

A STUDY OF MATERIAL HANDLING SYSTEM FOLLOWED BY GNB CORROSION CONTROLLERS

Submitted in partial fulfilment of the requirements for the Award of

MASTER OF BUSINESS ADMINISTRATION

BY

KARTHICK U

REGISTER NO: 42410102



**DEPARTMENT OF BUSINESS ADMINISTRATION
SCHOOL OF MANAGEMENT STUDIES**

SATHYABAMA

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

**Accredited with grade “A++” by NAAC | 12B Status by UGC | Approved by
AICTE**

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI-600119

DECEMBER 2023



SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
CATEGORY - 1 UNIVERSITY BY UGC**

SCHOOL OF MANAGEMENT STUDIES

BONAFIDE CERTIFICATE

This to certify that this Project Report is the Bonafide work of **KARTHICK U 42410102** who has done the Project work entitled “**A Study of material handling system followed by GNB Corrosion Controllers**” under my supervision from **September 2023 to October 2023**.

Dr. DHIVYA SATHISH

Internal Guide

MR. SUDALAIMUTHU

External Guide

Dr. BHUVANESWARI. G, MBA., Ph.D.

Dean – School of Management Studies

Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

COMPLETION CERTIFICATE



Arulmigu Sri Padaiveedu Renugambal Thunai

GNB CORROSION CONTROLLERS FABRICATION & PAINTING

Cell : 87788 68185, E-mail : gnbpainting@gmail.com, gnbfab@gmail.com, Website : www.gnbccindia.com

Date : 26/10/2023

TO WHOMSOEVER IT MAY CONCERN

We like to confirm that Mr. Karthick U (Reg No: 42410102), who is Doing 2nd year MBA (finance and Operation) at Sathyabama Institute of Science and Technology, Chennai Has successfully completed his internship in our organization under the supervision of Mr. Dass in Operation department. The period of internship lasted from 11/09/2023 to 21/10/2023.

It is further certified that the internship project report on " A STUDY ON MATERIAL HANDLING SYSTEM FOLLOWED BY GNB CORROSION CONTROLLERS" is the Bonafide work of Karthick U , which was carried out under the guidance from his internship supervisor.

We are glad to state that during the period of his internship programme, he was sincere, punctual and particularly strong in his analytical skills. His conduct and behavior were observed to be good.

We wish you a great success in all your future endeavors,

Sincerely,



Sudalaimuthu R
Manager
GNB Corrosion Controllers

Specialist in : Fabrication of Pressure Vessels and Piping Structural & Tanks,
Industrial Blasting, Zinc Metallizing & Protective Coating
NO: 595, AVADI ROAD, KONIMEDU, REDHILLS, CHENNAI-600052.

DECLARATION

I **KARTHICK U (42410102)** here by declare that the Project Report entitled “**A Study of material handling system followed by GNB Corrosion Controllers**” done by me under the guidance of **DR. DHIVYA SATHISH**, MBA., M.Phil., Ph.D., at **GNB Corrosion Controllers PVT LTD**, No.595, Avadi road, konimedu, redhills, Chennai-600052 is submitted in partial fulfilment of the requirements for the award of MASTER OF BUSINESS ADMINISTRATION degree.

DATE:

PLACE: CHENNAI

KARTHICK U

ACKNOWLEDGEMENT

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

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I would like to express my sincere and deep gratitude to my Project Guide **DR. DHIVYA SATHISH, MBA., M.Phil., Ph.D.**, for her valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I Wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Business Administration** who were helpful in many ways for the completion of the project

KARTHICK U

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ABSTRACT

Material handling systems is paramount for industries aiming to enhance operational efficiency and reduce costs. This study focuses on GNB Corrosion Controllers, investigating the current material handling system and proposing improvements to optimize cost efficiency. The research employs a comprehensive approach, integrating data analysis, simulation modeling, and cost-benefit analysis.

The initial phase involves a thorough examination of the existing material handling processes at GNB Corrosion Controllers, identifying key bottlenecks, inefficiencies, and areas for improvement. Data on material flow, processing times, and resource utilization are gathered to provide a baseline for comparison.

Simulation modeling is then employed to evaluate alternative material handling strategies. Various scenarios are simulated to assess the impact of proposed changes on efficiency, throughput, and resource utilization. This allows for the identification of the most cost-effective and operationally efficient material handling system.

Cost-benefit analysis is a crucial component of the study, considering both the initial investment required for system enhancements and the expected long-term savings in operational costs. Factors such as labour efficiency, reduced downtime, and resource optimization are quantified to provide a comprehensive understanding of the financial implications of the proposed changes.

The study aims to offer GNB Corrosion Controllers a roadmap for implementing a material handling system that not only meets current operational demands but also anticipates future growth and changes in production requirements. The findings contribute valuable insights into the broader field of industrial material handling, emphasizing the importance of a holistic approach to achieve optimal cost efficiency.

Keywords: Material handling, Cost efficiency, Simulation modeling, Optimization, Industrial processes, GNB Corrosion Controllers.

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CHAPTER 1

INTRODUCTION

1.1. INTRODUCTION

Operations in a manufacturing company encompass the entire process of transforming raw materials into finished goods. This multifaceted domain involves several key activities, starting with production planning and scheduling to ensure optimal resource utilization. The actual manufacturing process involves the use of machinery, technology, and skilled labour to convert raw materials into the final product. Quality control mechanisms are integrated throughout, ensuring that the products meet predetermined standards.

Logistics involves the management of the flow of goods from the point of origin to the point of consumption to meet various requirements. These goods can be physical items such as food, materials, animals, equipment, and liquids, as well as abstract items like time, information, particles, and energy. The management of logistics encompasses the integration of information flow, material handling, production, packaging, inventory, transportation, warehousing, and security. Simulation software is often employed to model, analyse, visualize, and optimize the complexity of logistics.

The coordination and synchronization of these diverse operational aspects are essential to achieving production goals, meeting customer demands, and sustaining competitiveness in the manufacturing sector.

MATERIAL HANDLING SYSTEM

Material handling is a critical aspect of the manufacturing process, directly impacting the cost, time, and quality dimensions of production. An optimized material handling system not only streamlines the flow of raw materials, semi-finished goods, and finished products but also contributes significantly to the reduction of operational bottlenecks, minimization of lead times, and enhancement of overall productivity.

A material handling system is a comprehensive framework designed to efficiently manage the movement, storage, and control of materials and products throughout various stages of the supply chain. This system encompasses a range of equipment, processes, and technologies aimed at optimizing the handling of goods, from raw materials in manufacturing to finished products in distribution and storage.

In a manufacturing company, material handling operations are pivotal components of the production process, encompassing the efficient movement, storage, and control of raw materials, components, and finished products. These operations begin with the receipt of raw materials from suppliers and extend throughout the various stages of production, including storage within the facility, processing, and assembly.

An effective material handling system ensures that the right materials are available at the right place and time, facilitating a smooth workflow and minimizing production delays.

Proper material handling not only influences the speed and accuracy of production but also contributes significantly to cost control, as it influences inventory levels, space utilization, and the prevention of damage to products during handling and storage.

A well-organized material handling strategy is fundamental to optimizing manufacturing operations and achieving higher levels of productivity and competitiveness in the marketplace.

Material Handling System (MHS) involves selecting appropriate material handling equipment, specifying unit load sizes, and applying effective design methods. This holistic approach recognizes the diverse factors influencing material handling and emphasizes adaptability for efficiency and cost-effectiveness.

Core components include the careful selection of conveyors, automated guided vehicles (AGV), lift trucks, and cranes; determining optimal unit load sizes; employing design methods for layout, automation, and safety; and ensuring adaptability to evolving business needs. Efficiency and cost-effectiveness are key considerations in achieving an optimal MHS.

OBJECTIVES OF MATERIAL HANDLING SYSTEM

Cost Reduction

Cost reduction involves implementing strategies to minimize expenses and improve efficiency in the production process. Minimizing material handling costs is a key goal that involves cutting labour expenses, lowering equipment costs, and improving operational efficiency. This objective aims to streamline the movement of materials within a system, ultimately enhancing overall cost-effectiveness.

Workplace Safety

A safe working environment is vital for employee well-being and operational efficiency. This includes minimizing manual handling risks through the promotion of ergonomic practices, providing comprehensive training, and utilizing assistive equipment. These measures collectively contribute to a workplace that prioritizes the health and safety of its employees, fostering a culture of well-being and productivity.

Space Utilization

Space utilization entails maximizing storage efficiency by implementing organized systems, thereby minimizing the requirement for excessive warehouse or manufacturing space. This involves strategic placement of inventory, utilization of vertical storage, and implementing efficient shelving systems. By optimizing space usage, businesses can enhance operational efficiency, reduce overhead costs, and streamline processes. This approach not only improves accessibility to items but also contributes to a more sustainable and cost-effective use of physical spaces within a facility.

Accurate Inventory Management

Accurate inventory management involves implementing systems that enable precise tracking and traceability of goods throughout the supply chain, ultimately enhancing inventory control and minimizing errors. Utilizing advanced technologies such as barcoding, RFID, or automated systems ensures real-time visibility into stock

levels, streamlining the monitoring of product movement and facilitating timely restocking. This not only prevents stockouts but also reduces the risk of overstocking.

Customer Service Improvement

Customer service improvement centres on elevating customer satisfaction by optimizing the efficiency and reliability of product delivery. This involves streamlining processes to ensure timely responses to customer demand. By enhancing logistics, supply chain management, and order fulfilment, businesses can meet customer expectations promptly, resulting in increased satisfaction and loyalty. This customer-centric approach not only improves the overall experience but also contributes to long-term relationships and positive brand perception.

Environmental Sustainability

Environmental sustainability in the workplace involves minimizing the ecological footprint by optimizing transportation routes, reducing energy consumption, and minimizing waste in material handling processes. This can be achieved through strategic planning of transportation logistics to optimize fuel efficiency, adopting energy-efficient technologies and practices, and implementing waste reduction strategies in material handling. By prioritizing these aspects, businesses can contribute to a more sustainable future, aligning their operations with environmental responsibility and conservation efforts.

Flexibility and Adaptability

Flexibility and adaptability in material handling systems are paramount for meeting dynamic production demands and ensuring operational efficiency. This involves designing systems that can seamlessly adapt to changing requirements, accommodate varying production volumes, and easily integrate new technologies. Flexible material handling solutions, such as modular conveyor systems or adjustable storage layouts, enable swift adjustments to meet evolving production needs. This adaptability not only enhances overall efficiency but also allows businesses to scale their operations effectively, staying responsive to market changes and maintaining a competitive edge in today's dynamic industrial landscape.

ADVANTAGES OF MATERIAL HANDLING SYSTEM

Increased Productivity

Automation and machines speed up work by doing tasks faster and more precisely than people. This makes everything run smoother and quicker, leading to better overall productivity. With machines handling routine jobs, workers can concentrate on more important and creative aspects of their work. This not only helps companies make more money but also encourages new ideas and growth within the organization.

Improved Safety

Automation makes workplaces safer by reducing the need for manual work. This creates a safer environment with fewer injuries. Automated processes not only lessen physical strain but also eliminate risks linked to human mistakes. This shift to automation makes workplaces more secure and efficient, ensuring the well-being of employees and lowering the chances of accidents.

Cost Savings

Setting up effective material handling systems can save a lot of money in the long run. By making processes smoother and cutting down on manual work, companies can reduce labour costs. These systems also help avoid damage to materials, preventing losses from mistakes or accidents. With well-designed material handling, everything runs more efficiently, making the best use of resources and saving even more money.

Enhanced Product Quality

Minimizing manual handling is integral to enhancing product quality by mitigating the risk of damage and minimizing defects. When products undergo less manual intervention, the potential for human errors and mishandling decreases significantly. This not only safeguards the integrity of the products but also ensures that they meet stringent quality standards. As a result, companies can deliver goods of

superior quality, meeting or even surpassing customer expectations, and reducing the likelihood of defects in the final output.

Efficient Space Utilization

Efficient space utilization is a critical aspect of well-designed material handling systems, as they play a pivotal role in optimizing storage space and minimizing the overall footprint needed for storage. Through strategic organization and utilization of space, these systems ensure that every square foot is maximized for storage efficiency. This involves implementing smart storage solutions such as rack systems, automated retrieval systems, and dynamic storage configurations that adapt to varying inventory levels. Overall, the emphasis on efficient space utilization in material handling systems leads to increased productivity, reduced operational costs, and a more streamlined and organized warehouse or distribution centre.

Adaptability to JIT Principles

Material handling systems play a crucial role in supporting Just-in-Time (JIT) manufacturing principles by ensuring the efficient and timely delivery of materials to the production line. These systems are designed to streamline the flow of materials, minimizing delays and optimizing the use of resources. By providing a seamless connection between suppliers and production processes, material handling systems help reduce excess inventory levels, a key objective of JIT. This adaptability to JIT principles not only enhances operational efficiency but also contributes to cost savings by minimizing storage costs and the risk of obsolete inventory.

1.2 INDUSTRY PROFILE

MATERIAL HANDLING SYSTEM IN A STEEL FABRICATION COMPANY

In a steel fabrication company, an efficient material handling system is crucial for streamlining operations and ensuring the smooth flow of materials throughout the production process. Here are key components and considerations for a material handling system in a steel fabrication company they are as follows

Raw Material Handling:

Efficient unloading of raw materials, such as steel coils or sheets, from incoming trucks or containers and Adequate storage space with organized racks or bins to store raw materials based on their types and sizes.

Material Transport:

Conveyor belts or roller conveyors to move materials between different workstations. For lifting and transporting heavy materials within the facility. Overhead cranes for lifting and moving large and heavy steel components.

Cutting and Machining:

Computerised Numerical Control (CNC) machines or other cutting equipment for shaping and sizing steel materials and Equipment for drilling, milling, and other machining processes.

Welding and Assembly:

Properly arranged workstations for welding processes and Sequential arrangement of workstations for assembling fabricated parts.

Finished Goods Handling:

Stations for inspecting and ensuring the quality of finished products and Packaging stations for preparing finished goods for shipment.

Automated Systems:

Incorporating robotics for tasks such as welding or material movement to improve efficiency and Self-guided vehicles for transporting materials within the facility.

Inventory Management:

Implementing barcoding or RFID systems for tracking and managing inventory and Utilizing inventory management software to monitor stock levels and reorder materials as needed.

Maintenance and Safety:

Scheduled maintenance for all material handling equipment and Implementing safety protocols and training for employees operating material handling equipment.

Corrosion Control in a Steel Fabrication Company:

Corrosion control is paramount in the steel industry to safeguard fabricated products from deterioration and ensure their longevity. Various measures are employed, including protective coatings such as paints, primers, and galvanization, which create barriers against corrosive elements. The integration of these measures, tailored to specific environments, plays a vital role in maintaining the quality and integrity of steel structures and products.

Coatings

Applying protective coatings, such as paint or primer, creates a barrier between the steel surface and the corrosive environment. These coatings can be tailored to resist

specific corrosive agents. Coating steel with a layer of zinc (galvanization) provides sacrificial protection. The zinc corrodes preferentially, safeguarding the underlying steel.

Cathodic Protection

Installing sacrificial anodes made of a more reactive metal (e.g., zinc or magnesium) near the steel structure can protect it by corroding instead of the steel. This is commonly used in underground pipelines and offshore structures.

Alloying

Using alloyed steels with elements like chromium, nickel, and molybdenum can enhance corrosion resistance. Stainless steel, for example, contains chromium that forms a passive oxide layer protecting the steel from corrosion.

Proper Design

Designing structures to facilitate proper drainage and ventilation helps prevent the accumulation of moisture, a common factor in corrosion.

Cathodic Protection:

In some cases, an external electrical current is applied to the steel structure to counteract the natural corrosion process.

Environmental Controls:

Maintaining optimal environmental conditions, such as controlling humidity and temperature, can mitigate corrosion risks.

Regular Inspection and Maintenance:

Implementing regular inspection schedules allows for the early detection of corrosion issues, enabling timely maintenance and prevention of further damage.

Material Selection:

Choosing materials that are inherently resistant to corrosion for specific applications can be an effective preventive measure.

Cathodic Protection:

Monitoring the effectiveness of cathodic protection systems through regular testing and adjustments ensures ongoing corrosion control.

Cleaning and Surface Preparation:

Properly cleaning and preparing the steel surface before applying coatings or other protective measures is essential for their effectiveness.

Combining multiple corrosion control measures and tailoring them to the specific environment and application is often the most effective strategy in the steel industry. Additionally, staying informed about advancements in corrosion control technologies is important for implementing the best practices in the field.

1.3 COMPANY PROFILE

GNB corrosion Controllers, Located at Avadi, established in the year of 2001.

The total area for blasting and painting facility available is around 2.5 acres, having the service capacity of 800MT per month with the skilled resources.

We wish to introduce ourselves as a Sand/ Grid Blasting & Painting Contractor in Various jobs at various sites. We are having more than 20 years' experience in this field. We will maintain the best quality & delivery schedule at the reasonable price.

Blast cleaning helps in surface preparation by removing contaminants before coating, painting or lining. Surface cleaning removes rust and other contaminants which could cause problems with paint adhesion, or in the most extreme cases, compromise the integrity of the surface metal itself.

The corrosion process involves the deterioration of a substance, usually a metal, or its properties because of a reaction with its environment. Corrosion processes change the iron in steel to another substance that no longer has the desired properties (i.e., strength, toughness).

THE MAJOR WORKS DONE IN THE PAST 20 YEARS AS FOLLOWS

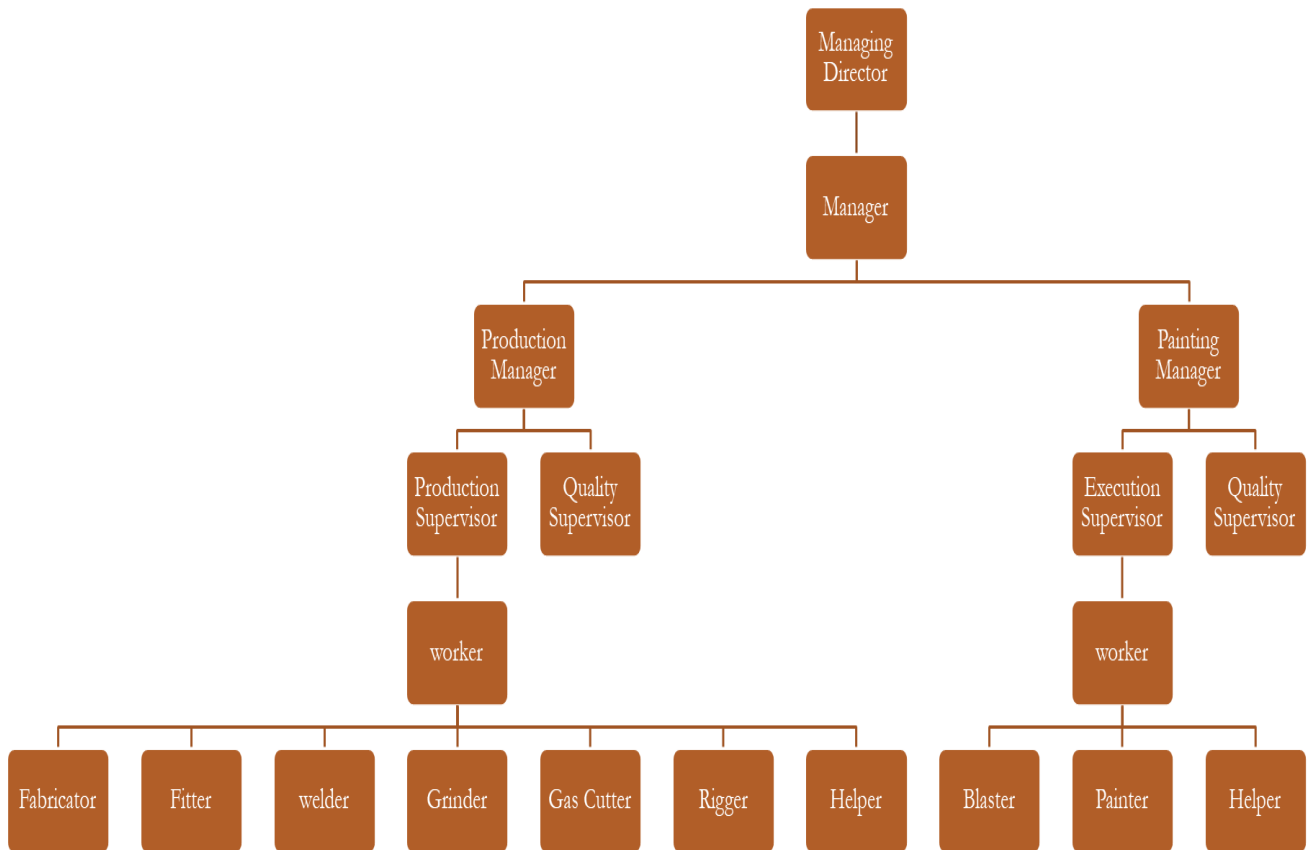
- **L.N.V** Projects (Chutes, Ducts) Red oxide Primers.
- **SUZLOW WIND MILLS** Epoxy Zinc Rich, Epoxy Intermediate Epoxy Polythene with RAL 9003 Shade
- **MANTAKRAF** (20,000 TPH Separators) Heavy Structural with Zinc Phosphate, Primers, HB MIO paints.
- **PROGEN SYSTEM& TECHNOLOGY LTD., Tiruvallur** Dist. from the Year 2006 to till date of Diffuser with Epoxy Silicates and Epoxy Final coat paints

- **TECHNIP ITALY** (Steels, Ducts, panels) Epoxy silicates, MIO, Polythene Paints
- **BATEMAN** (South African Projects) Beams & Columns with Red oxide
- **FORCES DUCTS** Epoxy Zinc Rich Primers
- **POLY GON** Towers Epoxy Zinc Rich, Intermediate, Polythene.
- **ANSALDO** Casting, Duct, Panels, Railing Epoxy, Zinc Rich Primers, Epoxy Weld able Primers, Epoxy Silicates Primers
- **GEA Projects** (De Reactor & Storage Tanks) Epoxy Zinc silicates & Finish Paints. GEA Projects ("C" frames) Epoxy primers, MIO, Dark Grey Polythene. Durrprojects (Post hard rails Protective Grids) Epoxy Zinc rich & Epoxy polythene. RAL9010, RAL1018, RAL9005.
- **Chennai Port** conveyor work.
- **SAINTGOBAIN** (Structural) Red oxide & Enamel finish.

WE HAVE THE PRIVILEGE OF WORKING WITH SOME OF THE REPUTED COMPANIES AS FOLLOWS

- KELD ELLENTOFT INDIA PRIVATE LTD. Gummidipoondi
- LBH EXPANSION JOINTS INDIA (P) LTD., Maraimalainagar
- TECHNO FAB MFG. LTD. (2007-2010), Kattur
- DAIMLER (BHARAT BENZ), Orakodam
- KOBELCO CRANES, Sri City, Tada
- EAGLE BURGMANN KE PVT LTD. Karanodai
- SUN INDUSTRIAL AUTOMATION & SOLUTIONS, Ekkattuthangal
- SRI PEE KAY DEE INDUSTRIES, Vadakarai
- REGEN POWERTECH PVT.LTD. MambattuVillage, Tada Mandal
- BGR ENERGY SYSTEM LTD. Panchetty
 - AIR FIN COOLER DIVISION OIL AND GAS DIVISION
 - ENVIRONMENTAL ENGINEERING DIVISION
- KSK ENGINEERING, Thirumullaivoyal

ORGANIZATIONAL STRUCTURE



Pre-Cleaning of the material:

Cleaning can be done with wiping by dry cloth to remove the organic solvent like grease and oil with kerosene etc. By cleaning of Alkaline like NaOH(soda), Trisodium Phosphate. This process done under the standard SSPC-SP 1 as followed.

Remedies design or fabrication defects

Removable of spur spatters and sharp edges etc.

Inspection / documentation of cleaning

Job completion report has to be produced before blasting. Ensured the grade of various kind of rust. Before blasting the day before inspection offered to the respective concern quality control team by us throw mail and telephonic.

After blasting the cleaning work and inspected from our side to ensure the quality as per accepted norms and standard.

A brief description of each of the four levels of cleanliness is as follows:

Brush Off - Loose mill scale, loose rust and foreign particles are removed.

Commercial - Mill scale, rust and foreign particles are substantially removed and grey metal is visible.

Near White Metal - Mill scale, rust and foreign particles are removed to the extent that only traces remain in the form of spots or stripes. The cleaned surface will show varying shades of grey.

White Metal - Visible mill scale, rust and foreign particles are entirely removed. The cleaned surface should have a uniform metallic colour but may show varying shades of grey when viewed at different angles.

Equipment for the cleanliness:

Air compressor

Fully maintained and serviced. Capable of 125psi discharge pressure.

Located upwind and away from the blasting area. Oil and particulate filter separator.

Blast Hose

Kept as straight and as short as possible.

Heavy wall hose for extension length, super flex for nozzle end flexibility.

All the instruction to be followed by manufacture of paint in the data sheet.

- a. Volume to mixing ratio.
- b. Thinner to be used
- c. Flash point
- d. Pot life
- e. Interval between the coatings
- f. Coverage of paint at required DFT.

Safety measures to be followed

- No short cuts to be used.
- Wear safety appliances to avoid direct skin contact
- No hot work during painting
- Do not use sparkling tools
- Ensure that the safety equipment requirements are in line with local regulation

PHOTO GALLERY OF WORKAPACE AND EQUIPMENT

Work Shop



Mobile Cranes



Office

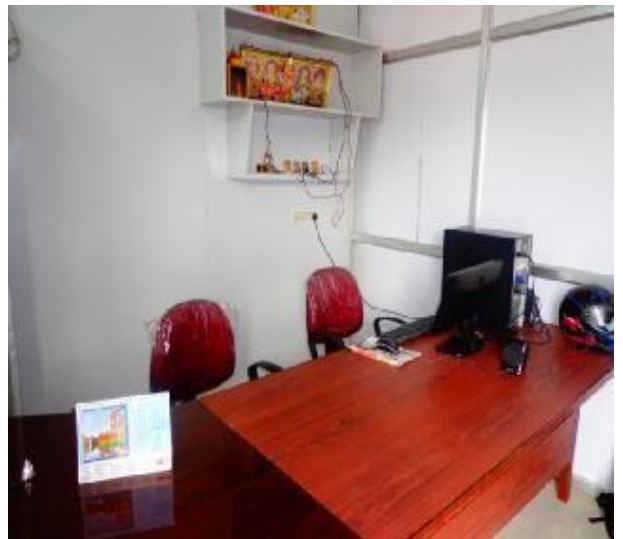


PHOTO GALLERY PRODUCTS HANDLED
M/s. KOBELCO CRANES



ENVIRONMENTAL ENGINEERING DIVISION - BGR ENERGY SYSTEM



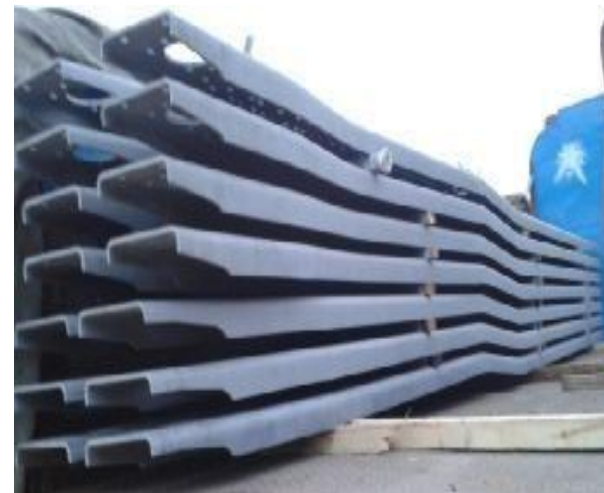
AIR FIN COOLER DIVISION & OIL AND GAS DIVISION - BGR ENERGY SYSTEM



REGEN POWER TECH



DAIMLER



BHARATH BENZ VEHICLE CHASIS METALLIZING



BGR Oil Receiver Tank



Walkway



TESTING METHOD
COAL THAR PAINT AFTER METALIZING



PROFILE CHECKING AFTER BLASTING



HOLIDAY TEST



NON-INDUSTRIAL PRODUCTS



1.4 STATEMENT OF THE PROBLEM

The study of research purpose is to know about the ways where we can reduce the cost that is incurred in material handling of a steel fabricated product in GNB Corrosion Controllers private limited

1.5 OBJECTIVE OF THE STUDY

- To study the material handling system followed by GNB Corrosion Controllers
- To analyze the existing method and process employed for material handling
- To find out the cost associated with material handling
- To explore and identify the best alternative so that cost incurred can be reduced with same quality

1.6 NEED FOR STUDY

- Studying the Material Handling System in an organization serves as a fundamental basis for making well-informed decisions and ongoing enhancements in how materials are managed and moved within the business
- Helps to understand and identify the problematic areas to Creating a strategic plan and implementing targeted actions based on identified issues in a material handling processes
- Understanding different Material Handling strategies to helps in streamlining processes, reducing production time, and minimizing waste, ultimately improving overall efficiency and reduces the cost incurred for production
- Analyzing various strategies which allows for identifying cost-effective methods, optimizing resource utilization, and lowering production.

1.7 SCOPE OF THE STUDY

- the Material Handling System help to reduce the cost incurred and increase the productivity and profit
- Analysing the Material Handling System employed by GNB Corrosion Controllers is crucial for optimizing their operations and achieving cost reduction across the entire process
- To identify opportunities for improvement and efficiency at each stage of the process. This includes assessing how materials are produced, transported, stored, and utilized in the manufacturing process. The ultimate goal is to enhance overall efficiency and reduce operational costs,
- Determine the opportunities for enhancement in material handling System is essential for minimizing the incurred costs and further boost the company's performance even more.

1.8. LIMITATION OF THE STUDY

- The study is restricted to only 130 employees of GNB Corrosion Controllers Private Limited. This implies that the findings may not accurately reflect the entire organization or industry in its entirety
- Since the study is based on the primary data collected. the information provided by the respondents could also be biased or inaccurate. No independent verification of the data was possible. Time is a major constraint
- The selected participants were occupied with various commitments, potentially constraining both the quantity of responses and the range of viewpoints.
- The findings of this report are tailored to a particular project, and the scope of the study might not lend itself to direct application in diverse projects or contexts.

CHAPTER 2

REVIEW OF LITERATURE

2.1 REVIEW OF LITERATURE

the review of literature is a crucial step in the research process. It not only provides a comprehensive understanding of the existing theoretical frameworks and research in the field of material handling management but also guides the formulation of the proposed study by identifying gaps, challenges, and areas where further investigation is needed. This process ensures that the new research contributes meaningfully to the academic discourse and practical understanding of challenges in material handling management in manufacturing industries.

Aditya A. Kamble, Prof. Pratik A. Patil, (2019), Material handling systems encompass the movement, storage, and control of materials in manufacturing, aiming to deliver the right amount of material to the correct destination at the right time and minimal cost. Despite not being a direct manufacturing process, it incurs significant costs and labour. Continuous automation is transforming material-handling equipment, presenting a diverse range of options in the market. Selecting the right system is crucial for reducing costs, avoiding interruptions and damage, and improving productivity and profitability. The paper provides insights into material handling equipment, offering guidelines for optimal system selection based on specific industry needs.

Amol Shelke, Arun Wakekar, Pravin Jadhav, Shubham Pardeshi, Prof. S.P. Walhekar, (2020), this aims to provide a practical and efficient solution for material handling in industrial settings by developing weight-operated and spring-operated devices that have high load capacity, low maintenance requirements, and reliability while eliminating the need for external power sources.

Mauro Gamberi & Riccardo Manzini & Alberto Regattieri, (2009), The challenge faced by small and medium-sized enterprises (SMEs) in measuring the direct costs of material handling due to various factors such as a large number of product types, complex production cycles, and market dynamics. In response to this, the paper suggests the need for flexible tools that enable production managers to create a material handling system model. This model should explicitly and rapidly calculate indices that are traditionally neglected or difficult to approximate, such as time and cost in material flow, storage area requirements, and material handling (MH) utilization percentage.

Ronelle roux, (2001), This aims to bridge the gap between theoretical knowledge about materials handling and its practical application within a specific industrial context. By conducting a case study and making recommendations, you hope to contribute to the enhancement of materials flow and production efficiency in a South African steel fabrication operation.

R.L. Kamalapurkar, P.P. Date, (2006), This aims to minimize total wastage, which includes both the material wasted due to layout issues and that wasted due to rejections of critical parts. This approach could potentially lead to significant cost savings and a more efficient use of sheet metal in these industries. The paper's methodology appears to be an innovative approach to address the issue of wastage in the sheet metal industry, particularly in cases where critical parts are involved. It combines material science, probabilistic analysis, and layout optimization to achieve the overall goal of reducing wastage in sheet metal production.

W. Hufenbach, M. Andrich, A. Langkamp, A. Czulak, (2006), The use of continuous fibre-reinforced magnesium alloys offers a promising solution for lightweight applications in industries such as automotive engineering. These materials provide a

means to achieve weight reduction while improving stiffness, strength, and creep resistance. However, their successful implementation relies on tailored fabrication techniques and careful consideration of the material's anisotropic properties in the design and engineering process.

Nilesh Bodkhe, Sanghshil L. Kanekar and Tushar G. Bhore, (2015), Pneumatic conveying systems offer a closed-loop, environmentally friendly solution for material handling, but their design involves careful consideration of air velocity, pressure, particle characteristics, and the conveying distance. Research in this field continues to evolve to improve system performance and efficiency.

Chia-Nan Wang, Yen-Hui Wang, Hsien-Pin Hsu, and Thanh-Tung Trinh, (2016), This suggest that the Rotacaster in the Heuristic Preemptive Dispatching (R-HPD) method is an effective approach for addressing the challenges of operating an automated material handling systems (AMHS) in a 450 mm wafer fab. It not only helps to reduce traffic congestion and improve overall efficiency but also significantly enhances the delivery time of wafer lots, especially for critical "hot" lots and normal lots. This research could have important implications for the semiconductor industry as it transitions to larger wafer sizes.

Syed Asad Ali Naqvi, Muhammad Fahad, Muhammad Atir, Muhammad Zubair & Muhammad Musharaf Shehzad, (2016), This underscores the significance of lean manufacturing principles, layout optimization, and systematic planning in the context of a rapidly changing industrial landscape driven by increasing technology demand and global competition. These strategies aim to enhance efficiency, reduce costs, and improve product quality within manufacturing industries.

Aydin Azizi, Poorya Ghafoorpoor Yazdi, (2018), This highlights the essential characteristics that modern manufacturing companies need to consider in their operations the text underscores the evolving nature of manufacturing, driven by the global economy and the need for companies to be agile, responsive, and technologically advanced. Smart material handling systems, as described, play a crucial role in meeting these evolving demands.

Mohd Ammar, Abid Haleem, Mohd Javaid, Rinku Walia, Shashi Bahl, (2021), Industry 4.0 technologies are driving significant changes in the industrial landscape by improving manufacturing processes, reducing costs, enhancing collaboration, and meeting the quality and transparency expectations of customers. These advancements involve the integration of digital tools, automation, data analytics, and remote collaboration to improve material quality, manufacturing systems, and overall business performance.

Natashia Angelina Theodora Sianturi, Didit Darmawan, Arif Rachman Putra, (2022), The effectiveness of material handling is critical to maintaining a smooth and efficient supply chain. When these material transfer principles are followed, it can lead to improved production processes, reduced lead times, lower costs, and enhanced customer satisfaction. Compliance with relevant regulations and industry standards is also essential to ensure the safety of workers and the integrity of products throughout the supply chain.

Jagadish Brahma Goulap, Yohannes Workeaferahu Elifneh and Abera Zerihun Belew, (2022), This study highlights the significance of materials management in the profitability of manufacturing companies and provides insights into the challenges faced by a specific steel industry in Ethiopia. The recommendations provided offer

practical steps for both the focal firm and the government to address these challenges and improve materials management practices, which, in turn, can positively impact profitability.

Gajanana Nadoli, (1994), The general structure of these simulation models would involve creating a digital representation of the wafer fab, its bays, equipment, materials, and the AMHS itself. Simulation examples under these categories would entail running scenarios, such as assessing the impact of changes in production schedules, equipment downtime, or system configurations. Engineers can use these simulations to make informed decisions about the AMHS design and optimize it for the specific needs of Intel's wafer fabs.

Rami Alghalayini, (2020), The research underscores the importance of a holistic approach to internal material handling system improvement. This includes addressing physical attributes, optimizing information systems, and ensuring proper integration with human elements. The findings emphasize that a successful material handling system is dependent on a balanced consideration of these factors, acknowledging the interconnected nature of physical, informational, and human components in the overall system. This approach is seen as vital for meeting customer demands and enhancing delivery performance in a competitive business environment.

Arjun Balasubramaniam and Naga Lakshmana Naidu Navuluri, (2019), This research suggests that a holistic approach, considering both technical and cultural aspects, is crucial for achieving efficiency in material handling and inventory control in the context of highly customized manufacturing. It also emphasizes the collaborative aspect with suppliers and customers for optimizing inventory and material handling operations.

Ivica Veža, ikola Gjeldum, Luka Celent, (2011), This discusses the application of lean manufacturing principles specifically in the context of bottler beverage production systems in Croatian enterprises, along with the challenges faced during implementation. The implementation of lean concepts in any production system, including beverage manufacturing, typically involves identifying and eliminating various forms of waste such as overproduction, excess inventory, unnecessary motion, waiting times, and defects. By doing so, companies aim to streamline their processes and improve overall efficiency.

Naveen Kumar & Dalgobind Mahto, (2013), This discusses a real-world case where various components are manufactured in industries, emphasizing the importance of productivity improvement and the need for balancing operations at different strategic workstations. The application of group technology is highlighted as a means to achieve goals such as minimizing total production cost and the number of workstations. In assembly line balancing, the goal is to distribute tasks among workstations in an efficient manner, ensuring that each workstation has a balanced workload. This helps to optimize production processes, reduce idle time, and enhance overall productivity.

Abu Md. Saifuddoha, Md. Ahasan Habib, Sohana Yasmin Sumi, Md. Jennurine, Md. Saiful Islam, (2013), This paper aims to enhance the productivity of the cement industry's supply chain by utilizing value stream mapping (VSM) to identify and address non-value-added activities. Through critical observations and interviews, the study uncovers issues such as overproduction, excess inventory, and information delays. The proposed solution involves the removal of these inefficiencies from the cement-processing sector. The innovative use of VSM is highlighted as a key aspect of the approach, marking a unique contribution to the field. The paper concludes by emphasizing the significance of waste removal for overall industry improvement.

Meghraj, Sumeet Kumar Nigam, H R Chandrakar, (2018), This aims to enhance the productivity of a Sponge Iron plant's crusher unit by implementing an effective material handling system. the study evaluates and selects material handling equipment (Conveyor, Industrial Truck, Loader). The Conveyor is prioritized, leading to a proposed framework layout that significantly improves plant efficiency by 79.99%, with a 52.50% reduction in transportation length. The study emphasizes the critical impact of facility layout choices on long-term success.

Kavishwar Roy Gaurh, Imtiyaz Khan, M. K. Ghosh, (2014), This study explores the selection of Material Handling Equipment in the automobile industry using Multi-Criteria Decision-Making Methods such as AHP, FAHP, and TOPSIS. Three criteria (Material, Move, Method) are considered, with the Method criterion deemed most important. The research concludes that Conveyor Systems are the most efficient choice for material handling, crucial for reducing manufacturing cycle time and overall costs in the automotive sector.

A. A. Gulghane, Prof P. V. Khandve, (2015), Effective construction materials management and waste reduction are critical for the success and sustainability of construction projects. Construction materials can constitute a significant portion of project costs, and their efficient management is essential. Construction waste, generated at various stages, poses environmental challenges. Minimizing waste through strategic procurement, inventory control, and waste reduction strategies is crucial. Sustainability efforts, including the use of eco-friendly materials and life cycle assessments, play a key role. Overcoming challenges and embracing opportunities, such as cost savings and positive public relations, are integral to advancing responsible construction practices.

Brett A. Peters and Taho Yang, (1997), This paper investigates the integration of layout and material handling system design in semiconductor fabrication facilities. It

proposes a methodology that utilizes a space filling curve approach for facility layout and exploits the structure of spine and perimeter configurations to formulate a network flow problem for material handling system design. Computational results show promise for solving this integrated design problem effectively in semiconductor manufacturing environments.

Guilherme Bergmann Borges Vieira, Giovana Savitri Pasa, Maria Beatriz Nunes de Oliveira Borsa, Gabriel Sperandio Milan, Alberto Pandolfo, (2011), This study addresses the imperative for companies, especially in the competitive global environment, to enhance agility, performance, and cost efficiency. Focusing on a major automotive industry player, the research centres on improving internal materials handling management, a critical aspect linked to production flow, transit time, resource utilization, and service levels. The objective is to systematically assess the impact of implemented changes on internal customers' perceptions of cost, safety, service reliability, agility, and overall satisfaction.

Purnama sahid Antasara, (2017), CV. Rattan Asik Asik Jos, a rattan furniture manufacturing company, faced challenges with its production layout, leading to increased material handling costs. To address this, the company evaluated and proposed a new plant layout using a product-oriented approach and S-shaped material flow. The implementation resulted in a 34% reduction in material handling costs, from IDR 4,850,299 to IDR 3,178,996, emphasizing the efficiency gains achieved through the redesigned layout.

Marc Goetschalckx, Edward Huang, Pratik Mital, (2012), This study addresses the design of material handling systems under uncertainty. Future conditions and planning decisions are uncertain and modelled through scenarios with individual costs. The system's performance is evaluated using the expected value and standard deviation

of these costs. The goal is to identify Pareto-optimal configurations that balance expected value and risk. Decision-making is based on a Pareto graph, considering the system owner's risk preferences for final implementation.

Srikant Datar, Sunder Kekre, Tridas Mukhopadyay, Eric Svaan, (1991), Manufacturing managers face challenges from global competition, high input costs, and customer demands for better quality at lower prices. The adoption of cell manufacturing for efficiency is hindered by traditional cost accounting systems. These systems provide inaccurate cost information, impeding process design improvements and leading to misleading cost/benefit signals. To enhance manufacturing competitiveness, there is a need for modernized accounting systems, such as activity-based costing, that accurately reflect the costs associated with innovative manufacturing practices like cell manufacturing.

Todd Ramsden, (2013), This study discusses the current status of fuel cell electric vehicles, highlighting that although they are in a pre-commercialization phase, hydrogen fuel cells are already being used commercially in material handling and backup power applications. Early market deployments of fuel cells in material handling equipment (MHE), such as forklifts in warehouse operations, show promise due to their zero emissions, more than 12 hours of operation without performance degradation, and quick refuelling, making them a compelling alternative to traditional battery systems.

Henry J. Kostanski, (1991), This assesses the cost of implementing an Automated Guided Vehicle (AGV) system versus conventional equipment in the Connector Building Complex at Defence Depot Richmond, Virginia. It concludes that various cost-effective alternatives exist, providing detailed resource requirements for each. Notably, a full-scale AGV system is deemed not cost-effective. Instead, the report recommends adopting conventional equipment, which would enable Defence Depot Richmond to

meet processing goals and potentially save \$6.2 million in discounted dollars for the Defence Logistics Agency.

Benoit Montreuil, Russell D. Meller, Eric Ballot, (2010), This Physical Internet is a revolutionary concept aiming to enhance sustainability in logistics and transportation. It relies on standardized, modular, and smart containers, along with interconnected logistics networks. The paradigm shift offers breakthrough opportunities for material handling and facility logistics. The paper introduces key elements—containers, movers (transportation systems), and nodes (key points in the logistics network), highlighting their innovative characteristics. This primer encourages further exploration of research avenues for advancing the Physical Internet.

P. Lenin, L. Krishnaraj, D. Narendra Prasad, V.R Prasath Kumar, (2014), Material mismanagement not only reduces contractor profits but also jeopardizes project completion. The study investigates existing material management practices in contracting companies using surveys, interviews, field visits, and discussions. Out of 26 factors assessed, the top five causes of cost overruns identified are design issues, market conditions, store issues, contractor issues, and external issues. The paper concludes with recommendations to mitigate material mismanagement in the construction industry, emphasizing the importance of addressing these key factors for improved project outcomes.

Ann Kristin Odland Håvås, (2018), This theory focuses on the importance of selecting the right maintenance strategy for cost-effective maintenance throughout the lifespan of assets, with a specific emphasis on Auto Store AS's smart warehousing system that utilizes advanced robots. Despite the system being relatively new, the emergence of errors has led to unexpected failures and increased replacements. The thesis suggests extending the analysis interval, transitioning to organizational learning, and investing in root cause analyses for a better understanding of errors. Real-time data and

condition monitoring are recommended for future studies. The key emphasis is on the importance of understanding root causes for developing an effective maintenance strategy.

U Tarigan, A Ishak, N A Fabiola, N Sembiring, K Syahputri, and U P P Tarigan, (2021), This study aimed to address irregular material flow patterns on the production floor of a wood processing factory (XYZ Company) using the Urban Algorithm and WinQSB Software. The approach led to a 56.57% reduction in material handling costs, with the best alternative layout identified as Layout II. The total displacement moment decreased from 1,211,335 to 546,745 times/month, and the operational material handling cost dropped from IDR 1,321,902 to IDR 574,083. Overall, the implementation improved efficiency and optimized the production floor layout.

P.V. Arulkumar, M. Saravanan, (2012), This paper appears to contribute to the field of material handling and layout design by proposing a method to reduce manufacturing costs through efficient layout planning, and by comparing the performance of two optimization algorithms in achieving this goal. The preference for the PSO algorithm suggests its potential application in real-world scenarios for optimizing material handling systems in manufacturing setups.

Anas Blasi, Bryce Gregory and Keith Thompson, (2013), This study investigates whether enhancing the velocity and acceleration of reach trucks in a warehouse reduces overall costs per pallet handled. Simulating a Maines Paper & Food Services facility, two scenarios with 15% and 25% performance increases were compared, assuming corresponding energy consumption rises of 30% and 50%. Results suggest modest cost savings, especially in larger warehouses with greater distances at maximum speed. The trade-off between decreased work times and increased energy consumption should be carefully considered, emphasizing the need for a tailored approach based on warehouse characteristics.

Ewa KULIŃSKA, (2015), This analysis explores materials management in manufacturing, focusing on costs and risk factors. Using the furniture industry as a case study and applying V.A. Gorbatov's algebraic principle, the study reveals that a risk factor in one area of a company has financial consequences across multiple stages of the process. This interconnectedness affects the calculation of actual process costs, impacting overall profitability. The study underscores the need for a holistic understanding of risk dynamics to make informed decisions and optimize operations in manufacturing enterprises.

Dileep Pandalai, Subin George Mathew, (2015), This paper aims to enhance the productivity of a tiller manufacturing industry by optimizing the layout of its machine shop. Currently facing challenges in meeting demand, the company outsources many parts, leading to increased material travel distances. The paper proposes strategies to minimize these distances, focusing on reorganizing the machine shop layout and bringing parts manufacturing in-house. The goal is to improve overall productivity, with an emphasis on cost-effectiveness and addressing the root causes of the company's inability to meet demand in recent years. The paper includes a comprehensive analysis of the current state, optimization strategies, cost-benefit considerations, and recommendations for implementation.

Qi Hao and Weiming Shen, (2008), This research proposes a hybrid simulation approach, combining discrete event and agent-based technologies, to model complex material handling processes in assembly lines. A prototype system is implemented using a commercial modeling tool, applying Just-In-Time (JIT) principles to both production and material handling. The system's performance is evaluated, and optimization directions are suggested. The hybrid modeling allows for simulating different scenarios, facilitating the creation of a responsive and adaptive manufacturing environment.

Daniela Marasova, Janka Saderova, and Lubomir Ambrisko, (2020), This article discusses a simulation model created in Tecnomatix to optimize material handling equipment's capacity utilization, focusing on six conveyance lines. The model visualizes material flow in the production process, allowing experiments with adjusted production times and workplace modifications. Graphs in the article show machinery and operator capacity utilization, with experimental results suggesting potential elimination of unfinished product accumulation. Overall, the study demonstrates the effectiveness of simulation modeling in identifying and addressing bottlenecks for improved production efficiency.

Nurul Hayati Abdul Halima, Noriah Yusufb, Roseleena Jaafarc, Ahmed Jaffard, Nur A'in Kasehe, Nur Nida Aziraf, (2015), This research focuses on the growth of the automotive industry in Malaysia over the past two decades. Despite the adoption of world-class manufacturing techniques, challenges were identified in the material handling system of a local automotive manufacturer. The study aimed to design and evaluate a new storage system for the Air Cleaner component, introducing standard poly-boxes and a gravity flow rack system. Computer simulations showed a 74% reduction in inventory levels and an 18.18% improvement in space utilization, indicating increased efficiency and optimization in material handling.

Semih Onut & Selin Soner Kara & Sinan Mert, (2009), This research addresses the challenging task of selecting Material Handling Equipment (MHE) for manufacturing companies in the steel construction industry in Istanbul, Turkey. The method involves Multiple Criteria Decision Making (MCDM) using fuzzy logic. Fuzzy Analytic Network Process (FANP) assigns weights to criteria, considering both tangible and intangible factors. Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is then applied to choose the most efficient MHE, considering production characteristics and cost efficiency. The study includes sensitivity analyses of the results, providing a systematic and structured approach to MHE selection.

Jesus A. Jimenez, Gerald T. Mackulak, and John W. Fowler, (2008), This emphasizes the importance of determining the appropriate level of detail for equipment capacity and automated material handling systems (AMHS). The paper introduces a classification method and framework for selecting the level of detail in fab models. A case study compares the performance of integrated capacity/AMHS models with coupled capacity/AMHS models, showing that the coupled model produces similar cycle time estimates while significantly improving CPU time efficiency

Mohsen M.D. Hassan, (2010), This research introduces a novel framework to guide the selection of material handling (MH) equipment and the design of complete MH systems. It categorizes equipment based on handling-related functions, allowing consideration of various types. The framework helps practitioners and managers overcome limitations in existing approaches, offering a wide range of equipment options without relying on extensive databases. The suggested steps emphasize user requirements and objectives, promoting collaboration between facility managers and designers. While acknowledging the need for further research, the paper fills a gap in the literature by providing organized steps for better decision-making in MH equipment selection.

Mounstapha Ahmed Bouh, Diane Riopel, (2015), This research reviews existing literature (27 articles) on material handling equipment selection, noting that developed systems typically use 50 equipment types and 42 attributes. It argues for increased robustness and practicality in these systems to better reflect the evolving market with a greater variety of material handling equipment. The paper proposes new and more comprehensive classifications for individual unit load material handling equipment types and attributes, emphasizing the necessity for updated lists in response to the expanding range of equipment in the market.

Zakarya Soufi, Pierre David, Zakaria Yahouni, (2021), This research discusses the critical importance of mastering the Material Handling System (MHS) in manufacturing, given that Material Handling activities can constitute a significant portion (15-70%) of total manufacturing costs. The focus is on selecting appropriate Material Handling Equipment (MHE) for manufacturing plants, with an emphasis on automation levels. The paper proposes a systematic selection methodology based on literature analysis and field studies, offering a comprehensive list of criteria. The suggested multi-criteria decision-making technique is the Analytic Hierarchy Process (AHP). The methodology is implemented in a demonstrator software tool and illustrated using a simple example, showcasing its practical application.

Nata'lia Horn' a'kova', Luka' s' Juri'k, Henrieta Hrablik Chovanova', Dagmar Caga'n'ova', Dagmar Babc'anova, (2019), This research discusses the selection of handling equipment for transporting and handling final products in an industrial enterprise. The authors used the Analytic Hierarchy Process (AHP) method to objectively decide on suitable equipment based on entry requirements, enterprise conditions, and trends in material handling. The Expert Choice program facilitated specific calculations. Emphasis was placed on increasing automation, productivity, and safety. The use of Intelligent/Smart solutions in handling finished goods was a key criterion for equipment selection. The paper underscores the role of AHP in improving decision objectivity and quality.

Thomy Eko Saputroa and Babak Daneshvar Rouyendegh, (2015), This research introduces a hybrid method for selecting Material Handling Equipment (MHE) in warehouse operations. This method integrates fuzzy TOPSIS, entropy-based objective weighting, and Multi-Objective Mixed Integer Linear Programming (MOMILP). The approach considers both subjective and objective criteria, aiming to minimize material handling disadvantages and total costs. The effectiveness of the method is demonstrated through a case study, showcasing its ability to handle complex decision-making in MHE selection for warehouse operations.

Chukwuedozie N. Ezema, Eric C. Okafor & Christiana C. Okezie, (2017), This research focuses on implementing a Just-in-Time (JIT) Material Handling System at the Juhel Oral Drug Process plant, primarily using the Kanban system. This JIT approach aims to streamline production, reduce waste, and optimize material, information, and cost flows. The simulation model employs a single-card pull system with workstations and buffers, emphasizing the significance of low setup times and effective variability management for successful JIT outcomes. The study highlights the flexibility of JIT, underscoring that its success depends on a company's ability to identify problems, be creative, and invest efforts in optimization.

Gunter Sharp, Yen-Tai Wan, Leon F. McGinnis, Marc Goetschalckx, Douglas Bodner, T. Govindaraj, (2001), This research proposes a four-step approach to tackle the complex challenge of selecting and specifying material handling systems for manufacturing operations. The steps include task extraction, filtering and matching tasks with resources, task aggregation, and system selection. The approach aims to address the variety of available technologies and the significant fixed costs associated with material handling systems. It emphasizes a holistic consideration of task characteristics, technology types (e.g., forklifts, AGVS), and task aggregation to optimize material handling processes in manufacturing.

B. S. Manda U. S. Palekar, (2019), An overview of recent research in the design and control of material handling systems. Material handling systems play a crucial role in various industries, optimizing the movement, storage, and control of materials and products throughout the manufacturing process. This overview suggests that research in this field covers both shopfloor transportation systems and storage systems, addressing issues ranging from integrated design to performance analysis.

CHAPTER 3

RESEARCH METHODOLOGY

3.1. RESEARCH METHODOLOGY:

Research methods are the systematic approaches and tools employed to investigate a subject or topic, while research methodology encompasses the practical "how" of conducting a study. It involves acquiring the skills and knowledge necessary to perform tests, experiments, surveys, and critical analyses. It outlines the step-by-step process of data collection, analysis, and interpretation, ensuring a structured and rigorous approach to inquiry. A well-defined research methodology is crucial for producing meaningful insights and contributing to the advancement of knowledge in a given field.

3.2. RESEARCH DESIGN:

Descriptive research design

Descriptive research is a type of research design that focuses on observing and describing the characteristics, behaviours, or phenomena of a particular subject or group of subjects. The primary goal of descriptive research is to provide an accurate representation of what is being studied.

3.3. SAMPLING TECHNIQUE:

Probability sampling

Every person in the population has an equal chance of getting chosen when using probability sampling. Since it yields the most representative samples, this kind of sampling is frequently employed in research investigations. Cluster sampling is selected under probability sampling

Cluster sampling

Cluster sampling is a type of probability sampling method in which the population is divided into clusters or groups, and a random sample of these clusters is selected for analysis.

3.4. SOURCES OF DATA:

In the manufacturing company , various sources of data play a vital role in decision-making, design, production, marketing, and understanding consumer preferences, and Sources of Data begins with figuring out what sort of data is needed, followed by the collection of a sample from a certain section of the population. Next, you have to utilize a certain tool to gather the data from the chosen sample.

In data collection, there are 2 types

- Primary Data
 - primary data refer to original information collected directly from the source for a specific study. Researchers employ various methods to gather primary data, including surveys, interviews, focus groups, experiments, and direct observations.
- Secondary Data
 - Secondary data refer to information that has already been collected by someone else for a purpose other than the current research project. This data can be sourced from various existing records, databases, or previously conducted studies.

3.5. STRUCTURE OF QUESTIONNAIRE:

Questionnaire was divided into two sections. First part was designed to know the general information about employees and the second part contained the respondent 's opinions about material handling system followed by **GNB**

CORROSION CONTROLLERS

- Basic Introduction
- Personal Details
- Research related Questions
- Perception Questions
- Likert Scaling Questions
- Suggestion Question

3.6. SAMPLE SIZE

The sample size for this research project is 130

3.7. SAMPLE DESIGN:

Sample design is a critical phase in research projects, influencing the credibility and reliability of findings by determining how a subset of a population is chosen to represent the entire group. Two main categories govern this process: probability sampling and non-probability sampling. In a specific study, cluster sampling, a form of probability sampling, is employed. This method involves dividing the population into clusters and randomly selecting entire clusters for analysis.

3.8 SAMPLING

❖	Sampling Design	: Probability Sampling
❖	Sampling Techniques	: Cluster Sampling
❖	Sample Unit	: Employees
❖	Sample Size	: 130 Respondents

3.9. PERIOD OF STUDY

The period of the study is to determine the research process is carried out for 3 months.

3.10. AREA OF THE STUDY

The targeted people are the employees of **GNB CORROSION CONTROLLERS Private Limited**

3.11. HYPOTHESIS:

HYPOTHESIS 1

- **H0:** There is no significant difference between the age of the employees and the steps taken to achieve cost reduction in the production
- **H1:** There is significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

HYPOTHESIS 2

- **H0:** There is no significant difference between educational qualification and problems faced often in handling of materials
- **H1:** There is significant difference between educational qualification and problems faced often in handling of materials

3.12. TOOLS FOR ANALYSIS

A questionnaire was created to get the response from the sample required to achieve the research objective. Following are the tools used for data analysis,

3.12.1. PERCENTAGE ANALYSIS

Percentage analysis is a crucial method in research and data interpretation, particularly when dealing with categorical data or discrete response options. This approach involves expressing parts of a whole as percentages, providing a clear and concise way to understand the distribution of responses within a given category. By calculating

the percentage of participants who chose a specific option, researchers can highlight the prevalence or significance of certain trends or opinions within the sample.

3.12.2. ANALYTICAL TOOLS

SPSS tool is used to test hypothesis

Chi square test

The chi-square test assesses the independence of categorical variables by comparing the observed frequencies in a contingency table with the frequencies expected under the assumption of no association. This test is valuable in various fields, such as biology, social sciences, and market research, where researchers seek to understand whether the observed distribution of categories differs significantly from what would be anticipated by chance. The test outputs a chi-square statistic, which is then compared to a critical value or p-value to determine statistical significance.

CORRELATION

Correlation is a statistical measure that quantifies the extent to which two variables are related. The correlation coefficient, often denoted by "r," summarizes this relationship. A correlation coefficient of 1 indicates a perfect positive correlation, meaning that as one variable increases, the other variable also increases proportionally.

- A correlation coefficient of -1 indicates a perfect negative correlation, meaning that as one variable increases, the other variable decreases proportionally.
- A correlation coefficient of 0 suggests no linear correlation between the two variables.

Pearson correlation

The Pearson correlation coefficient (often denoted as "r") is a measure of the linear relationship between two variables. It quantifies both the strength and direction of the linear association between the variables. The coefficient can range from -1 to 1

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

DATA ANALYSIS

Data analysis involves examining raw data to inform decision-making. Various concepts and methodologies in data analysis are integrated into technologies and algorithms designed to process data for human interpretation. By employing data analysis techniques, it becomes possible to uncover trends and indicators that might be overlooked in large datasets. This valuable information can then be utilized to enhance processes, thereby improving the overall efficiency of a business or system.

DATA INTERPRETATION

Data interpretation involves utilizing data analysis methods to make conclusions. It assigns significance to data analysis, determining its meaning and implications. Given the evident importance of interpreting data accurately, it is crucial to perform this task with precision.

Data is frequently sourced from various outlets and can enter the review process in a non-linear fashion. Additionally, the subjective nature of data analysis adds complexity to the overall process.

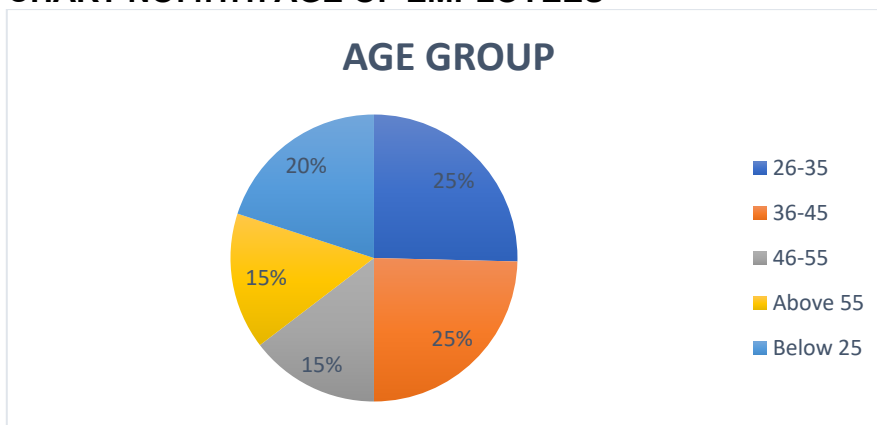
4.1 PERCENTAGE ANALYSIS

TABLE:4.1.1. AGE OF THE EMPLOYEES

S.NO	AGE GROUP	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	26-35	33	26%
2	36-45	32	24%
3	46-55	19	14%
4	Above 55	20	16%
5	Below 25	26	20%
	TOTAL	130	100%

Source: Primary Data

CHART NO:4.1.1. AGE OF EMPLOYEES



INTERPRETATION

From the above table it is interpreted as, 20% of employees are below 25 years, 26% of employees are between the age 26 to 35, 24% of employees are between the age 36-45, 14% of employees are between the age 46-55, 16% of employees above 55 years

INFERENCE

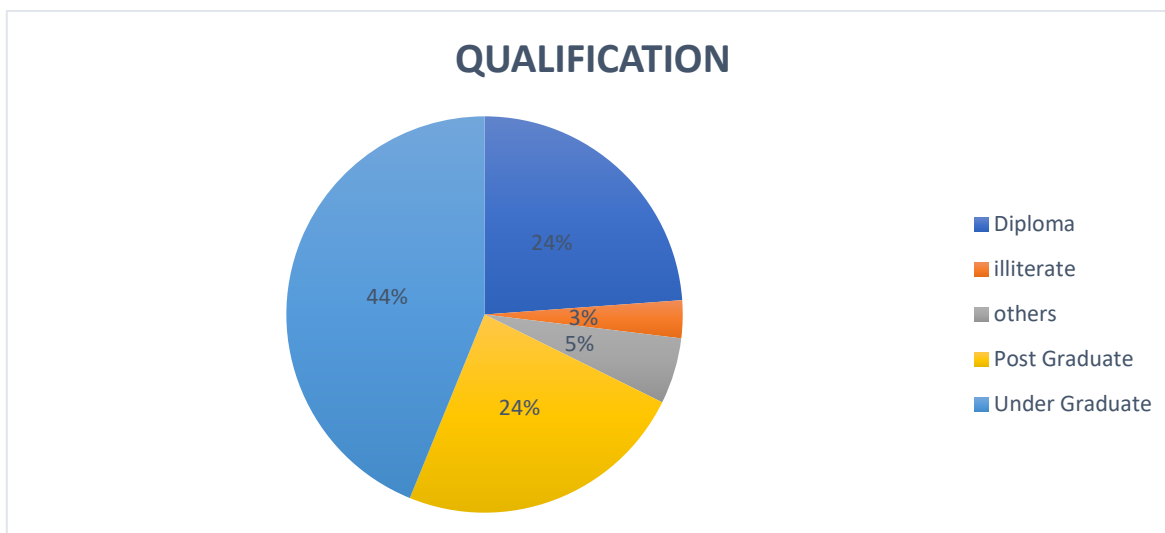
Majority 26% of employees are between the age 26 to 35.

TABLE:4.1.2. EDUCATIONAL QUALIFICATION OF THE EMPLOYEES

S.NO	QUALIFICATION	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	Diploma	31	24%
2	Under graduate	57	44%
3	Post graduate	31	24%
4	Illiterate	4	3%
5	Others	7	5%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.2. EDUCATIONAL QUALIFICATION OF THE EMPLOYEES



INTERPRETATION

From the above table it is interpreted as, 24% of employees studied diploma, 44% of employees studied undergraduate, 24% of employees studied postgraduate, 3% of employees are illiterate, 5% of employee's other qualification

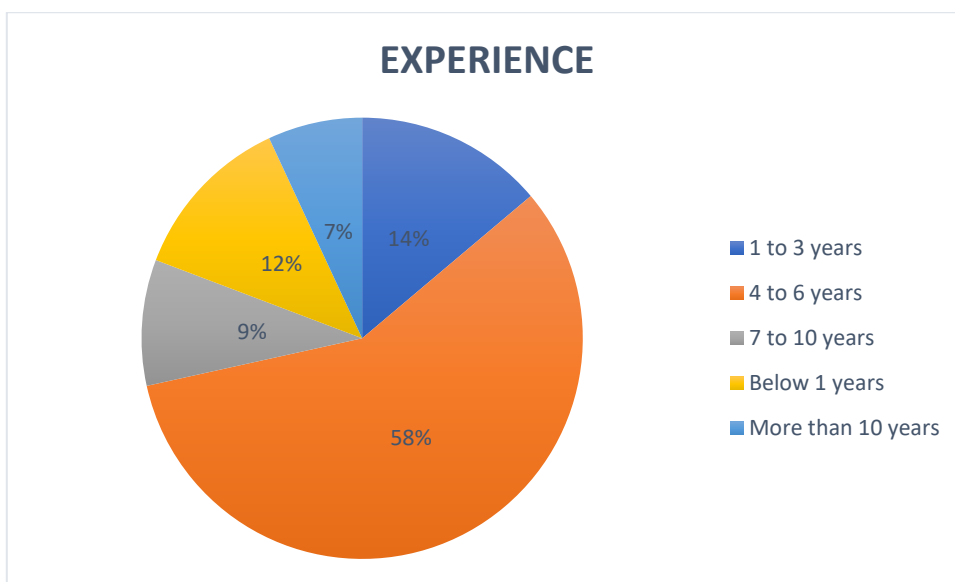
INFERENCE

Majority 44% of the employees studied undergraduate

TABLE:4.1.3. EXPERIENCE OF THE EMPLOYEES

S.NO	EXPERIENCE	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	Below 1 year	16	12%
2	1 to 3 years	18	14%
3	4 to 6 Years	75	58%
4	7 to 10 years	12	9%
5	More than 10 years	9	7%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.3. EXPERIENCE OF THE EMPLOYEES

INTERPRETATION

From the above table it is interpreted as, 12% of employees has 1 year experience, 14% of employees has 1-to-3-year experience, 58% of employees has 4-to-6-year experience, 9% of employees has 7-to-10-year experience, 7% of employees has more than 10-year experience,

INFERENCE

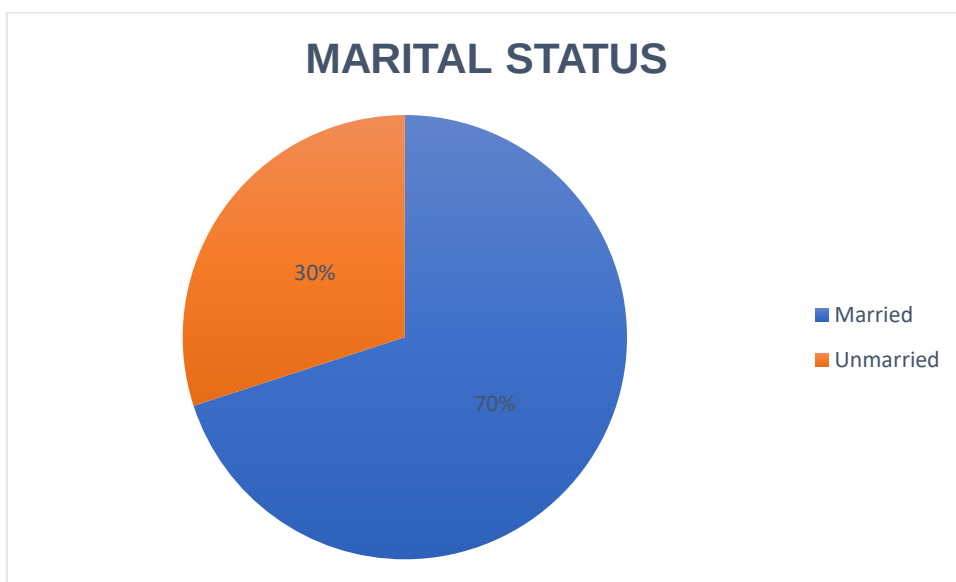
Majority 58% of employees has 4 to 6year experience

TABLE:4.1.4. CLASSIFICATION OF MARITAL STATUS OF THE EMPLOYEES

S.NO	MARITAL STATUS	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	Married	91	70%
2	Unmarried	39	30%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.4. CLASSIFICATION OF MARITAL STATUS OF THE EMPLOYEES



INTERPRETATION

From the above table it is interpreted as, 70% of employees are married, 30% of employees are unmarried

INFERENCE

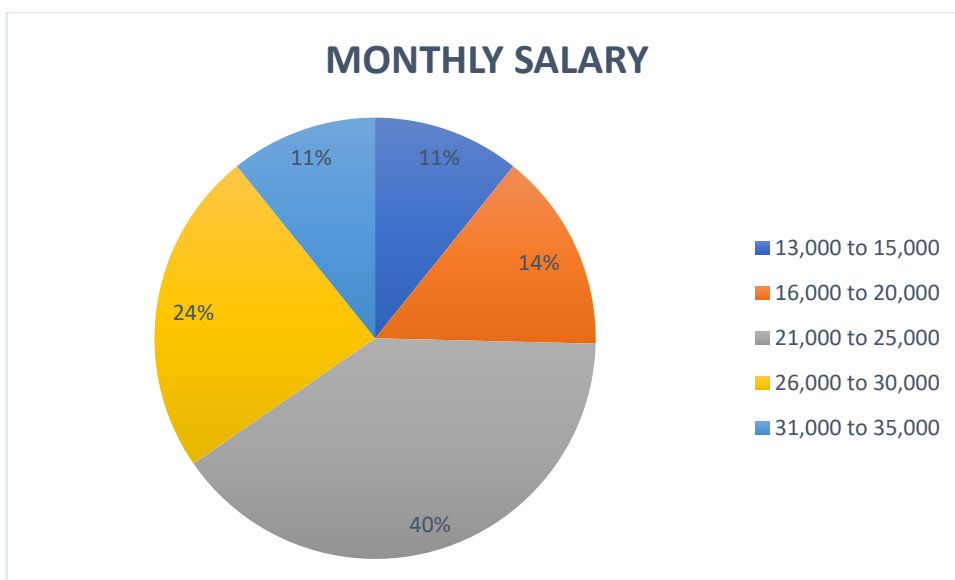
Majority 70% of the employees are married

TABLE:4.1.5. MONTHLY SALARY PROVIDED BY THE COMPANY

S.NO	MONTHLY SALARY	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	13,000 to 15,000	14	11%
2	16,000 to 20,000	19	14%
3	21,000 to 25,000	52	40%
4	26,000 to 30,000	31	24%
5	31,000 to 35,000	14	11%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.5. MONTHLY SALARY PROVIDED BY THE COMPANY



INTERPRETATION

From the above table it is interpreted as, 11% of employees has 13,000 to 15,000 salary, 14% of employees has 16,000 to 20,000 salary, 40% of employees has 21,000 to 25,000 salary, 24% of employees has 26,000 to 30,000 salary, 11% of employees has 31,000 to 35,000 salary

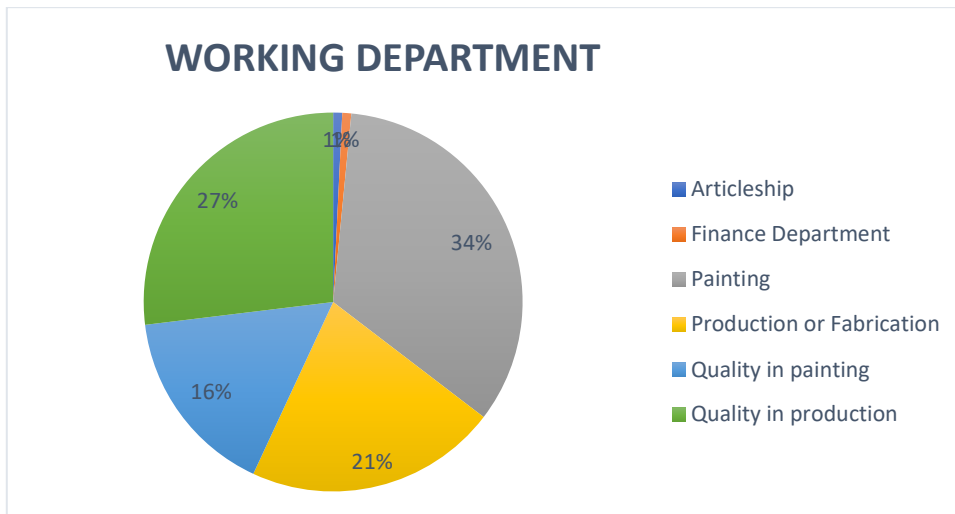
INFERENCE

Majority 40% of employees has 21,000 to 25,000 salary

TABLE:4.1.6. EMPLOYEES WORKING DEPARTMENT

S.NO	WORKING DEPARTMENT	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	Article ship	1	1%
2	Finance Department	1	1%
3	Painting	44	34%
4	Production or Fabrication	28	21%
5	Quality in painting	21	16%
6	Quality in production	35	27%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.6. EMPLOYEES WORKING DEPARTMENT

INTERPRETATION

From the above table it is interpreted as, 1% of employees are doing Article ship, 1% of employees are doing Finance Department, 34% of employees are doing painting, 21% of employees are doing production, 16% of employees are doing quality in painting, 27% of employees are doing quality in production

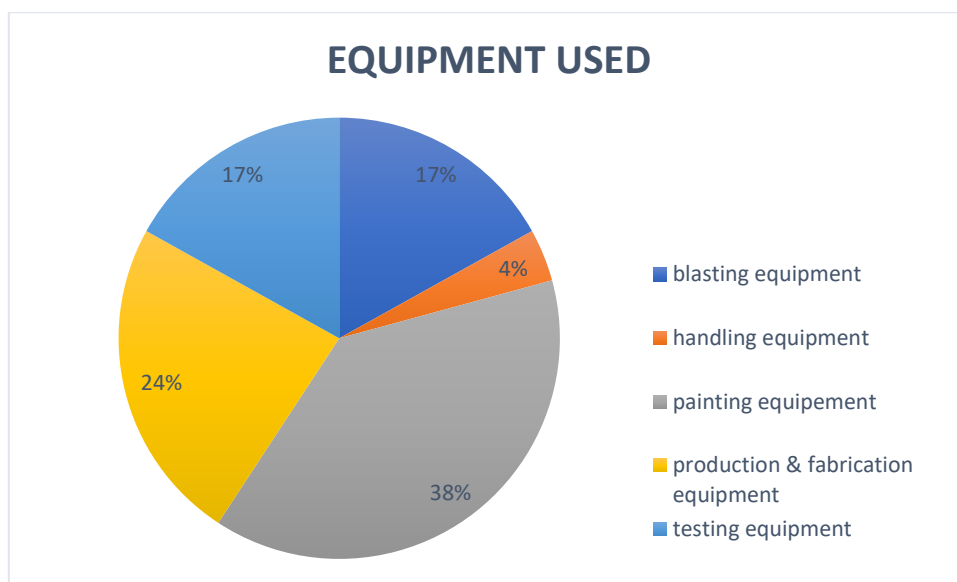
INFERENCE

Majority 34% of employees are doing painting work

TABLE:4.1.7. EQUIPMENT USED IN MATERIAL HANDLING

S.NO	EQUIPMENT USED	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	blasting equipment	22	17%
2	handling equipment	5	4%
3	painting equipment	50	38%
4	production & fabrication equipment	31	24%
5	testing equipment	22	17%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.7. EQUIPMENT USED IN MATERIAL HANDLING

INTERPRETATION

From the above table it is interpreted as, 17% of employees are handling blasting equipment, 4% of employees are handling equipment, 38% of employees are handling painting equipment, 24% of employees are handling production & fabrication equipment, 17% of employees are handling testing equipment.

INFERENCE

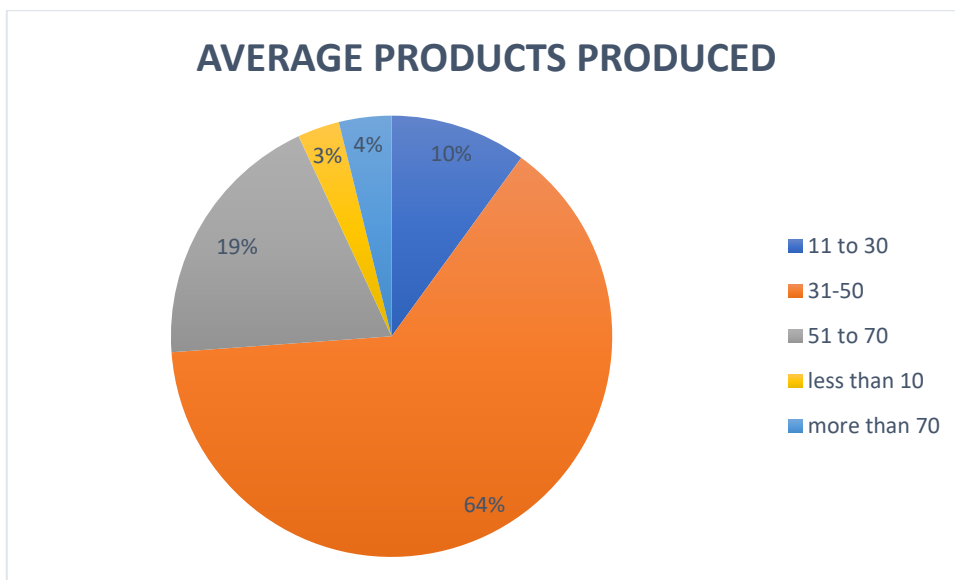
Majority 38% of employees are handling painting equipment

TABLE:4.1.8. THE AVERAGE PRODUCTS THAT ARE PRODUCED IN A DAY

S.NO	AVERAGE PRODUCTS PRODUCED	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	11 to 30	13	10%
2	31 to 50	83	64%
3	51 to 70	25	19%
4	less than 10	4	3%
5	more than 70	5	4%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.8. THE AVERAGE PRODUCTS THAT ARE PRODUCED IN A DAY



INTERPRETATION

From the above table it is interpreted as, 10% of employees produces 11 to 30 products, 64% of employees produces 31 to 50 product, 19% of employees produces 51 to 70 products, 3% of employees produces less than 10 products, 4% of employees produces more than 70 products

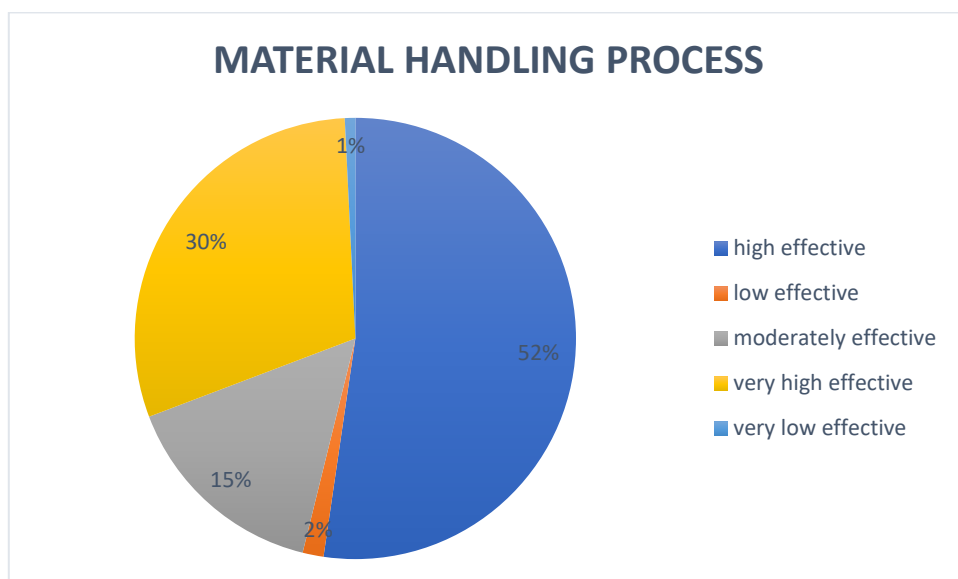
INFERENCE

Majority 64% of employees produces 31 to 50 product a day

TABLE:4.1.9. CURRENT MATERIAL HANDLING PROCESS

S.NO	MATERIAL HANDLING PROCESS	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	high effective	68	52%
2	low effective	2	2%
3	moderately effective	20	15%
4	very high effective	39	30%
5	very low effective	1	1%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.9. CURRENT MATERIAL HANDLING PROCESS

INTERPRETATION

From the above table it is interpreted as, 52% of employees are high effective, 2% of employees are low effective, 15% of employees are moderately effective, 30% of employees are very high effective, 1% of employees are very low effective.

INFERENCE

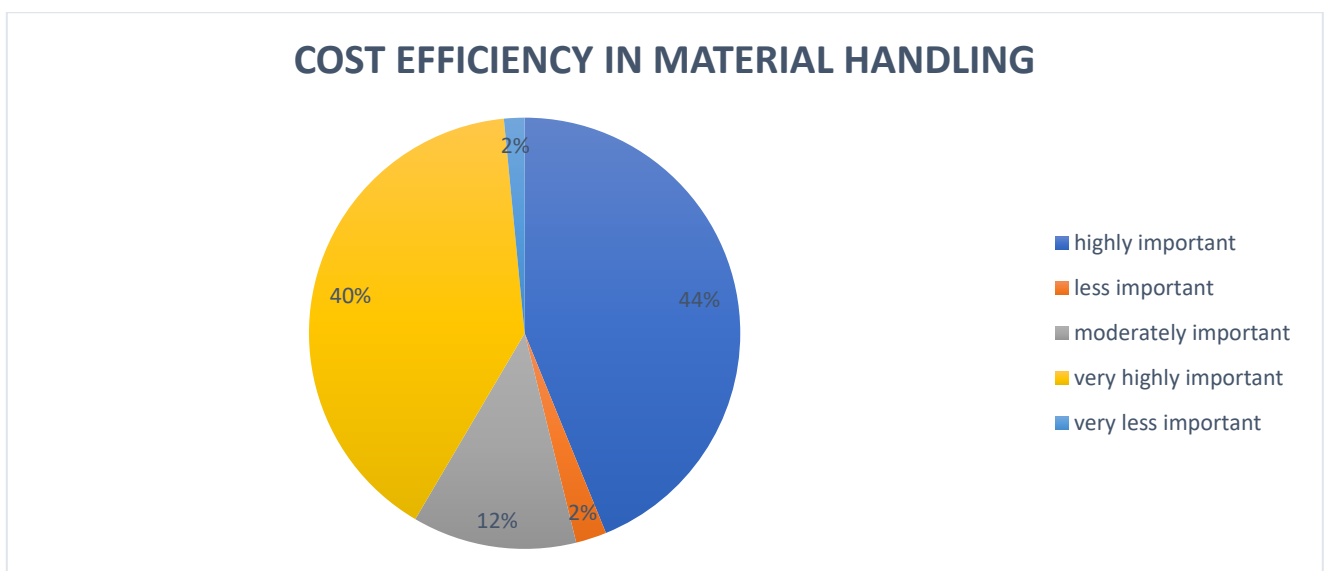
Majority 52% of employees are high effective current Material Handling process

TABLE:4.1.10. COST EFFICIENCY IN MATERIAL HANDLING IS IMPORTANT

S.NO	COST EFFICIENCY IN MATERIAL HANDLING	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	highly important	57	44%
2	less important	3	2%
3	moderately important	16	12%
4	very highly important	52	40%
5	very less important	2	2%
	TOTAL	130	100%

Source: Primary Data

CHART:4.1.10. COST EFFICIENCY IN MATERIAL HANDLING IS IMPORTANT



INTERPRETATION

From the above table it is interpreted as, 44% of employees are highly important, 2% of employees are less important, 12% of employees are moderately important, 40% of employees are very highly important, 2% of employees are very less important

INFERENCE

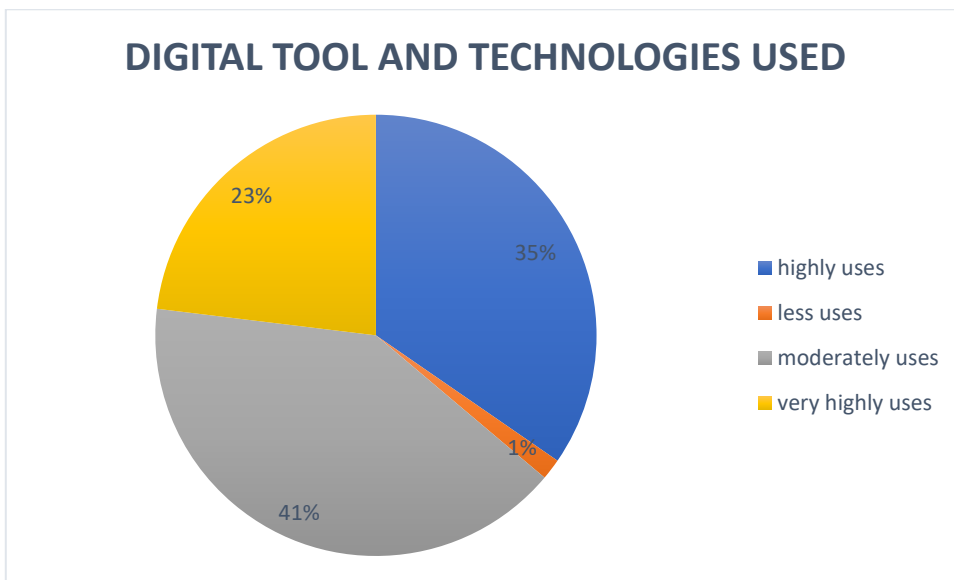
Majority 44% of employees are saying cost efficiency in material handling is highly important for customer satisfaction

TABLE:4.1.11. DIGITAL TOOL AND TECHNOLOGIES USED FOR OPERATIONS

S.NO	DIGITAL TOOL AND TECHNOLOGIES USED	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	highly uses	45	35%
2	less uses	2	1%
3	moderately uses	53	41%
4	very highly uses	30	23%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.11. DIGITAL TOOL AND TECHNOLOGIES USED FOR OPERATIONS



INTERPRETATION

From the above table it is interpreted as, 35% of employees highly uses, 1% of employees less uses, 41% of employees moderately uses, 23% of employees very highly uses.

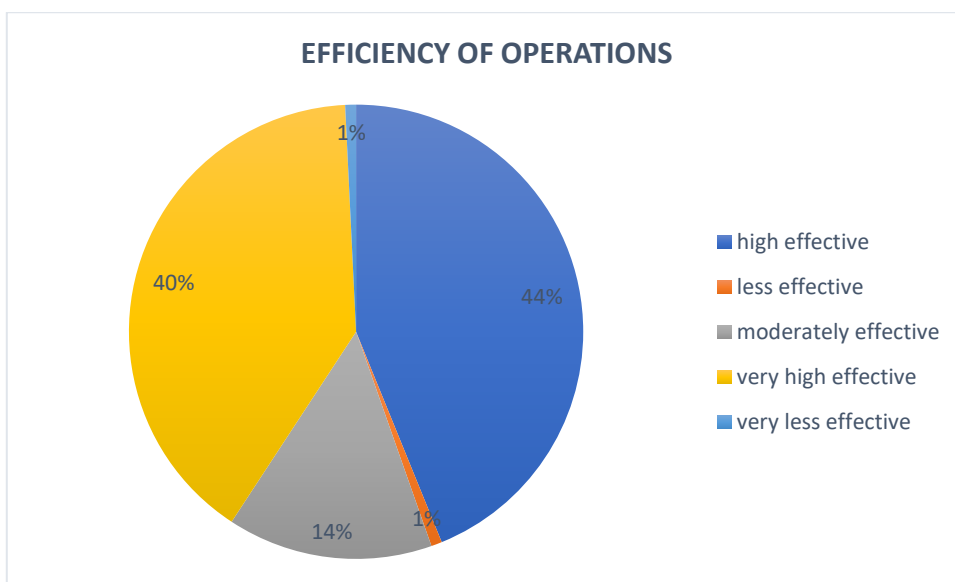
INFERENCE

Majority 41% of employees moderately uses digital tool and technologies for operations

TABLE:4.1.12. OPERATIONS BASED ON COST, TIME AND QUALITY

S.NO	EFFICIENCY OF OPERATIONS	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	high effective	57	44%
2	less effective	1	1%
3	moderately effective	19	14%
4	very high effective	52	40%
5	very less effective	1	1%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.12. OPERATIONS BASED ON COST, TIME AND QUALITY

INTERPRETATION

From the above table it is interpreted as, 44% of employees are high effective, 1% of employees are less effective, 14% of employees are moderately effective, 40% of employees are very high effective, 1% of employees are very less effective

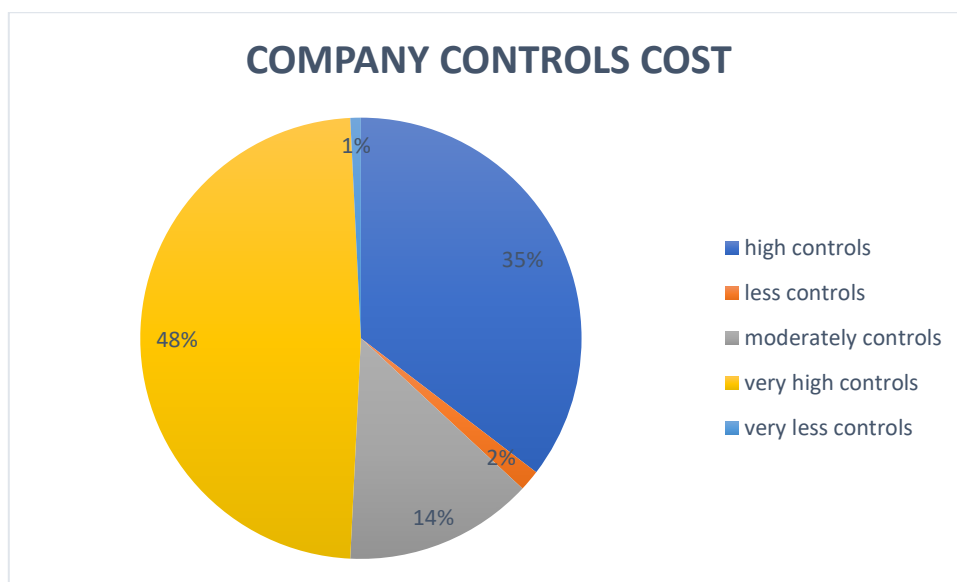
INFERENCE

Majority 44% of employees are high effective in operations based on cost, time and quality

TABLE:4.1.13. COMPANIES CONTROL ON COST INCURRED FOR PRODUCTION

S.NO	COMPANY CONTROLS COST	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	high controls	46	35%
2	less controls	2	2%
3	moderately controls	18	14%
4	very high controls	63	48%
5	very less controls	1	1%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.13. COMPANIES CONTROL ON COST INCURRED FOR PRODUCTION

INTERPRETATION

From the above table it is interpreted as, 35% of employees says high controls, 2% of employees says less controls, 14% of employees says moderately controls, 48% of employees says very high controls, 1% of employees says very less controls

INFERENCE

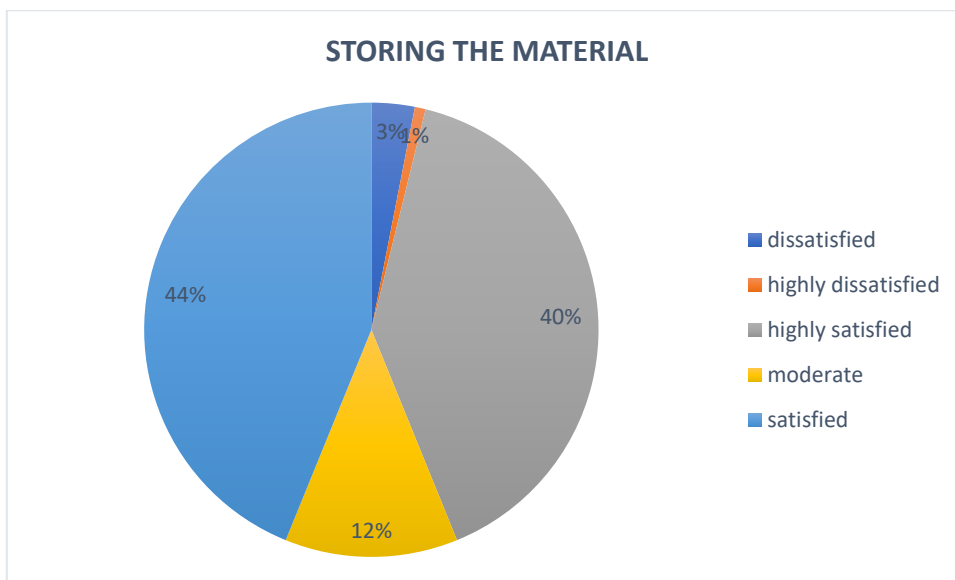
Majority 48% of employees says the company very highly controls cost incurred for production

TABLE:4.1.14. EXISTING METHOD OF STORING THE MATERIAL

S.NO	STORING THE MATERIAL	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	dissatisfied	4	3%
2	highly dissatisfied	1	1%
3	highly satisfied	52	40%
4	moderate	16	12%
5	satisfied	57	44%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.14. EXISTING METHOD OF STORING THE MATERIAL



INTERPRETATION

From the above table it is interpreted as, 3% of employees are dissatisfied, 1% of employees are highly dissatisfied, 40% of employees says highly satisfied, 12% of employees are moderate, 44% of employees are satisfied

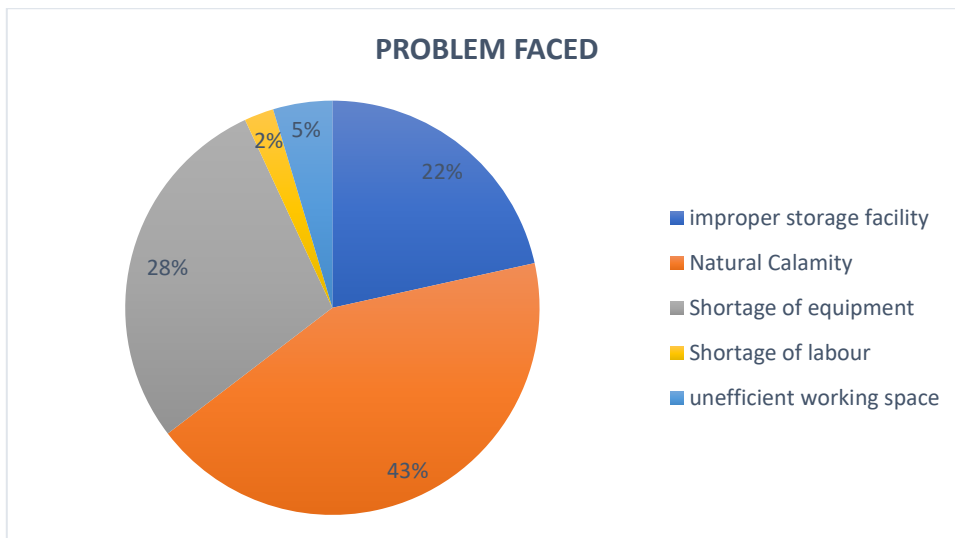
INFERENCE

Majority 44% of employees are satisfied with the Existing method of storing the material

TABLE:4.1.15. PROBLEM FACED IN THE HANDLING OF MATERIALS

S.NO	PROBLEM FACED	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	improper storage facility	28	22%
2	Natural Calamity	56	43%
3	Shortage of equipment	37	28%
4	Shortage of labour	3	2%
5	inefficient working space	6	5%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.15. PROBLEM FACED IN THE HANDLING OF MATERIALS

INTERPRETATION

From the above table it is interpreted as, 22% of employees says improper storage facility, 43% of employees says Natural Calamity, 28% of employees says Shortage of equipment, 2% of employees says Shortage of labour, 5% of employees says inefficient working space

INFERENCE

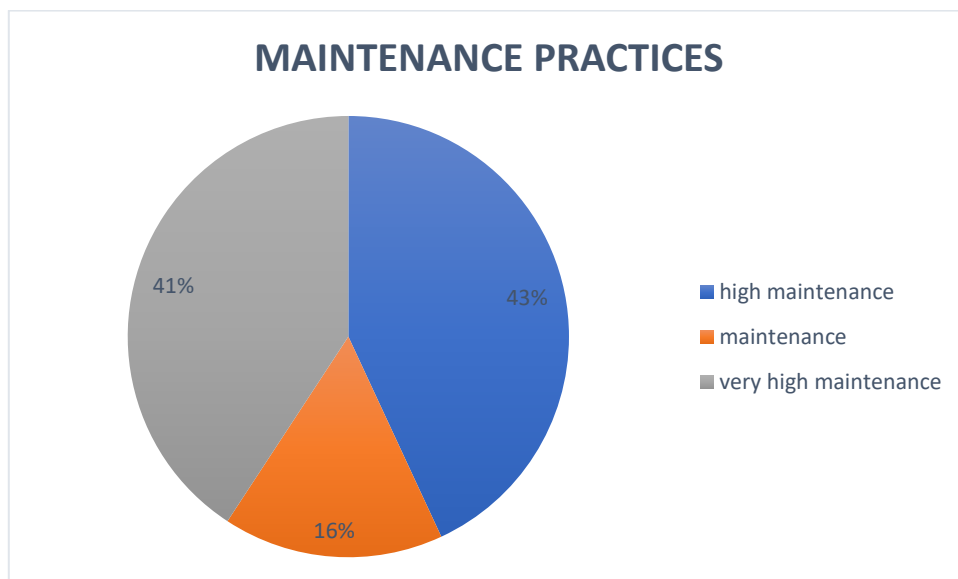
Majority 43% of employees says Problem faced often in the handling of materials is Natural Calamity

TABLE:4.1.16. MAINTENANCE PRACTICE TO REDUCE COSTS

S.NO	MAINTENANCE PRACTICES	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	high maintenance	56	43%
2	maintenance	21	16%
3	very high maintenance	53	41%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.16. MAINTENANCE PRACTICE TO REDUCE COSTS



INTERPRETATION

From the above table it is interpreted as, 43% of employees says high maintenance, 16% of employees says maintenance, 41% of employees says very high maintenance.

INFERENCE

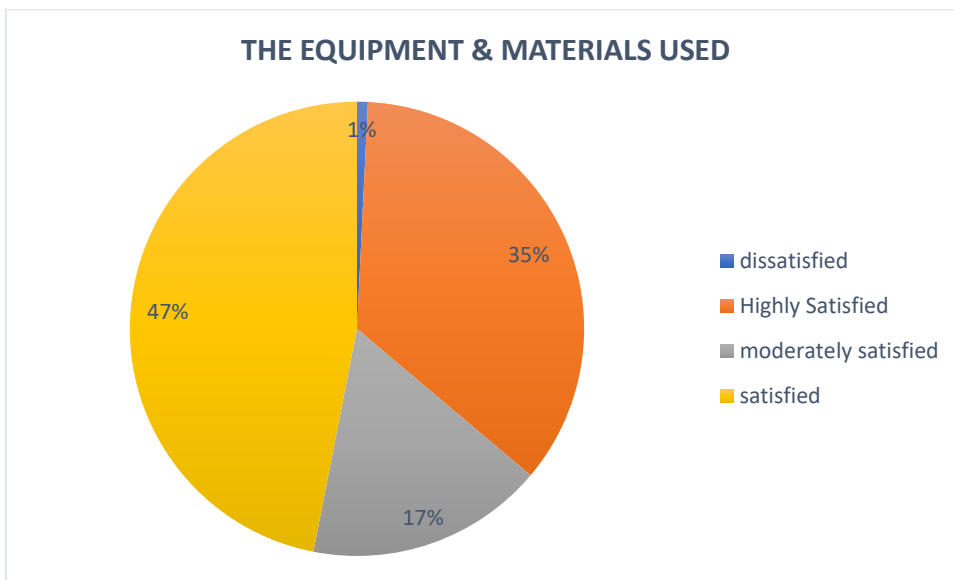
Majority 43% of employees says high maintenance practices to extend the lifespan of equipment and reduce replacement and repair costs

TABLE:4.1.17. THE EQUIPMENT & MATERIALS USED FOR OPERATION

S.NO	THE EQUIPMENT & MATERIALS USED	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	dissatisfied	1	1%
2	Highly Satisfied	46	35%
3	moderately satisfied	22	17%
4	satisfied	61	47%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.17. THE EQUIPMENT & MATERIALS USED FOR OPERATION



INTERPRETATION

From the above table it is interpreted as, 1% of employees are dissatisfied, 35% of employees are Highly Satisfied, 17% of employees are moderately satisfied, 47% of employees are satisfied

INFERENCE

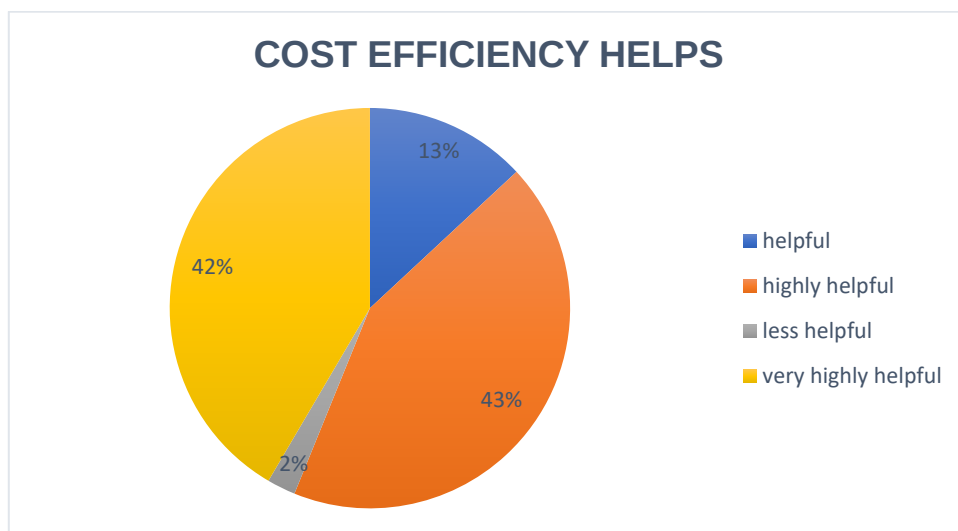
Majority 47% of employees are satisfied with the equipment & materials used for operation

TABLE:4.1.18. COST EFFICIENCY HELPS IN PRODUCTION OF QUALITY MATERIALS

S.NO	COST EFFICIENCY HELPS	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	helpful	17	13%
2	highly helpful	56	43%
3	less helpful	3	2%
4	very highly helpful	54	42%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.18. COST EFFICIENCY HELPS IN PRODUCTION OF QUALITY MATERIALS



INTERPRETATION

From the above table it is interpreted as, 13% of employees says helpful, 43% of employees says highly helpful, 2% of employees says less helpful, 42% of employees says very highly helpful, 5% of employees says inefficient working space

INFERENCE

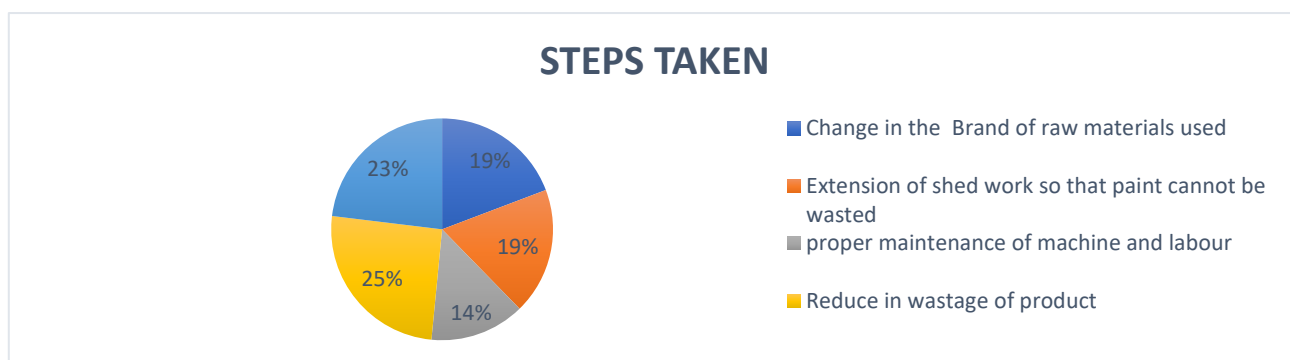
Majority 43% of employees says cost efficiency highly helpful in production of quality materials highly helpful

TABLE:4.1.19. THE STEPS TAKEN TO ACHIEVE COST REDUCTION IN PRODUCTION

S.NO	STEPS TAKEN	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	Change in the Brand of raw materials used	25	20%
2	Extension of shed work so that paint cannot be wasted	24	18%
3	proper maintenance of machine and labour	18	14%
4	Reduce in wastage of product	33	25%
5	Usage of equipment with good Specification	30	23%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.19. THE STEPS TAKEN TO ACHIEVE COST REDUCTION IN PRODUCTION



INTERPRETATION

From the above table it is interpreted as, 20% of employees says Change in the Brand of raw materials used, 18% of employees says Extension of shed work so that paint cannot be wasted, 14% of employees says proper maintenance of machine and labour, 25% of employees says Reduce in wastage of product, 23% of employees says Usage of equipment with good Specification

INFERENCE

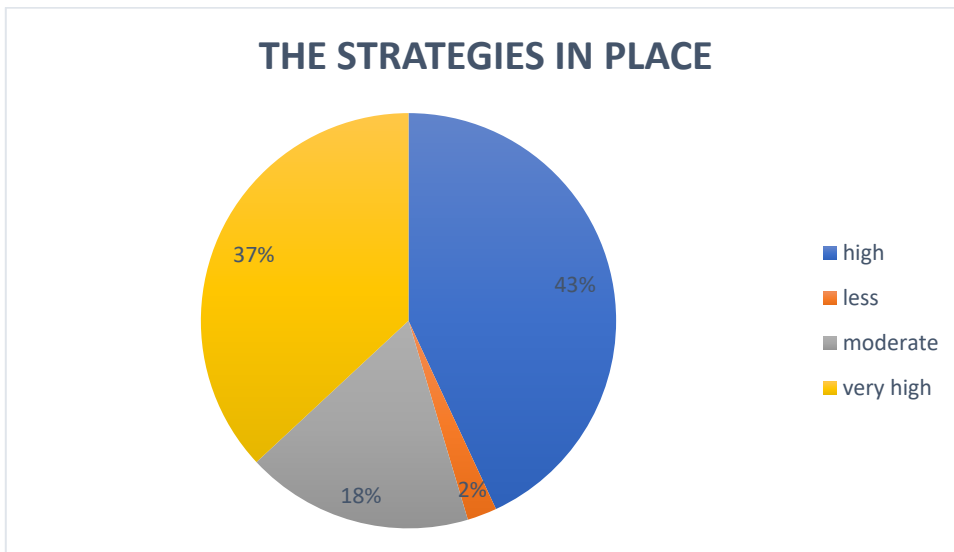
Majority 25% of employees says the steps that can be taken to achieve cost reduction in the product produced is Reduce in wastage of product

TABLE: 4.1.20.THE STRATEGIES IN PLACE TO NEGOTIATE BETTER TERMS OR REDUCE COSTS IN PRODUCTION

S.NO	THE STRATEGIES IN PLACE	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	High	56	43%
2	Less	3	2%
3	moderate	23	18%
4	very high	48	37%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.20. THE STRATEGIES IN PLACE TO NEGOTIATE BETTER TERMS OR REDUCE COSTS IN PRODUCTION



INTERPRETATION

From the above table it is interpreted as, 43% of employees says high strategic, 2% of employees says less strategic, 18% of employees says moderate strategic, 37% of employees says very high strategic

INFERENCE

Majority 43% of employees says these strategies are high in place to negotiate better terms or reduce costs in production

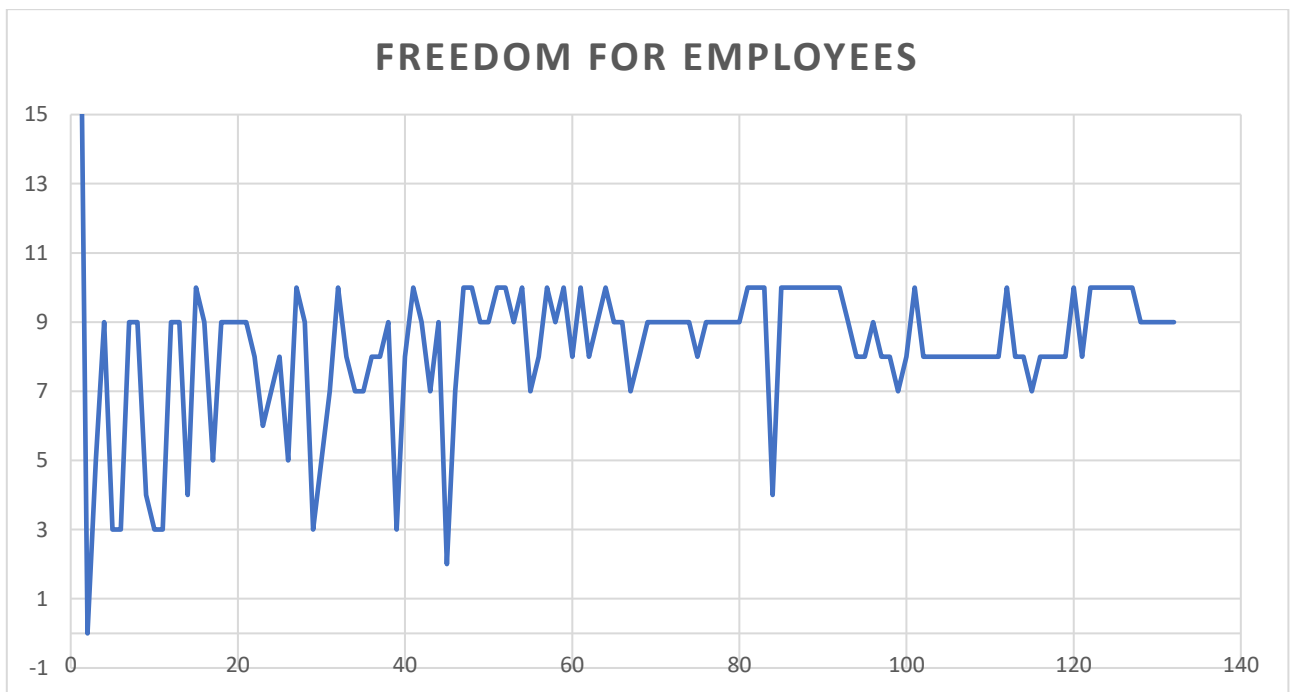
CHART:4.1.21. Freedom for employees to use their skills in the areas of operations of the company

NUMBER OF RESPONDENTS – 130

PERCENTAGE – 100%

Source: Primary Data

CHART



Average rating – 8.25

4.2 CHI-SQUARE TESTS

TABLEN0:4.2.1 RELATIONSHIP BETWEEN THE AGE OF THE EMPLOYEES AND THE STEPS TAKEN TO ACHIEVE COST REDUCTION IN THE PRODUCTION

age * What are the steps that can be taken to achieve cost reduction in the product produced? Crosstabulation

			What are the steps that can be taken to achieve cost reduction in the product produced?					Total
			Change in the Brand of raw materials used	Extension of shed work so that paint cannot be wasted	proper maintenance of machine and labour	Reduce in wastage of product	Usage of equipment with good Specification	
age	26-35	Count	7	6	6	7	7	33
		Expected Count	6.3	6.1	4.6	8.4	7.6	33.0
	36-45	Count	6	6	6	8	6	32
		Expected Count	6.2	5.9	4.4	8.1	7.4	32.0
	46-55	Count	0	4	2	7	6	19
		Expected Count	3.7	3.5	2.6	4.8	4.4	19.0
	Above 55	Count	6	3	0	5	6	20
		Expected Count	3.8	3.7	2.8	5.1	4.6	20.0
	Below 25	Count	6	5	4	6	5	26
		Expected Count	5.0	4.8	3.6	6.6	6.0	26.0
	Total	Count	25	24	18	33	30	130
		Expected Count	25.0	24.0	18.0	33.0	30.0	130.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.063 ^a	16	.740
Likelihood Ratio	18.041	16	.322
N of Valid Cases	130		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 2.63.

HYPOTHESIS

Null hypothesis H0: There is no significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

Alternate hypothesis H1: There is significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

INTERPRETATION

The p value is 0.740 which is higher than the significance value (0.05) hence null hypothesis H0 is accepted. And H1 is rejected

INFERENCE

There is no significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

4.3 CORRELATIONS

TABLEN0:4.3.1 RELATIONSHIP BETWEEN EDUCATIONAL QUALIFICATION AND PROBLEMS FACED OFTEN IN HANDLING OF MATERIALS

Correlations			
		Educational Qualification	Problem faced often in the handling of materials is
Educational Qualification	Pearson Correlation	1	-.118
	Sig. (2-tailed)		.181
	N	130	130
Problem faced often in the handling of materials is	Pearson Correlation	-.118	1
	Sig. (2-tailed)	.181	
	N	130	130

HYPOTHESIS

Null hypothesis H0: There is no significant difference between educational qualification and problems faced often in handling of materials

Alternative hypothesis H1: There is significant difference between educational qualification and problems faced often in handling of materials

INTERPRETATION

The p value is -.118 which is less than the significance value (0.05) hence alternative hypothesis H1 is accepted. And H0 is rejected

INFERENCE

There is significant difference between educational qualification and problems faced often in handling of materials

CHAPTER 5

FINDINGS, SUGGESTIONS AND CONCLUSION

5.1. FINDINGS

- Majority 70% of the employees are married
- Majority 26% of employees are between the age 26 to 35.
- Majority 44% of the employees studied undergraduate
- Majority 58% of employees has 4 to 6year experience,
- Majority 40% of employees has 21,000 to 25,000 salary
- Majority 34% of employees are doing painting work
- Majority 38% of employees are handling painting equipment
- Majority 64% of employees produces 31 to 50 product a day
- Majority 52% of employees are high effective current Material Handling process
- Majority 44% of employees are saying cost efficiency in material handling is highly important for customer satisfaction
- Majority 41% of employees moderately uses digital tool and technologies for operations
- Majority 44% of employees are high effective is operations based on cost, time and quality
- Majority 48% of employees says the company very highly controls cost incurred for production
- Majority 44% of employees are satisfied with the Existing method of storing the material
- Majority 43% of employees says Problem faced often in the handling of materials is Natural Calamity
- Majority 43% of employees says high maintenance practices to extend the lifespan of equipment and reduce replacement and repair costs
- Majority 47% of employees are satisfied with the equipment & materials used for operation

- Majority 43% of employees says cost efficiency highly helpful in production of quality materials highly helpful
- Majority 25% of employees says the steps that can be taken to achieve cost reduction in the product produced is Reduce in wastage of product
- Majority 43% of employees says these strategies are high in place to negotiate better terms or reduce costs in production
- The average rating of the all employees about the GNB Corrosion Controllers is 8.25

CHI-SQUARE TESTS

- By using chi square for finding the relation between age and the steps taken to achieve cost reduction in the production The p value is 0.740 which is higher than the significance value (0.05) hence null hypothesis H_0 is accepted and H_1 is rejected. There is no significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

CORRELATION

- By using correlation for finding the relation between educational qualification and problems faced often in handling of materials The p value is -0.118 which is less than the significance value (0.05) hence alternative hypothesis H_1 is accepted and H_0 is rejected. There is significant difference between educational qualification and problems faced often in handling of materials

5.2. SUGGESTION

- Clearly define project goals, objectives, and constraints collaboratively to ensure a comprehensive understanding. By fostering collaboration and leveraging diverse skills, the team can create an optimized material handling system that meets operational needs efficiently.
- Implement lean principles to streamline material handling processes and reduce unnecessary steps. Integrate automated systems for material movement to enhance efficiency and reduce dependency on manual labour.
- Explore the use of automation, such as conveyor systems or robotic material handlers, to improve overall efficiency.
- Regularly maintain and inspect material handling equipment to ensure optimal performance and reduce unexpected breakdowns. Consider predictive maintenance technologies to anticipate equipment issues and prevent costly repairs.
- Enhance corrosion control measures by implementing protective coatings and periodic inspections. Invest in corrosion-resistant materials where applicable to improve the longevity of fabricated products.

5.3 CONCLUSION

In conclusion, this study on GNB Corrosion Controllers underscores the critical role of efficient material handling systems in enhancing operational efficiency and reducing costs within industrial settings. Through a comprehensive approach that integrates data analysis, simulation modeling, and cost-benefit analysis, the research identifies key bottlenecks and inefficiencies in the current material handling processes. This study enables the evaluation of alternative strategies, facilitating the selection of the most cost-effective and operationally efficient material handling system. this study aims to provide GNB Corrosion Controllers with a roadmap for implementing a material handling system that not only addresses current operational demands but also anticipates future growth and changing production requirements. Continuous monitoring and adaptation to industry best practices are essential for long-term success in the competitive steel fabrication market.

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ANNEXURE-QUESTIONNAIRE

A Study on Material Handling System Followed by GNB Corrosion Controllers.

1. Name
2. Age
 - a) Below 25
 - b) 26-35
 - c) 36-45
 - d) 46-55
 - e) Above 55
3. Educational Qualification
 - a) illiterate
 - b) Diploma
 - c) Under Graduate
 - d) Post Graduate
 - e) others
4. Marital Status
 - a) Married
 - b) Unmarried
5. How much experience do you have steel fabrication production company?
 - a) Below 1 years
 - b) 1 to 3 years
 - c) 4 to 6 years
 - d) 7 to 10 years
 - e) More than 10 years

6. What is your current monthly salary that you receive from the company?
- a)13,000 to 15,000
 - b)16,000 to 20,000
 - c)21,000 to 25,000
 - d)26,000 to 30,000
 - e)31,000 to 35,000
7. Mention your working department?
- a) Production or Fabrication
 - b) Quality in production
 - c) Painting
 - d)Quality in painting
 - e) Other:
8. Equipment used by you in material handling of a fabricated product?
- a) production & fabrication equipment
 - b) blasting equipment
 - c) painting equipment
 - d)testing equipment
 - e) handling equipment
9. Tell us the average products that are produced in your department in a day?
- a) less than 10
 - b)11 to 30
 - c)31-50
 - d) 51 to 70
 - e) more than 70

10. Do you believe our current material handling process is efficient?
- a) Very Low efficient
 - b) Low efficient
 - c) Average efficient
 - d) Highly efficient
 - e) Very Highly efficient
11. How cost efficiency in material handling is important for customer satisfaction?
- a) Very Low important
 - b) Low important
 - c) Average important
 - d) High important
 - e) Very high important
12. How Much the Company Uses Digital Tool and Technologies for Operations?
- a) highly uses
 - b) less uses
 - c) moderately uses
 - d) very highly uses
 - e) very less uses
13. How Efficient Is Operations Based on Cost, Time and Quality?
- a) high effective
 - b) less effective
 - c) moderately effective
 - d) very high effective
 - e) very less effective

14. How does the company controls cost incur for production?

- a) high controls
- b) less controls
- c) moderately controls
- d) very high controls
- e) very less controls

15. Existing Method of Storing the Material Is?

- a) Highly Dissatisfied
- b) Dissatisfied
- c) moderate
- d) Satisfied
- e) Highly Satisfied

16. Problem Faced Often in The Handling of Materials Is

- a) Shortage Of Labour
- b) Shortage of Equipment
- c) Natural Calamity
- d) Improper storage facility
- e) Inefficient working space

17. Do the company provide maintenance practices to extend the lifespan of equipment and reduce replacement and repair costs?

- a) Very low maintenance
- b) low maintenance
- c) maintenance
- d) high maintenance
- e) Very high maintenance

18. Satisfied With the Equipment & Materials Used for Operation

- a) Highly Dissatisfied
- b) Dissatisfied
- c) moderate
- d) Satisfied
- e) Highly Satisfied

19. whether cost efficiency helps you in production of quality materials?

- a) very less helpful
- b) less helpful
- c) helpful
- d) highly helpful
- e) very highly helpful

20. What Are the Steps That Can Be Taken to Achieve Cost Reduction in The Product Produced?

- a) Change In the Brand of Raw Materials Used
- b) Extension Of Shed Work So That Paint Can't Be Wasted
- c) Usage of Equipment with Good Specification
- d) Reduce in Wastage of Product
- e) Proper maintenance of machine and labour
- f) Others

21. Are There Strategies in Place to Negotiate Better Terms or Reduce Costs in production?

- a) Very Low
- b) Low
- c) Average
- d) High
- e) Very high

ANNEXURE II - RESEARCH ARTICLE
A STUDY OF MATERIAL HANDLING SYSTEM FOLLOWED
BY GNB CORROSION CONTROLLERS

Dr. DHIVYA SATHISH, Associate Professor

School of management studies, Sathyabama institute of science and
Technology Chennai

dhivya.sathish05@gmail.com

Mr. U KARTHICK, student

School of management studies, Sathyabama Institute of Science and
Technology Chennai

karthick312960@gmail.com

ABSTRACT

The main purpose of this study is to enhance operational efficiency and reduce costs within the material handling systems at GNB Corrosion Controllers. This comprehensive approach commences with an in-depth examination of the existing processes employed by the company. This entails a meticulous analysis of each step in the material handling workflow, the equipment utilized, and an assessment of the overall efficiency of the current system. Identifying bottlenecks and inefficiencies within this initial phase is crucial for establishing a baseline for improvement. The study aims to propose changes that result in a cost-effective and operationally efficient material handling system.

KEYWORDS

Material handling system, GNB Corrosion Controllers, Cost efficiency, Simulation modeling, Optimization, Industrial processes, Industrial material handling.

INTRODUCTION

In a manufacturing company, operations span the entire process of transforming raw materials into finished goods. This multifaceted domain involves various critical activities, commencing with production planning and scheduling to ensure efficient resource utilization. The manufacturing process itself employs machinery, technology, and skilled labour to convert raw materials into the end product. Quality control mechanisms are integrated throughout the process to ensure that products meet predetermined standards. Logistics, on the other hand, involves managing the flow of goods from the origin to the consumption point to meet diverse requirements. These goods encompass abstract items like time, information, particles, and energy. Logistics management integrates information flow, material handling, production, packaging, inventory, transportation, warehousing, and security. The use of simulation software is common for modeling, analysing, visualizing, and optimizing the intricate logistics processes. Efficiently aligning and harmonizing these various operational components is crucial to achieving production targets, meeting customer needs, and maintaining competitiveness in the manufacturing industry.

OBJECTIVE OF THE STUDY

- To study the material handling system followed by GNB Corrosion Controllers
- To analyze the existing method and process employed for material handling
- To find out the cost associated with material handling
- To explore and identify the best alternative so that cost incurred can be reduced with same quality

NEED FOR THE STUDY

- Studying the Material Handling System in an organization serves as a fundamental basis for making well-informed decisions and ongoing enhancements in how materials are managed and moved within the business
- Helps to understand and identify the problematic areas to Creating a strategic plan and implementing targeted actions based on identified issues in a material handling processes
- Understanding different Material Handling strategies to helps in streamlining processes, reducing production time, and minimizing waste, ultimately improving overall efficiency and reduces the cost incurred for production
- Analyzing various strategies which allows for identifying cost-effective methods, optimizing resource utilization, and lowering production.

SCOPE OF THE STUDY

- the Material Handling System help to reduce the cost incurred and increase the productivity and profit
- Analysing the Material Handling System employed by GNB Corrosion Controllers is crucial for optimizing their operations and achieving cost reduction across the entire process
- To identify opportunities for improvement and efficiency at each stage of the process. This includes assessing how materials are produced, transported, stored, and utilized in the manufacturing process. The ultimate goal is to enhance overall efficiency and reduce operational costs,
- Determine the opportunities for enhancement in material handling System is essential for minimizing the incurred costs and further boost the company's performance even more.

REVIEW OF LITERATURE

Minimising material handling cost using relative factors for fixed area cell layout problem, P.V. Arulkumar, M. Saravanan, (2012).

This paper appears to contribute to the field of material handling and layout design by proposing a method to reduce manufacturing costs through efficient layout planning, and by comparing the performance of two optimization algorithms in achieving this goal. The preference for the PSO algorithm suggests its potential application in real-world scenarios for optimizing material handling systems in manufacturing setups.

DESIGN ANALYSIS & FABRICATION OF PNEUMATIC MATERIAL HANDLING SYSTEM, Nilesh Bodkhe, Sanghshil L. Kanekar and Tushar G. Bhore, (2015).

pneumatic conveying systems offer a closed-loop, environmentally friendly solution for material handling, but their design involves careful consideration of air velocity, pressure, particle characteristics, and the conveying distance. Research in this field continues to evolve to improve system performance and efficiency.

Aspects of material handling system in the steel fabrication environment, Ronelle roux, (2001).

This aims to bridge the gap between theoretical knowledge about materials handling and its practical application within a specific industrial context. By conducting a case study and making recommendations, you hope to contribute to the enhancement of materials flow and production efficiency in a South African steel fabrication operation.

Productivity improvement of a manufacturing facility using systematic layout planning, Syed Asad Ali Naqvi, Muhammad Fahad, Muhammad Atir, Muhammad Zubair & Muhammad Musharaf Shehzad, (2016).

This underscores the significance of lean manufacturing principles, layout optimization, and systematic planning in the context of a rapidly changing industrial landscape driven by increasing technology demand and global competition. These strategies aim to enhance efficiency, reduce costs, and improve product quality within manufacturing industries.

RESEARCH METHODOLOGY

The research in question adopts a descriptive research design, delving into the current conditions within the organization. Descriptive research, synonymous with statistical research, is the chosen approach for this study. The sampling method employed is convenience sampling, a nonprobability technique.

The statistical tools used for analysis are Simple percentage analysis method, Chi square and Correlation.

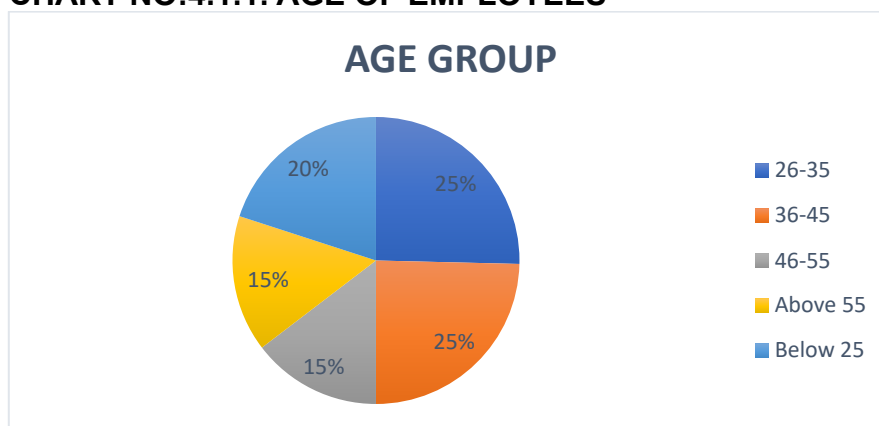
DATA ANALYSIS AND INTERPRETATION

TABLE:4.1.1. AGE OF THE EMPLOYEES

S.NO	AGE GROUP	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	26-35	33	26%
2	36-45	32	24%
3	46-55	19	14%
4	Above 55	20	16%
5	Below 25	26	20%
	TOTAL	130	100%

Source: Primary Data

CHART NO:4.1.1. AGE OF EMPLOYEES



INTERPRETATION

From the above table it is interpreted as, 20% of employees are below 25 years, 26% of employees are between the age 26 to 35, 24% of employees are between the age 36-45, 14% of employees are between the age 46-55, 16% of employees above 55 years

INFERENCE

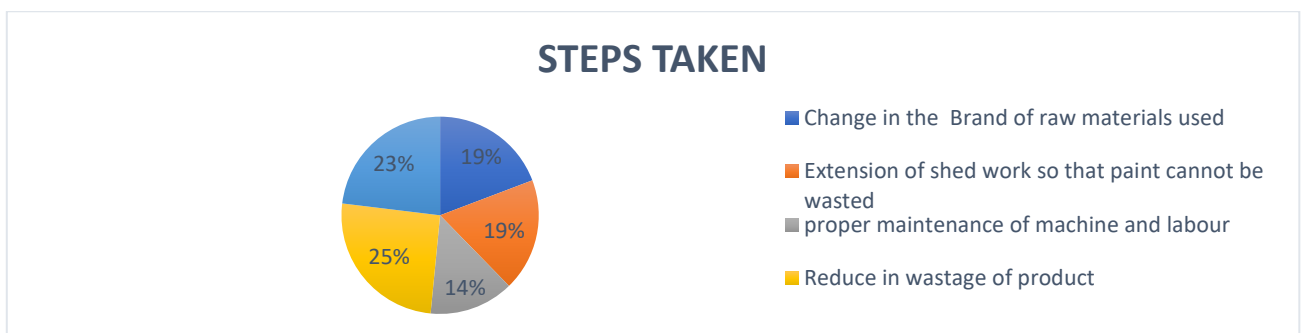
Majority 26% of employees are between the age 26 to 35.

TABLE:4.1.2. THE STEPS TAKEN TO ACHIEVE COST REDUCTION IN PRODUCTION

S.NO	STEPS TAKEN	NO.OF. RESPONDENTS	PERCENTAGE ANALYSIS
1	Change in the Brand of raw materials used	25	20%
2	Extension of shed work so that paint cannot be wasted	24	18%
3	proper maintenance of machine and labour	18	14%
4	Reduce in wastage of product	33	25%
5	Usage of equipment with good Specification	30	23%
	TOTAL	130	100%

Source: Primary Data

CHART: 4.1.2. THE STEPS TAKEN TO ACHIEVE COST REDUCTION IN PRODUCTION



INTERPRETATION

From the above table it is interpreted as, 20% of employees says Change in the Brand of raw materials used, 18% of employees says Extension of shed work so that paint cannot be wasted, 14% of employees says proper maintenance of machine and labour, 25% of employees says Reduce in wastage of product, 23% of employees says Usage of equipment with good Specification

INFERENCE

Majority 25% of employees says the steps that can be taken to achieve cost reduction in the product produced is Reduce in wastage of product

4.2 CHI-SQUARE TESTS

TABLENO:4.2.1 RELATIONSHIP BETWEEN THE AGE OF THE EMPLOYEES AND THE STEPS TAKEN TO ACHIEVE COST REDUCTION IN THE PRODUCTION

age * What are the steps that can be taken to achieve cost reduction in the product produced? Crosstabulation

			What are the steps that can be taken to achieve cost reduction in the product produced?					Total
			Change in the Brand of raw materials used	Extension of shed work so that paint cannot be wasted	proper maintenance of machine and labour	Reduce in wastage of product	Usage of equipment with good Specification	
age	26-35	Count	7	6	6	7	7	33
		Expected Count	6.3	6.1	4.6	8.4	7.6	33.0
	36-45	Count	6	6	6	8	6	32
		Expected Count	6.2	5.9	4.4	8.1	7.4	32.0
	46-55	Count	0	4	2	7	6	19
		Expected Count	3.7	3.5	2.6	4.8	4.4	19.0
	Above 55	Count	6	3	0	5	6	20
		Expected Count	3.8	3.7	2.8	5.1	4.6	20.0
	Below 25	Count	6	5	4	6	5	26
		Expected Count	5.0	4.8	3.6	6.6	6.0	26.0
	Total	Count	25	24	18	33	30	130
		Expected Count	25.0	24.0	18.0	33.0	30.0	130.0

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.063 ^a	16	.740
Likelihood Ratio	18.041	16	.322
N of Valid Cases	130		

a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 2.63.

HYPOTHESIS

Null hypothesis H0: There is no significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

Alternate hypothesis H1: There is significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

INTERPRETATION

The p value is 0.740 which is higher than the significance value (0.05) hence null hypothesis H0 is accepted. And H1 is rejected

INFERENCE

There is no significant difference between the age of the employees and the steps taken to achieve cost reduction in the production

4.3 CORRELATIONS

TABLENO:4.3.1 RELATIONSHIP BETWEEN EDUCATIONAL QUALIFICATION AND PROBLEMS FACED OFTEN IN HANDLING OF MATERIALS

Correlations			
		Educational Qualification	Problem faced often in the handling of materials is
Educational Qualification	Pearson Correlation	1	-.118
	Sig. (2-tailed)		.181
	N	130	130
Problem faced often in the handling of materials is	Pearson Correlation	-.118	1
	Sig. (2-tailed)	.181	
	N	130	130

HYPOTHESIS

Null hypothesis H0: There is no significant difference between educational qualification and problems faced often in handling of materials

Alternative hypothesis H1: There is significant difference between educational qualification and problems faced often in handling of materials

INTERPRETATION

The p value is -.118 which is less than the significance value (0.05) hence alternative hypothesis H1 is accepted. And H0 is rejected

INFERENCE

There is significant difference between educational qualification and problems faced often in handling of materials

SUGGESTIONS

- Clearly define project goals, objectives, and constraints collaboratively to ensure a comprehensive understanding.
- Implement lean principles to streamline material handling processes and reduce unnecessary steps.
- Explore the use of automation, such as conveyor systems or robotic material handlers, to improve overall efficiency.
- Regularly maintain and inspect material handling equipment to ensure optimal performance and reduce unexpected breakdowns.
- Enhance corrosion control measures by implementing protective coatings and periodic inspections. Invest in corrosion-resistant materials where applicable to improve the longevity of fabricated products.

CONCLUSIONS

In conclusion, this study on GNB Corrosion Controllers underscores the critical role of efficient material handling systems in enhancing operational efficiency and reducing costs within industrial settings. Through a comprehensive approach that integrates data analysis, simulation modeling, and cost-benefit analysis, the research identifies key bottlenecks and inefficiencies in the current material handling processes. This study enables the evaluation of alternative strategies, facilitating the selection of the most cost-effective and operationally efficient material handling system. this study aims to provide GNB Corrosion Controllers with a roadmap for implementing a material handling system that not only addresses current operational demands but also anticipates future growth and changing production requirements.

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