
3. Skill and Effectiveness of the Worker.
4. Production Volume.(Kumar. *el at* ,2016)

1.3.3 Measurement of Productivity

The basic objectives of productivity measurement are:

1- To study performance of system overtime.

2- To have relative comparison of different systems for a given level; and

3- To compare the actual productivity of the system with its planned productivity. (Kumar. *el at* ,2016).

The most common way is to express both outputs and the inputs in monetary terms.

1.3.3.1 Raw material productivity can be increased by:

1- Proper choice of design.

2- Better handling of materials and reduction of rejection.

3- Recycling and reuse of materials.

4- Searching alternative cheaper material.

$$\text{material productivity} = \frac{\text{number of units produced}}{\text{cost of mateial}}$$

(pandey,2018)

It's one of important productivity in productivity formula because of inconstant of raw materials; any change in raw materials effect on final product, raw materials quality has main relationship with the quality of final product.

Toyota's productivity for all of its processes is outstanding. The Toyota Production System (called TPS) is referenced continually by businesses all over the world. TPS is P/OM-hub-centric, connecting all other business functions (Gupta .*el at* ,2014).

1.3.3.2 Labor Productivity

Output can be measured in total quantity produced and labor can be measured in total man hours required to produce that output

$$\text{labor productivity} = \frac{\text{number of units produced}}{\text{man hours utilized}}$$

(pandey,2018)

Output and labor can also be measured in terms of their value in money value.

Labor productivity can be increased by**:**

1- Providing training to use best method of production.
2- Constantly motivating the workers by providing financial and non-financial incentives.
3- Keeping high morale of the employees.
4- Improving working condition on the plant. (pandey,2018)

1.3.3.3 Machine Productivity

Output can be measured in total quantity produced and machine can be measured in total machine hours required to produce that output.

$$\text{machine productivity} = \frac{\text{actual input}}{\text{actual machine hours utilized}}$$

(pandey,2018)

Machine productivity can be improved by:

1- Preventive maintenance.
2- Use of proper speed, feed, etc.
3- Using method study techniques (Using best method).
4- Use of skilled, properly trained workers. (pandey,2018).

1.3.3.4 Capital Productivity

$$\text{capital productivity} = \frac{\text{Turn over}}{\text{actual machine hours utilized}}$$

(pandey,2018).

Capital productivity can be improved by:

1. Better utilization of capital resources like land, building machines etc.
2. Careful make or buy decision.
3. By using modern techniques of production, maintenance, flexible Manufacturing system, proper plant layout etc. (pandey,2018).

1.3.3.5 Productivity Index

Productivity index issued to compare the productivity during the current year with the productivity during the base year.

Base year is any year which the company uses for comparative study

$$\text{productivity index} = \frac{\text{productivity during thr current year}}{\text{productivity during the base year}}$$

(pandey,2018).

Sources of Information for Productivity Index, There are three major sources**:**

1- Product Identification Information.

2- Accounting Information.

3- Work Measurement Information. (pandey,2018).

1.4 Steel industries

Steel is generally an alloy consist of iron, carbon and other elements of metals. Because of its high tensile strength and low cost, it is a major component used in buildings, infrastructure, tools, ships, automobiles, machines, appliances, and weapons.

The base metal of Steel is Iron. Iron is able to take on two crystalline forms body centered cubic and face centered cubic, depending on its temperature and pressure. In the body-centered cubic arrangement, the an iron atom in the center and eight atoms at the vertices of each cubic unit cell;

in the face-centered cubic, there is one atom at the center of each of the six faces of the cubic unit cell and eight atoms at its vertices. It is the interaction of the allotropes of iron with the alloying elements, primarily carbon, that gives steel and cast iron their range of unique properties.

The ratio of carbon in steel alloys may contribute up to 2.14% of its weight. Varying the amount of carbon and many other alloying elements, as well as controlling their chemical and physical makeup in the final steel. (Oakland, 2014), Steel was produced in bloomery furnaces for thousands of years, but its large-scale, industrial use began only after more efficient production methods were devised in the 17th century, with the production of blister steel and then crucible steel. With the invention of the Bessemer process in the mid-19th century, a new era of mass-produced steel began. This was followed by the Siemens-Martin process and then the Gilchrist-Thomas process that refined the quality of steel. With their introductions, mild steel replaced wrought iron.

Further refinements in the process, such as basic oxygen steelmaking (BOS), largely replaced earlier methods by further lowering the cost of production and increasing the quality of the final product. Today, Steel is one of the most common manmade materials in the world, with more than 1.6 billion tons produced annually. Modern steel is generally identified by various grades defined by assorted standards organizations. (Strategic Planning Handbooks may, 2001).

1.4.1Ancient Steel

The earliest known production of Steel is seen in pieces of ironware excavated from an archaeological site in Anatolia and are nearly 4,000 years old, dating from 1800 BC. Horace identifies steel weapons such as the falcata in the Iberian Peninsula, while Noric steel was used by the Roman military.

The Chinese of the Warring States period (403–221 BC) had quench hardened steel, while Chinese of the Han dynasty (202 BC – 220 AD) created steel by melting together wrought iron with cast iron, gaining an ultimate product of a carbon-intermediate steel by the 1st century AD.

The Steel industry is always considered an indicator of economic progress, because of the critical role played by steel in infrastructural and overall economic development in 1980 there were more than 500,000 U.S. steelworkers. In 2000, the number of steelworkers fell to 224,000 U S.

In 2008, steel began international trading as a commodity on the London Metal Exchange. At the end of 2008, the steel industry faced a sharp downturn that led to many cut-backs. (https://en.wikipedia.org/wiki/Steel ,8 Aug-2018).

The Steel bar represents the biggest part of steel products according to American Steel institute figure 1-1

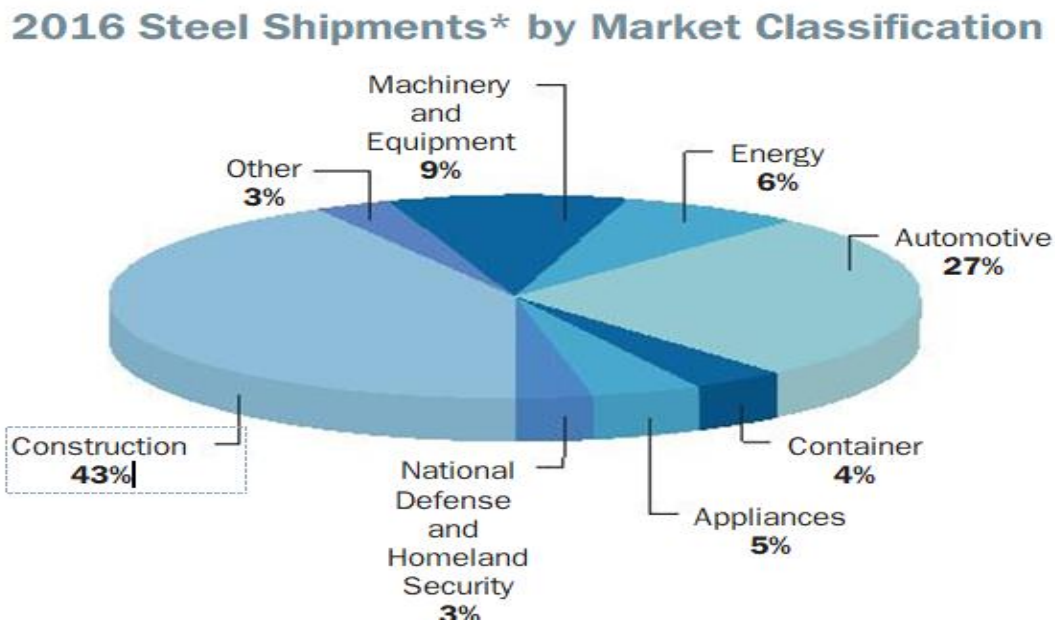


Figure1-1 the Steel products shipments (American Steel institute, Profile ,2017)

1.4.2 Steel industry in Sudan

(Sudanese chambers of industries association report, 2019) reported the steel factories don't work by full capacity.

1.4.3Elements existed in steel melting

In steel melting there are many elements existed, these elements have effected on the specification of melting, these elements should be taken consideration to prevent any problems in production process.

The important elements existed in steel melting and their effects are:

1-Carbon

Is the most important elements in Steel, it is essential in steels which have to be hardened by quenching and the degree of Carbon controls the hardness and strength, the materials as well as response to heat treatment and ductility, forgeability and machinability will decrease if the amount of Carbon increase as well as weldability properties of the Steel (https://www.linkedin.com/pulse/21-chemical-elements-effectscom ,20-jun-,

2020). Is generally Carbon can be present up to 2% (although most welded steels have less than 0.5%). (Effect of chemical elements in steel,Ameican welding society ,2019).

2-Silicon

Is one of the principal deoxidizers for Steel .Silicon helps to improve bubbles of Oxygen from the molten Steel, it is the element that is most commonly used to produce semi and fully killed steels, and normally appears in amounts less than .4%usually only small amounts .2% are present in rolled steel when it is used as a deoxidizer, however castings .35% to 1% is commonly present. Silicon dissolves in iron and tends to strengthen it, some filler metals may contain up to 1% to provide enhanced cleaning and deoxidation(https://www.linkedin.com/pulse/21-chemical-elements-effectscom ,20-jun-2020).

3- Manganese

could be the second most important element after Carbon on Steel, Manganese has effects similar to those of Carbon, and the steel producer uses these two elements in combination to obtain material with desired properties, Manganese is a necessary for the process of hot rolling of Steel by it is combination with oxygen and sulfur (https://www.linkedin.com /pulse/21-chemical-elements-effectscom ,20-jun-2020). It is a mild deoxidant acting as a cleanser taking the sulfur and Oxygen out of the melt into the slag. It increases the harden ability and tensile strength but decrease ductility. It combines with sulfur to form globular Manganese sulphides. Essential in free cutting steels for good machinability. A steel usually contains at least 0.3% Manganese because it assists in the deoxidation of the steel, prevents the formation of iron sulfide and inclusions, and promotes

greater strength by increasing the hardenability of the steel. (Effect of chemical elements in steel, American welding society ,2019).

4-Phosphorus

Although it increases the tensile strength of steel and improves machinability it is generally regarded as an undesirable impurity because of it is embrittling effect. Of Phosphorus element will have various effects on steel depending on concentration, (https://www.linkedin.com/pulse/21-chemical-elements-effectscom, 20-jun-2020) is generally considered to be an undesirable impurity in steels. It is normally found in amounts up to 0.04% in most carbon steels. In hardened steels, it may tend to cause embrittlement. In low-alloy high-strength steels, phosphorus may be added in amounts up to 0.10% to improve strength and corrosion resistance. (Effect of chemical elements in steel, American welding society ,2019).

5-Sulfur

Is usually an undesirable impurity in steel rather than an alloying element. In amounts exceeding 0.05% it tends to cause brittleness and reduce walkability. Alloying additions of sulfur in amounts from 0.10% to 0.30% will tend to improve the machinability of steel. Such types may be referred to as "resulfurized" or "free-machining". Free-machining alloys are not intended for use where welding is required. (Effect of chemical elements in steel, American welding society, 2019).

1.5 Strategic planning

1.5.1 Definition

Strategic planning is a tool for organizing the present on the basis of the projections of the desired future. That is, a strategic plan is a road map to lead an organization from where it is now to where it would like to be in five Or ten years.

It is necessary to have a strategic plan for your chapter or division. In order to develop a comprehensive plan for your chapter or division which would include both long- range and strategic elements.

1.5.2 Conditions of strategic plan

The strategic plan has five conditions, these conditions are:

1- Simple.

2- Written.

3- Clear.

4- Based on the real current situation.

5- Have enough time allowed to give it a time to settle. It should not be rushed. Rushing the plan will cause problems.

1.6 Problem resarch:

Survey in industrial organization had shown some of them lake the scientific way to deal with the problems, so this proposal has strategic plan to solve these problems.

(Sudanese chambers of industries association report, 2019) reported the full capacity of steel factories is 1,195,000 ton a year but actually the produced was 34% from full capacity, many problems exposure improve productivity.

Hypotheses

Industrial management helps Dubai steel factory to increase the productivity and sales and that are going in barrel line with strategic vision of Dubai steel factory.

This research introduces new system to manage all the operation production with the best way to make decision to choose one of many options to achieve Dubai factory for steel goals, and strategic plan to every department to improve and follow up to transfer Dubai steel factory from local market to international market.

1.7 Objectives:

The objectives of this research can be as follows:

General objective:

Increase the productivity and efficiency in Dubai steel factory using techniques and tools of industrial management to achieve the strategic vision of Dubai steel factory.

Specific objective:

1- Increase in using industrial management in industrial organization.
2- Regulating the work in industrial organization
3- Increase the productivity.
4- Increase the efficiency.
5- Using industrial management tools to control the operations.
6- Orientation to region and international measurement.
7- Acquiring the skills of decision making and experience to deal with variety circumstances.
8- Modifying the Silicon, Manganese alloy formula in steel factories in Sudan.
9- Make strategic plan based on data analysis from questionnaires.
10- Productivity calculations for materials, labors and machines.

CHAPTER TWO
LITERATURE REVIEW

2.1 steel industry

Steel industry contributes in national incoming because of variety using in different ways in our life, so its unique industry. Improvement productivity means more goods that reflects on economics in increase domestic production, therefore supply the raw materials in other industries like construction, automotive, containers, machinery and equipment and other using, that means stability in the economic without need to import from outside that reflects on national incoming positively .improvement productivity in steel industries matches with the industries needed therefore increase domestic production because of the steel industries have unique characteristics and widely using.

Many exposures face this improvement of productivity, this study will illustrate most of the problems existence during production process also expected problems will happen and the best way to deal with them and the studies that done to solve these barriers by using industrial management tools, also illustrate the modern way to increase productivity according to previous studies to avoid any problems may be happen in production line to reach optimum productivity and gains maximum profit. That brings more investment in this industry.

Prosperity in this industry depends on solve all the problems exposure improvement productivity, using modern ways in production line effect on the throughput positively that encourage other industries to adopt this ways in their production processes consequence increase productivity these points

lead to steady state in the market therefore competitions among firms will increase that mean more quality, less price and more offers in demands.

2-2 Cost reduction

Cost reduction one of tools using to improve productivity. It deals with input and increases the efficiency of input to reach the optimization of inputs less materials using, increase the efficiency of machine, decrease the time of production and decrease the energy using during the production process.

(David .*et al*, 2019) said to succeed in increasing profit of production integrated SCOOP (Steel Cot Optimization) can be the answer as a result. It aims at serving to senior managers of steel plants improve gain or cut back cost by optimizing the getting of raw materials, adjusting the operation parameters, and distinguishing worth making investment opportunities whereas matching all quality and operational necessities. SCOOP makes thought regarding chemical equilibriums, method physical science, productivity constraints and materials handiness, and it includes all prices concerned within the steelmaking processes. exploitation LMP (liters per minute) of raw materials and monetary value of finish product giving specific info and also the defects are appeared consistent with the info and everyone these analyses is nice facilitate for steelmakers to create right choices and respond quickly to dynamical market conditions. Some typical SCOOP applications in numerous practical areas include:

• Procurement: use LMP to gauge truth price of accessible raw materials within the market and confirm the best purchase. LMP may be wont to hash out worth or volume with suppliers.

• Production planning: optimize production of consequence cluster and specialize in the foremost profitable product supported calculated cost.

• Strategic study: establish method bottlenecks and calculate ROI (return of investment) for brand new method enhancements to require correct call.

• Method / operations: decide the best method parameters, like sulphur content and chemical element content in hot metal, coke quality

•collaborative management: it's necessary and makes considerably enhance communication between folks from totally different useful departments (purchasing, cost, operations then on) Over the past 10 years, SCOOP system has been with success enforced in additional than fifteen steel plants (including ArcelorMittal, ThyssenKrupp, ERDEMIR, ESSAR, Usiminas, CSN, Gerdau, Severstal, etc.). SCOOP has created vital contributions many steel plants and achieved annual advantage of several greenbacks per ton of steel. These advantages come back in the main from the subsequent areas:

• Integrated optimization of entire steelmaking method from stuff buying to downstream facilities rather than considering native optimization of individual operation “silos”.

• Higher understanding of processes and sophisticated impacts involving multiple operation units. Because the result, choices may be created consequently to realize most overall profit.

• Extra negotiation power gained by assessing true price of raw materials as compared with their terms. (David.*et al* ,2019).

Water consumption is always a function of water availability in connection with Energy efficiency, Treatment efficiency, Legal regulatory and Safety and health requirements. This consumption shows in figures 2-1 and 2-2

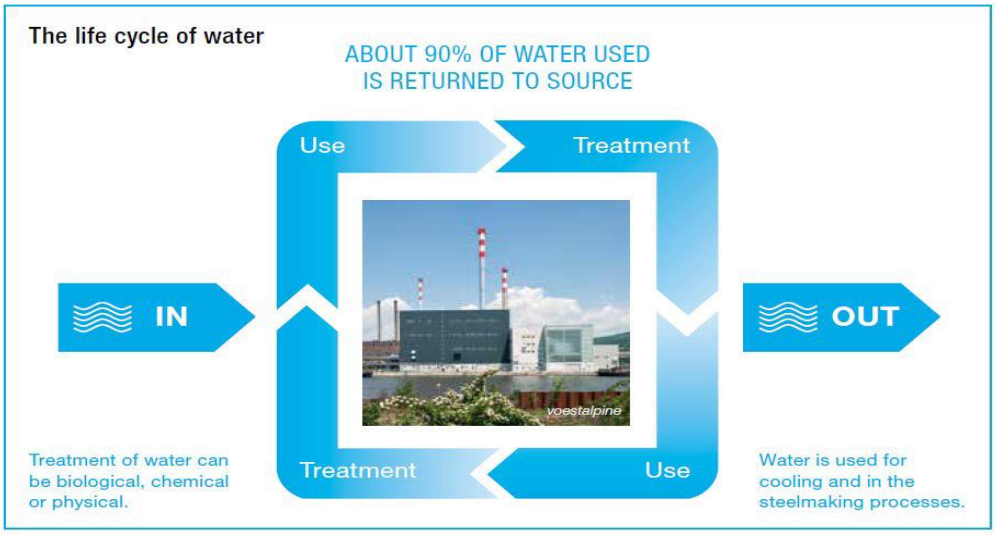


Figure 2-1 the life cycle of water (Thörner ,2018)

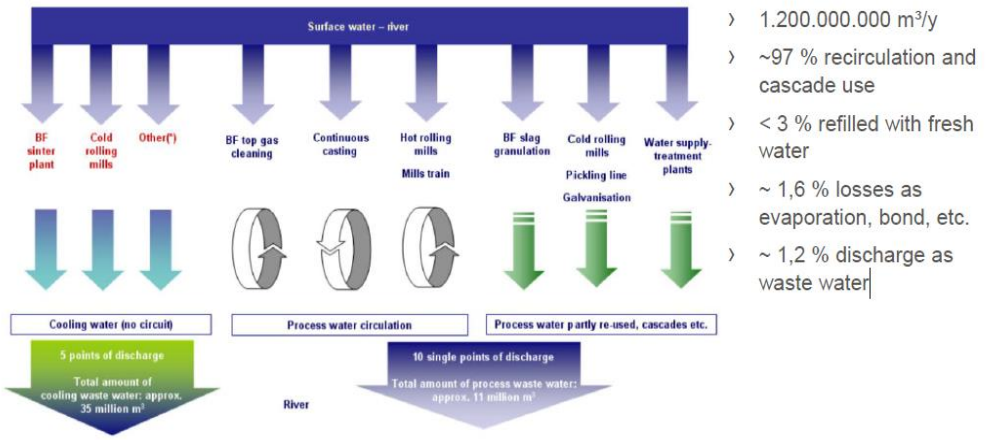


Figure 2-2 the percentage of waste water (Thörner ,2018)

In Germany there was figure shows the consumption of water from 1083 to 2014

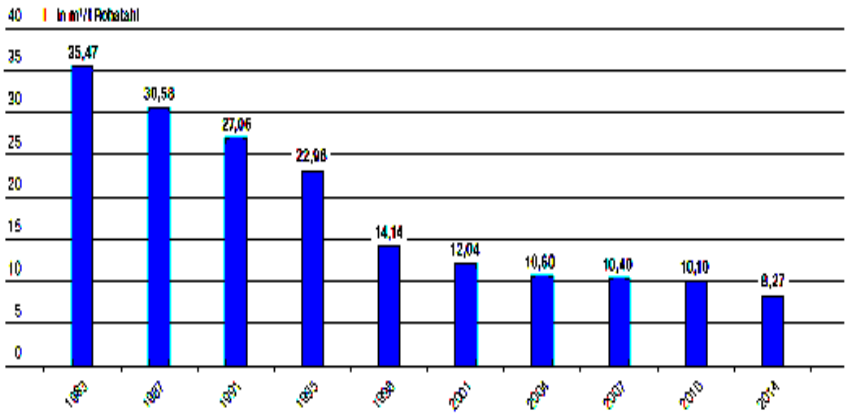


Figure 2-3 the water consumption in steel industry in Germany (Thörner ,2018)

Challenges for the steel industry in water management

1-review water framework directive (WFD).

2- Ordinance on facilities for the handing of substance hazardous to water.

3- Energy efficiency in water management.

It is necessary to assess the effectiveness of water reuse in an integrated manner, taking all environmental aspects into consideration.

Resource efficiency should consider actual consumption, difference in intake and discharge (of the same or better quality), as well as availability aspects and influences on other resource categories such as energy (Thörner ,2018).

Figure 2-4 shows the water management in steel industry

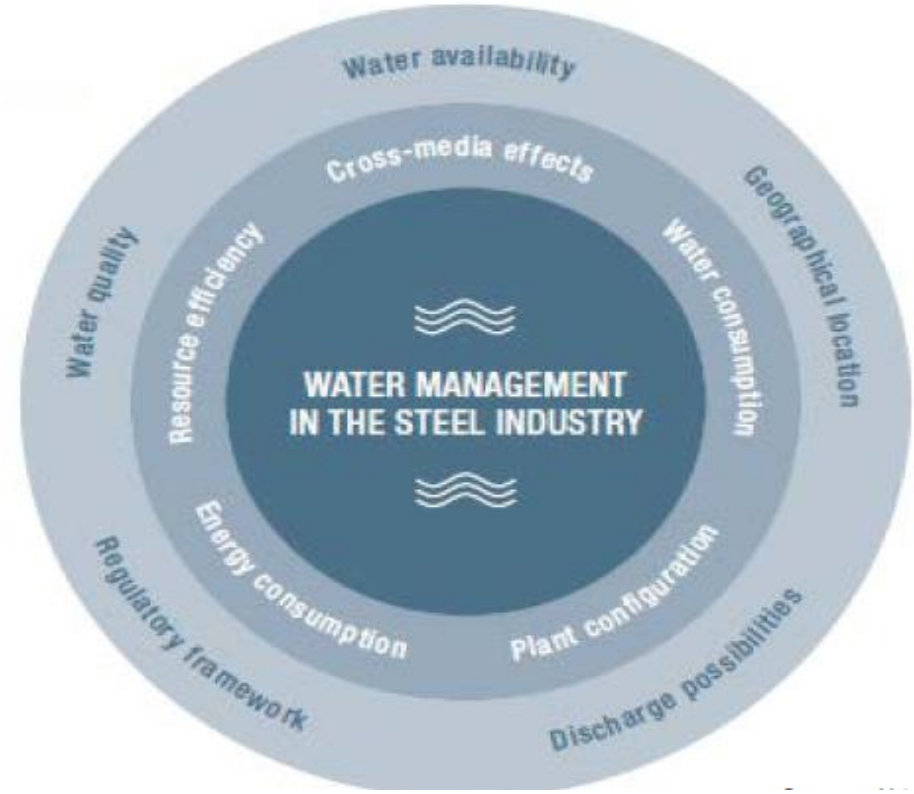


Figure 2-4 the water management in steel industry (Thörner ,2018)

(singh. *el at*,2016) said Supply Chain Inventory Management plays an awfully very important role in achieving operational excellence of any business organization. It's terribly important and difficult task for an integrated iron and manufactory to match the need of Raw Materials with unsteady steel market demand, they analyzed the importance and criticality of Raw Materials Inventory Management with reference to varied production rates during a typical integrated iron and manufactory of India. Furthermore, we tend to analyze the assorted factors and functions, that have an effect on the raw materials inventory management and perform the worth analysis of the Inventory. The current system had analyzed, supported the SWOT analysis and advised the advance by introducing correct price

effective material procure and storage thus on minimize waste and material holdup and with success meet the provision and demand of raw materials. Expenditure Breakup affects on the cost, that obvious in figure2-5

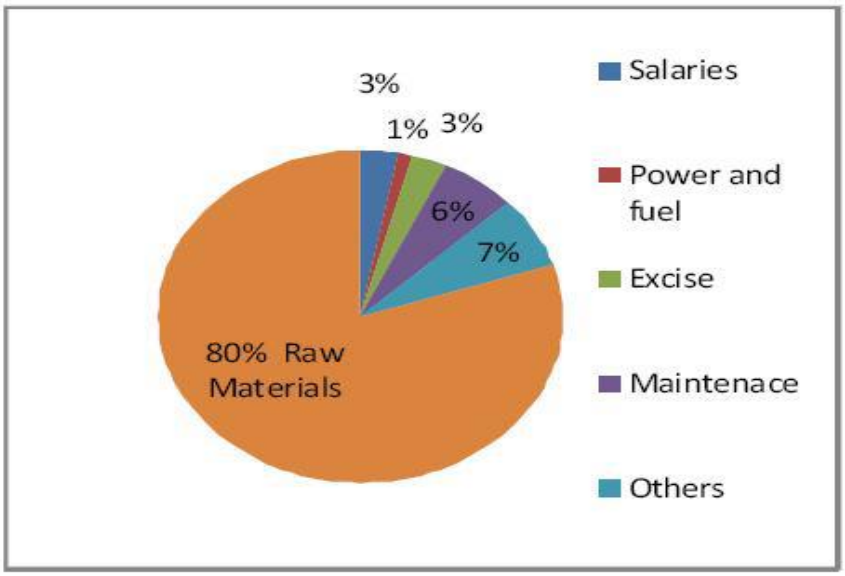


Figure 2-5 Expenditure Breakup (singh. *el at*,2016)

Also break up hot Metal Works Cost important to reach optimization cost, figure 2-6 illustrates that

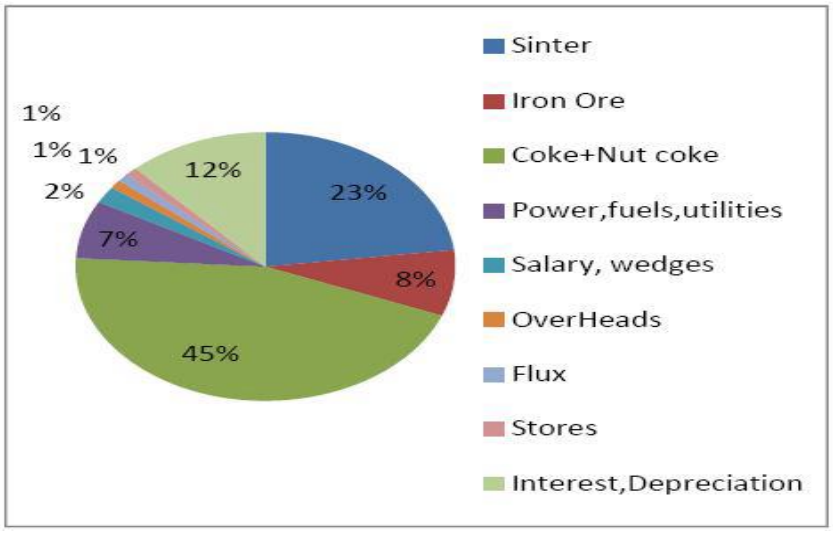


Figure 2-6 break up hot Metal Works Cost (singh. *el at*,2016)

Sinter work sector has many factors illustrated in figure 2-7

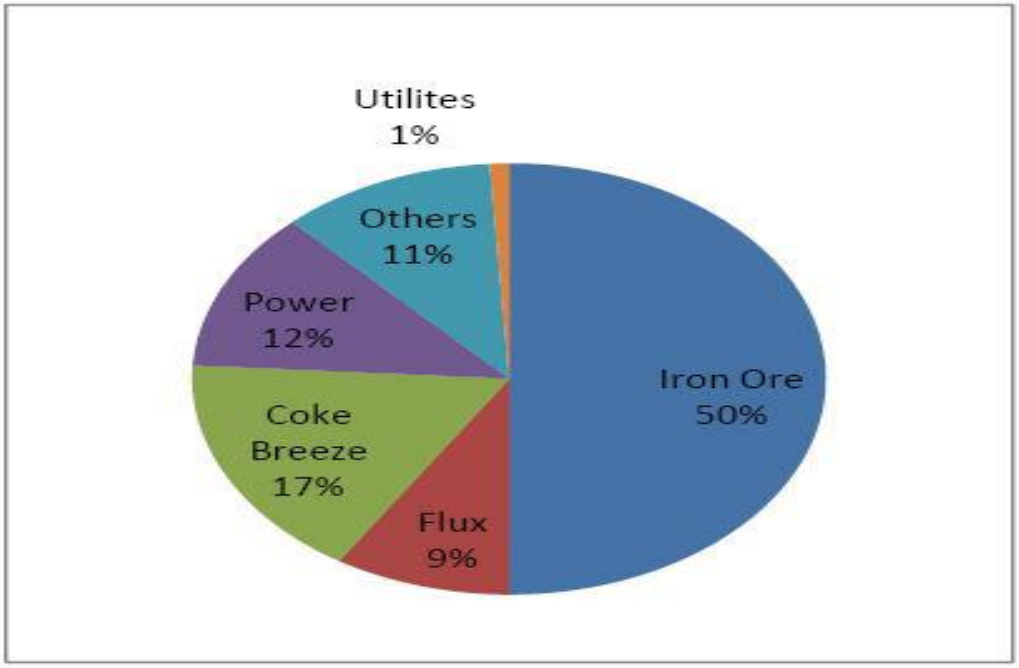


Figure 2-7 shows Breakup of Sinter Works Cost (singh. *el at*,2016)

Optimum inventory, over inventory and underneath inventory is that the goal of each organization. Each cause monetary impact and health of the business moreover as impact business opportunities. As a result of combination in production method, therefore stuff inventory system ought to be designed over a variety of probable values. Stuff Inventory Management ought to be Associate in Nursing integrated system and dependence of perform models for higher cognitive process to avoid any unsure within the demand and provide of stuff, so response to a haul is fast and acceptable. Once this happens organization achieved optimum inventory level, scale back stock outs, Lower cost of materials, and etc. price volatility in Indian Iron & Steel Industries ultimate from the match between demands and provide of stuff. This adversely affects the iron producing industries for integrated stuff internal control. Consistent stuff feed owing a captive supply

is evidenced a lot of helpful. Contrary to on top of buying from non-captive sources economically if viable, is adopted, however can't be trusty upon unforeseen hindrance and force measures. At the edge of steel boom in domestic market and international market, procuring raw materials from valued sources with price fight. (singh. *el at*,2016)

American iron and steel institute illustrates Economic Impact of the American Iron and Steel Industry in the table 2-1

Table 2-1 illustrate the economic Impact of the American Iron and Steel Industry

	Jobs	Wages	Industry Output
Direct Impact			
Materials / Mill Services	75,606	$5,791,881,500	$25,982,986,900
Iron and Steelmaking / Steel Mill Products	140,877	$13,765,596,100	$115,074,150,700
Other Steel Products / Processing / Distribution	170,270	$13,987,958,700	$65,591,246,400
Total Direct Impact	386,753	$33,545,436,300	$206,648,384,000
Total Supplier Impact	715,510	$52,694,054,800	$172,914,724,100
Total Induced Impact	877,743	$45,016,028,500	$143,029,447,900
Total Economic Impact	1,980,006	$131,255,519,600	$522,592,556,000

	Federal Taxes	State and Local Taxes	Total Taxes
Business Taxes	$33,125,794,600	$22,738,282,400	$55,864,077,000

(American iron and steel institute,23 may 2018)

2-3Time lines

Time means the period of product the steel, decrease this period reflects positively on cost of product thus improve productivity. Many studies were made to study the problems that lead to delay the time. Here some of studied made in time management in steel industries.

(Kuyama.*et al* ,2016) are studied the optimization technology for Crane Handling programing in a very Steel producing method Recently,

optimization technologies are ordinarily applied in supply programing due to considerably advanced computing technologies. A replacement system applied for programing of crane handling in a very block yard was bestowed. The projected technique consisted of programing optimization and supply simulation. Procedure simulation was conducted with operation knowledge in JFE Steel, permitting a comparison to be created between actual and theoretical crane handling operations. They additionally same will cut back the amount of handlings by half-hour. The effective transportation of slabs contributes to a rise of the client satisfaction. On the opposite hand, related to recent will increase in pc capability, optimization technologies are wide applied to supply scheduling. Since fast reformulation of schedules in response to changes in operational conditions and changes within the production schedule is demanded in supply programing, calculation speed is additionally needed together with optimality. In recent years, the steel producing method has become additional advanced as results of the trends toward higher grades and larger diversity in steel merchandise in response to customers' wants. As there's additionally a height-end want for shorter delivery dates, supply programing and production designing have additionally assumed larger importance than within the past. Supply in a very steel works isn't merely a matter of transporting finished merchandise and intermediate merchandise from the previous method to the subsequent method in accordance with the delivery schedule; it additionally has the role of rearranging the order of merchandise within the production schedule within the following method ahead therefore on change sleek transportation to the subsequent method. For this reason, establishing economical supply schedules are a difficult task.

Figure 2-8 shows the proposal optimization algorithm of crane handling schedule to reduce the time and arrangement work place

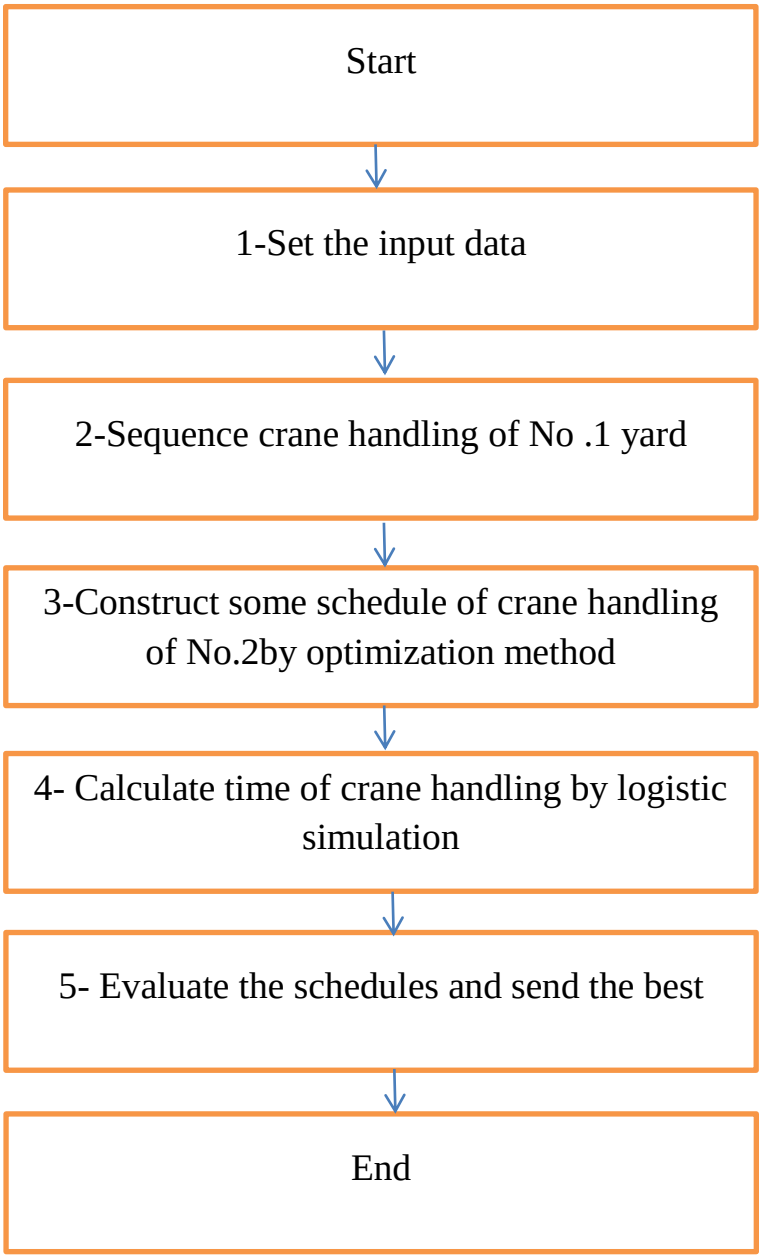


Figure 2-8 shows the proposed optimization algorithm of crane handling schedule (shuji.*et al* ,2016)

Comparison between the number of the actual handlings and the proposed handling shows Figure 2-9

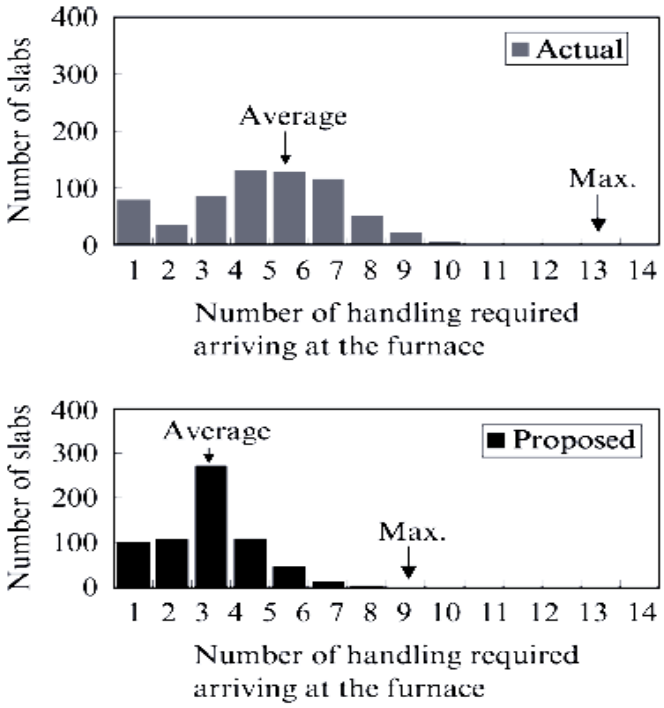


Figure 2-9 shows comparison between the number of the actual handlings and the proposed handling (shuji.*et al* ,2016)

The results of a simulation showed that a half-hour reduction within the range of crane handling operations is feasible compared with operation by Grus operators. Practical application of the developed system within the future is afoot. The developed system will contribute to client satisfaction through a discount of time interval by higher potency in block transportation. (shuji.*et al*, 2016).

(Steel industry and cost control – IspatGuru ps://www.ispatguru.com/steel-industry-and-cost-control/ ,5 feb 2020) found the process important management in steel factories could also be a variable system that's subjected to sizable quantity of lay manufacturing variable touching, the worth performance of the manufactory.it is necessary to isolate the lay

influence of the variable to know the role contend by the each variable on the worth performance of the manufactory. Major variable touching the worth performance of a manufactory unit of measurement mentioned below:

1 -productivity

It is the actual rate of production, higher is that the productivity of the units of a manufactory is that the worth of production. Higher productivity winds up in higher utilization of plant and machinery.

2-Production

Is the physical output from a unit for good price management, it's a necessity that each unit of the manufactory got to run to its most capability. once production from unit is beneath its capability then there is a rise among the precise consumption levels, to boot once any unit is underutilized then it will result into higher charge (over heads, depreciation, interest, etc.) per unit output .further it's needed that the aptitude of each succeeding unit got to match with the preceding unit so as that there is no underutilization of any units.

3-Raw materials

State of affairs raw materials contribute to major price of production. Thence specific consumption of the staple mustn't be quite what is required by the technology used. Any waste of raw materials their deterioration throughout storage got to be totally avoided. Any staple quality plays necessary. Role in value management lower quality raw materials although cheaper per ton results into higher consumption of not solely of its own however else utterly totally different raw materials else as higher consumption of fuel and energy. Thence there is large result on the worth of the merchandise

4-Fuel

All science methodology in an exceedingly very manufacturing plant takes place at heat and thence they are fuel intensive. Any price of fuel is typically on the increase, therefore specific can easy of the fuel got to be controlled with the bounds as needed by the used technology any technology is up gradation throughout this house got to incline priority so as that specific consumption of the fuel are typically reduced .pay back periods of such up graded will not be long thus price got to be applied on such modification with non-hesitation.

5-Energy

Besides fuel, there unit of measurement differing kinds of energy that unit of measurement utilized in manufacturing plant. Out of these, voltage options a considerable contribution on the worth of production. The quality of electrical power (power factory) is very necessary since it's a vast contribution on the energy consumption and therefore to the worth.

6- Maintenance

If the timely and proper maintenance of plant and instrumentation is neglected then it a mounts to breakdowns hit and miss disturbance of the processes. Processes disturbance cause either lower output or product quality fluctuations or every. This has large data price implications. Thus saving on maintenance is typically counter-production and will not be practiced if the aim is to chop back overall costs**. (**Steel industry and cost control – IspatGuru h□ps://www.ispatguru.com/steel-industry-and-cost-control/ 5 feb 2020).

The nature of steel producing merchandise and their processes expose tiny and medium-sized enterprises (SMEs) to a coffee productivity rate and

late deliveries. Lean Six alphabetic character (LSS) may be a leading technique in producing and purification productivity rate and mathematical development. Though it permits actual measure of mathematical developments and may uncover any waste and defect deviations from the merchandise, its capability in sustaining/improving productivity rate isn't well studied. This study presents a model to beat this limitation by developing a LSS model to boost productivity rate in steel producing SMEs. A quantitative analysis methodology was employed in order to check the on top of problems. Those managers and supervisors of SMEs United Nations agency are directly concerned in steel producing merchandise are the scope of respondents .The results give managers with deep insight into the approaches for up productivity rate. The numerous p worth of zero.000 < 0.05 indicates that the model is statistically vital which there's a powerful relationship between productivity and LSS, and it additionally increased the team's data of steel producing processes. Supported the study findings, it absolutely was finished that the planned model considerably improves the steel producing merchandise and enhances the aptitude of the LSS technique.

(Dogra. *el at*,2011) studied tmp (total productive maintenance) During high growth era firms area unit creating technical progress in automation and centralization of the plants, that wants great amount of manual work to maintain the automation systems. The strategy of maintaining the instrumentality of a plant is crucial for the effectiveness of producing. Total productive maintenance (TPM) is a maintenance program that involves ideas for maintaining plant and equipment effectively.

2.4 Quality

The famous method to apply quality it is DMAIC method it is illustrated in figure 2-10

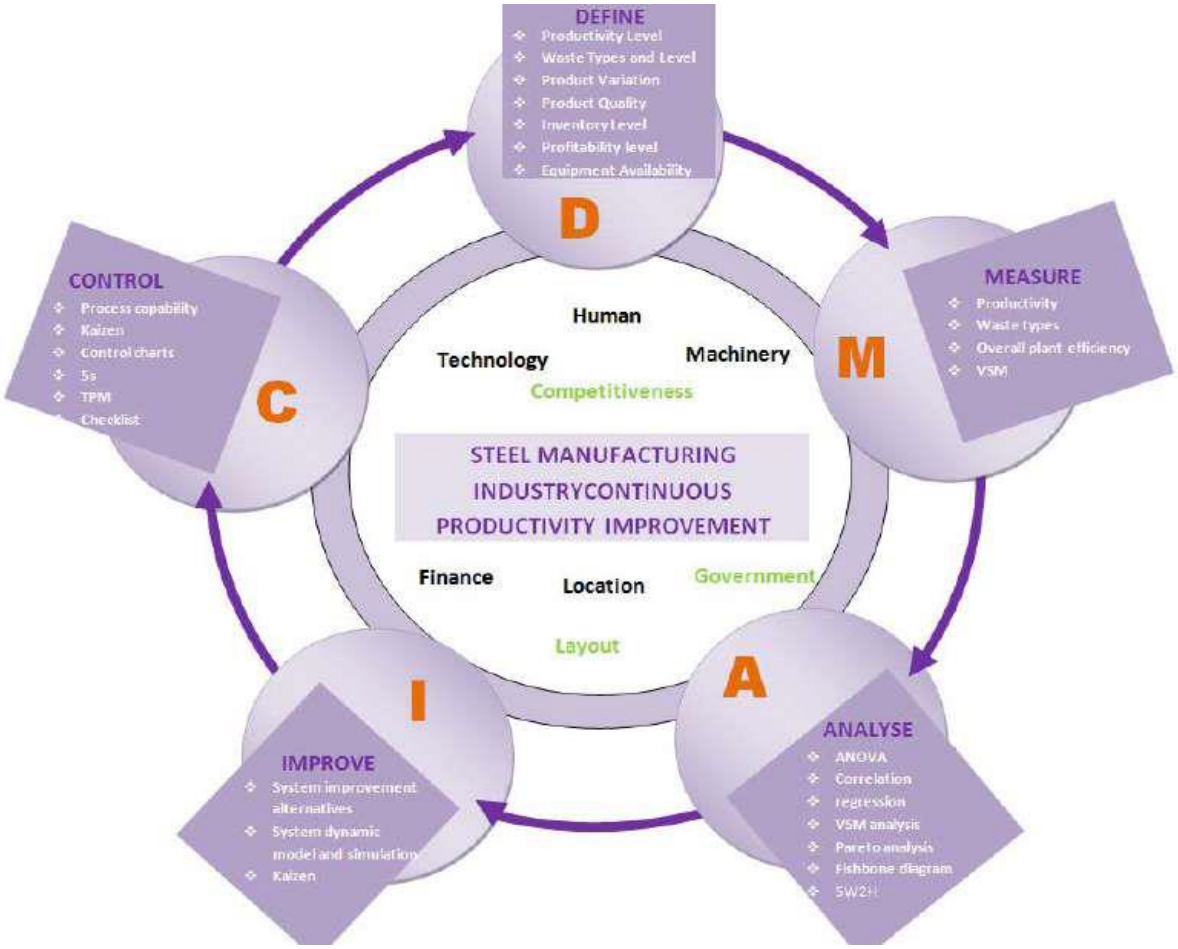


Figure 2-10 shows DMAIC structure (Munyai *.el at,* 2017)

Lean Six Sigma Model for Steel Manufacturing SMEs Their studied contributed vastly to the event of steel producing SMEs in up productivity and economical delivery of the organization, and yielded findings and proposals. The literature review given numerous ground systems at intervals the sector of SME producing method, and a Lean Six letter model for productivity improvement, human skills and information, finance, location, machinery, technology, aggressiveness, government and layout. the foremost important findings of this study indicate that the most difficulties according

to (Munyai *.el at* ,2017) Janus-faced by managers or supervisors within the steel producing SMEs area unit lack of consistent activity of financial gain per value of workers, lack of data, lack of coaching in LSS, low productivity rate, absence of the most recent technology, lack of commitment from management, lack of state support, and poor utilization of machines as a results of breakdowns and unskilled workers and poor in operation procedures., preventing them to enhance their productivity rate and producing processes, in addition as timely delivery to the purchasers. These et al. area unit the most difficulties preventing managers or supervisors of steel producing SMEs to reinforce their normal procedures by adding worth activities making certain consistency in steel producing SMEs in Republic of South Africa. The findings of this study have additionally examined productivity improvement models from alternative researchers. In future study, there's a necessity worth Stream Mapping, Cause-and-effect diagram, Just-in-time (JIT) and Total Preventative Maintenance (TPM) that be able to notice, distinguish and map the severity and extent of distinguishing bottleneck or waste in addition as reducing the merchandise variations to reveal minimum within the steel producing business. This method are quicker and a lot of correct than exploitation ancient ways. However, the findings of this study may well be helpful to steel producing managers answerable for demonstrating the value effective techniques in geographical area. for example, the understanding of application of LSS model and also the ability establish, assess and improve productivity level is essential to realize competitive advantage and steel producing SME managers affect challenges related to low productivity. A holistic Lean Six letter model of SMEs to enhance productivity rate, scale back waste and overrun within the steel producing business in addition as difficulties Janus-faced by managers

or supervisors in Republic of South Africa are clearly investigated and known, mentioned well, and suggestions or recommendations concerning these impacts and difficulties were additionally mentioned. They counseled that Steel producing industries area unit extremely regarded once addressing the difficulties in creation of employment in cities, cities or perhaps rural areas of Republic of South Africa. They are principally involved with up human capital, advanced technology and effective and economical layout within the organization, increasing aggressiveness, and growing economies in artistic and innovative ways that. The govt. ought to increase its efforts to support SMEs in steel producing to use a LSS model and input resource factors, which inspires development. Firstly, LSS is coaching programmer for each manager and workers, as well as the SME owner, have to be compelled to be organized by management. Secondly, the analysis advises that the perplexity of those value-adding activities be addressed by making certain that there's management support and commitment, quality, delivery, dependability and adaptability. Productivity of those SMEs are increased by introducing coaching on yellow belt and inexperienced belt level to workers for LSS tools awareness and identification of risk factors like waste and defects; black belt level for supervisors in distinguishing issues and breakdown answer waste reduction and master belt for house owners or managers for implementing and watching LSS tools,. Once productivity is increased in these SMEs for aggressiveness, gross domestic product improves within the country and development of the economy within the country prevails. Based on the factors addressed that negatively influence productivity of steel producing SMEs, the study recommends that if workers area unit motivated through skills, knowledge, training, innovation, responsibilities and answerableness, they'll have the flexibility to form

choices to the advantage of these SMEs. Further, with relevancy government failure to support SMEs, the study endorses that house owners take the initiative to approach government agencies place in situ, like SEDA and Productivity Storm Troops, for relevant info benefiting their businesses. Future analysis ought to additionally target assessing the impact of technology, development of LSS model associated with alternative producing industries like food and beverages in addition as textiles and wear. Handiness of the most recent technology tools employed in LSS like Just-in-time (JIT), Total quality management (TQM), Total Preventative Maintenance (TPM), Material necessities designing (MRP), applied mathematics method management (SPC), Kaizen and method capability can facilitate and accelerate the producing method for improved operational performance in SMEs. These tools is effectively used if GSMSMEs collaborate with each government agencies and lecturers within the type of conferences, workshops and seminars, as well as experiential coaching of scholars throughout their final year as well as senior students.(Munyai. *el at* ,2017).

In the steel creating method, effective programming is required for improvement of productivity. They were studied a dynamic method with a unharness time, wherever times of job might modification throughout production process thanks to uncertainties, the target is to make sure continuity of the assembly method and simply in time delivery of ultimate merchandise. an answer methodology is developed that mix a model prophetic management (MPC) strategy based mostly approach and lagrangian relaxation formula. The MPC approach tackle the parallel method programing downside, and therefore the rolling horizon approach permits applying lagrangian relaxation formula to resolve the model of the

programing downside during a rolling fashion. Machine experiments area unit applied examination the projected. Methodology with the passive adjustment usually adopted by some internal control engineers. The result shows that the projected methodology yields considerably higher results

They found that, once range the amount the quantity} of jobs and therefore the number of rolling windows area unit fastened, the quantity of machines will increase in most cases. This is often according to the intuition that for a hard and fast variety of jobs and rolling windows, once the quantity of machines will increase, there's a lot of selection of machines for every job and therefore the downside becomes easier to unravel. From the column of improvement within the tables, it absolutely was determined that our planned technique greatly outperforms the passive adjustment technique, that shows that the planned technique yield considerably higher result with smart improvement.(Isaac .*el at* ,2014).

The constant improvement in quality is imperative attributable to fight and quality of life in twenty initial centuries. The standard is achieved in varied ways that. Quality improvement in characteristics of quality or quality goals is vital for purchasers and organization itself. Variety of approaches in quality improvement, viz, lean, six sigma, PDCA, 5S etc. are often used to attain the required level of quality taking into thought the intricacies of the organization. Numerous issues which may be faced square measure the inflated complexness of business atmosphere, dependence on range of external factors and atmosphere risk, the danger refers to internal and external business factors. It’s a well-known indisputable fact that the expansion relies on range of parameters like the investment climate, quality production, improved productivity, higher human resource utilization etc. A country's industry provides a lot of dynamic and expansive suggests that of

its economic future. Steel consumption per capita is directly associated with the condition within which a population lives. Steel production and consumption is accepted as a measuring instrument of any country's progress. Equally metal rolling is one in all the foremost necessary producing processes within the contemporary world. The big majority of all metal merchandise made nowadays square measure subject to metal rolling at one purpose in their manufacture. Quite ninetieth of production of metal and nonferrous alloys goes through this route .Rolled product is influenced by numerous factors like incoming material, mechanical and electrical instrumentality, lubrication, management methods, maintenance of the instrumentality etc.

They analyzed the potential for the advance of rolling method parameters that may be completed within the long run. The developments delineated higher than purpose to the peculiarities of rolling processes and their consequences. The assessment of the connection between input and output will improve the potency and may facilitate the identification of input and output parameters for absolute best rolling system. Reviewing the effectiveness as mirrored within the relationship between the results (outcomes) and therefore the purpose of the projected work.i.e.to discover however rolling industries in Central Asian country will profit by implementing the popular continuous improvement methodology Lean Six alphabetic character. The advantages preserved from the emerged work will contribute to boost quality of varied parameters and in sustaining quality management programs. The construct given here can offer a tenet to approach for rising quality and productivity improvement in rolling merchandise by victimization lean six alphabetic character methodologies. a considerable scope exists for developing models in rolling method and their

validation in industrial observe. To conclude Lean six alphabetic characters may be applied at completely different phases and may facilitate a company to satiate its go after quality (Ahmad. *at el*, 2014).

This study aims to handle the issues that face an oversized company during a Developing country like India relating to defects within the consequence. at the start during this paper the eye is drawn towards the proportion of the energy consumed by Indian steel industries and thereby their importance of up energy potency during this sector. It's mentioned that the efforts for up the method for energy economic performance area unit already being done as a primary focus. The main target of this study is on defect reduction which might be a little however terribly impactful live once thought of during a future. By applying six letter principles, the firm will establish this state of affairs that operations area unit in. Six letter DMAIC methodologies will be utilized in the project to see the project's CTQ characteristics. It defines the potential causes as a primary step of implementation then distinctive the probable cause goes to the sources of variation. Study is helpful for any company that must notice the foremost price economical

Energy one of the important factor in steel sector because of huge number of consumption that obvious in figure 2-11

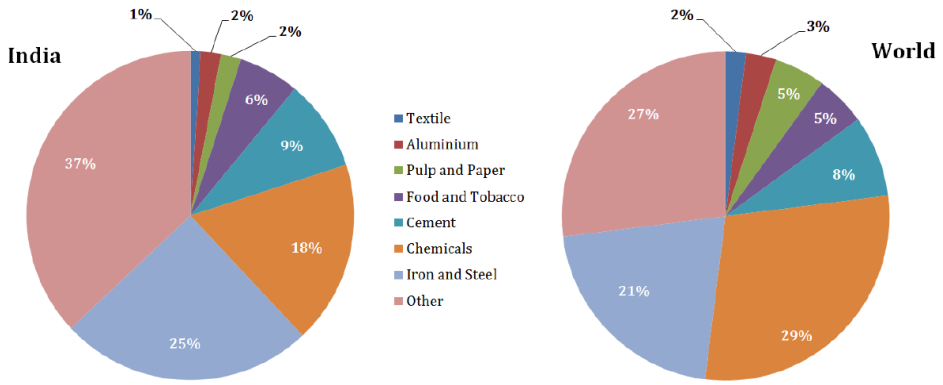


Figure 2-11 illustrate Sectoral energy consumption (2009), India (150Mtoe) and World (3019 Mtoe) (Jadhav. *at el* ,2014).

2-4-1 Six Sigma implementation requirement and hurdles

However to be able to implement the six sigma approach in the industry following are some of the important points to be taken into account also have it overcome the below discussed barriers.

2-4-1-1 Six sigma prerequisite:

1. Sturdy support from high Management and its involvement.
2. Folks ought to settle for changes and will be able to learn.
3. Adequate and correct coming up with.
4. For the folks to bear in mind of quality, workshops ought to be organized often.
5. Open discussions and involvement of all folks concerning quality matters.
6. perceive and implement cross business correct definition of internal and external customers and so an intensive attention to them.

2-4-1-2. Challenges in implementing six sigma:

1. No adequate support from Top Management.
2. Resistance of people in organization for a change.
3. Lac of Planning, inadequate planning or sometimes improper planning.
4. Lack of Training.
5. Lack of participation in the talk regarding quality matters or not involving people at all level in the discussions.
6. Insulating organization from Cross business.
7. No proper definition of internal and external customers and thus not a thorough attention to them.

This study suggests a very impactful way of energy efficient practice which is, unlike other sophisticated methods of resource energy saving, indirect method of efficient utilization of energy. As we already know defect generation not only cause the loss of money in terms of material but also loss of useful company space, time spent on decision regarding disposal or rework. Not only has this but it also led to lowering the employee morale and company reputation in a long term. Through reduction of defects company can save the energy consumed in the processing of such defective components in steel industries. And the saving is higher as the proportion of energy consumption in steel sector is considerable. The methods implemented at one place can successfully be implemented at other with minor modifications (Jadhav. *at el* ,2014)..

Also this study gives initial definition and theory of six sigma based on grounded theory approach. Although Six Sigma builds off prior quality management practices and principles, it offers a new structure for improvement. The structural differences simultaneously promote both more control and exploration in improvement efforts. Some organizations may

find benefit from the Six Sigma approach because it fits their organizational needs better. Academics need to better understand Six Sigma so that they do not overhype it or too quickly dismiss it as nothing new. It proposes a rigorous base definition of Six Sigma from the literature and field study that can be used for further research. We differentiate Six Sigma from TQM and other quality management approaches. (Jadhav. *at el* ,2014).

A new quality and operation management technique is projected for merchandise in production processes. The projected technique relies on variable applied mathematics method management that's one among the applications of principal element analysis. The standard and operation management system mistreatment the projected technique was developed and has been applied to actual plants. The projected technique allows noticing the deviation from the conventional correlation among the producing conditions of the target production processes. Significant effects on hurrying of quality anomaly detection are achieved in industrial production processes. The developed system has created contributions to reducing chance of occur an outsized quantity of product defects.

A quality and operation management methodology for a series of production processes to notice abnormality of operation conditions sensitively so as to stop resulting in inferior quality was developed. The projected methodology relies on variable applied math method management victimization principal part analysis and agglomeration technique. A system supported the projected methodology was developed and applied to quality and operation management of assorted production processes. During this study the applying results of the developed system for cold-rolled steel, which is created through steel creating, hot rolling, cold rolling and warmth treatment processes, and is reportable.

Steel production and consumption is accepted as a measuring instrument of any country's progress. Equally metal rolling is one in all the foremost necessary producing processes within the contemporary world. The big majority of all metal merchandise made nowadays square measure subject to metal rolling at one purpose in their manufacture. Quite ninetieth of production of metal and nonferrous alloys goes through this route. Rolled product is influenced by numerous factors like incoming material, mechanical and electrical instrumentality, lubrication, management methods, maintenance of the instrumentality etc. A quality and operation management methodology for a series of production processes to sight abnormality of operation conditions sensitively so as to forestall resulting in inferior quality was developed. The projected methodology is predicated on variable applied mathematics method management exploitation principal part analysis and bunch technique. A system supported the projected methodology was developed and applied to quality and operation management of varied production processes. (Shigemori .*el at*, 2013).

The quality of the projected system was confirmed through its industrial application; therefore it's with confidence expected that the system may be used for varied functions. Accordingly, the authors conceive to expand the scope of application of this technique to quality and operation management issues in varied different processes during which it's necessary to cut back watching load or to notice faults a lot of sensitively thanks to environmental changes. This system has been tributary to improvement of quality abnormality detection and restraint of mass inferior quality occurrence greatly. The coverage of the projected technique and also the system square measure about to be enlarged for varied Processes within the future (Shigemori .*el at*, 2013).

2-5 COVID-19 pandemic effects

The COVID-19 pandemic has slashed steel consumption forecasts furthermore because the overall economic outlook across the EU and therefore the world. ending measures enforced by governments ranging from March 2020 have considerably compact producing activity and steel-using industrial sectors, though these measures are utterly faraway from internment or a minimum of had restrictions upon them generally mitigated around early June thus on permit economic and industrial activity to restart. This affected the automotive sector above all, however it and different industries had already been experiencing subdued developments within the last half of 2019 because of the downslide of the producing sector within the EU, escalating trade wars between the US and a number of other of its main commercialism partners and chronic uncertainty relating to Brexit. All of those factors combined diode to continuing any deterioration in business sentiment and checked investment growth throughout 2019, even before the onset of the pandemic(Economic and steel market outlook Data up to, and including second quarter ,2020).

This study provides watching reports on crude steelmaking capability developments on a daily basis, employing a big selection of publically obtainable and business knowledge sources. This study additionally presents Associate in nursing updated summary of regional capability trends, together with Associate in nursing assessment of gross capability additions within the amount till 2022, in addition as info on cross-border capability investments. The most recent gettable information suggests that world steelmaking capability (in nominal crude terms) increased in 2019 by one.5% from the number of 2018. Moreover, several investments come still come about round the world et al square measure within the designing stages. Ought to these

comes be realized, world steelmaking capability might increase by some 2-3% between 2020 and 2022 within the absence of closures. Within the context of worldwide excess capability, it'll be vital for policymakers to continue closely watching investments and closures that come about within the industry (Hijikata, 2020)

(Gajdzik .*el at*,2021) presents an analysis of the degree of production in Polska throughout the COVID-19 crisis within the half of 2020 compared to the degree of production throughout the money crisis initiated within the U.S.A. throughout the amount 2007–2008, whose effects, within the type of an oversized decrease in production, were seen in 2009 in Polska. A comparison is additionally created to periods of prosperity in 2004, 2007, and 2017 (when there was a decent economic state of affairs within the steel market in Poland). The choice of the time period—the half of 2020—was supported the emergence of a brand new state of affairs within the economy, that was imprisonment. The aim of the analysis is to see the impact of the COVID-19 state of affairs on the steel market (volume of steel production) in Polska. The analysis performed might facilitate entrepreneurs manage their firms throughout the COVID-19 crisis. This paper belongs to the class of analysis work. The applied math analysis was completed concerning production in Polska. 3 amounts were analyzed: the primary half 2020—the period termed the COVID-19 crisis; the year 2019—the year of an oversized decrease in production in Poland caused by the planet money crisis; and periods of prosperity within the steel market—the years 2004, 2007, and 2017 (periods before crises). The analysis shows that, so as to assess the impact of the COVID-19 crisis on the functioning of enterprises or industries, it's necessary to research things and compares it with different things within the past. Moreover, crisis management within the COVID-19

state of affairs should be extremely rationalized and real, and therefore the varied industrial sectors and Companies forming them ought to adapt this method to their own state of affairs. Results: On the idea of the applied math knowledge, it had been found that, within the short term (months), the assembly of steel throughout the COVID-19 crisis was a bit more than within the money crisis of 2009 (excluding production in Gregorian calendar month 2020), and less than throughout the boom within the steel market (the comparison to the periods once there was a boom within the Polish steel market was created to point out the dynamics of decline) (Gajdzik *.el at*,2021)

2.6 Steel industry in Sudan

In Sudan there are (110) steel factories, foundry and workshops according to (Sudanese chambers of industries association report, 2019). The total of production from steel industries is 406.300 tons of Steel in 2015 the planning production was 1.195.000 tons of Steel the percentage of actual production not more than 34% (Sudanese Business & Employers federation Initiative toward economical fix up. July 2019), the Steel industry exposures to many problems (raw materials, electricity breaking off, customs charges, operation process, maintenance, and internal decision making).

Dubai steel factory uses this formula to calculate the Amount of alloy silicon, manganese addition according to Vulcan specification, Grade (2) the routine formula is:

Amount of alloy silicon, manganese= (amount of manganese in melting +amount of manganese in alloy)*weight of melting (kg) ⁄60

(https://valcanalloys.in/silicon-manganese/(5-may-2020).

The components and percentage of silicon and manganese alloy illustrated in table 2-2

Table (2) Illustrates the specific of silicon & manganese alloy

CHEMICAL SPECIFICATION	SIMN GRADE 1	SIMN GRADE 2
Manganese (Mn)	60.0% min	65.0% min
Silicon (Si)	14.0% max	16.0% min
Carbon (C)	2.50% max	2.50% max
Phosphorus (P)	0.35% max	0.30% max
Sulphur (S)	0.05% max	0.05% max
Size	Lumps / Powder	Lumps / Powder
Packaging	50 Kg HDPE bags / Jumbo bags	50 Kg HDPE bags / Jumbo bags

(https://valcanalloys.in/silicon-manganese/(5-may-2020).

Dubai steel factory in Sudan located in Khartoum south, it is one of many factories produce steel bar.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials

In this research we have questionnaires made in Dubai steel factory to improve productivity and the results were analyzed by SPSS, make strategic plan according to the analysis of data from questionnaire, also we took 303 reports describe the specific elements in the melt to modify formula that used to calculate the amount of silicon and manganese alloy added to melt.15 reports were taken to calculate the productivity for labors, materials and machines.

3.2 Methods

Four methods were used in this chapter

3.2.1method one: Questionnaires

Dubai steel factory in Sudan is one of the many factories in Sudan, it's produced about 11.000 tons of steel in 2018 (Sudanese chambers of industries association report, 2019).

To increase productivity Dubai steel factory in Sudan was taken as case study to display the problems. To achieve these goals, questionnaires were distributed to collect the data from the persons who deal with these problems daily and their suggestions to improve the productivity, these questionnaires covered almost of all the people wok in Dubai steel factory in Sudan, to achieve more information and specifics answer. These questionnaires covered 14 Engineers and Administrators and 84 Labors and Foremen. Questionnaires analysis was made by SPSS (statistical package for social sciences).

Here the questionnaires were distributed in Dubai steel factory to improve productivity.

3.2.2method two: New formula for adding silicon manganese alloy

Optimum amount from additional materials (silicon and manganese) alloy to steel melting reduce cost, less time for treatment and more quality, all the elements in the melting were taken in consideration, already there is routinely used formula in steel bar industry but this formula takes two variations (weight and manganese) only, also there are other elements which effected on the properties of melting were calculated, the ratios in every batch has explained in the ratios of the elements already existence in the melting, in this study 303 reports (have specifications of melting) had analyzed to obtain newly formula,

According to Vulcan alloy, grade (2) was used when the data collected. The obtained formula was tested three times in production line.

Sudanese standard and metrology organization has standard for rating elements in steel bar table 3-1

Table 3-1 ratio of elements in steel bar

Element		Percentage of elements (max)		
		Grade 250	Grade 420	Grade 460
Carbon	C	0.22	0.30	0.25
Manganese	Mn	0.90*	1.20**	-
Silicon	Si	0.25	0.35	-
Phosphor	P	0.05	0.05	0.05
Sulphur	S	0.05	0.05	0.05
Carbon equiva lent	Ceq	0.42	0.05	0.51
* 0.55 min ** 0.95 min - Differs from one product to another				

(Sudanese stander, 2013)

3-2-3 Method three: strategic plan:

Strategic plan will be set according to data analysis to be effectiveness and matches with the Dubai steel factory in Sudan vision and exposures.

3-2-4 Method four: productivity calculations:

15 reports were taken from Dubai steel factory in Sudan to calculate the productivity for materials, labors and machines to calculate the minimum, average and maximum productivity.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Cranach's alpha method: -

Where reliability was calculated using Cranach's alpha equation shown below:

Reliability coefficient = $\frac{n}{N-1} * \frac{1 - \text{Total variations questions}}{\text{variation college grades}}$

Validity = $\sqrt{\frac{n}{n-1} * \frac{1 - \text{Total variations questions}}{\text{variation college grades}}}$

n: number of sample

4.1.1 Labor

Cranach alpha coefficient = (0.88), a reliability coefficient is high and it indicates the stability of the scale and the validity of the study Validity coefficient is the square of the islands so reliability coefficient is (0.93), and this shows that there is a high sincerity of the scale and that the benefit of the study.

4.1.2 Engineers

Cranach alpha coefficient = (0.82), a reliability coefficient is high and it indicates the stability of the scale and the validity of the study Validity coefficient is the square of the islands so reliability coefficient is (0.91), and this shows that there is a high sincerity of the scale and that the benefit of the study.

4.1.3Cranach's alpha method: -

Table 4-1 Cranach's alpha method

Valid	Sample	reliability	Validity
Labor	84	0.88	0.93
Engineers	14	0.82	0.91

Source: researcher

Table 4-2 the frequency and percentage for the labors and engineers

Valid	Labor		Engineers	
	Frequencies	Percentage	Frequencies	Percentage
Managerial	26	87%	16	67%
Technical	4	13%	8	33%
Total	30	100%	24	100%

Source: researcher

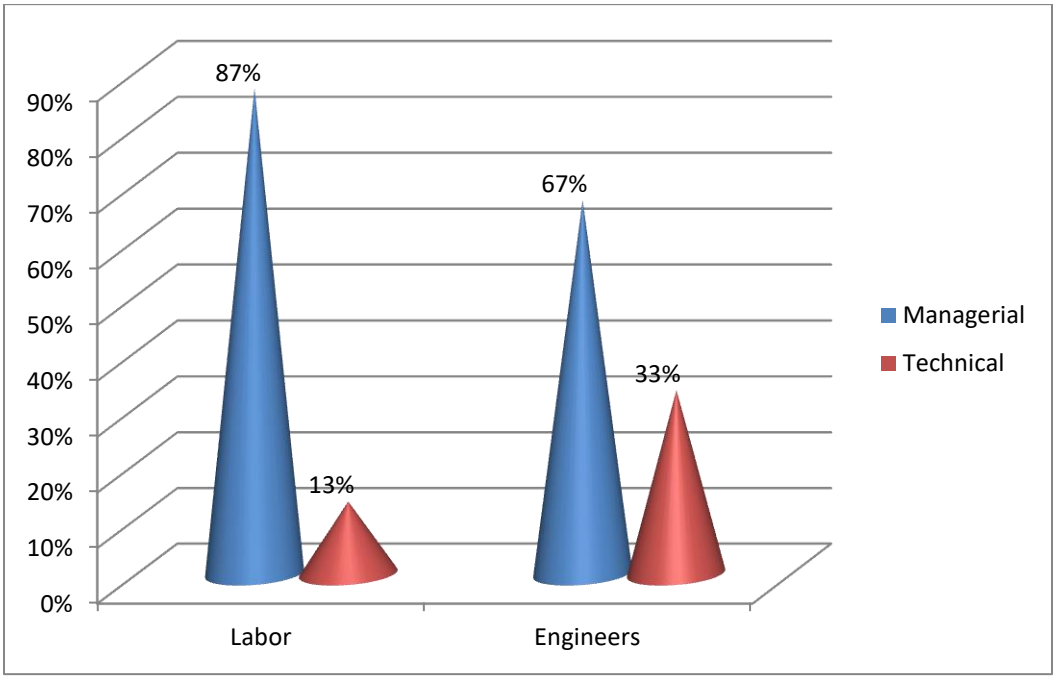


Figure 4-1 the percentage of managerial and technical problems for labors and Engineers Source: researcher

Figure (4-1) illustrates the views of the distribution of the Labor by Managerial by (%87.0) and Technical by (%13.0) and the Engineers by Managerial by (%67.0) and Technical by (%33.0).

4.2 Analysis questionnaire for Engineers and Administrators

Table 4-3 illustrates the frequency and percentage for the Engineers and Administrators

No	Phrases	Yes	%	No	%
1	Any repeated problem	6	42.9	8	57.1
2	Any new and modern way to deal with repeated problem	6	42.9	8	57.1
3	Are there improvement in administrative system	6	42.9	8	57.1
4	Does the way to deal with problems doing by scientific ways?	8	57.1	6	42.9
5	does the top management concern about workers	8	57.1	6	42.9
6	The factory have a strategic plan	8	57.1	6	42.9
7	The Factory have a report archive department	10	71.4	4	28.6
8	are the modern way apply to manage the work	10	71.4	4	28.6
9	do you have courses for administration and engineers	8	57.1	6	42.9
10	Factory contribute in social service	9	64.3	5	35.7
11	does the factory have injuries or fetal cases had happened	12	85.7	2	14.3
12	does the environment of work comfortable to work	12	85.7	2	14.3
13	does the production plan cover all the variations that may be happen during production process	9	64.3	5	35.7
14	do you have update for production plan	11	78.6	3	21.4
15	is the scheduling of work suitable for workers	10	71.4	4	28.6
16	Schedule adjusted according to product situation	12	85.7	2	14.3
17	Does the control of production is done by scientific ways and control administration tools	14	100.0	0	0.0

18	are there analysis of reasons that effect on production plan	12	85.7	2	14.3
19	are there cooperation between departments	11	78.6	3	21.4
20	Work station meet safety and health conditions	12	85.7	2	14.3
21	is the factory plan included save the environment	9	64.3	5	35.7
22	Waste riding	12	85.7	2	14.3
23	Available safety and occupational health plan	12	85.7	2	14.3
24	Are the gases come out from furnace harmful	9	64.3	5	35.7
25	Top management concern pollution	11	78.6	3	21.4
26	do you have medical insurance	12	85.7	2	14.3
27	The factory have ISO certificate	10	71.4	4	28.6
28	You have unsolved problem	13	92.9	1	7.1

Source: researcher

From the table4-3 result shows:

Any repeated problem by the Yes (%42.9) and No by (%57.1).

Any new and modern way to deal with repeated problem by the Yes (%42.9) and No by (%57.1).

Is there improvement in administrative system by the yes (%42.9) and no by (%57.1).

Does the way to deal with problems doing by scientific ways by the yes (%57.1) and no by (%42.9).

Does the top management concern about workers by the yes (%57.1) and no by (%42.9).

The factory has a strategic plan by the Yes (%57.1) and No by (%42.9).

The Factory has a report archive department by the Yes (%71.4) and No by (%28.6).

Is the modern way applied to manage the work by the Yes (%71.4) and No by (%28.6).

Do you have courses for administration and engineers by the Yes (%57.1) and No by (%42.9).

Factory contribute in social service by the Yes (%64.3) and No by(%35.7).

Does the factory have injuries or fetal cases had happened by the Yes (%85.7) and No by (%14.3).

Does the environment of work comfortable to work by the Yes (%85.7) and No by (%14.3).

Does the production plan cover all the variations that may be happen during production process by the Yes (%64.3) and No by (%35.7).

Do you have update for production plan by the Yes (%78.6) and No by (%21.4).

Is the scheduling of work suitable for workers by the Yes (%71.4) and No by (%28.6).

Schedule adjusted according to product situation by the Yes (%85.7) and No by (%14.3).

Does the control of production is done by scientific ways and control administration tools by the Yes (%100) and No by (%0.0).

Are there analyses of reasons that effect on production plan by the Yes (%85.7) and No by (%14.3).

Is there cooperation between departments by the Yes (%78.6) and No by (%21.4).

Work station meet safety and health conditions by the Yes (%85.7) and No by (%14.3).

Is the factory plan included save the environment by the Yes (%64.3) and No by (%35.7).

Waste riding by the yes (%85.7) and no by (%14.3).

Available safety and occupational health plan by the Yes (%85.7) and No by (%14.3).

Are the gases come out from furnace harmful by the Yes (%64.3) and No by (%35.7).

Top management concern pollution by the Yes (%78.6) and No by (%21.4).

Do you have medical insurance by the Yes (%85.7) and No by (%14.3).

The factory have ISO certificate by the Yes (%71.4) and No by (%28.6).

You have unsolved problem by the Yes (%92.9) and No by (%7.1).

Table 4-4 chi-square teat results for Engineers and Administrators

No	Phrases	Chi-square value	df	Sig.	Median	Interpretation
1	Any repeated problem	4.28	1	0.000	2.00	No
2	Any new and modern way to deal with repeated problem	4.28	1	0.000	2.00	No
3	Are there improvement in administrative system	4.28	1	0.000	2.00	No
4	Does the way to deal with problems doing by scientific ways?	4.28	1	0.000	1.00	Yes
5	does the top management concern about workers	4.28	1	0.000	1.00	Yes
6	The factory have a strategic plan	4.28	1	0.000	1.00	Yes
7	The Factory have a report archive department	2.57	1	0.000	1.00	Yes
8	are the modern way apply to manage	2.57	1	0.000	1.00	Yes

	the work					
9	do you have courses for administration and engineers	4.28	1	0.000	1.00	Yes
10	Factory contribute in social service	1.14	1	0.000	1.00	Yes
11	does the factory have injuries or fetal cases had happened	7.14	1	0.000	1.00	Yes
12	does the environment of work comfortable to work	7.14	1	0.000	1.00	Yes
13	does the production plan cover all the variations that may be happen during production process	1.14	1	0.000	1.00	Yes
14	do you have update for production plan	4.57	1	0.000	1.00	Yes
15	is the scheduling of work suitable for workers	2.57	1	0.000	1.00	Yes
16	Schedule adjusted according to product situation	7.14	1	0.000	1.00	Yes
17	Does the control of production is done by scientific ways and control administration tools	7.14	1	0.000	1.00	Yes
18	are there analysis of reasons that effect on production plan	4.57	1	0.000	1.00	Yes
19	are there cooperation between departments	7.14	1	0.000	1.00	Yes
20	Work station meet safety and occ health conditions	1.14	1	0.000	1.00	Yes

21	is the factory plan included save the environment	7.14	1	0.000	1.00	Yes
22	Waste riding	7.14	1	0.000	1.00	Yes
23	Available safety and occupational health plan	1.14	1	0.000	1.00	Yes
24	Are the gases come out from furnace harmful	4.57	1	0.000	1.00	Yes
25	Top management concern pollution	7.14	1	0.000	1.00	Yes
26	do you have medical insurance	2.57	1	0.000	1.00	Yes
27	The factory have ISO certificate	10.28	1	0.000	1.00	Yes
28	You have unsolved problem	10.28	1	0.000	1.00	Yes

Source: researcher

The results of table 4-4 Interpreted as follows:

1. The value of chi – square calculated to signify the differences between the any repeated problem was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
2. The value of chi – square calculated to signify the differences between the Any new and modern way to deal with repeated problem was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
3. The value of chi – square calculated to signify the differences between the Are there improvement in administrative system was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

4. The value of chi – square calculated to signify the differences between the Does the way to deal with problems doing by scientific ways was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
5. The value of chi – square calculated to signify the differences between the does the top management concern about workers was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
6. The value of chi – square calculated to signify the differences between the factory have a strategic plan was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
7. The value of chi – square calculated to signify the differences between the Factory have a report archive department was (2.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
8. The value of chi – square calculated to signify the differences between the are the modern way apply to manage the work was (2.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
9. The value of chi – square calculated to signify the differences between the do you have courses for administration and engineers was (4.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
10. The value of chi – square calculated to signify the differences between the Factory contribute in social service was (1.14) with P-value

(0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

11. The value of chi – square calculated to signify the differences between the does the factory have injuries or fetal cases had happened was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
12. The value of chi – square calculated to signify the differences between the does the environment of work comfortable to work was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
13. The value of chi – square calculated to signify the differences between the does the production plan cover all the variations that may be happen during production process was (1.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
14. The value of chi – square calculated to signify the differences between the do you have update for production plan was (4.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
15. The value of chi – square calculated to signify the differences between the is the scheduling of work suitable for workers was (2.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
16. The value of chi – square calculated to signify the differences between the Schedule adjusted according to product situation was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

17. The value of chi – square calculated to signify the differences between the Does the control of production is done by scientific ways and control administration tools was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
18. The value of chi – square calculated to signify the differences between the are there analysis of reasons that effect on production plan was (4.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
19. The value of chi – square calculated to signify the differences between the are there cooperation between departments was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
20. The value of chi – square calculated to signify the differences between the Work station meet safety and health conditions was (1.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
21. The value of chi – square calculated to signify the differences between the is the factory plan included save the environment was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
22. The value of chi – square calculated to signify the differences between the Waste riding was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
23. The value of chi – square calculated to signify the differences between the Available safety and occupational health plan was (1.14) with P-

value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

24. The value of chi – square calculated to signify the differences between the Are the gases come out from furnace harmful was (4.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
25. The value of chi – square calculated to signify the differences between the Top management concern pollution was (7.14) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
26. The value of chi – square calculated to signify the differences between the do you have medical insurance was (2.57) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
27. The value of chi – square calculated to signify the differences between the factory have ISO certificate was (10.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.
28. The value of chi – square calculated to signify the differences between the you have unsolved problem was (10.28) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

Table 4-5 the frequency and percentage for the problems for Engineers and Administrators

Valid	Frequencies	Percentage
Machine problem	3	13%
Salary problem	7	29%
Not Following technology	3	13%
Materials problem	4	17%
Improve managers and employees skills	7	29%
Total	24	100%

Source: researcher

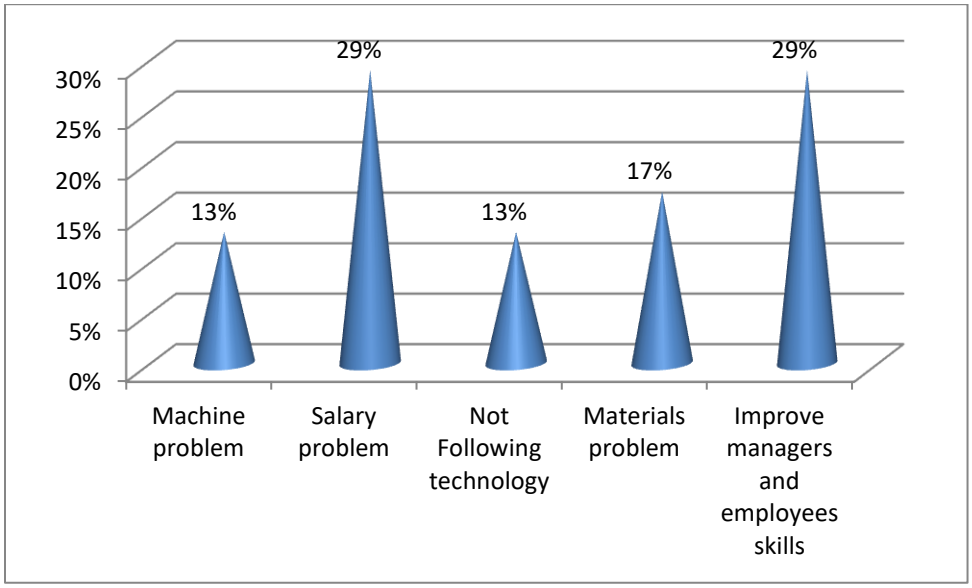


Figure 4-2 the five problems in Engineers and Administrators data analysis

Source: researcher

Figure 4-2 illustrates the views of the distribution of the sample by Machine problem by (%13.0) and Salary problem by (%29.0) and Not

Following technology by (%13.0) and Materials problem by (%17.0) and Improve managers and employees skills by (%29.0)

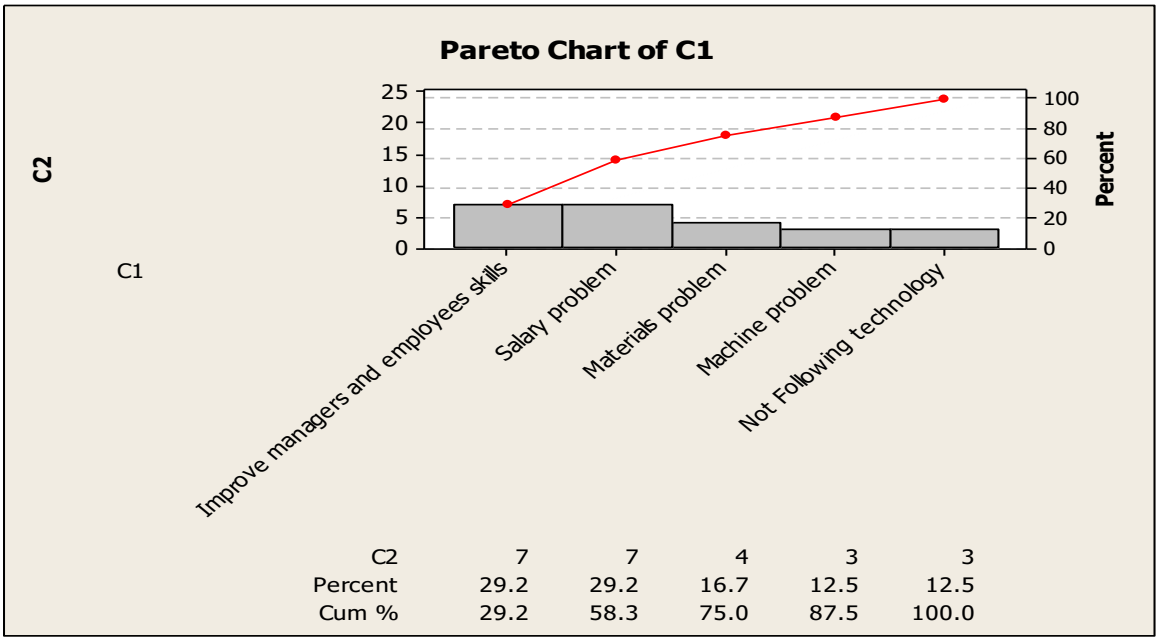


Figure 4-3 Pareto chart

Source: researcher

4.3 analysis questionnaire for Formen and Labors Data analysis for Formen and Labors

Table 4-6 the frequency and percentage for the Does the way to employee easy

Valid	Frequencies	Percentage
Yes	78	92.9%
No	6	7.1%
Total	84	100.0%

Source: researcher

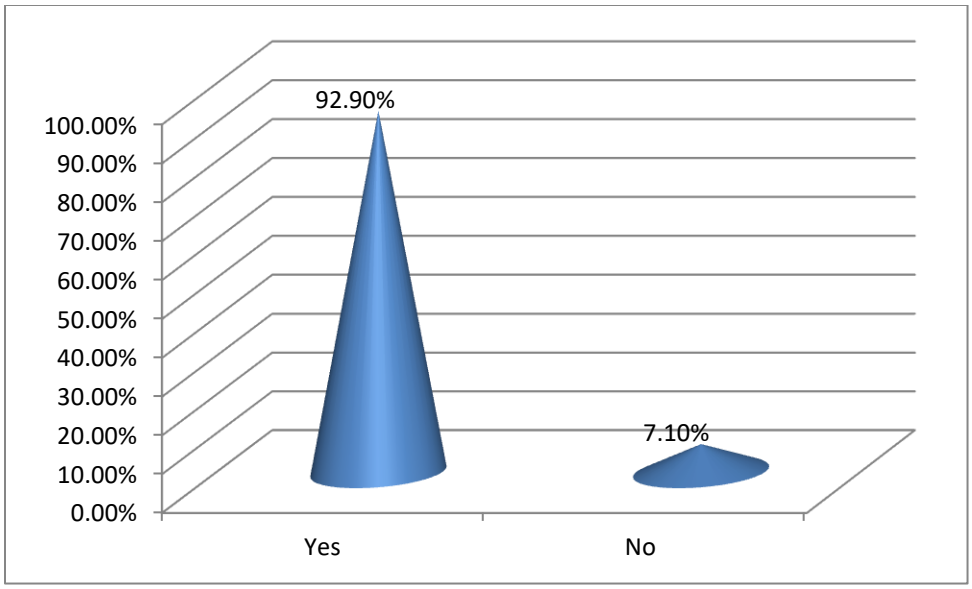


Figure 4-4 the frequency and percentage for the Does the way to employee easy

Source: researcher

Figure 4-4 illustrates the views of the distribution of the sample by yes by (%92.9) and no by (%7.1).

Table 4-7 the frequency and percentage for the Are there concern about environment

Valid	Frequencies	Percentage
Yes	67	79.8%
No	17	20.2%
Total	84	100.0%

Source: researcher

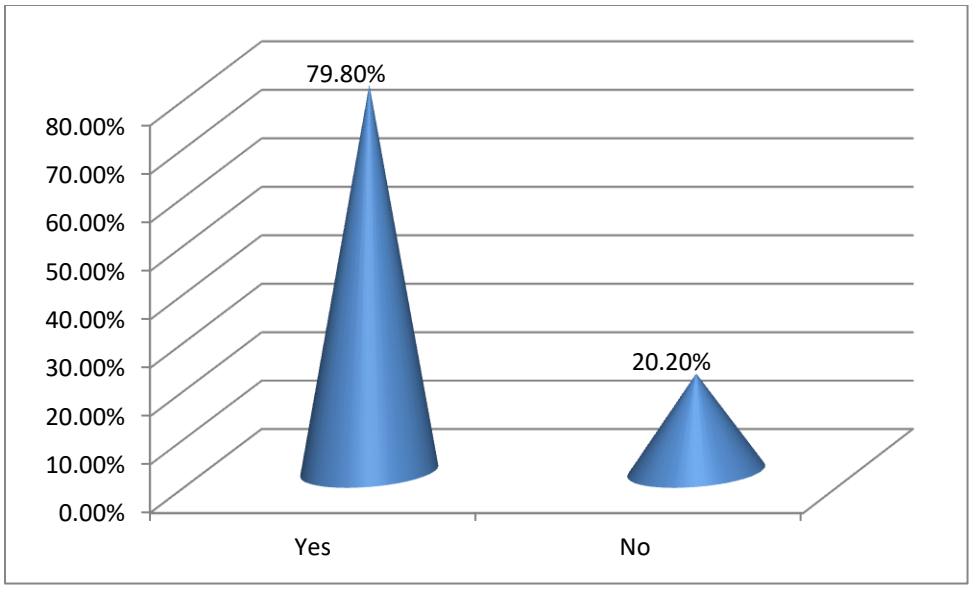


Figure 4-5 the frequency and percentage for the Are there concern about environment

Source: researcher

Figure 4-5 illustrates the views of the distribution of the sample by yes by (%79.8) and no by (%20.2).

Table 4-8 the frequency and percentage for the enough training

Valid	Frequencies	Percentage
Yes	51	60.7%
No	33	39.3%
Total	84	100.0%

Source: researcher

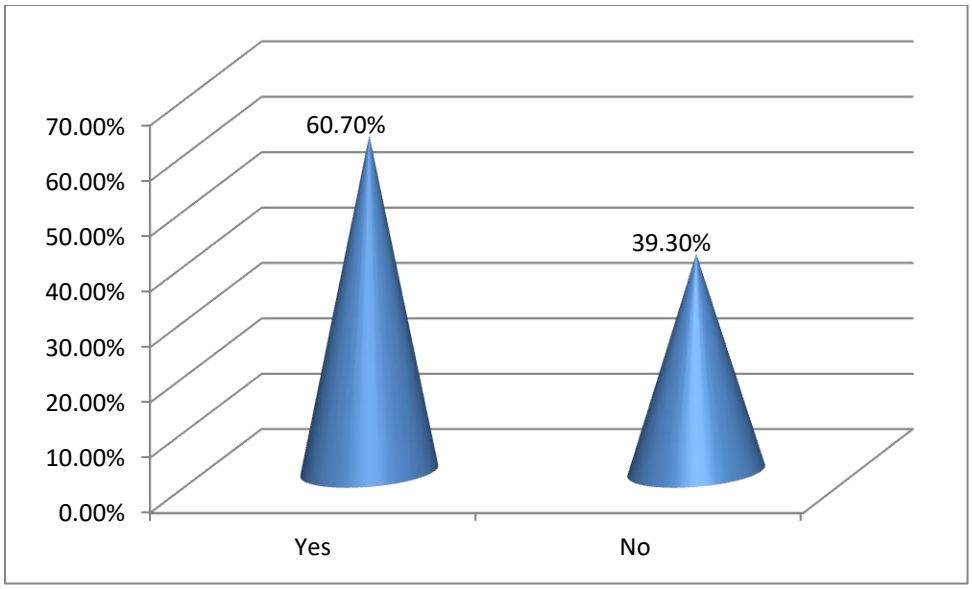


Figure 4-6 the frequency and percentage for the enough training

Source: researcher

Figure 4-6 illustrates the views of the distribution of the sample by yes by (%60.7) and no by (%37.9).

Table 4-9 the frequency and percentage for the Loyalty

Valid	Frequencies	Percentage
Yes	59	70.2%
No	25	29.8%
Total	84	100.0%

Source: researcher

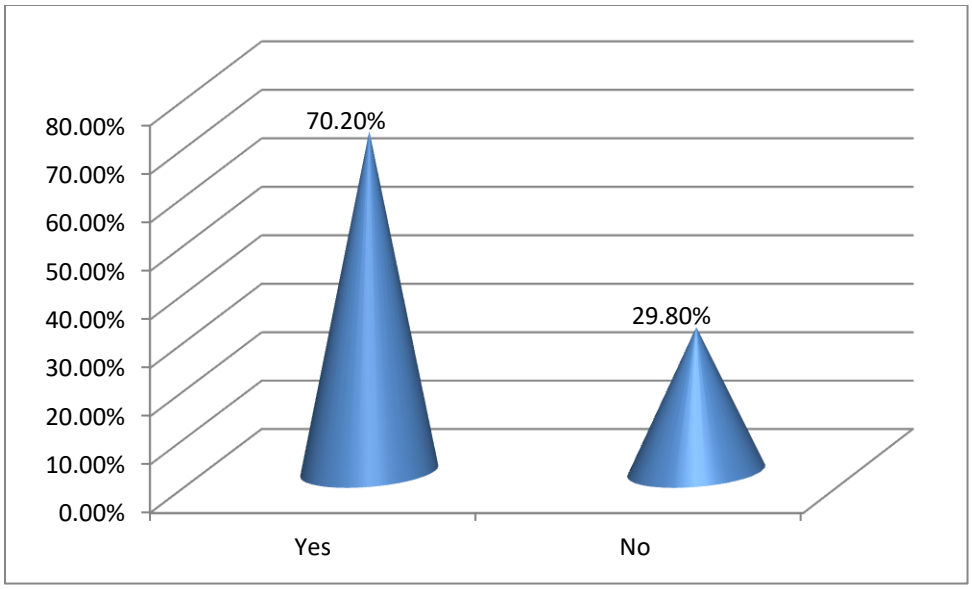


Figure 4-7 the frequency and percentage for the Loyalty

Source: researcher

Figure 4-7 the views of the distribution of the sample by yes by (%70.2) and no by (%29.8).

Table 4-10 the frequency and percentage for the have incentive

Valid	Frequencies	Percentage
Yes	56	66.7%
No	28	33.3%
Total	84	100.0%

Source: researcher

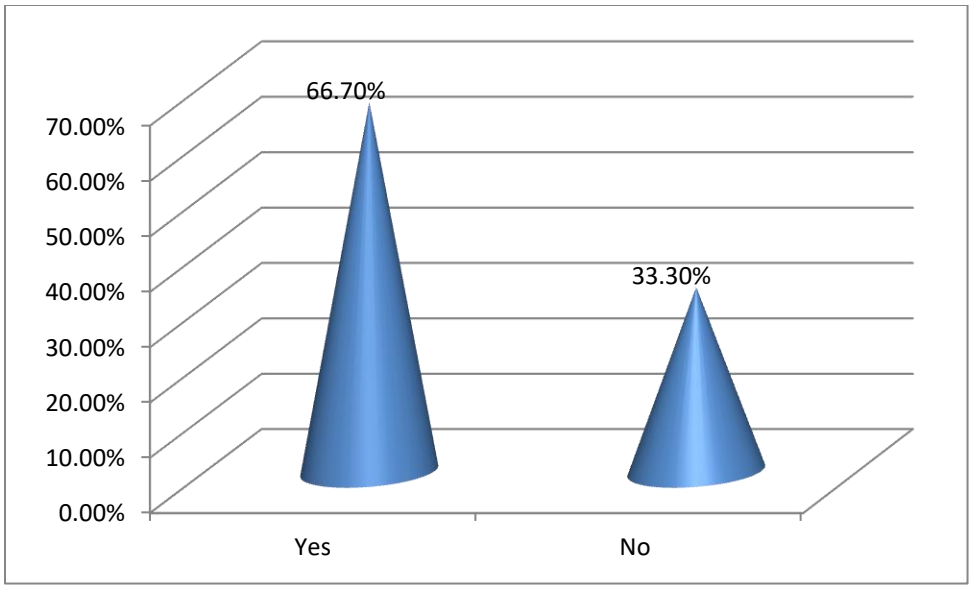


Figure 4-8 the frequency and percentage for the have incentive

Source: researcher

Figure 4-8 the views of the distribution of the sample by yes by (%66.7) and no by (%33.3).

Table 4-11 the frequency and percentage for the Quitting

Valid	Frequencies	Percentage
Yes	44	52.4%
No	40	47.6%
Total	84	100.0%

Source: researcher

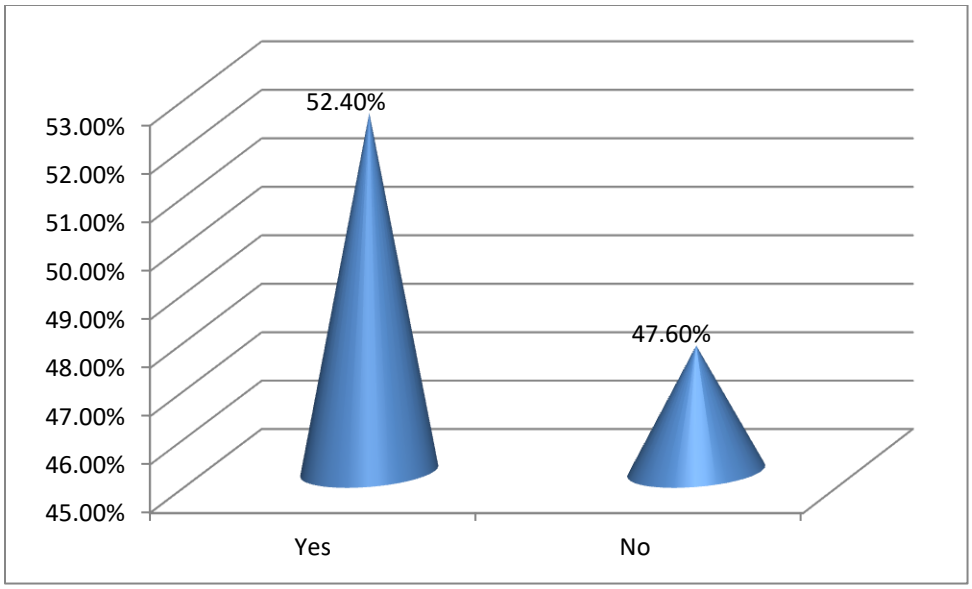


Figure 4-9 the frequency and percentage for the Quitting

Source: researcher

Figure 4-9 illustrates the views of the distribution of the sample by yes by (%52.4) and no by (%47.6).

Table 4-12 the frequency and percentage for the Available labors social solidarity

Valid	Frequencies	Percentage
Yes	55	65.5%
No	29	34.5%
Total	84	100.0%

Source: researcher

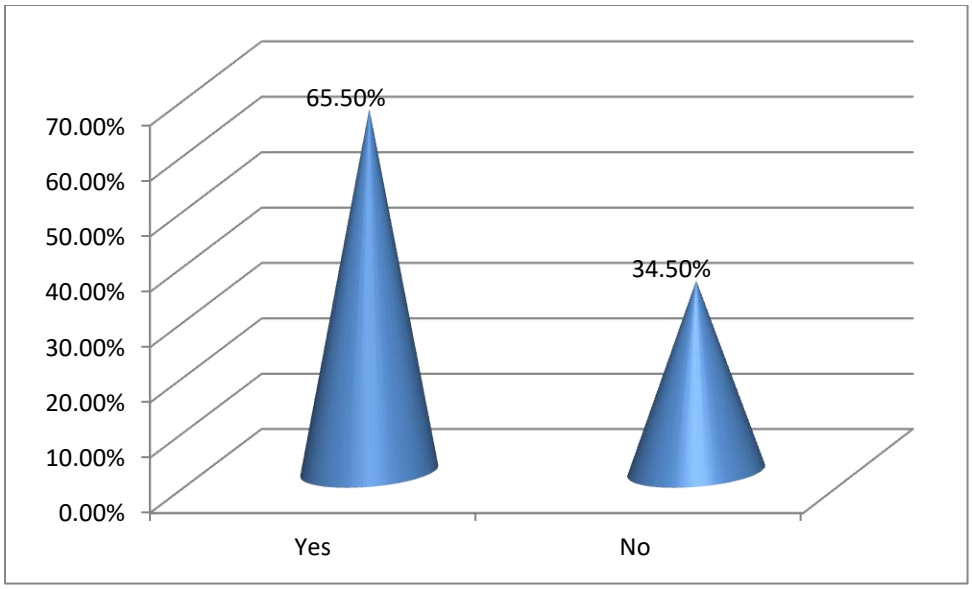


Figure 4-10 the frequency and percentage for the Available labors social solidarity

Source: researcher

Figure 4-10 the views of the distribution of the sample by yes by (%65.5) and no by (%34.5).

Table 4-13 the frequency and percentage for the Top managers concerned your suggestions

Valid	Frequencies	Percentage
Yes	65	77.4%
No	19	22.6%
Total	84	100.0%

Source: researcher

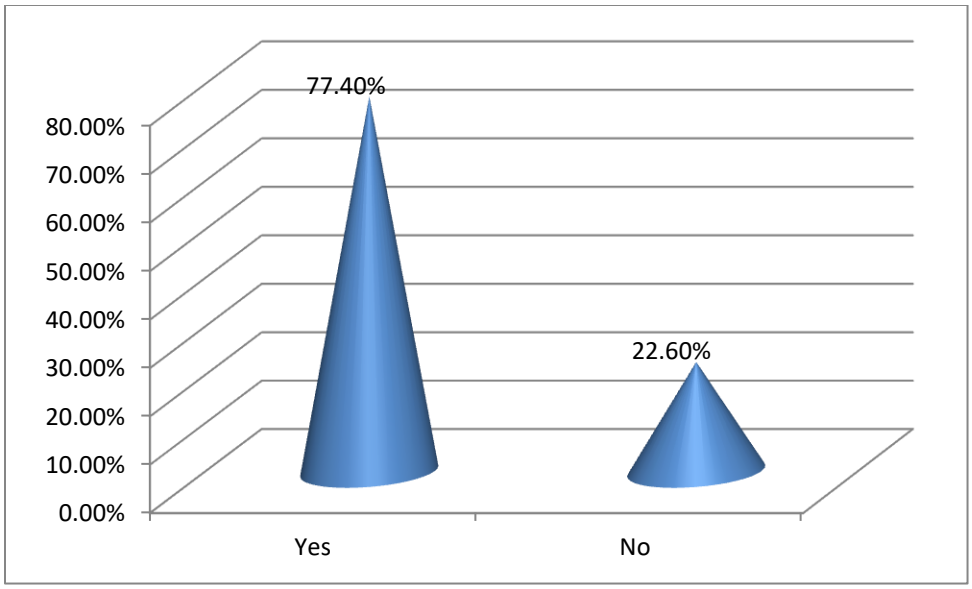


Figure 4-11 the frequency and percentage for the Top managers concerned your suggestions

Source: researcher

Figure 4-11 illustrates the views of the distribution of the sample by yes by (%77.4) and no by (%22.6).

Table 4-14 the frequency and percentage for the you trust top managers' promises

Valid	Frequencies	Percentage
Yes	57	67.9%
No	27	32.1%
Total	84	100.0%

Source: researcher

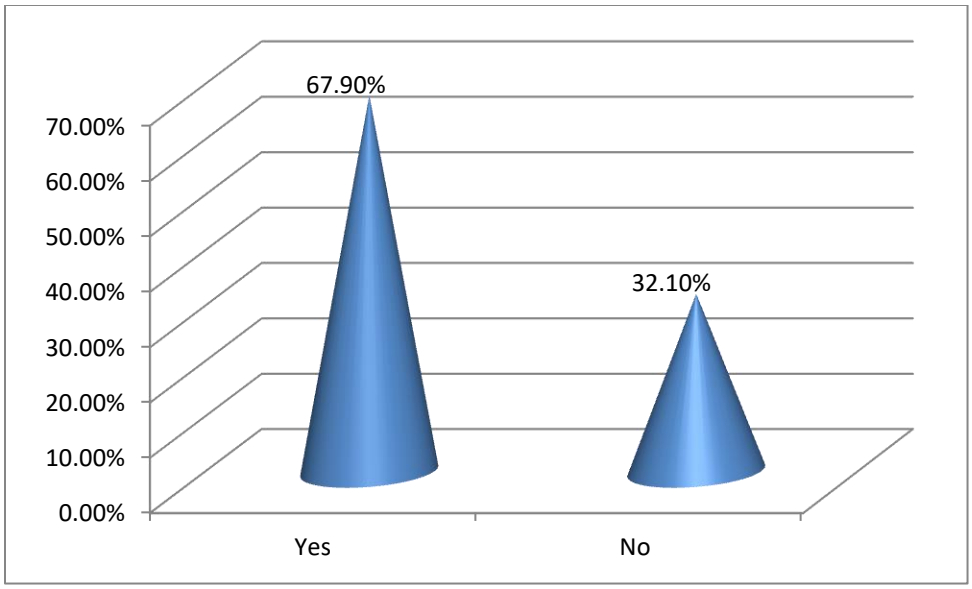


Figure 4-12 the frequency and percentage for the you trust top managers' promises

Source: researcher

Figure 4-12 the views of the distribution of the sample by yes by (%67.9) and no by (%32.1).

Table 4-15 the frequency and percentage for the Short and easy administrative process

Valid	Frequencies	Percentage
Yes	76	90.5%
No	8	9.5%
Total	84	100.0%

Source: researcher

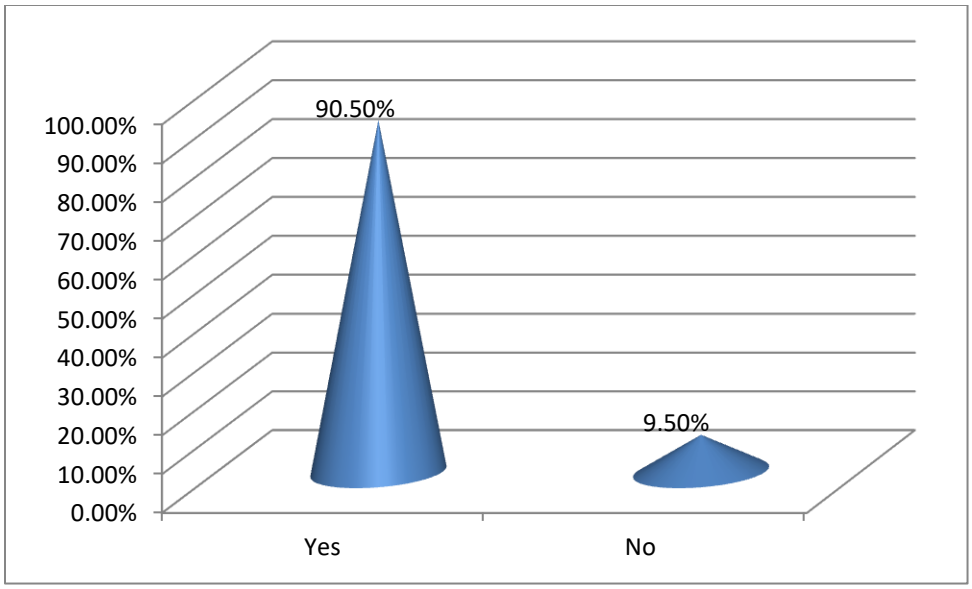


Figure 4-13 the frequency and percentage for the Short and easy administrative process

Source: researcher

Figure 4-13illustrates the views of the distribution of the sample by yes by (%90.5) and no by (%9.5).

Table 4-16 the frequency and percentage for the Suitable work environment

Valid	Frequencies	Percentage
Yes	66	78.6%
No	18	21.4%
Total	84	100.0%

Source: researcher

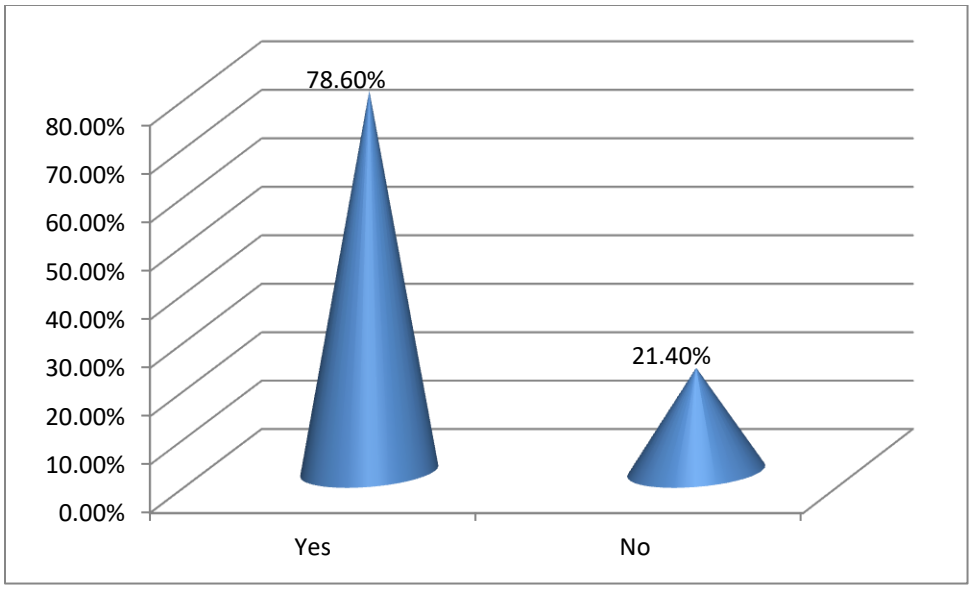


Figure 4-14 the frequency and percentage for the Suitable work environment

Source: researcher

Figure 4-14 illustrates the views of the distribution of the sample by yes by (%78.6) and no by (%21.4).

Table 4-17 the frequency and percentage for the Exits trade workers Union

Valid	Frequencies	Percentage
Yes	65	77.4%
No	19	22.6%
Total	84	100.0%

Source: researcher

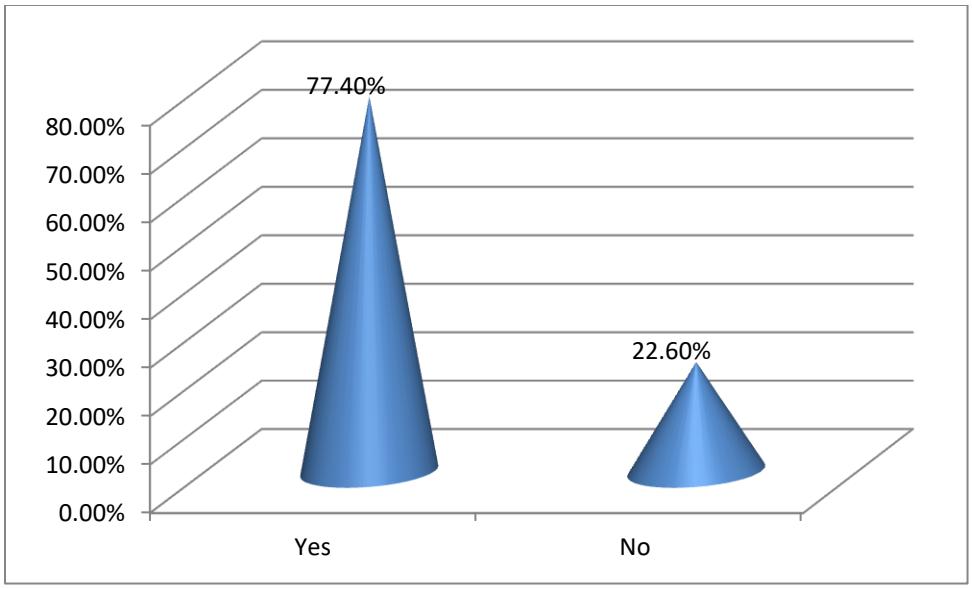


Figure 4-15 the frequency and percentage for the Exits trade workers Union

Source: researcher

Figure 4-15 illustrates the views of the distribution of the sample by yes by (%77.4) and no by (%22.6).

Table 4-18 the frequency and percentage for the Satisfied with the salary

Valid	Frequencies	Percentage
Yes	44	52.4%
No	40	47.6%
Total	84	100.0%

Source: researcher

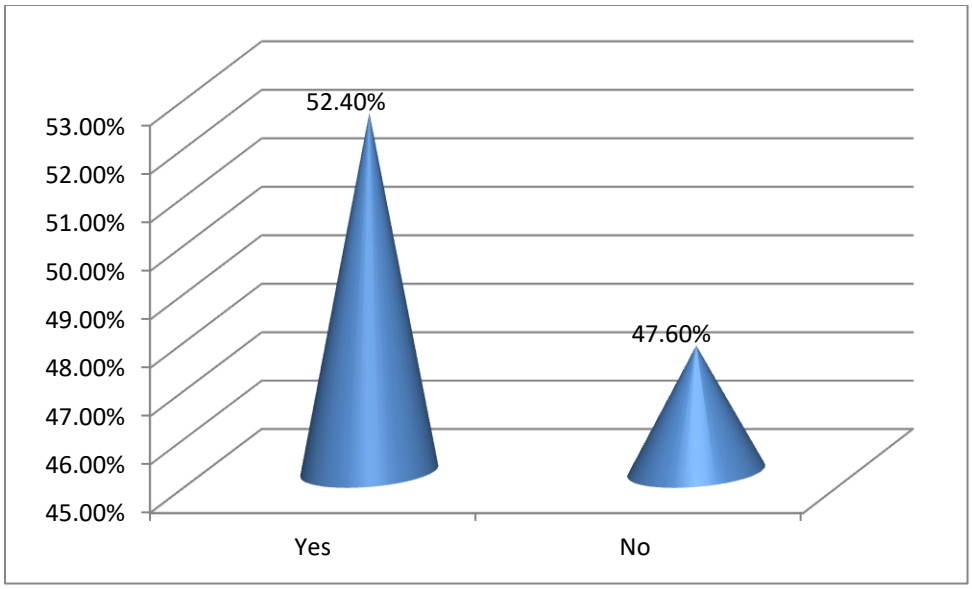


Figure 4-16 the frequency and percentage for the Satisfied with the salary

Source: researcher

Figure 4-16 the views of the distribution of the sample by yes by (%52.4) and no by (%47.6).

Table 4-19 the frequency and percentage for the you've any unsolved problem

Valid	Frequencies	Percentage
Yes	22	26.2%
No	62	73.9%
Total	84	100.0%

Source: researcher

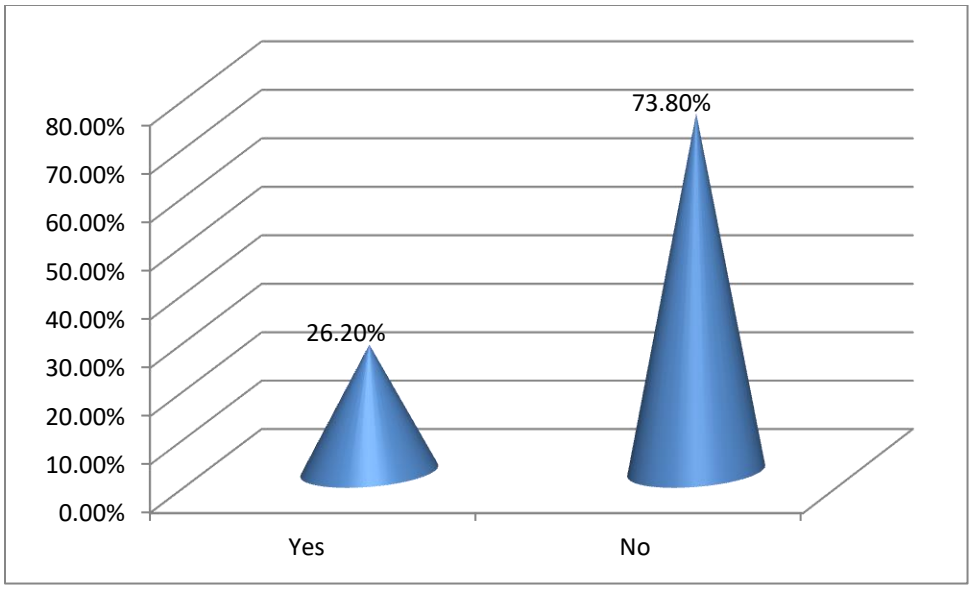


Figure 4-17 the frequency and percentage for the you've any unsolved problem Source: researcher

Figure 4-17 the views of the distribution of the sample by yes by (%26.2) and no by (%73.8).

Table 4-20 the frequency and percentage for the problems for formen and labors.

Valid	Frequencies	Percentage
Solve machine problem	3	10%
Increase salary	8	27%
Not following technology	7	23%
Materials	9	30%
Improve managers and employees skills	3	10%
Total	30	100%

Source: researcher

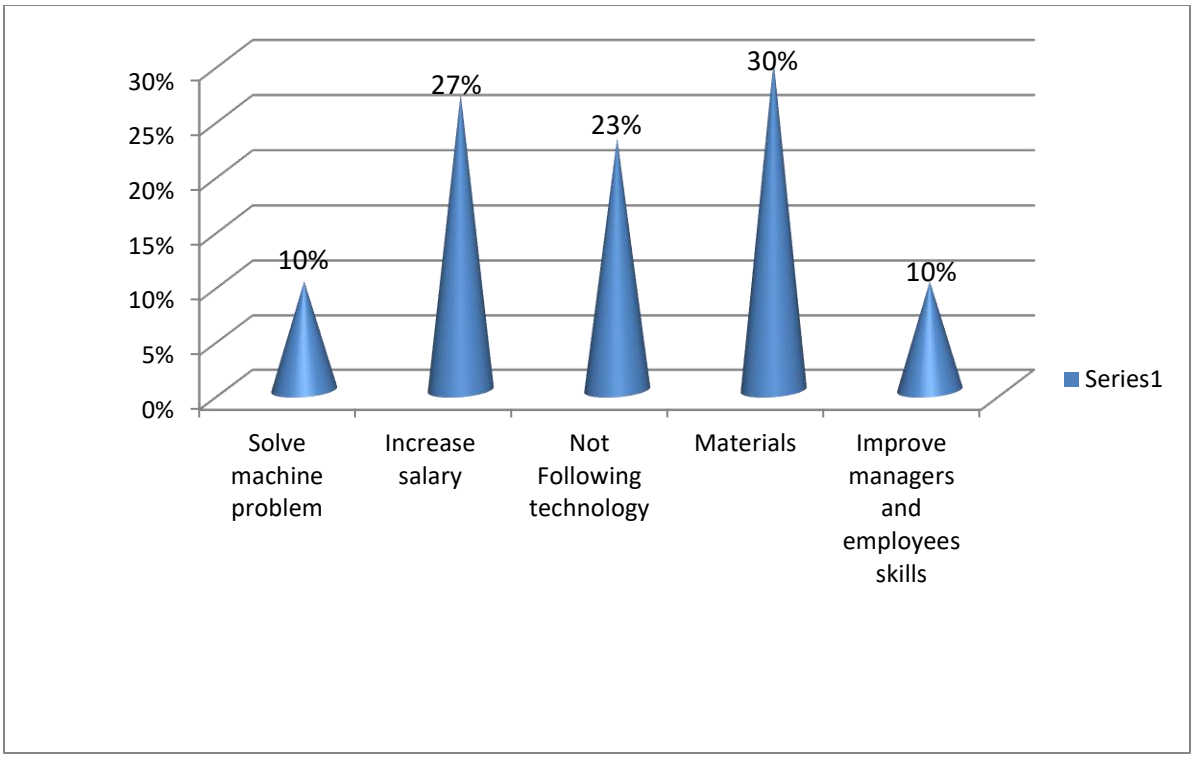


Figure 4-18 the frequency and percentage for the problems for formen and labors

Source: researcher

Figure 4-18 illustrates the views of the distribution of the sample by Solve machine problem by (%10.0) and Increase salary by (%27.0) and not following technology by (%23.0) and Materials by (%30.0) and Improve managers and employees skills by (%10.0).

Table 4-21 illustrates chi-square teat results for Formen and labors

No	Phrases	Chi-square value	df	Sig.	Median	Interpretation
1	Does the way to employee easy	61.71	1	0.000	1.00	Yes
2	Are there concern about environment	29.76	1	0.000	1.00	Yes

3	Enough training	13.85	1	0.000	1.00	Yes
4	Loyalty	13.76	1	0.000	1.00	Yes
5	have incentive	19.33	1	0.000	1.00	Yes
6	Quitting	15.19	1	0.000	1.00	Yes
7	Available labors social solidarity	18.04	1	0.000	1.00	Yes
8	Top managers concerned your suggestions	25.19	1	0.000	1.00	Yes
9	You trust top managers' promises	10.71	1	0.000	1.00	Yes
10	Short and easy administrative process	55.04	1	0.000	1.00	Yes
11	Suitable work environment	27.42	1	0.000	1.00	Yes
12	Exist trade workers Union	25.19	1	0.000	1.00	Yes
13	Satisfied with the salary	15.19	1	0.000	1.00	Yes
14	You've any unsolved problem	17.19	1	0.000	2.00	No

Source: researcher

The results of table 4-21 Interpreted as follows:

1- The value of chi – square calculated to signify the differences between the does the way to employee easy was (61.71) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

2- The value of chi – square calculated to signify the differences between the Are there concern about environment was (29.76) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

3-The value of chi – square calculated to signify the differences between the enough training was (13.85) with P-value (0.000) which is lower than the

level of significant value (5%) These refer to the existence of differences statistically.

4-The value of chi – square calculated to signify the differences between the Loyalty was (13.76) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

5-The value of chi – square calculated to signify the differences between the have incentive was (19.33) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

6-The value of chi – square calculated to signify the differences between the Quitting was (15.19) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

7-The value of chi – square calculated to signify the differences between the Available labors social solidarity was (18.04) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

8- The value of chi – square calculated to signify the differences between the Top managers concerned your suggestions was (25.19) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

9-The value of chi – square calculated to signify the differences between the you trust top managers' promises was (10.71) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

10-The value of chi – square calculated to signify the differences between the Short and easy administrative process was (55.04) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

11-The value of chi – square calculated to signify the differences between the Suitable work environment was (27.42) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

12-The value of chi – square calculated to signify the differences between the Exist trade workers Union was (25.19) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

13-The value of chi – square calculated to signify the differences between the Satisfied with the salary was (15.19) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

14-The value of chi – square calculated to signify the differences between the you've any unsolved problem was (17.19) with P-value (0.000) which is lower than the level of significant value (5%) These refer to the existence of differences statistically.

Method two: new formula for adding silicon and manganese alloy

Table 4-22 illustrates the Correlations between elements in the Dubai steel melting

Valid		SI MN kg	temperature ^{o}C	C(.22-.3)	SI (.25-.35)	MN (0.2)	P (0.05)	S (0.05)	weight ton
SI MN kg	Pearson Correlation	1	-0.399(**)	**0.065**	0.343(**)	0.533(**)	0.147(*)	0.155(**)	0.606(**)
	Sig. (2-tailed)	.	0.000	**0.261**	0.000	0.000	0.010	0.007	0.000
temperature ^{o}C	Pearson Correlation	-0.399(**)	1	**0.009**	-.133(*)	-.179(**)	-0.139(*)	**-0.110**	-0.513(**)
	Sig. (2-tailed)	0.000	.	**0.880**	0.021	0.002	0.015	**0.056**	0.000
C(.22-.3)	Pearson Correlation	**0.065**	0.009	1	**0.068**	0.122(*)	**0.002**	**0.017**	**0.010**
	Sig. (2-tailed)	**0.261**	0.880	.	**0.240**	0.033	**0.968**	**0.764**	**0.860**
SI (.25-.35)	Pearson Correlation	0.343(**)	-0.133(*)	0.068	1	0.506(**)	**0.007**	**0.012**	0.204(**)
	Sig. (2-tailed)	0.000	0.021	0.240	.	0.000	**0.908**	**0.837**	0.000
MN (0.2)	Pearson Correlation	0.533(**)	-0.179(**)	0.122(*)	0.506(**)	1	**0.029**	**0.032**	0.132(*)

		SI MN kg	temperature ^{o}C	C(.22-.3)	SI (.25-.35)	MN (0.8)	P (0.05)	S (0.05)	weight ton
	Sig. (2-tailed)	**0.000**	0.002	0.033	0.000	.	**0.621**	**0.580**	0.021
P (0.05)	Pearson Correlation	**0.147(*)**	-.0139(*)	0.002	0.007	0.029	1	0.850(**)	**-0.041**
	Sig. (2-tailed)	0.010	0.015	0.968	0.908	0.621	.	0.000	**0.481**
S (0.05)	Pearson Correlation	0.155(**)	**-0.110**	**0.017**	**0.012**	**0.032**	.850(**)	1	**-0.053**
	Sig. (2-tailed)	0.007	**0.056**	**0.764**	**0.837**	**0.580**	.000	.	**0.354**
weight ton	Pearson Correlation	0.606(**)	-0.513(**)	**0.010**	0.204(**)	0.132(*)	-.041	-0.053	1
	Sig. (2-tailed)	0.000	0.000	**0.860**	0.000	0.021	.481	0.354	.

Source: researcher

The value of the correlation coefficient is (-0.399) with a significant value (0.00). This means that there is a correlation between **SI MN kg** and **temperature ^{o} C.**

The value of the correlation coefficient is (0.065) with a significant value (0.261). This means that there is no a correlation between **SI MN kg** and **C (.22-.3).**

The value of the correlation coefficient is (0.343) with a significant value (0.00). This means that there is a correlation between **SI MN kg** and **SI (.25-.35).**

The value of the correlation coefficient is (0.533) with a significant value (0.00). This means that there is a correlation between **SI MN kg** and **MN (0.2).**

The value of the correlation coefficient is (0.147) with a significant value (0.01). This means that there is a correlation between **SI MN kg** and **p (0.05).**

The value of the correlation coefficient is (0.155) with a significant value (0.00). This means that there is a correlation between **SI MN kg** and **S (0.05).**

The value of the correlation coefficient is (0.606) with a significant value (0.00). This means that there is a correlation between **SI MN kg** and **weight ton.**

The value of the correlation coefficient is (0.009) with a significant value (0.888). This means that there is no a correlation between **temperature ^{o} C** and **C (.22-.3).**

The value of the correlation coefficient is (-0.133) with a significant value (0.02). This means that there is a correlation between **temperature ^{o} C** and **SI (.25-.35).**

The value of the correlation coefficient is (-0.179) with a significant value (0.00). This means that there is a correlation between **temperature ^{o} C** and **MN (0.2).**

The value of the correlation coefficient is (-0.139) with a significant value (0.00). This means that there is a correlation between **temperature ^{o} C** and **P (0.05).**

The value of the correlation coefficient is (-0.110) with a significant value (0.06). This means that there is no a correlation between **temperature ^{o} C** and **S (0.05).**

The value of the correlation coefficient is (-0.513) with a significant value (0.00). This means that there is a correlation between **temperature ^{o} C** and **weight ton.**

The value of the correlation coefficient is (0.068) with a significant value (0.240). This means that there is no a correlation between **C (.22-.3)** and **SI (.25-.35).**

The value of the correlation coefficient is (0.122) with a significant value (0.03). This means that there is a correlation between **C (.22-.3)** and **MN (0.2).**

The value of the correlation coefficient is (0.002) with a significant value (0.986). This means that there is no a correlation between **C (.22-.3)** and **P (0.05).**

The value of the correlation coefficient is (0.017) with a significant value (0.764). This means that there is no a correlation between **C (.22-.3)** and **S (0.05).**

The value of the correlation coefficient is (0.010) with a significant value (0.860). This means that there is no a correlation between **C (.22-.3)** and **weight ton.**

The value of the correlation coefficient is (0.506) with a significant value (0.000). This means that there is a correlation between **SI (.25-.35)** and **MN (0.2**

The value of the correlation coefficient is (0.007) with a significant value (0.908). This means that there is no a correlation between **SI (.25-.35)**and **P (0.05).**

The value of the correlation coefficient is (0.012) with a significant value (0.837). This means that there is no a correlation between **SI (.25-.35)** and **S (0.05).**

The value of the correlation coefficient is (0.204) with a significant value (0.00). This means that there is a correlation between **SI (.25-.35)** and **weight ton.**

The value of the correlation coefficient is (0.029) with a significant value (0.621). This means that there is no a correlation between **MN (0.2)** and **P (0.05).**

The value of the correlation coefficient is (0.032) with a significant value (0.580). This means that there is no a correlation between **MN (0.2)** and **S (0.05).**

The value of the correlation coefficient is (0.132) with a significant value (0.02). This means that there is a correlation between **MN (0.2)** and **weight ton.**

The value of the correlation coefficient is (0.850) with a significant value (0.000). This means that there is a correlation between **P (0.05**and **S (0.05)**

The value of the correlation coefficient is (-0.041) with a significant value (0.481). This means that there is no a correlation between **P (0.05)** and **weight ton.**

The value of the correlation coefficient is (-0.053) with a significant value (0.354). This means that there is no a correlation between **S (0.05)** and **weight ton.**

4-1Regression

Table 4-23 illustrates Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.778(a)	0.605	0.595	19.596

a Predictors: (Constant), WEIGHT, C, P, MN, SI, TEMPER, S Source: researcher

R: Coefficient correlation

Table 4-24 illustrates Anova (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	173404.930	7	24772.133	64.511	0.000(a)
	Residual	113278.733	295	383.996		
	Total	286683.663	302			

a Predictors: (Constant), WEIGHT, C, P, MN, SI, TEMPER, S b Dependent Variable: SIM Source: researcher

df: degree of freedom

F: test

Sig: Significant value

Table 4-25 illustrates Coefficients (a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	51.287	246.460		0.208	0.835
	TEMPER	-0.060	0.147	-0.018	-0.406	0.685
	C	1.739	38.043	0.002	0.046	0.964
	SI	-0.468	24.417	-0.001	-0.019	0.985
	MN	150.017	14.280	0.452	10.505	0.000
	P	18.123	29.590	0.043	0.612	0.541
	S	58.278	30.894	0.131	1.886	0.060
	WEIGHT	9.855	0.788	0.546	12.508	0.000

a Dependent Variable: SIM Source: researcher

B: autoregressive

Beta: coefficient of variables

t: test

sig: Significant value

After data analysis by SPSS (statistical package for social sciences) the results showed there are coefficient correlation between the elements and also between elements and melting. To avoid any change in properties the amount of alloy must be corrected to hinder any problems during the casting stage. New formula made according to all the elements effect the properties

of steel and already these elements existence in different ratios. With the coefficient correlation R= 0.778 the new formula is:

SIMN addition KG = 51.287 - 0.06(TEMPER) + 1.739 (C) -0.468 (SI) + 150.017 (MN) +18.123 (P) + 58.278(S) +9.855(WEIGHT)

SIMN: amount of silicon &manganese alloy adding (kg)

(TEMPER) :temperature of melting (c)

(C): carbon percentage

(SI): silicon percentage

(MN): manganese percentage

(P): Phosphoresce percentage

(S): sulfur percentage

(WEIGHT): weight of melting ton

This formula was made in comport program (python program) the formulation of was as follow:

```
While True:
Temp = float (input ('Enter Temperature: '))
Car = float (input ('Enter Carbon percentage: '))
Si   = float (input ('Enter Silicon percentage: '))
Mn   = float (input ('Enter Manganese percentage: '))
Phos = float (input ('Enter Phosphor percentage: '))
Sul = float (input ('Enter Sulfur percentage: '))
Wgt = float (input ('Enter Weight percentage: '))
c = 51.287
Atemp = -0.06
Acar = 1.739
ASI = -0.468
Amn = 150.017
```

```
Aphos = 18.123
Asul = 58.278
Awgt = 9.855
                Simi = c + (atemp * temp) + (acarb * carb) + (asi * si) + (amn *
mn) + (aphos * phos) + (asul * sul) + (awgt * wgt)
Simi = round (Simi, 3)
Print ('\n\amount of Simi Alloy Added is: ' + str (Simi) + ' kg')
Print ('\n\tThanks\n\n')
```

4.5 method three: Strategic plan

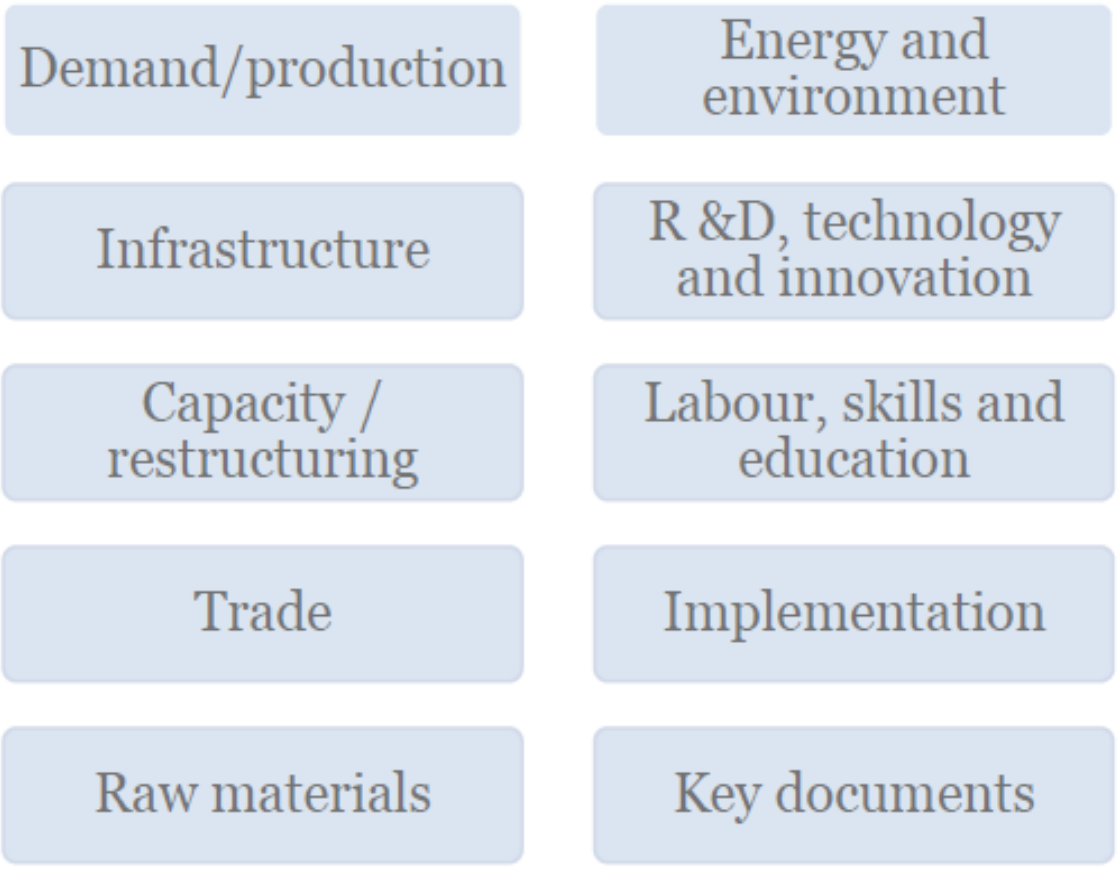
This strategic plan will focus on the existence problems in the factory and the strategic vision for the factory according to circumstances that effect on this strategy, this strategy will guide to more productivity, more information about problems and the suitable solutions for that.

This strategy based on the results of questionnaires and the previous study in this field, correspond this strategy with the needs of factory ensure the matching with the factory goals therefore achieve our aim from this study.

Strategy plan will make according to the results of questionnaires to be adopted the circumstance in the Dubai steel factory to be applied and flexible.

This strategy includes all the factors effect on steel manufacture, these keys are illustrated in table 4-26

Table 4-26 illustrates key components of the steel policy



(STRATEGIC POLICIES FOR THE STEEL INDUSTRY
DSTI/SU/SC(2015)3 78th Steel Committee Meeting Paris, 11-12 May 2015)

1-Demand production

According to questionnaires results there are many problems existence in Dubai steel factory face production, this problems as follow:

1. The machines problems
2. Quality of product.
3. Materials problems.

All these exposures effect on demands. The relationship between demand and production are expulsion.

More demand means more production to match the demand, improvement productivity raise the rate production therefor all the demand request will be available.

2-Infrastructure

The factory lakes to infrastructures to helps the production process done by smoothly , Enhance the infrastructure of factory contributes to do the work by correct way by brief the time to production, that reduction the cost of production and also giving the workers encouragement to do work smoothly.

3-Capacity restructuring

More capacity needs restricting the factory, so before we increase the capacity we must be taken action to deal with this capacity increase until to be this capacity effects on the factory policy and production processes.

4-Trade

External policy must be included the trade because it reflects on the production, it is the way to promote the goods in local market because the factory doesn't have orientation to export, internal competition are became more fiercer, the market department must be adopting ways like offers, bones and events, to guaranty demand of their products

5- Raw materials.

Raw materials one of the problems existence in the factory it comes in the first problems according to questionnaires results, because of direct effecting on the quality and production, solve this problems by make contracts with more than one supplier, using this merit creates competition between them by this way factory can get the raw materials with more quality and less price to ensure the availability of raw materials.

6-Energy and environment

Energy one of the important factor effect on production process in the factory, it is coming in the secondly after raw materials, all the production needs energy in the factory especially in Sudan nowadays, many factories made shod down because of energy, that caused many losses and also hinder continuous production. And miserliness of demand effect on factory reputation environment concern one of the important requiring the production to reduce carbondioxide emissions

7- R & D (research and development) technology and innovation.

Not follow up technology on of problems existence illustrated in questionnaires results.

New technology not available in the factory and also research not included in factory policy. Technology and innovation are important to improve productivity by using modern way in production. Technology is the way to do work easier and in the less time, this merit gives factory distinction among other and absolutely more customers have loyalty to factory. Addition merit of using technology in factory are reduction of production costs, more quality and brief time of production process, all these advantages reflect on the performance of factory positively.

Innovation is the way to be unique in your field and put your factory in the first. Innovate new goods according to consumers need create more confidence between factory and their customers and also will be attraction to gain new consumers, therefore stability in the demand .

8-Labor, skills and education

No training for workers and training center not existence in the factory, it depends on the skill worker. Train on the modern technology global orientation to improve productivity.

Employing skill labors raise the productivity of factory, because they have ability to deal with problems more the unskilled labors according to the previous studied. Education includes training that done to raise the efficiency of workers that ensures do the job by correct way.

9-Implementation

Implementation the work by modern and scientific way required technology, this matches with previous point {R & D (research and development) technology and innovation}. Adopting new technology to implement according the factory circumstance match with factory policy ,therefor we ensure no barriers during the implementation process The way of executive work so important because of effecting on performance of factory, implementation includes all the unexpected action may be will happen to provide the incharge person plan to deal with the prospective problems.

10 -key documents.

Key documents are the records of the previous process, we need them to face problems to show the way to solve the problems according to key documents, any decision maker will take must be matched with key documents to avoid any inconsistency and ensure not stop the production process.

4-6 method four: productivity calculations

4-6-1 materials productivity

The results of materials productivity illustrated in figure 4-19

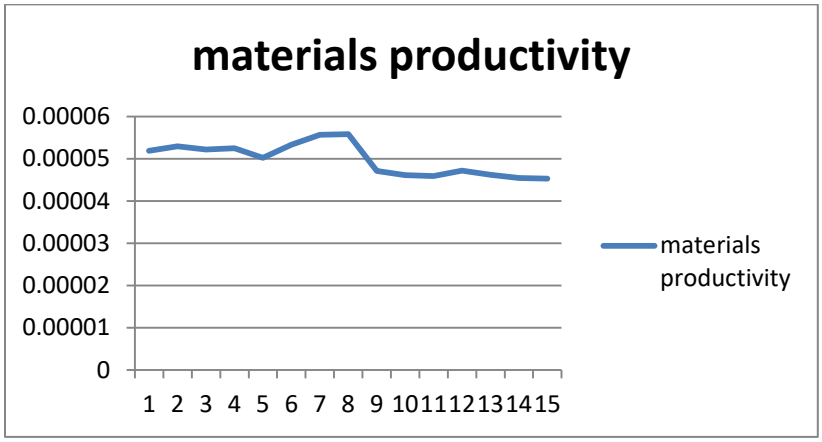


Figure 4-19 shows materials productivity

Source: researcher

Data analysis illustrated three levels for productivity, maximum was 5.5782E05, average was 5.0289E05 and minimum was 4.5282E05

4-6-2 labors productivity

The results of labor productivity illustrated in figure 4-20

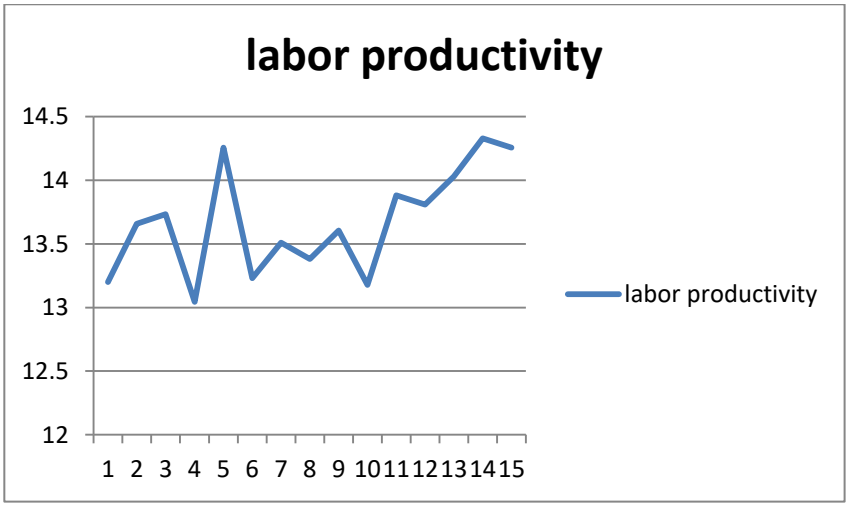


Figure 4-20 shows labors productivity

Source: researcher

Data analysis illustrated three levels for productivity, maximum was 14.239, average was 13.7136 and minimum was 13.043.

4-6-3 machines productivity

The results of machine productivity illustrated in figure 4-21

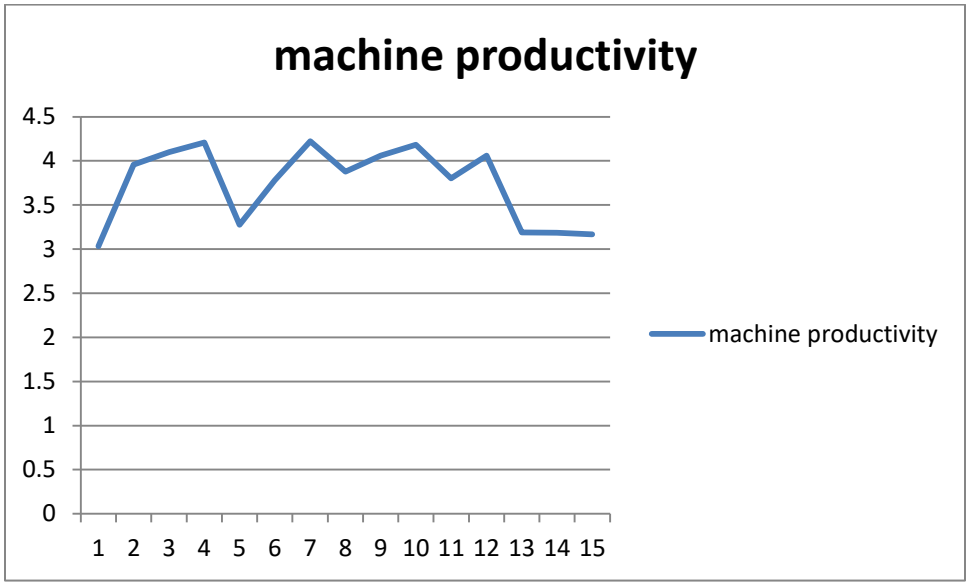


Figure 4-21 shows machines productivity

Source: researcher

Data analysis illustrated three levels for productivity, maximum was 4.2212, average was 3.7704 and minimum was 3.0344.

4-7 Discussion

The questionnaires illustrated the areas of problems, according to analysis the area was improper management this finding matches well with the results reported in (Sudanese Business & Employers federation Initiative toward economical fix up. July 2019) they reported that the production was about 34% from the full capacity, solving of the reported problems will contribute in increase efficiency and improvement productivity.

According to Chaudhary.*el at*, (2016) change in efficiency of input leads to decline in total productivity, this agrees with the results in this present study, this point found in analysis data machine problems and materials problems.

According to Soltany *.el at*, (2013) there are problems in purchasing and providing principal raw materials, the target of the present study is to minimize the total cost but some constrains in resources, and production, to avoid that model contains all these constrains should be applied, showed in this study as far as not follow up technology.

The new formula has strong correlation than previous formula uses in Dubai steel factory. Because new formula covers seven variations and the previous formula uses in Dubai steel factory covered only two variations, more variations mean more flexibility to variations, so this new formula will decrease the change in properties of melting and also will less treatment during the production process. Correct amount of alloy will gain time during and the casting these lead to the saving casting temperature therefore no need to reheat.

according to (international standard ISO 6935-1 Second edition ,15-1-2007) the formula uses is:

$$cev = c + \frac{Mn}{6} + \frac{Cr+V+Mo}{5} + \frac{Cu+Ni}{15}$$ (International standard ISO 6935-1 Second edition, 15-1-2007)

Cev: is the carbon equivalent.

C: Carbon.

Mn: Manganese.

Cr: Chrome.

V: Vanadium.

MO:Molybodenum

Cu: Copper.

Ni: Nichel.

Where C, Mn, Cr, V, Mo, Cu and Ni are the mass fractions, expressed as percentages, of the respective Chemical elements of the steel.

This formula took seven variations different except C and Mn that matched with modification formula taking all the elements in the melting.

Strategic plan has built according to data analysis and took the recommendations of (78th Steel Committee Meeting Paris, 11-12 May 2015) to cover all the sectors it matches with (Teik Oh, OTS Management Pty Ltd, teikoh.com May 2005) totally.

Productivity calculation for materials, labors and machine contributes to control the production process that through the monitoring the production and gives routine data after every batch. Productivity is represent internal factor to efficiency of production by the calculate the productivity, more productivity means number of waste less this point agreed with Toyota orientation (lean) it means to reduce the waste (Neha .*el at* , 2013)

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

After analysis the questionnaires ,managerial problems was the most of the barriers faces Dubai steel factory in Sudan(67%) in Engineers and Administrators, and (87%) in Labors and Formen, technical problems was (33%) in Engineers and Administrators, and (13%) in Labors and Formen to improve productivity in Dubai steel factory in Sudan depends on the solving many problems existed in work place (machine problem, Salary problem, not following up technology, materials problems, improve managers and employees skills) the way of dealing with these problems will have this impact on productivity, steel factories must be adopted industrial management policy to go far and conserve their position in local competition must be changed his policy and start to apply industrial tools mentioned above to achieve more quality, less cost, less time and absolutely more profits.

The amount of silicon , manganese alloy so important because any incorrect of amount effects on the properties of steel, so it is more cost in production, optimal amount avoid any problems in pouring process this hinder any additional treatment that grantee continuous production without any delay in the operation process and that improve productivity. The previous formula took two variations in consider (weight and the number of manganese in melting).in the present formula there are seven variations, so it is more strong and flexible to deal with more circumstance during the production process. Apply the new formula in induction furnace with grade (2) gains more quality of steel melting, less time for treatment and optimal amount of silicon and manganese alloy using.

Strategic plan contributes in improve productivity because it contains vision in long time therefore it is containing study state in production process.

Calculation of productivity for labors, materials and machines one of control tools to compare the productivity of labors, materials and machines with three levels of productivity.

After this study the production is expected to increase to 68% instead of 34% within 6 months and will increase above 70% if Dubai steel factory in Sudan solve existences problems, apply new formula in adding silicon manganese alloy, follow strategic plan and using calculation of productivity to compare and take action in short time to contain the productivity in top of level.

5.2 Recommendations

- Apply industrial management orientation to improve productivity in others industries.
- Adoption of decision making policy to avoid any incorrect decisions.
- Using productivity calculation to control the production process.
- Using new formula in steel factory contributes to set the amount of silicon &manganese alloy adding therefor less cost, time for treatment and more quality.
- Finally strong recommended establishing foundation for steelmakers to control the scraps price, identify the steel price in domestic market and more cooperation between the steelmakers.

Future study

- Use six sigma tools in steel industries to improve productivity.
- Raise the efficiency by study the problems that barriers the increase the efficiency in steel factories in cast plant.
- Apply lean method to improve productivity in steel factories.
- Apply Kaizen concept to increase productivity in other manufactures.

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