

**A STUDY ON INVENTORY MANAGEMENT IN INDIAN POWER SECTOR WITH
REFERENCE NLC INDIA LIMITED**

Submitted in partial fulfillment of the requirements for the award of

Master of Business Administration

by

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DEPARTMENT OF BUSINESS ADMINISTRATION

SCHOOL OF MANAGEMENT STUDIES

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai – 600 119

April – 2021



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SCHOOL OF MANAGEMENT STUDIES

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of SWARNA GUPTA (39410214) who carried out the project entitled "**A Study on Inventory Management in Indian Power Sector With Reference NLC India Limited**" under my supervision from January 2021 to March 2021.

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DECLARATION

I SWARNA GUPTA 39410214 hereby declare that the Project Report entitled **A Study on Inventory Management in Indian Power Sector with Reference NLC India Limited** done by me under the guidance of Dr. R.Thamilselvan at SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI is submitted in partial fulfillment of the requirements for the award of Master of Business Administration degree.

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SWARNA GUPTA

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ABSTRACT

Inventory constitutes the most significant part of firms in the power sector. Because of the huge inventories maintained, a considerable sum of an organization's fund is being committed to them. Thus it becomes absolutely imperative to manage inventories efficiently so as to avoid the costs of production rates, overstocking, stock outs and unnecessary cost. This study therefore sought to investigate on the influence of inventory management on the performance of the power sector in NLC India Limited. The study also sought to establish the influence of raw material management, inventory control, warehouse management and process auditing on the performance of NLC India Limited. The study recommends that NLC India Limited to should enhance material flow in the organization as a way or enhancing efficiency in service delivery. The study also recommends that NLC India Limited management should improve inventory tracking by adopting various tools.

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**A STUDY ON INVENTORY MANAGEMENT IN INDIAN POWER SECTOR WITH
REFERENCE NLC INDIA LIMITED**

CHAPTER-I

INTRODUCTION

1.1 INTRODUCTION

A business can run smoothly its operating activities only when appropriate amount of inventory is maintained. Inventory affects all operating activities like manufacturing, warehousing, sales etc. The amount of opening inventory and closing inventory should be sufficient enough so that the other business activities are not adversely affected. Thus, inventory plays an important role in operations management.

The term stock means to the great or materials utilized as a part of the organization with the end goal of creation and deals stock assumes exceptionally imperative part in organization without sufficient stock the organization can't gain its productivity. Stock is one of the important things of current asset which have smooth running of its tasks stock organization is that parts of current assets organization, which is stressed over keeping up perfect interest for stock and applying strong control system to restrict the total stock organization cost. Inventories incorporates crude materials stock, work-in advance, and completed products stock the fundamental objective of compelling association of stock is to limit the aggregate expenses. As indicated by Charles A. kopek, might be characterized as the co-appointment of arrangement of capacity rendering to an arrangement which will financially use plant, empowers and manages the systematic developments of products through their whole exchange cycle, from getting of all materials to the transportation of completed merchandise at pre-decided rate. Buy creation and deal offices are generally worried about the administration of inventories.

MEANING OF INVENTORY MANAGEMENT

Inventory management is the practice overseeing and controlling of the ordering, storage and use of components that a company uses in the production of the items it sells. A component of supply chain management, inventory management supervises the flow of goods from manufacturers to warehouses. Inventory control

means efficient management of capital invested in raw materials and supplies, work-in-progress and finished goods.

1.2 INDUSTRY PROFILE

The electricity industry in India has evolved significantly to provide a wide range of opportunities across the value chain, in both, the regulated as well as deregulated businesses. Our market is the world's fifth largest in terms of generation capacity and the third largest in terms of network. The growing demand, network extension and up gradation, reduction in energy intensity, unbundling of supply services and growth of cross-border trade present various opportunities for this industry. However, a number of challenges remain, such as of fuel supply, counter-party risk posed by distribution companies, monopoly restrictions on open access and the availability of project finance.

We have been active advisors to the electricity industry since 1991 and associated with many landmark developments over this time. The power sector advisory team has over 150 specialist staff bringing a rich life-cycle experience to our clients planning, developing or scaling their electricity business in India.

Power is among the most critical component of infrastructure, crucial for the economic growth and welfare of nations. The existence and development of adequate infrastructure is essential for sustained growth of the Indian economy.

India's power sector is one of the most diversified in the world. Sources of power generation range from conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar, and agricultural and domestic waste. Electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, massive addition to the installed generating capacity is required.

In May 2018, India ranked fourth in the Asia Pacific region out of 25 nations on an index that measured their overall power. India was ranked fourth in wind power,

fifth in solar power and fifth in renewable power installed capacity as of 2018. India ranked sixth in the list of countries to make significant investments in clean energy at US\$ 90 billion. India is the only country among the G20 nations that is on track to achieve the targets under the Paris Agreement.

1.3 COMPANY PROFILE

NLC Tamil Nadu Power Limited (NTPL), is a joint venture company of NLC India Ltd (formerly known as NLC Ltd) and M/s TANGEDCO (Tamil Nadu Generation and Distribution Company), incorporated under the company act. The Equity participation between NLC and TANGEDCO is at the ratio of 89:11. GOI had issued sanction for the implementation of coal based 2 X 500MW Thermal Power Project by NTPL at Tuticorin at an estimated cost of Rs.4909.54 Cr. Unit 1 and Unit 2 have been declared for commercial operation w.e.f. 18th June 2015 and 29th August 2015. RCE – 2 for the project (Completion cost of the project) works out to Rs.7293.48 Cr. (June – 15 base). Power Purchase Agreement has been signed with TANGEDCO, ESCOMs of Karnataka State, Puducherry Electricity Department, Kerala State Electricity Board and DISCOMs of Andhra Pradesh. Power evacuation from this project is being carried out by M/s Power Grid Corporation of India. NTPL has signed a fuel supply agreement with Mahanadhi Coal fields Limited for supply of 3.0 MTPA of coal and in order to meet the shortfall in requirement, a contract has also been awarded on M/s. MSTC for supply of imported coal.

Neyveli Uttar Pradesh Power Limited (NUPPL) is a joint venture between NLC India and Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited, Ghatampur in the State of Uttar Pradesh, for setting up of 3 x 660 MW power project. NUPPL has taken into possession of the entire land of 828 hectares required for this project. LOA for Steam Generator (SG) and Turbo Generator (TG) and Balance of Plant packages have been issued. Erection works under progress. Expected Commissioning by November 2021.

NLC India at present has four open cast lignite mines namely Mine I, Mine II, Mine IA and Barsingsar Mine. The lignite mined out is used as fuel to the linked Pit head

power stations. Also raw lignite is being sold to small scale industries to use it as fuel in their production activities.

Power Generation

NLC India has five pithead Thermal Power Stations with an aggregate capacity of 3240 MW. Further, NLC India has installed 34 Wind Turbine Generators of capacity 1.50 MW generating capacity of 3731 MW(excl. JVs).each and also commissioned 440 MW Solar Photo Voltaic Power plant in Neyveli, resulting in an overall power.

Neyveli New Thermal Power Project

The Neyveli New Thermal Power Project (2x500 MW) is being implemented at a revised capital cost of Rs.7080.41 Cr as replacement for the more than five decades old 600 MW Thermal Power Station I and adopts pulverized fuel firing technology. LOA for Steam Generator package (NTA 1) and Turbo-Generator package (NTA 2) have been issued to M/s BHEL. LOA has also been issued for the Balance of Plant Package (NTA 3). The milestone activity of boiler light up of both the units 1 & 2 were completed. Unit 1 Commercial operation declared on 28.12.2019. Unit 2 test synchronization achieved in February 2020. The project is nearing completion. Unit 2 is rescheduled to be commissioned in March 2020.

Expansion of Mine 1A

In order to meet the additional requirement of lignite arising out of implementation of 1000 MW Neyveli New Thermal Power Project at Neyveli, expansion of Mine-IA is being implemented, which would result in raising the Mine IA capacity by 4 MTPA. Ministry of Coal has accorded approval for mining expansion plan of Mine 1A. Acquisition of required land has been taken up with Government of Tamil Nadu. Land acquisition works are under Progress. Bithnok Thermal Power Station (250MW) with linked Lignite Mine (2.25MTPA) Rajasthan

Bithnok Thermal Power Project (250MW) with the linked lignite mine of 2.25 MTPA capacity at Bithnok in the State of Rajasthan is being set up at an aggregate estimated cost of Rs.2709.93 Cr. Power Purchase Agreement has been signed

with Rajasthan DISCOMs. Agreement for supply of 25 cusecs of water from IGNP canal has been entered into. Government of Rajasthan (GoR) has issued award for acquisition of 1175.87 hectares of private land in Bithnok and transferred 1290 hectares of Government land to the project. It is proposed to implement the project through Engineering, Procurement & Commissioning (EPC) contract mode. EPC Contract was awarded for all the major packages and works commenced. Meanwhile Rajasthan Government expressed that it will not be in the interest of the DISCOMs to purchase power at offered terms and conditions. The project has been put on hold and the issues are being taken up with the EPC Contractor and GoR in respect of the tariff issue.

Barsingsar Thermal Power Station Extension (250MW) with linked Hadla Lignite Mine (1.9 MTPA), Rajasthan

A lignite based Thermal Power Plant with a capacity of 250 MW as an extension of the existing power plant at Barsingsar is being set up. The fuel requirement for the above power plant is to be met from linked Hadla Mine of 1.9 MTPA and the existing Barsingsar Mine. The aggregate estimated cost of the project is Rs.2635.04 Cr. All statutory clearances have been obtained. EPC Contract was awarded for all the major packages and works commenced. Meanwhile Rajasthan Government expressed that it will not be in the interest of the DISCOMs to purchase power at offered terms and conditions. The project has been put on hold and the issues are being taken up with Contractor and GoR in respect of the tariff issue.

Talabira II & III Coal Blocks (20.00 MTPA)

Coal Block allotted on 08.02.2016. AAP approved by NLC Board for Rs. 25.11 Cr for Pre projects activities. LOA issued to M/s Talabira (Odisha) Mining Private Limited, Ahmedabad on 06.02.2018 for Mine Development & Operation. Mine Operation commenced from 11.12.2019. Top soil excavation and conservation at top soil area under progress.

End users: Pithead NLC Talabira Thermal Power Project (3x800 MW) and NTPL (2x500 MW).

Pachwara South Coal Blocks (11 MTPA)

Coal Block allotted on 08.02.2016. AAP approved by NLC Board for Rs. 25.11 Cr for Pre projects activities. LOA issued to M/s Talabira (Odisha) Mining Private Limited, Ahmedabad on 06.02.2018 for Mine Development & Operation. Mine Operation commenced from 11.12.2019. Top soil excavation and conservation at top soil area under progress.

End users: Pithead NLC Talabira Thermal Power Project (3x800 MW) and NTPL (2x500 MW).

Solar Power Projects

2x10 MW in South Andaman: LOA issued to M/s L&T on 12.10.2018 for setting up the SPP with 8 MWhr BESS. Though the schedule period of completion of the project is 17 months, the contractor was insisted upon to commission the project earlier. Accordingly, 2.5 MW of the project was commissioned on 31.12.2018, within a short period of 2.5 months. Erection activities are going on for commissioning the balance quantity by March 2020.

NLC Talabira TPP (NTTPP) Phase-I (3 X 800 MW)

NLCIL Board accorded in principle approval for taking up 2000 MW Coal based pit head Power Station at Odisha. Odisha IPICOL has given 'In principle' approval to set up 2400 MW Thermal Power Plant at Tareikela, Jharsuguda District in Odisha. EAC of MoEF&CC granted ToR on 08.12.2017. NLCIL Board accorded approval for the Feasibility Report (FR).

Administrative approval for acquisition of private land of 1053.74 acres received from Government of Odisha on 14.08.2018. Section 4(1) notification issued for Jharsuguda District for conducting SIA Study. SIA study initiated by NCDS, Odisha.

Tender Specification finalization for single package EPC tender is in advanced stage of completion and final draft will be ready by March 2020.

Thermal Power Station -II Second Expansion 2x660 MW with linked Mine-III (11.5 MTPA), Neyveli Tamil Nadu

It is proposed to increase the power generating capacity by adding another 1320 MW thermal power plant as the second expansion to the existing TPS-II at Neyveli. A new mine, Mine-III of capacity of 11.5 MTPA is proposed to be set up to exploit the mineable lignite reserves of about 380 MT available in the south of the existing Mine-II to meet the fuel requirement of the proposed thermal power plant.

PPA has been signed with TANGEDCO, Kerala SEB, Puducherry, Government of Andhra Pradesh, and Government of Telangana.

TOR received from MOEF on 23.03.2017. FR was approved by Board on 20.07.2017.

LOA issued to M/s. DCPL for Project Consultancy works on 24.08.2017.

Public Hearing was conducted on 15.02.2018.

Tender Specification finalization for single package EPC tender is in advanced stage of completion.

For Mine III, final Environment Clearance application is uploaded in MoEF&CC website on 13.11.2019.

1.4 NEED FOR THE STUDY

- To analyze the different factors influencing inventory management system in Indian Power Sector.
- To analyze the inventory by using ratio analysis in order to ascertain the efficiency on inventory management system.

1.5 STATEMENT OF PROBLEM

- Inventories often constitute a major element of the total working capital and hence it has been correctly observed, “Good inventory management is good financial management”.
- Inventory a double edged sword is usually an asset of an Industry, if not used properly it will become liability. If inventories are kept at a high level, higher interest and storage costs would be incurred. On the other hand, a low level of inventories may result in underutilization of capacity and lower sales.
- It is therefore absolutely very important to manage inventories efficiently and effectively in order to overcome unnecessary investment.
- And to identify the problems/challenges involved in the Inventory Management in Indian Power Sector with Reference NLC India Ltd.

1.6 OBJECTIVES OF THE STUDY

PRIMARY OBJECTIVE

- A study on the inventory management of Indian Power Sector with Reference NLC India Ltd.

SECONDARY OBJECTIVES

- To study the inventory management system followed by Indian Power Sector.
- To analyze the different factors influencing inventory management system in Indian Power Sector.
- To analyze the inventory by using ratio analysis in order to ascertain the efficiency on inventory management system.

1.7 SCOPE OF THE STUDY

The scope of the study is to know-how to the policy of the company investment procurement like, storage, handling, accounting, storage and stock out, issued to be formulated of inventory control to determine the lead time of the company. The lead time the mean under the time under the fostering of "procurement have an indent by the stores and the receipt of materials by them to know-how towards the cost-effective running of the determine stores to of safety stock, the difference between the amount means stocked to satisfy demand during a certain time interval and the mean demand expected for the period and for the purpose of providing protection against the excess of stock.

1.8 LIMITATIONS OF THE STUDY

- Some of the data has been maintained has confidential by NLC India limited.
- All techniques the inventory Management is not used by NLC India limited therefore it was possible to explain only few methods of inventory management.
- The study is conducted within a limited time.

1.9 CHAPTER FRAMEWORK

CHAPTER 1: INTRODUCTION

This chapter discusses about Introduction to Inventory Management, Industry Profile, Company Profile, Need for the Study, Statement of Problem, Objectives of the Study, Scope of the Study, and Limitations of the Study.

CHAPTER 2: REVIEW OF LITERATURE

This chapter discusses about Review of Literature of various authors who had been conducted research study on inventory management, and Theoretical Study of various ratio analysis used in this study.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter discusses about Research Methodology, Research Design, Data Collections, Period of Study, and Tools Used for Study.

CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

This chapter discusses about Various Ratio Analysis, Trend Analysis, and Comparative Balance sheet for 5 years from 2015-2020.

CHAPTER 5: FINDINGS, SUGGESTIONS, CONCLUSION

This chapter discusses about Findings, Suggestions, and Conclusion for the study.

CHAPTER-II

REVIEW OF LITERATURE

2.1 REVIEW OF LITERATURE

TITLE: Deterioration Control Decision Support for Perishable Inventory Management

AUTHOR: Ya Yang, Huihui Chi, Wei Zhou, Tijun Fan, Selwyn Piramuth

JOURNAL NAME: Decision Support Systems, Volume No. 134, July 2020

Deterioration rate is an important characteristic of perishable products. While deterioration in perishables is unavoidable, there are proven ways to lower their deterioration rates. The optimal FPE indicator value and the optimal order quantity are investigated through numerical analysis. We perform sensitivity analysis and conclude with related managerial implications.

TITLE: Capacity and Inventory Management: Review, Trends, and Projections

AUTHOR: Jing-Sheng Song, Geert-Jan van Houtum, Jan A. Van Mieghem

JOURNAL NAME: Manufacturing & Service Operations Management, Volume No. 22, Issue No. 1, Jul 2019, ISSN: 1523-4614 (print), ISSN: 1526-5498

We present a reproducible, objective review of research trends using text mining and citations of papers published in Manufacturing & Service Operations Management during its first 20 years whose abstracts or keywords contain capacity or inventory. The review is followed by our subjective projections on future research opportunities.

TITLE: Inventory Management with Online Payment and Preorder Discounts

AUTHOR: Md. Rakibul Hasan, Yosef Daryanto, Tutul Chandra Roy, Yi_Feng

JOURNAL NAME: Industrial Management and Data Systems, Volume No. 120, Issue No. 11, October 2020, ISSN: 0263-5577

The advancement of technology opens many opportunities for retailing businesses to increase their profit through innovative strategies, such as discount offers, preorder programs and online payment services. The purpose of this study is to investigate decision-making methods for retailers who sell deteriorating products that utilize an e-commerce platform and offering preorder.

TITLE: Inventory Management in Supply Chains with Consideration of Logistics, Green Investment and Different Carbon Emissions Policies

AUTHOR: Yeu-Shiang Huang, Chih-Chiang Fang, Ying- An Lin

JOURNAL NAME: Computers and Industrial Engineering, Volume No. 139, January 2020

This study investigates the effects that carbon policies and green technologies may have on the integrated inventory of a two-echelon supply chain with consideration of carbon emissions during the processes of product production, transportation, and storage. Besides, the government should set the limit of carbon emissions within a reasonable range under the cap-and-trade policy to avoid suppliers overly trading their quotas of carbon emissions.

TITLE: Combined Maritime Fleet Deployment and Inventory Management with Port Visit Flexibility in Roll-On Roll-Off Shipping

AUTHOR: Bo Dong, Marielle Christiansen, Kjetil Fagerholt, Tolga Bektas

JOURNAL NAME: Logistics and Transportation Review, Volume No. 140, August 2020, Pages-101988

We consider a combined fleet deployment and inventory management problem in Roll-on Roll-off shipping. Along given trade routes there are ports with inventories that should be kept within their limits. Current planning practice is to visit all ports every time a trade route is serviced. We instead aim at determining the sailing routes of each voyage along the trade route, where some ports can be skipped on certain voyages. A novel mixed integer programming model is proposed and tested on realistic instances. The results indicate that substantial gains can be achieved from this more flexible way of planning.

TITLE: A Computational Model for Determining Levels of Factors in Inventory Management Using Response Surface Methodology

AUTHOR: Chia-Nan Wang, Thanh-Tuan Dang, Ngoc-Ai-Thy Nguyen

JOURNAL NAME: Mathematics, Volume NO. 8, Issue No. 8, July 2020, Pages-1210

Inventory management plays a critical role in balancing supply availability with customer requirements and significantly contributes to the performance of the whole supply chain. The managerial implications of this model's results not only suggest the best levels of factors for a case study of the leading air compressor manufacturers in Thailand, but also provide a guideline for decision-makers to satisfy customer demand at the minimum possible total inventory cost. Therefore, this paper can be a useful reference for warehouse supervisors, managers, and policymakers to determine the best levels of factors to improve warehouse performance.

TITLE: Spare Parts Inventory Management: A New Hybrid Approach

AUTHOR: Leandro Reis Muniz, Samuel Vieira Conceicao, Lasara Fabricia Rodrigues, Joao Flavio de Freitas Almeida, Tassia Bolotari Affonso

JOURNAL NAME: The International Journal of Logistics Management, Volume No. 32, Issue No. 1. November 2020, ISSN: 0957-4093

The purpose of this paper is to present a new hybrid approach based on criticality analysis and optimisation to deal with spare parts inventory management in the initial provisioning phase in the mining industry. Spare parts represent a significant part of mining companies' expenditures, so it is important to develop new approaches to reduce the total inventory value of these items.

TITLE: A Solution Framework for the Long-Term Scheduling and Inventory Management of Straight Pipeline Systems with Multiple-Sources

AUTHOR: William Hitoshi Tsunoda Meira Leandro Magatao Flavio Neves Jr Lucia V.R Arruda Joans Portugal Vaqueiro Susana Relvas Ana Paula Barbosa-Povoa

JOURNAL NAME: Computers and Operations Research, Volume No. 127, March 2021, Pages-105143

This paper addresses the long-term scheduling of pumping and delivery operations on straight multiproduct pipeline systems connecting multiple-sources to multiple-destinations. The approach is validated by solving an illustrative example and two real-world based pipeline problems. Results show that the proposed framework is able to obtain solutions in reasonable run time with detailed inventory management and respecting several operational constraints of the system.

TITLE: Modeling And Analysis of Inventory Management Systems in Healthcare: A Review and Reflections

AUTHOR: Esha Saha, Pradip Kumar Ray

JOURNAL NAME: Computer and Industrial Engineering, Volume No. 137, November 2019, Pages-106051, ISSN: 0360-8352

Inventory management in a healthcare system needs to be compatible with its operations and critical characteristics ensuring minimization of inventory-related cost as well as maximization of service level with a significant reduction in the price of treatment and wastage of resources. An integrated research framework as applicable in the present context is presented as a direct consequence of the review of the literature with future research directions.

TITLE: A Two-Stage Stochastic Programming Model for Inventory Management in the Blood Supply Chain

AUTHOR: Mary Dillon, Fabricio Oliveria, Babak Abbasi

JOURNAL NAME: International Journal of Production Economics, Volume No. 187, May 2017, Pages-27-41, ISSN: 0925-5273

Managing inventories in the blood supply chain is a challenging task, mainly due to the uncertain nature of the demand for blood units, the perishable nature of the blood, and a strong subjective bias towards criteria other than cost minimisation. In particular, we observed that it would be possible to revise the current inventory

control policies by reducing current target levels to diminish wastage and total cost without compromising the service level.

TITLE: Optimum Sustainable Inventory Management with Backorder and Deterioration under Controllable Carbon Emissions

AUTHOR: Umakanta Mishra, Jei-Zheng Wu, Biswajit Sarkar

JOURNAL NAME: Journal of Cleaner Production, Volume No. 279, January 2021, Pages-123699, ISSN: 0959-6526

Reducing carbon emissions is crucial in the development of a green supply chain. Greenhouse firms regulate carbon emission constraints to achieve sustainable supply chains. The results of this paper are sustainable inventory management in the carbon tax and cap partial backlogging case has a better justifiable profit with the highest cycle time and the lowest value of the fraction length period as well as the lower green technology investment cost compared with other models.

TITLE: Sustainable Inventory Management with Deteriorating and Imperfect Quality Items Considering Carbon Emission

AUTHOR: Sunil Tiwari, Yosef Daryanto, Hui Ming Wee

JOURNAL NAME: Journal of Cleaner Production, Volume No. 192, August 2018, Pages-281-292, ISSN: 0959-6526

Sustainable inventory management seeks to reduce the environmental and social impacts of an industry without affecting its profitability. This study presents an integrated single-vendor single-buyer inventory model for deteriorating items with the imperfect quality considering carbon emission. This paper proposes a solution procedure and provides a numerical example to illustrate the theory.

TITLE: Inventory Management of Surgical Supplies and Sterile Instruments in Hospitals: A Literature Review

AUTHOR: Ehsan Ahmadi, Dale T.Masel, Ashley Y.Metcalf, Kristin Schuller

JOURNAL NAME: Health Systems, Volume No. 8, Issue No. 2, July 2018

Operating rooms are considered a significant revenue source, as well as the main source of waste and cost, among the hospital's departments. Any cost savings in operating rooms will have a broad financial impact. We have analysed the literature in a systematic manner and organised the identified papers into two groups: the papers that were published by scientific researchers and developed optimisation techniques and the papers that were published by practitioners and reported their observations of the current issues in the operating room.

TITLE: Optimal Production, Replenishment, Delivery, Routing and Inventory Management Policies for Products with Perishable Inventory

AUTHOR: Yuzhuo Qiu, Jun Qiao, Panos M.Pardalos

JOURNAL NAME: Omega, Volume No. 82, January 2019, Pages 193-204, ISSN: 0305-0483

This paper presents a generalized production-inventory-routing model with perishable inventory. We analyse the optimal integrated decisions of when and how much to deliver and sell products with varying manufacturing periods. We discuss main inventory management policies to demonstrate the applicability of the model in real-world applications for production routing problems (PRPs) with perishable inventory.

TITLE: Relationship between Inventory Management and Uncertain Demand for Fast Moving Consumer Goods Organizations

AUTHOR: Ndivhuwo Nemptajela, Charles Mbohwa,

JOURNAL NAME: Procedia Manufacturing, Volume No. 8, 2017, Pages 699-706, ISSN: 2351-9789

This paper addresses relationship between inventory management and uncertain demand. It also assesses the effects of uncertain demand on inventory management in the fast moving consumer goods (FMCG). The findings imply that poor inventory management will result in demands not being satisfied, organisations will either have too much or too little on hand, and this will result to the organisations' failure.

TITLE: Points of Distribution Location and Inventory Management Model for Post-Disaster Humanitarian Logistics

AUTHOR: Nick Loree, Felipe Aros-Vera

JOURNAL NAME: Logistics and Transportation Review, Volume No. 116, August 2018, ISSN: 1366-5545

This paper develops a mathematical model to determine the location of points of distribution (PODs) and inventory allocation in Post-Disaster Humanitarian Logistics (PD-HL). The model minimizes facility placement, logistics, and deprivation costs and allows for demand nodes to be served from multiple PODs. This is significant in conditions when one POD may not have the inventory to serve all demand points that it has been assigned.

TITLE: Blood Inventory Management in Hospitals: Considering Supply and Demand Uncertainty and Blood Transshipment Possibility

AUTHOR: Mehdi Najafi, Ali Ahmadi, Hossein Zolfagharinia

JOURNAL NAME: Operations Research for Health Care, Volume No. 15, December 2017, Pages-43-56, ISSN: 2211-6923

Despite significant advancements in medicine, human blood is still a scarce resource. Only humans produce it, and there is currently no other product or alternative chemical process that can be used to generate blood. Since blood is also a perishable product, its inventory management is difficult. Since the proposed model contains uncertain parameters, the use of chance constraint programming creates a deterministic counterpart. The deterministic model is then adapted to include approximations to remove non-linearity.

TITLE: Opportunistic Maintenance Strategy for Wind Turbines Considering Weather Conditions and Spare Parts Inventory Management

AUTHOR: Chen Zhang, Wei Gao, Tao Yang, Sheng Guo

JOURNAL NAME: Renewable Energy, Volume No. 133, April 2019, Pages 703-711, ISSN: 0960-1481

The wind power industry has experienced rapid growth over the past few decades, but the operation and maintenance costs have become huge challenges to achieve better economic returns and enhance the market competitiveness. The optimal maintenance and inventory strategy is obtained with the decision variables of opportunistic maintenance reliability threshold and reorder stock level, and the effects of various applied parameters are described.

TITLE: Reducing Emissions in Transportation and Inventory Management: (R,Q) Policy with Considerations of Carbon Reduction

AUTHOR: Tang Shao long, Wang Wenjie, Cho Stella, Yan Hong

JOURNAL NAME: European Journal of Operational Research, Volume No. 269, Issue No. 1, August 2018, Pages 327-340, ISSN: 0377-2217

In this study, we examine three approaches on the effects of controlling carbon emissions in transportation and inventory management. A Business-As-Usual Scenario Model (BAUSM), which delineates how carbon footprints from inventory storage and related transportation are captured, is firstly developed as the benchmark model. Optimization algorithms are developed for solving models and related properties are investigated to examine the effects of carbon reduction and associated costs of three models.

TITLE: UWB Localization with Battery-Powered Wireless Backbone for Drone-Based Inventory Management

AUTHOR: Nicola Macoir, Jan Bauwens, Ben Van Herbruggen, Jen Rossey, Jeroen Hoebeke, Eli De Poorter

JOURNAL NAME: Sensors, Volume No. 19, Issue No. 3, January 2019, Pages-467, ISSN: 1424-8220

Current inventory-taking methods (counting stocks and checking correct placements) in large vertical warehouses are mostly manual, resulting in (i) large personnel costs, (ii) human errors and (iii) incidents due to working at large

heights. To remedy this, the use of autonomous indoor drones has been proposed. The resulting system has a theoretical update rate of up to 2892 Hz (assuming no hardware dependent delays). Moreover, the anchor nodes have an average current consumption of only 27 mA (compared to 130 mA of traditional UWB infrastructure nodes).

TITLE: Inventory Management at a Chilean Hospital Pharmacy: Case Study of a Dynamic Decision-Aid Tool

AUTHOR: Fabian Silva-Aravena, Irlanda Ceballos- Fuentealba, Eduardo Alvarez-Miranda

JOURNAL NAME: Mathematics, Volume No. 8, Issue No. 11, ISSN: 2227-7390

Pharmacy inventory management is a critical process in healthcare centres. On the one hand, effective drug procurement is fundamental for fulfilling the therapeutic requirements of patients. On the other hand, as hospital pharmacies' purchasing and storage costs comprise an important share in the hospital budgets; efficient inventory management may play a central role in operational cost containment. In this study, we present the methodological features of a decision-aid tool for planning the purchases and inventory levels for the controlled medication pharmacy of the Regional Hospital of Talca, Chile.

TITLE: An Application of Economic Model Predictive Control to Inventory Management in Hospitals

AUTHOR: J.M.Maestre, M.I.Fernandez, I.Jurado

JOURNAL NAME: Control Engineering Practice, Volume No. 71, February 2018, Pages 120-128, ISSN: 0967-0661

In this paper, we present experimental results from the application of model predictive control (MPC) to inventory management in a real hospital. In particular, the stock levels of ten different drugs that belong to the same laboratory have been controlled by using an MPC policy. The results obtained after four months show that the adopted approach outperforms the method employed by the hospital and reduces both the average stock levels and the work burden of the pharmacy department.

TITLE: A Survey of Semiconductor Supply Chain Models Part II: Demand Planning, Inventory Management, and Capacity Planning

AUTHOR: Reha Uzsoy, John W.Fowler, Lars Monch

JOURNAL NAME: International Journal of Production Research, Volume No. 56, Issue No. 13, February 2018, ISSN: 4546-4546

Part I of this three-part series described semiconductor supply chains from the decision-making and functional perspectives, using this as a framework to review the industrial engineering and operations research literature on the problems arising in these supply chains. Part I then reviewed the literature on Strategic Network Design, supply chain coordination, sustainability and simulation-based decision support. This paper, Part II, reviews the areas of Demand Planning, Inventory Management and Capacity Planning in semiconductor supply chains. Part III concludes the series by discussing models to support Master Planning, Production Planning and Demand Fulfilment in this industry.

TITLE: Green Inventory Management

AUTHOR: Johan Marklund, Peter Berlin

JOURNAL NAME: Sustainable Supply Chains, Volume No. 6, September 2016, Pages 189-218, ISSN: 1929-7910

Managing inventories, and thereby material flows, is of key importance for achieving efficient and sustainable supply chains. Green inventory management is characterized by complementing the traditional economic (cost) focus with environmental (emissions) considerations. A literature overview illustrates what issues have been addressed so far in this emerging field. We conclude that there is a promising potential for green inventory management practices to reduce both costs and emissions, but much remains to be done. Not least in terms of developing more general green inventory models for practical use.

TITLE: Inventory Management in Mass Customization Operations: A Review

AUTHOR: Shu Guo, Tsan-Ming Choi, Bin Shen, Sojin Jung

JOURNAL NAME: IEEE Transactions on Engineering Management, Volume No. 66, Issue No. 3, August 2019, ISSN: 0018-9391, Electronic ISSN: 1558-0040

Mass customization (MC), as an operations program to satisfy target consumers by offering personalized products or services, has attracted substantial attention from both the industry and academia. Under this program, one of the most important issues is an efficient management of the related inventories, including the work-in-process inventories, standard items, and the customized items, which can ultimately contribute to a profitable business for the companies who have launched MC. This paper, therefore, focuses on reviewing the mass customization based literature and identifying various methods to effectively manage inventory for MC schemes.

TITLE: Impact of Inventory Management on Demand Fulfillment, Cost and Emission of Forest-Based Biomass Supply Chains Using Simulation Modeling

AUTHOR: Shaghaygh Akhtari, Taraneh Sowlati, Diana G.Siller-Benitez, Dominik Roeser

JOURNAL NAME: Biosystems Engineering, Volume No. 178, February 2019, Pages 184-199, ISSN: 1537-5110

Biomass has emerged as an attractive renewable source of energy to shift away from fossil fuels. The high cost of biomass feedstock and variations in its availability and quality are among the key barriers in bioenergy and biofuel development. Therefore, it is crucial to design and operate biomass supply chains that are efficient. The simulation model is applied to a case study in Canada to assess different scenarios. The fixed order quantity system often results in higher demand fulfilment; however, it has higher cost and CO₂ eq. emission compared with the order-up-to-level system.

TITLE: A Literature Review on Multi-Echelon Inventory Management: The Case of Pharmaceutical Supply Chain

AUTHOR: Noucaiba Sbai, Abdelaziz Berrado

JOURNAL NAME: MATEC Web of Conferences, Volume No. 200, Issue No. 13, September 2018, ISSN: 2261-2364

In a complex supply chain network where inventories are found across the entire system as raw materials or finished products, the need for an integrated approach for managing inventory had become crucial. The implementation of the multi-echelon inventory management in such supply chains helps keeping the stock of pharmaceutical products available at the different installations. This paper provides an insight into the multi-echelon inventory management problem, especially in the pharmaceutical supply chain. A classification of several multi-echelon inventory systems according to a set of criteria is provided. A synthesis of multiple multi-echelon pharmaceutical supply chain problems is elaborated.

TITLE: Supply Chain Joint Inventory Management and Cost Optimization Based on Ant Colony Algorithm and Fuzzy Model

AUTHOR: Wenfang Yu, Guisheng Hou, Pengcheng Xia, Jingjing Li

JOURNAL NAME: Technical Gazette, Volume No. 26, Issue No. 6, 2019, Pages 1729-1737, ISSN: 1330-3651

With the advancement of the marketization process, inventory management has transformed from a single backup protection function to an essential function for enterprises, which helps to survive and develop. Inventory control in supply chain management is the important content of supply chain management. In view of the achievements and shortcomings of the current research, a more systematic and improved optimization model of the supply chain inventory was proposed by using the basic ideas of ant colony algorithm and fuzzy model.

TITLE: Evaluation of the Role of Inventory Management in Logistics Chain of an Organization

AUTHOR: Joseph Afolabi Oluwaseyi, Morakinyo Kehinde Onifade, Olumide F. Odeyinka

JOURNAL NAME: Scientific Journal on Transport and Logistics, Volume No. 8, Issue No. 2, April 2017, ISSN: 2336-3037

The operation of inventory management determines the efficiency of storage of products. The progress in techniques and management principles improves the moving load, delivery speed, service quality, operation costs, the usage of facilities and energy saving. Inventory management takes a crucial part in the manipulation of logistics. Reviewing the current condition, a strong system needs a clear frame of logistics and a proper inventory implements and techniques to link the producing procedures. The objective of the paper is to define the role of inventory management in logistics for the reference of further improvement.

TITLE: Threshold-Based Allocation Policies for Inventory Management of Red Blood Cells

AUTHOR: Vahid Sarhangian, Hossein Abouee-Mehrizi, Opher Baron, Oded Berman

JOURNAL NAME: Manufacturing and Service Operations Management, Volume No. 20, Issue No. 2, December 2017, Pages 161-388

Under current regulations, red blood cell (RBC) units can be transfused to patients up to 42 days after donation. In this work, we study the performance of a practical family of threshold-based allocation policies, designed to trade off the age of RBC transfusions with their availability at hospitals. To this end, we consider a stylized model of a hospital blood bank that procures its required blood from local donations. For this model, we develop a new method to exactly evaluate the performance of the threshold policy in terms of the distribution of the age of allocated units and the proportion of outdates and lost demand.

TITLE: Inventory Management of Perishable Items in Long-Term Humanitarian Operations Using Markov Decision Processes

AUTHOR: Guilherme O. Ferreira, Edilson F. Arruda, Lino G. Marujo

JOURNAL NAME: International Journal of Disaster Risk Reduction, Volume No. 31, October 2018, Pages 460-469

Humanitarian organizations often rely on donations of goods to keep their operations running for a long period. However, the donation of perishable goods, such as food and medicine, is a great challenge for logistic managers of such organizations, since deteriorated items may impose a threat to the population, if used incorrectly, and a huge cost for humanitarian operations, due the difficulties underlying their disposal policies. This paper aims at developing a decision making model for inventory management of perishable goods for long term humanitarian operations, using Markov Decision Process.

TITLE: Inventory Management and Performance of SMEs in the Manufacturing Sector of Harare

AUTHOR: W Muchaendepi, C Mbohwa, T Hamandishe, J Kanyepe

JOURNAL NAME: Procedia Manufacturing, Volume No. 33, 2019, Pages 454-461, ISSN: 2351-9789

The study assessed the inventory management (IM) strategies that are used by SME's in the manufacturing sector of Harare, Zimbabwe. The study used qualitative research design which was descriptive in nature. The study also used purposive sampling technique. A sample used a sample size of 244 respondents. Data was collected from the questionnaires which were completed and received back. The research established that most SME's use the Just-In-Time method of inventory management and do not have knowledge on the other computerized systems and methods.

TITLE: Influence of Inventory Management on the Performance of the Energy Sector in Kenya: A Case of Kenya Power Limited

AUTHOR: Kamau Martin, Dr. Patrick Mwangangi

JOURNAL NAME: International Journal of Logistics and Procurement Management, Volume No. 1, Issue No. 1, May 2017, Pages 91-109

Inventory constitutes the most significant part of firms in the energy sector. Because of the huge inventories maintained, a considerable sum of an organization's fund is being committed to them. Thus it becomes absolutely imperative to manage inventories efficiently so as to avoid the costs of changing

production rates, overstocking, stock outs and unnecessary cost. This study therefore sought to investigate on the influence of inventory management on the performance of the energy sector in Kenya with a special focus on Kenya Power Limited.

TITLE: Benefits of Current and Future Policies on Emissions of China's Coal-Fired Power Sector Indicated by Continuous Emission Monitoring

AUTHOR: Yan Zhang, Xin Bo, Yu Zhao, Chris P.Nielsen

JOURNAL NAME: Environmental pollution, Volume No. 251, August 2019, Pages 415-424, ISSN: 0269-7491

Emission inventories are critical to understanding the sources of air pollutants, but have high uncertainties in China due in part to insufficient on-site measurements. The emission intensity (the ratio of emissions to economic output) of Northwest China was larger than that of other regions, attributed mainly to its less intensive economy and industry. Transmission of electricity to more-developed eastern provinces raised the energy consumption and emissions of less-developed regions. Judged by 95 percentiles of flue-gas concentrations measured by CEMS, most power plants met the current national emission standards in 2015 except for those in Northwest and Northeast China, while plants that met the ultra-low emission policy were much scarcer.

TITLE: Low Interest Rate Environment: Inventory Management in Finland and Baltic States

AUTHOR: Olli Pekka Hilmola, Weidong Li, Andres Tolli

JOURNAL NAME: International Journal of Productivity and Performance Management, Volume No. 70, Issue No. 3, April 2019, ISSN: 1741-0401

For decades, it was emphasized that manufacturing and trading companies should aim to be lean with very small inventories. However, in the recent decade, time-significant change has taken place as nearly all of the "old west" countries have now low interest rates. Holding inventories have been beneficial for the sake of customer service and for achieving savings in transportation and fixed ordering costs.

TITLE: Driving Forces and Clustering Analysis of Provincial-Level CO₂ Emissions from the Power Sector in China From 2005 To 2015

AUTHOR: Changyi Liao, Saige Wang, Yiyi, Zhang, Dan Song, Chaohai Zhang

JOURNAL NAME: Journal of Cleaner Production, Volume No. 240, December 2019, Pages 118026, ISSN: 0959-6526

Understanding the drivers of provincial-level CO₂ emissions from the power sector is critical for realizing power sector decarbonization and achieving national carbon reduction targets. In this study, the CO₂ emissions from electricity generation in 30 provinces of China during the period of 2005–2015 are systematically inventoried. By investigating the driving forces of changes in CO₂ emissions from the power sector, this study aims to provide insights for provincial decarbonization pathways of the power sector.

TITLE: Inventory Management Systems on Supply Chain Performance of Fast-Moving Consumer Goods Manufactures in Kenya

AUTHOR: Eric Jepherson Muhalia, Dr. Patrick Karanja Ngugi, Dr. Makori Moronge

JOURNAL NAME: International Journal of Supply Chain and Logistics, Volume No. 5, Issue No. 1, January 2021, Pages 1-10, ISSN: 2520-4661

The purpose of this study was to determine the influence of inventory management systems on supply chain performance of fast-moving consumer goods manufacturers in Kenya.

TITLE: Numerical Study of Inventory Management under Various Maintenance Policies

AUTHOR: Joeri Poppe, Rob J.I.Basten, Robert N.Boute, Marc R.Lambrecht

JOURNAL NAME: Reliability Engineering and System Safety, Volume No. 168, December 2017, Pages 262-273, ISSN: 0951-8320

Capital assets, such as manufacturing equipment, require maintenance to remain functioning. Maintenance can be performed when a component breaks down and needs replacement, or the maintenance and part replacement can be performed

preventively. Preventive policies increase the total demand for spare parts compared to corrective maintenance, since the former do not exploit the entire useful life of the components. This leads to higher inventory requirements.

TITLE: Deployment of Lean Six Sigma in Strategic Inventory Management

AUTHOR: Noor Azam Md Saad

JOURNAL NAME: Journal of Advanced Research in Business and Management Studies, Volume No. 13, Issue No. 1, December 2018, ISSN: 2462-1935

In today's very competitive business environment around the world, organizations need to be lean and mean as their strategy for competitive advantage. The research is to explore in depth what is the characteristic of Lean Six Sigma methodologies when applied in this aspect. The problems faced during the journey will be examined to identify the limitations of the Lean Six Sigma methodology may have and how it can be made better.

TITLE: Strategic Inventory Management Practices and the Performance of Supermarkets in Nairobi Country, Kenya

AUTHOR: Robert M. Arasa, John O.Achuora

JOURNAL NAME: European Journal of Business and Management Research, Volume No. 5, Issue No. 2, April 2020, ISSN: 2507-1076

This study establishes the influence of strategic inventory management practices on the performance of supermarkets in Nairobi County, Kenya. Further the study suggests that future research should focus on undertaking a comparable study incorporating a wider spatial and population scope as well as give attention to constructs affecting the effectiveness of strategic inventory management practices once they are implemented by supermarkets in order to obtain a comprehensive understanding of the subject matter and contribute towards the existing body of knowledge in this area.

TITLE: Inventory Management under Joint Product Recovery and Cap-and-Trade Constraints

AUTHOR: Marthy Gracia Alvarado, Marc Paquet, Amin Chaabane, Lionel Amodeo

JOURNAL NAME: Journal of Cleaner Production, Volume No. 167, November 2017, Pages 1499-1517, ISSN: 0959-6526

The influence of environmental legislation in inventory control policies is explored. Previous work on product recovery is extended using the introduction of a cap-and-trade mechanism in an infinite-horizon inventory system in which demand and returns are uncertain. The results indicate that decisions are sensitive to carbon prices. The inventory policy could play an important role in compliance with environmental legislation, although there is threshold carbon price beyond which the company must focus on strategic decisions rather than tactical decisions.

TITLE: Using a Kanban System for Multi-Echelon Inventory Management: The Case of Pharmaceutical Supply Chains

AUTHOR: Malak Mouaky, Abdelaziz Berrado, Loubna Benabbou

JOURNAL NAME: International Journal of Logistics System and Management, Volume No. 32, Issue No. 3-4, March 2019, ISSN: 1742-7975

This paper explores the implementation of a kanban system within a multi-echelon pharmaceutical supply chain (MEPSC). This paper presents how a kanban system could manage pharmaceuticals inventory and enhance the information sharing through a multi-echelon supply chain. There are two primary findings: a) that the implementation of Kanban system provides a strategic benefit and improves the quality of services and information sharing through a multi-echelon supply chain; b) It also provides a foundation to leverage innovation in pharmaceutical supply chains; it gives the opportunity to the organisation to move away from the current push delivery and logistics systems towards improved logistics strategy models to empower front-line caregivers.

TITLE: Inventory Management Practices and Financial Performance of Small and Medium Scale Enterprises in Laikipia Country, Kenya

AUTHOR: Jeremiah Nyaga Wanjira, Dr. John Mungai Njagiru

JOURNAL NAME: International Academic Journal of Economics and Finance, Volume No. 3, Issue No. 2, September 2018, Pages117-132, ISSN: 2518-2366

Despite the instrumental role that they play in the economy, most SMEs fail within their first years of operation. The instruments were tested for validity and reliability using pretesting, seeking expert opinion and using Cronbach's Alpha Reliability test. Secondary data was gathered from the SMEs books of accounts, management reports and other available resources. To that effect, only 24.50% of variation in the financial performance was explained by other predictors not included in the model. Regression analysis results demonstrated that inventory management had positive effects on performance. The study recommended pursuit of measures to improve the model of inventory management implemented by small scale firms.

TITLE: Extent of Use of Information and Communications Technology and Inventory Management in the Nigerian Brewery Industry

AUTHOR: Olusegun Timothy Odesola, Grace Oluyemisi Akinola

JOURNAL NAME: Journal of Information Systems Engineering and Business Intelligence, Volume No. 4, Issue No. 2, 2018, ISSN: 2443-2555

This paper examined the extent of usage of Information and Communications Technology (ICT) for inventory management in the Nigerian brewery industry; investigated the level of adoption of ICT in the inventory management phases; and the effect of the extent of ICT usage on its adoption by firms in the industry. Primary data formed the methodology of the study. The analysis of data collected was done using descriptive (tables and percentages) and inferential statistics. The results showed that majority of the respondents were using ICT tools and its associated components in their inventory management. The study recommends that firms in the industry should make judicious use of the identified ICT usage by

adopting ICT solutions for their operations to boost the efficiency and effectiveness of their operations.

TITLE: S & OP Maturity to Increase the Successful Inventory Management Initiatives in Industrial Machinery Rental Peruvian SMEs

AUTHOR: Alexa Alfaro, Fanny Valverde, Carlos Raymundo

JOURNAL NAME: International Journal of Engineering Research and Technology, Volume No. 12, Issue No. 7, 2019, Pages 1081-1099, ISSN: 0974-3154

Currently, most Peruvian SMEs are growing in the informal sector, thus they fail to establish their processes correctly or to have adequate inventory management. This has become a critical factor for their development, causing both economic and structural problems. On the other hand, there is a lack of research on inventory management in service companies. Therefore, a model is proposed for managing the inventories of service companies in the industrial machinery rental sector based on the Sales Operation Planning (S&OP) tool. This model is based on a maturity model allowing the company to evaluate its current situation and identify the necessary requirements to be able to scale up S&OP development in the company.

TITLE: Safety in Inventory Management and Wastage Analysis at Construction Sites

AUTHOR: Bishal Paul, Santosh Tondihal, Bibhuti Bushan Das

JOURNAL NAME: Recent Trends in Civil Engineering, Volume No. 105, November 2020, Pages 509-517, ISSN: 1158-2936

Inventory control in construction projects is a key function to the project success. Inventory serves as a link between planning and execution of a project. In construction industry, majority of the cost is involved in inventories so it is important to keep the inventories under strict control otherwise it may lead to cost and time overrun. As construction industry consumes large part of inventories, so it produces huge amount of wastes. This paper mainly put emphasis on safety stock analysis aiming to determine the safety stock of inventories after calculation of average lead time, actual lead time, and average demand per day,

standard deviation and service factor from the set of data obtained from the site. It also aims to provide a model for automation of safety stocks to prevent stock-outs using PYTHON software.

TITLE: Performance Improvement of Inventory Management System Processes by an Automated Warehouse Management System

AUTHOR: Anas M.Atieh, Hazem Kaylani, Yousef Al-Abdallat, Abeer Qaderi, Luma Ghoul, Lina Jaradat, Iman Hdairis

JOURNAL NAME: Procedia CIRP, Volume No. 41, February 2016, Pages 568-572, ISSN: 2212-827

This study investigates the impact of a warehouse management system on supply chain performance that provides less resources effort, more efficient, and reliable inventory management system. The supply chain procedures carried out in the warehouse were reviewed before customizing software that can handle the necessary transactions. The system handles three phases of product lifecycle: receiving, processing, and distribution of SIM and prepaid scratch cards. Each phase of the product lifecycle was discussed in detail and the process/procedure gaps were identified. It also highlights the gap between theory and practice; to motivate researchers to develop and customize new systems for mitigating supply chain disruptions.

2.2 THEORITICAL STUDY

RATIO ANALYSIS

Ratio analysis is a quantitative procedure of obtaining a look into a firm's functional efficiency, liquidity, revenues, and profitability by analysing its financial records and statements. Ratio analysis is a very important factor that will help in doing an analysis of the fundamentals of equity.

According to Myers, "Ratio analysis of financial statements is a study of relationship among various financial factors in a business as disclosed by a single set of statements and a study of trend of these factors as shown in a series of statements."

Types of ratios are given below:

1. Liquidity Ratios

This type of ratio helps in measuring the ability of a company to take care of its short-term debt obligations. A higher liquidity ratio represents that the company is highly rich in cash.

The types of liquidity ratios are

1. Current Ratio: The current ratio is the ratio between the current assets and current liabilities of a company. The current ratio is used to indicate the liquidity of an organization in being able to meet its debt obligations in the upcoming twelve months. A higher current ratio will indicate that the organization is highly capable of repaying its short-term debt obligations.

Current Ratio = Current Assets / Current Liabilities

2. Quick Ratio: The quick ratio is used to ascertain information pertaining to the capability of a company in paying off its current liabilities on an immediate basis.

The formula used for the calculation of a quick ratio is-

Quick Ratio= (Current Asset- Inventories)/ Current Liabilities

2. Profitability Ratios

This type of ratio helps in measuring the ability of a company in earning sufficient profits.

The types of profitability ratios are

1. Gross Profit Ratios: Gross profit ratios are calculated in order to represent the operating profits of an organization after making necessary adjustments pertaining to the COGS or cost of goods sold.

The formula used for the calculation of gross profit ratio is-

Gross Profit Ratio = (Gross Profit / Net Sales) * 100

2. Net Profit Ratio: Net profit ratios are calculated in order to determine the overall profitability of an organization after reducing both cash and non-cash expenditures.

The formula used for the calculation of net profit ratio is-

Net Profit Ratio = (Net Profit / Net Sales) * 100

3. Solvency Ratios

Solvency ratios can be defined as a type of ratio that is used to evaluate whether a company is solvent and well capable of paying off its debt obligations or not.

The types of solvency ratios are

1. Debt Equity Ratio: The debt-equity ratio can be defined as a ratio between total debt and shareholders fund. The debt-equity ratio is used to calculate the leverage of an organization. An ideal debt-equity ratio for an organization is 2:1.

The formula for debt-equity ratio is-

Debt Equity Ratio = Total Debts / Shareholders Fund

4. Turnover Ratios

Turnover ratios are used to determine how efficiently the financial assets and liabilities of an organization have been used for the purpose of generating revenues.

The types of turnover ratios are

1. Fixed Assets Turnover Ratios: Fixed assets turnover ratio is used to determine the efficiency of an organization in utilizing its fixed assets for the purpose of generating revenues.

The formula used for the determination of fixed assets turnover ratio is-

Fixed Assets Turnover Ratio = Net Sales / Average Fixed Assets

2. Inventory Turnover Ratio: Inventory turnover ratio is used to determine the speed of a company in converting its inventories into sales.

Inventory Turnover Ratio = Cost of Goods Sold / Average Inventories

3. Inventory Conversion Period

Inventory conversion period reports us about the average time to convert our total inventory into sales. It is relationship between total days in year and inventory turnover ratio. In other words, it measures the length of time on average between the acquisition and sale of merchandise.

Inventory Conversion Period= Day in a year/ Inventory Ratio

4. Inventory to Current Assets

Inventory to current assets shows that how much liquidity of a firm is kept in the inventory whereas inventory is less than current and also inventory is the non-liquid current assets.

Inventory to Current Assets = Total Inventory/ Total Current Assets

5. Inventory to Total Assets

Inventory to total assets demonstrates the bit of advantages tied up in inventories this assistance to screen your levels. Resources are the organization's assets, for example, stock; money accounts receivables and equipment's. A fitting stock to add up to resources proportion relies upon the business and specific business technique.

Inventory to Total Assets = Inventory /Total Assets

6. Inventory to Working Capital

Inventory to working capital ratio characterized as a strategy to show what portion of an organization inventories is financed from its accessible money is basic to business which hold stock and make due on cash supplies out general the lower the day the proportion the higher the liquidity.

Inventory to Working Capital = Inventory/ Working Capital

7. Inventory to Capital Employed Ratio

This ratio indicates the relationship between the total capitals employed and inventories it shows how much capital utilized to invest in the inventories other than the other assets. The normal manufacturing firms have low ratio of inventory total capital employed in the organization.

Inventory to Capital Employed Ratio= Inventory/ Capital Employed

8. Inventory to Sales Ratio

Inventory to Sales Ratio metric measures the amount of inventory you are carrying compared to the number of sales orders being fulfilled.

Inventory to Sales Ratio= Inventory/ Sales

9. Raw Materials Turnover Ratio

Raw materials turnover proportion is a proportion in which raw materials is changed over into completed products or semi-completed which will be prepared available to be purchased. The equation is changed over for raw materials turnover is

Raw Materials Turnover Ratio= Sales/ Raw Material

10. Raw Materials Conversion Period

It refers to the quantity of days or time taken for the generation unit to change over raw materials to completed products.

Raw Material Conversion Period = 365 Days/ Raw Materials Turnover Ratio

11. Inventory Percentage Ratio

Inventory percentage ratio is calculated using the formula

Inventory Percentage Ratio= Inventory/ Total Inventory*100

5. Trend Analysis

Trend analysis is a technique used in technical analysis that attempts to predict future stock price movements based on recently observed trend data. Trend analysis is based on the idea that what has happened in the past gives traders an idea of what will happen in the future.

Trend Percentage= Current Year/ Base Year

CHAPTER-III

RESEARCH METHODOLOGY

Research methodology is a systematic way of solving the problem. It includes the overall research design, the sampling procedure, data collection method and analysis procedure.

3.1 RESEARCH DESIGN

The research design used in this study is descriptive research.

3.2 SOURCES OF DATA

The secondary data has been collected from company annual reports, company websites, magazines and other sources.

3.3 PERIOD OF THE STUDY

Period of study is 5 years 2015-2016, 2016-2017, 2017-2018, 2018-2019, and 2019-2020.

3.4 TOOLS USED FOR THE STUDY

The statistical used for this study are ratio analysis, bar diagram, comparative balance sheet, trend analysis.

CHAPTER-IV

DATA ANALYSIS AND INTERPRETATION

4.1 CURRENT RATIO

Current Ratio= Current Asset/ Current Liability

TABLE NO.: 4.1 CURRENT RATIO

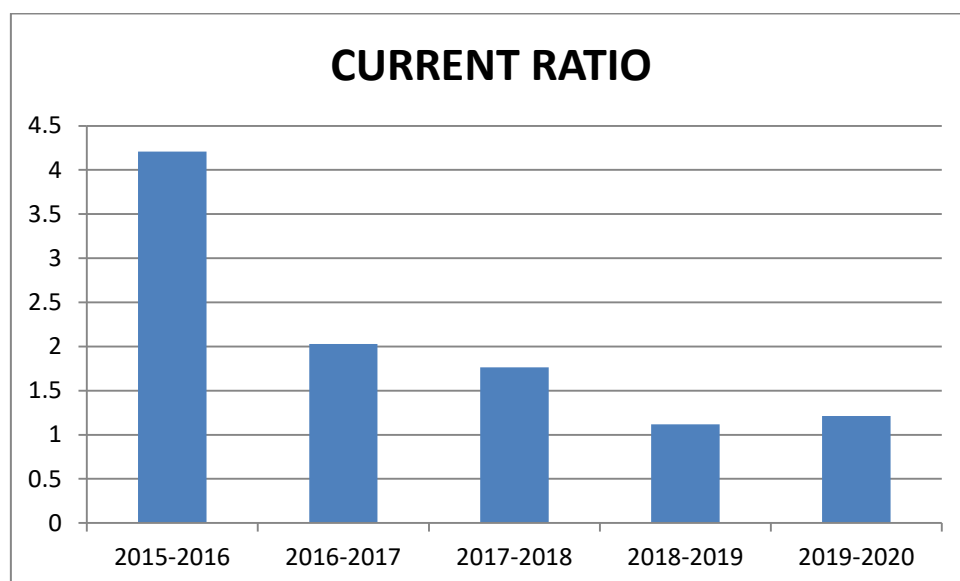
YEAR	CURRENT ASSET (IN Cr)	CURRENT LIABILITIES (IN Cr)	RATIO (TIMES)
2015-2016	8689.25	2065.54	4.21
2016-2017	8708.76	4289.36	2.03
2017-2018	10134.86	5749.4	1.76
2018-2019	9033.41	8086.41	1.12
2019-2020	10551.74	8694.74	1.21

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the current ratio is increased in the year 2015-2016 with 4.21 times, whereas exceptionally low in the year 2018-2019 with 1.12 times, therefore it is inferred that it is fluctuating trend.

CHART NO.: 4.1



4.2 QUICK RATIO

Quick Ratio= (Current Asset- Inventory)/ Current Liability

TABLE NO.: 4.2 QUICK RATIO

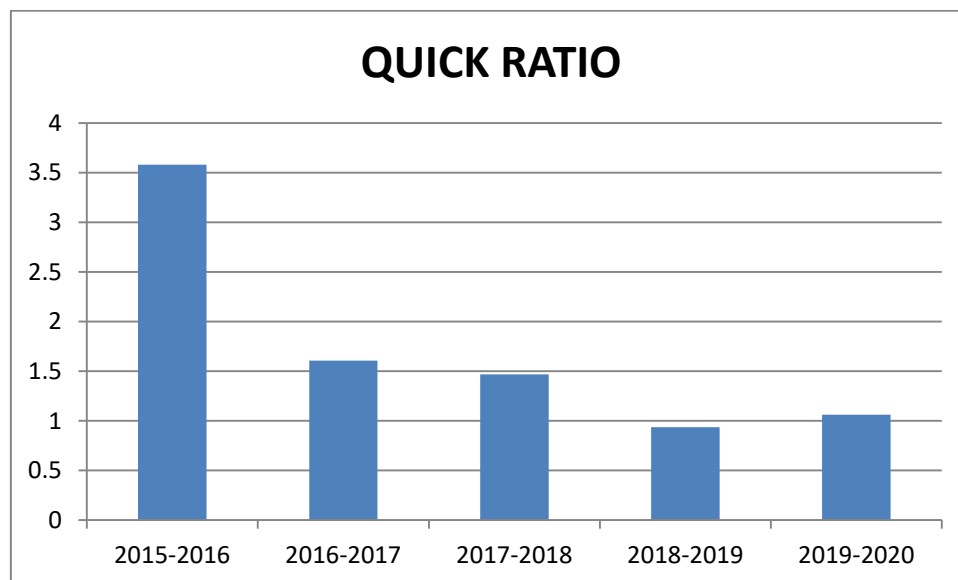
YEAR	CURRENT ASSET (IN Cr)	INVENTORY (IN Cr)	CURRENT LIABILITIES (IN Cr)	RATIO (TIMES)
2015-2016	8689.25	1294.64	2065.54	3.58
2016-2017	8708.76	1813.24	4289.36	1.61
2017-2018	10134.86	1688.90	5749.4	1.47
2018-2019	9033.41	1464.38	8086.41	0.94
2019-2020	10551.74	1324.55	8694.74	1.06

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the quick ratio is increased in the year 2015-2016 with 3.58 times, exceptionally low in the year 2018-2019 with 0.94 times, therefore it is fluctuating trend.

CHART NO.: 4.2



4.3 GROSS PROFIT RATIO

$$\text{Gross Profit Ratio} = (\text{Gross Profit} / \text{Sales}) \times 100$$

TABLE NO.: 4.3 GROSS PROFIT RATIO

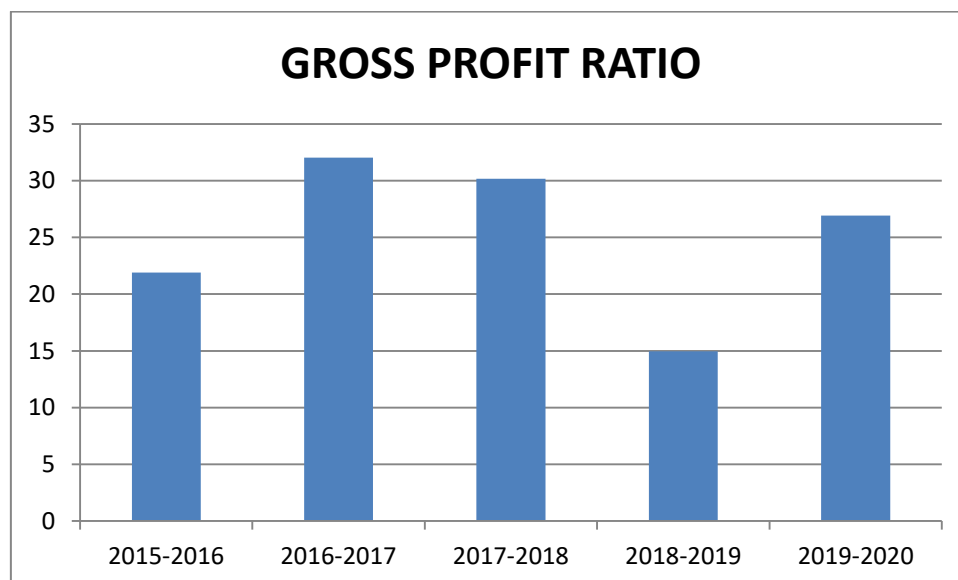
YEAR	GROSS PROFIT (IN Cr)	SALES (IN Cr)	RATIO (%)
2015-2016	1455.97	6652.05	21.89
2016-2017	2770.94	8652.59	32.02
2017-2018	2562.82	8496.20	30.16
2018-2019	1068.75	7145.92	14.96
2019-2020	2130.45	7916.30	26.91

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the gross profit ratio is increased in the year 2016-2017 with 32.02%, exceptionally low in the year 2018-2019 with 14.96%, therefore it is inferred that it is fluctuating trend.

CHART NO.: 4.3



4.4 NET PROFIT RATIO

$$\text{Net Profit Ratio} = (\text{Net Profit} / \text{Sales}) * 100$$

TABLE NO.: 4.4 NET PROFIT RATIO

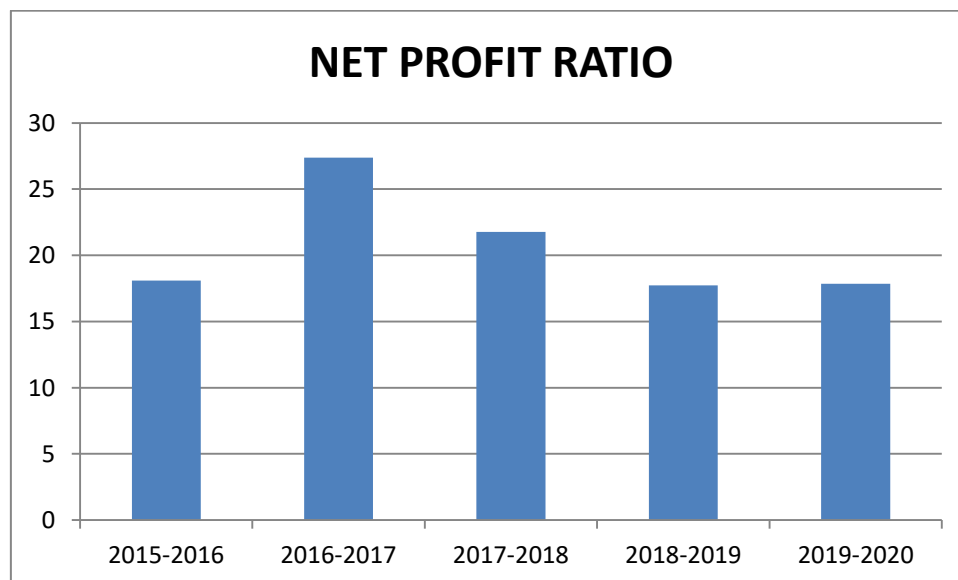
YEAR	NET PROFIT (IN Cr)	SALES (IN Cr)	RATIO (%)
2015-2016	1204.15	6652.05	18.10
2016-2017	2368.81	8652.59	27.38
2017-2018	1848.78	8496.20	21.76
2018-2019	1266.97	7145.92	17.73
2019-2020	1413.85	7916.30	17.86

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the net profit ratio is increased in the year 2016-2017 with 27.38%, exceptionally low in the year 2018-2019 with 17.73%, therefore it is inferred that it is fluctuating trend.

CHART NO.: 4.4



4.5 DEBT EQUITY RATIO

Debt Equity Ratio=Total Liabilities/ Shareholders Funds

TABLE NO.: 4.5 DEBT EQUITY RATIO

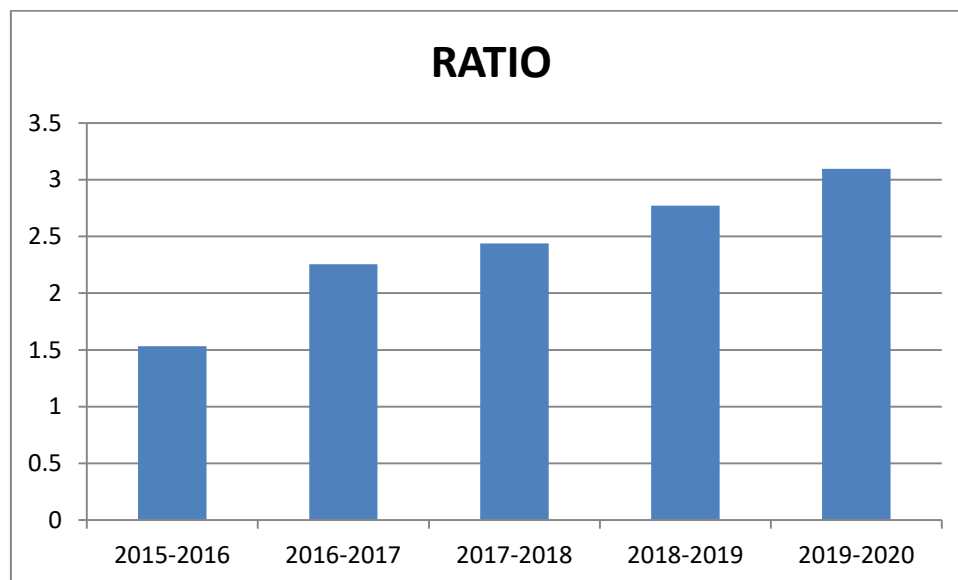
YEAR	TOTAL LIABILITIES (IN Cr)	SHAREHOLDERS FUNDS (IN Cr)	RATIO (TIMES)
2015-2016	23687.21	15468.64	1.53
2016-2017	27509.38	12198.62	2.26
2017-2018	32506.41	13334.58	2.44
2018-2019	34682.34	12511.32	2.77
2019-2020	39119.09	12639.51	3.09

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the debt equity ratio is increased in the year 2019-2020 with 3.09 times, exceptionally low in the year 2015-2016 with 1.53 times, therefore it is inferred that it is increasing trend.

CHART NO.: 4.5



4.6 FIXED ASSET TURNOVER RATIO

Fixed Asset Turnover Ratio= Sales/ Fixed Asset

TABLE NO.: 4.6 FIXED ASSET TURNOVER RATIO

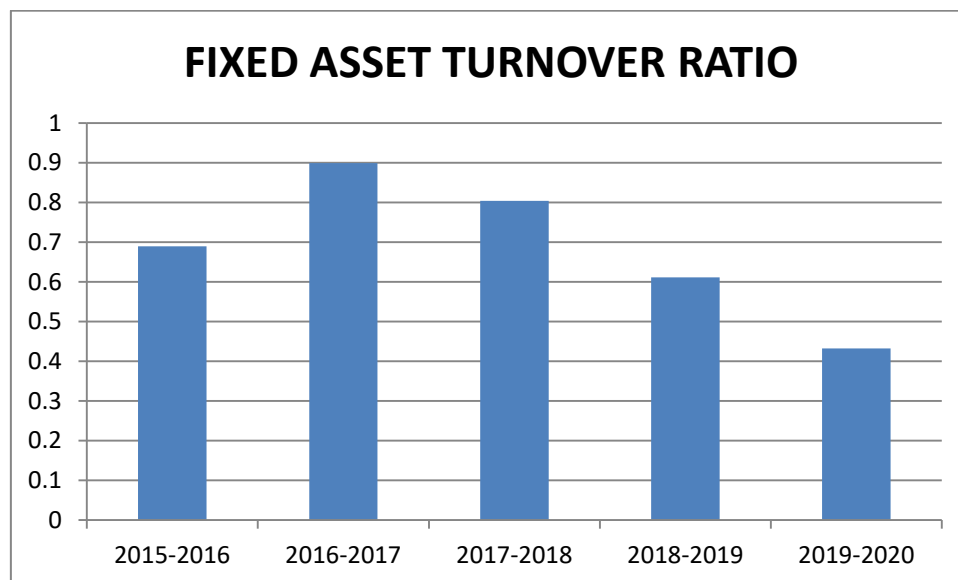
YEAR	SALES (IN Cr)	FIXED ASSET (IN Cr)	RATIO (TIMES)
2015-2016	6652.05	9654.23	0.69
2016-2017	8652.59	9625.03	0.90
2017-2018	8496.20	10574.11	0.80
2018-2019	7145.92	11684.43	0.61
2019-2020	7916.30	18308.16	0.43

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the fixed asset turnover ratio is increased in the year 2016-2017 with 0.90 times, exceptionally low in the year 2019-2020 with 0.43 times, therefore it is inferred that it is decreasing trend.

CHART NO.: 4.6



4.7 INVENTORY TURNOVER RATIO

Inventory Turnover Ratio=Sales/ Average Inventory

TABLE NO.: 4.7 INVENTORY TURNOVER RATIO

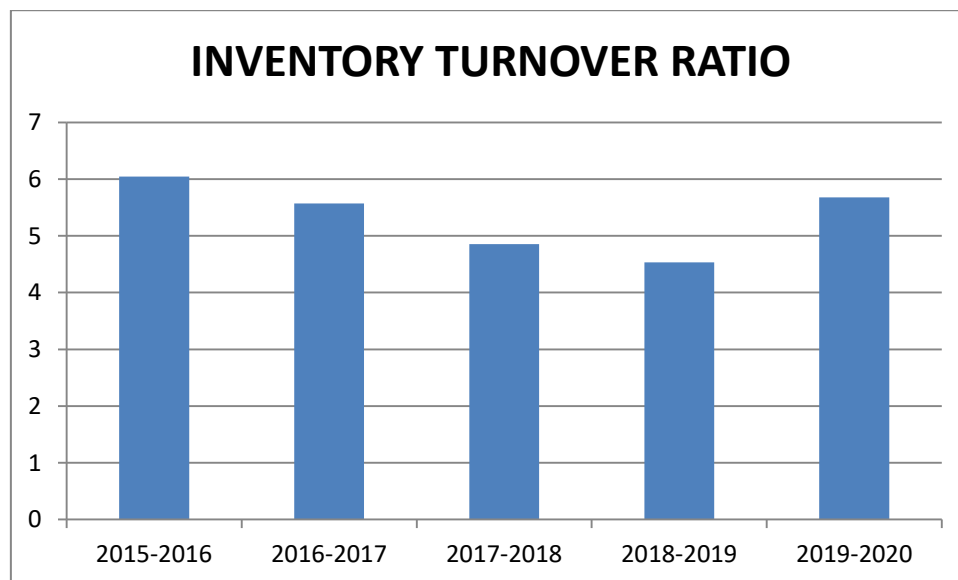
YEAR	SALES (IN Cr)	INVENTORY (IN Cr)	RATIO (TIMES)
2014-2015	-	907.40	-
2015-2016	6652.05	1294.64	6.04
2016-2017	8652.59	1813.24	5.57
2017-2018	8496.20	1688.90	4.85
2018-2019	7145.92	1464.38	4.53
2019-2020	7916.30	1324.55	5.68

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory turnover ratio is increased in the year 2015-2016 with 6.04 times, exceptionally low in the year 2018-2019 with 4.53 times, therefore it is inferred that it is fluctuating in trend.

CHART NO.: 4.7



4.8 INVENTORY CONVERSION PERIOD

Inventory Conversion Period=365/Inventory Conversion Ratio

TABLE NO.: 4.8 INVENTORY CONVERSION PERIOD

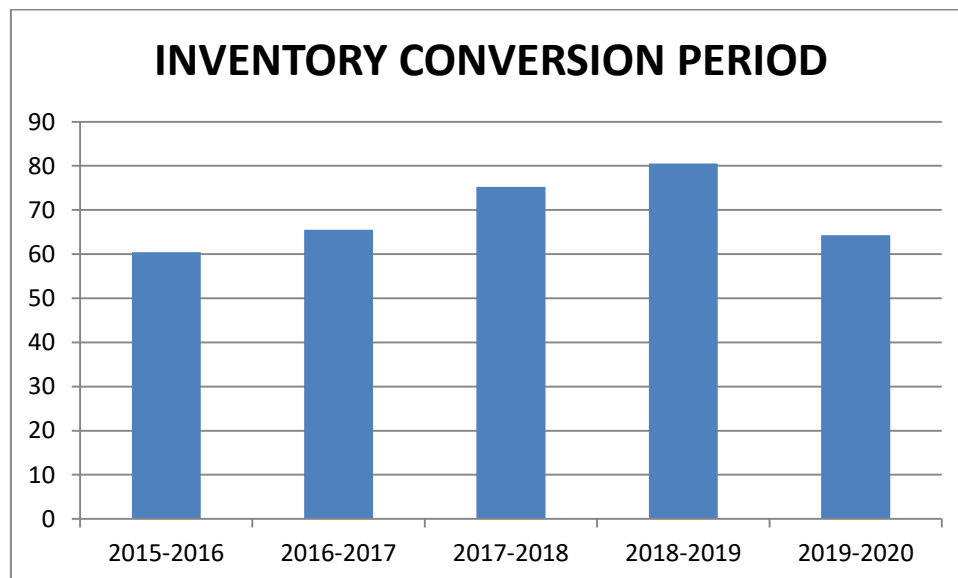
YEAR	DAYS IN A YEAR (DAYS)	INVENTORY RATIO (TIMES)	INVENTORY CONVERSION PERIOD (DAYS)
2015-2016	365	6.04	60.41
2016-2017	365	5.57	65.55
2017-2018	365	4.85	75.23
2018-2019	365	4.53	80.53
2019-2020	365	5.68	64.30

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory conversion period is increased in the year 2018-2019 with 80.53 days, exceptionally low in the year 2015-2016 with 60.41 days, therefore it is inferred that it is fluctuating trend.

CHART NO.: 4.8



4.9 INVENTORY PERCENTAGE RATIO

Inventory Percentage Ratio= Inventory/ Total Inventory*100

TABLE NO.: 4.9 INVENTORY PERCENTAGE RATIO

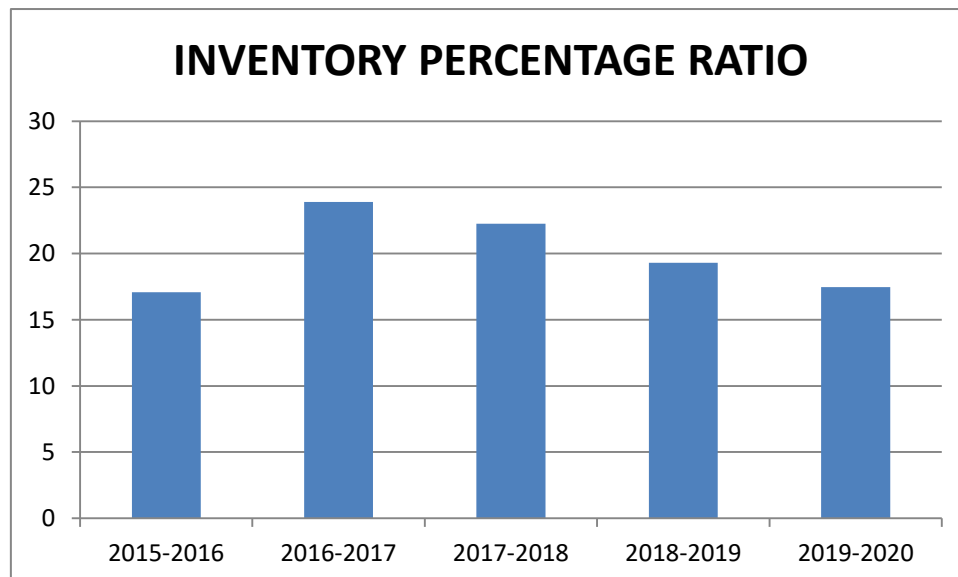
YEAR	INVENTORY (IN Cr)	INVENTORY PERCENTAGE (%)
2015-2016	1294.64	17.07
2016-2017	1813.24	23.90
2017-2018	1688.90	22.26
2018-2019	1464.38	19.30
2019-2020	1324.55	17.46
TOTAL	7585.71	100

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory percentage ratio is increased in the year 2016-2017 with 23.90%, exceptionally low in the year 2015-2016 with 17.07%, therefore it is inferred that it is decreasing trend.

CHART NO.: 4.9



4.10 INVENTORY TO CURRENT ASSET RATIO

Inventory in Current Asset Ratio= Inventory/ Current Asset

TABLE NO.: 4.10 INVENTORY TO CURRENT ASSET RATIO

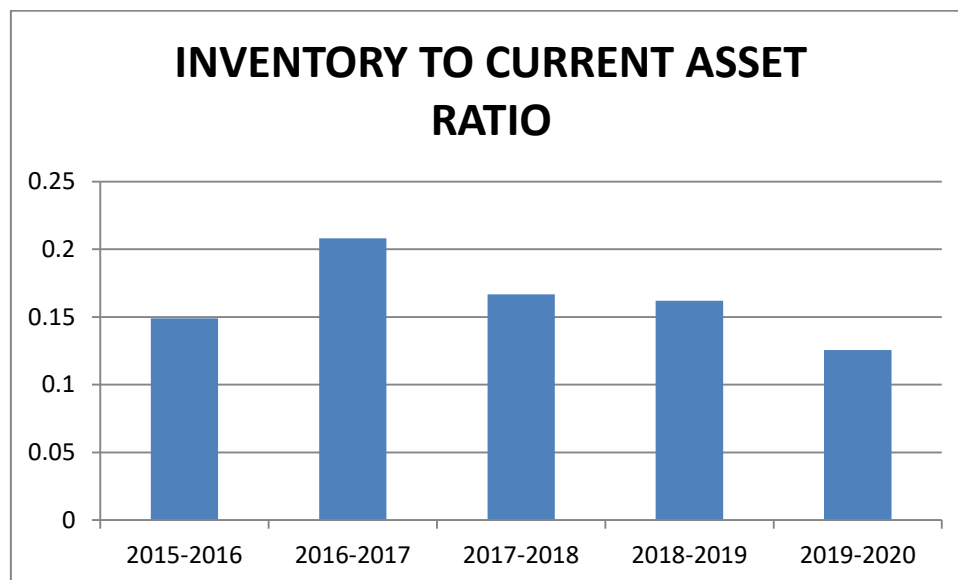
YEAR	INVENTORY (IN Cr)	CURRENT ASSET (IN Cr)	RATIO (TIMES)
2015-2016	1294.64	8689.25	0.15
2016-2017	1813.24	8708.76	0.21
2017-2018	1688.90	10134.86	0.17
2018-2019	1464.38	9033.41	0.16
2019-2020	1324.55	10551.74	0.13

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory to current asset ratio is increased in the year 2016-2017 with 0.21 times, exceptionally low in the year 2019-2020 with 0.13 times, therefore it is inferred that it is decreasing trend.

CHART NO.: 4.10



4.11 INVENTORY TO TOTAL ASSET RATIO

Inventory to Total Asset=Inventory/Total Asset

TABLE NO.: 4.11 INVENTORY TO TOTAL ASSET RATIO

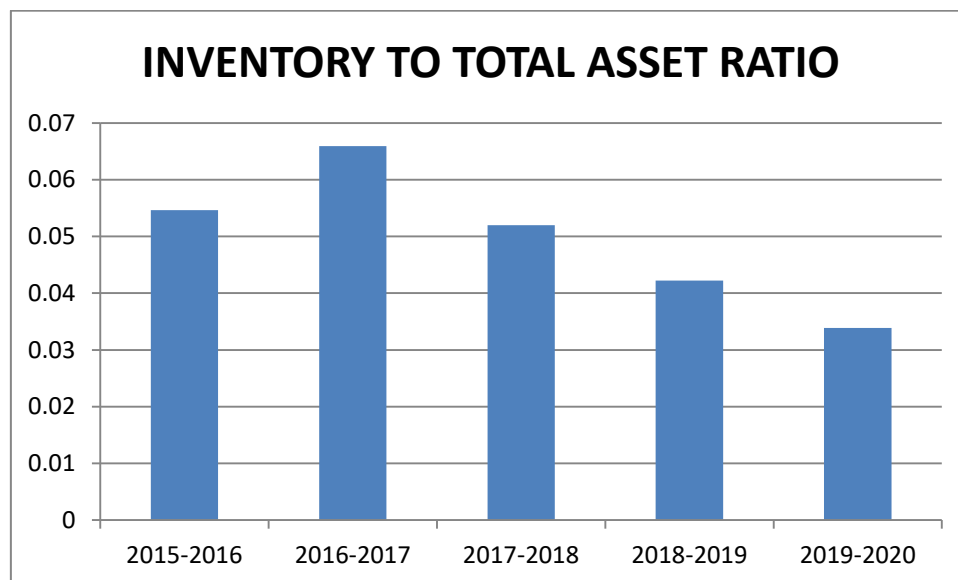
YEAR	INVENTORY (IN Cr)	TOTAL ASSET (IN Cr)	RATIO (TIMES)
2015-2016	1294.64	23687.21	0.055
2016-2017	1813.24	27509.4	0.066
2017-2018	1688.90	32506.41	0.052
2018-2019	1464.38	34682.34	0.042
2019-2020	1324.55	39119.09	0.034

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory to total asset ratio is increased in the year 2016-2017 with 0.066 times, exceptionally low in the year 2019-2020 with 0.034 times, therefore it is inferred that it is decreasing trend.

CHART NO.: 4.11



4.12 INVENTORY TO WORKING CAPITAL RATIO

Inventory to Working Capital Ratio=Inventory/Working Capital

TABLE NO.: 4.12 INVENTORY TO WORKING CAPITAL RATIO

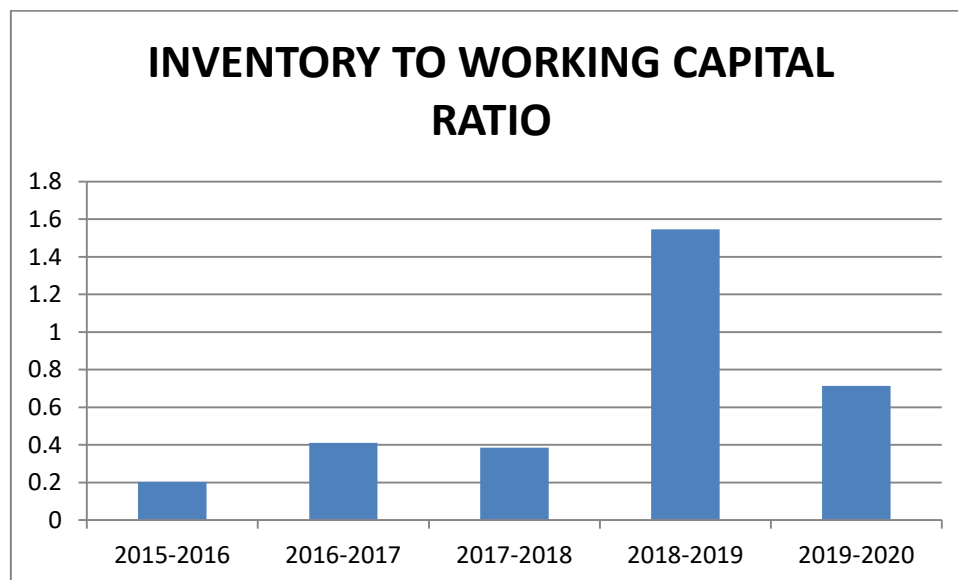
YEAR	INVENTORY (IN Cr)	WORKING CAPITAL (IN Cr)	RATIO (TIMES)
2015-2016	1294.64	6382.62	0.20
2016-2017	1813.24	4419.4	0.41
2017-2018	1688.90	4385.46	0.39
2018-2019	1464.38	947	1.55
2019-2020	1324.55	1857	0.71

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory to working capital ratio is increased in the year 2018-2019 with 1.55 times, exceptionally low in the year 2015-2016 with 0.20 times, therefore it is inferred that it is fluctuating trend.

CHART NO.: 4.12



4.13 INVENTORY TO CAPITAL EMPLOYED RATIO

Inventory to Capital Employed Ratio= Inventory/ Capital Employed

TABLE NO.: 4.13 INVENTORY TO CAPITAL EMPLOYED RATIO

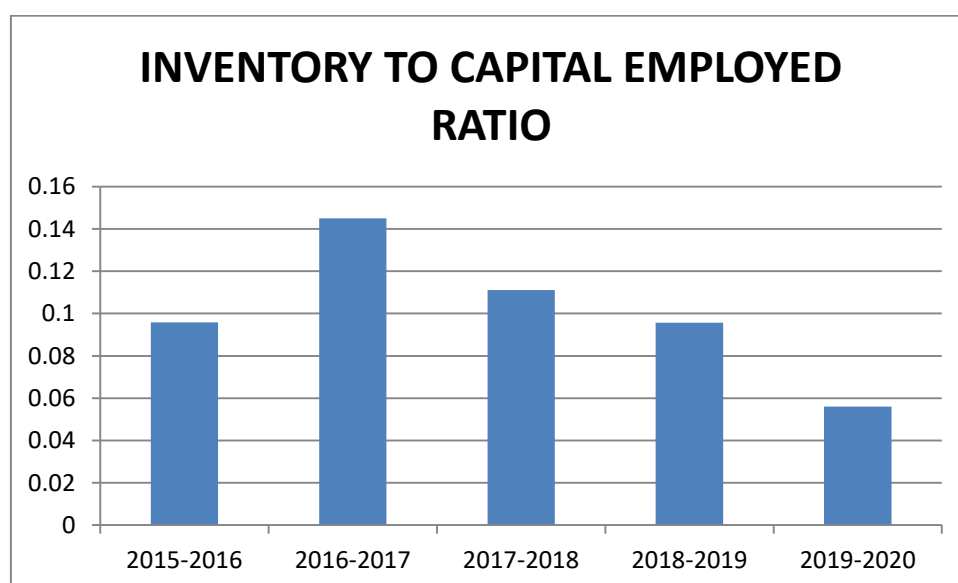
YEAR	INVENTORY (IN Cr)	CAPITAL EMPLOYED (IN Cr)	RATIO (TIMES)
2015-2016	1294.6	13505	0.096
2016-2017	1813.2	12501	0.145
2017-2018	1688.9	15198	0.111
2018-2019	1464.4	15304	0.096
2019-2020	1324.6	23648	0.056

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory to capital employed ratio is increased in the year 2016-2017 with 0.145 times, exceptionally low in the year 2019-2020 with 0.056 times, therefore it is inferred that it is decreasing trend.

CHART NO.: 4.13



4.14 INVENTORY TO SALES RATIO

Inventory to Sales Ratio=Average Inventory/ Sales

TABLE NO.: 4.14 INVENTORY TO SALES RATIO

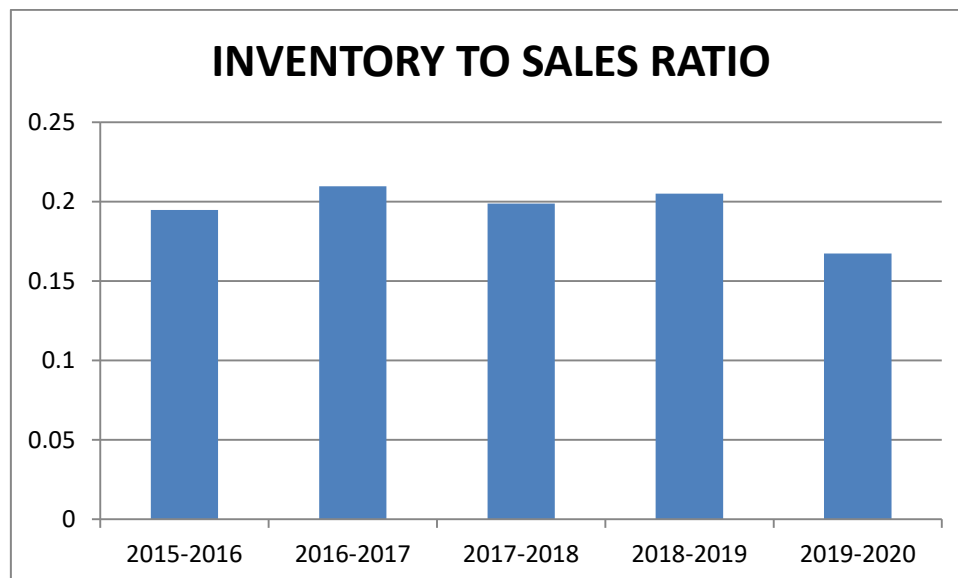
YEAR	INVENTORY (IN Cr)	SALES (IN Cr)	RATIO (TIMES)
2015-2016	1294.64	6652.05	0.195
2016-2017	1813.24	8652.59	0.210
2017-2018	1688.90	8496.20	0.199
2018-2019	1464.38	7145.92	0.205
2019-2020	1324.55	7916.30	0.167

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the inventory to sales ratio is increased in the year 2016-2017 with 0.210 times, exceptionally low in the year 2019-2020 with 0.167 times, therefore it is inferred that it is fluctuating trend.

CHART NO.: 4.14



4.15 RAW MATERIAL TURNOVER RATIO

Raw Material Turnover Ratio=Sales/ Raw Material

TABLE NO.: 4.15 RAW MATERIAL TURNOVER RATIO

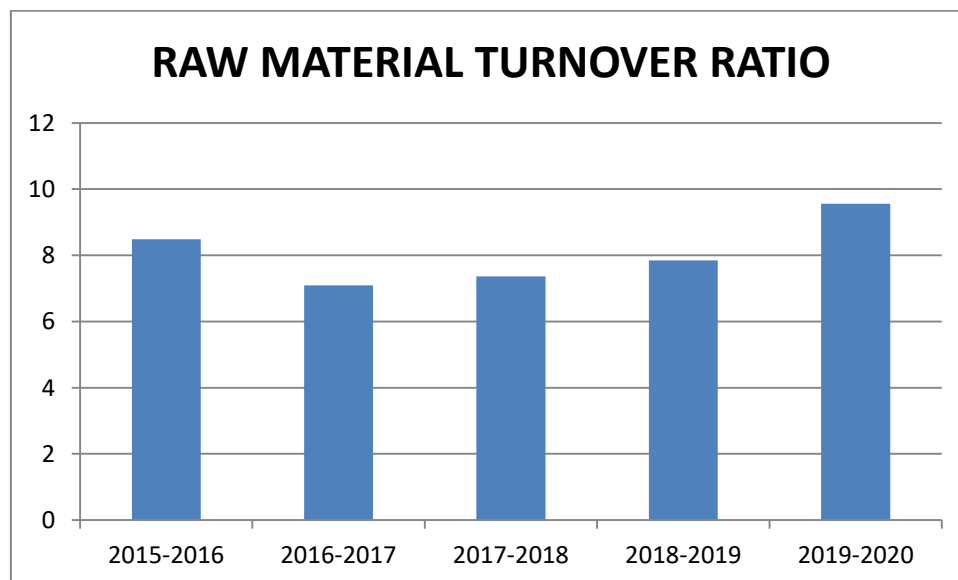
YEAR	SALES (IN Cr)	RAW MATERIAL (IN Cr)	RATIO (TIMES)
2015-2016	6652.05	784.06	8.48
2016-2017	8652.59	1220.77	7.09
2017-2018	8496.20	1153.53	7.37
2018-2019	7145.92	910.41	7.85
2019-2020	7916.30	828.42	9.56

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the raw material turnover ratio is increased in the year 2019-2020 with 9.56 times, exceptionally low in the year 2016-2017 with 7.09 times, therefore it is inferred that it is increasing trend.

CHART NO.: 4.15



4.16 RAW MATERIAL CONVERSION PERIOD

Raw Material Conversion Period= 365 Days/ Raw Material Turnover Ratio

TABLE NO.: 4.16 RAW MATERIAL CONVERSION PERIOD

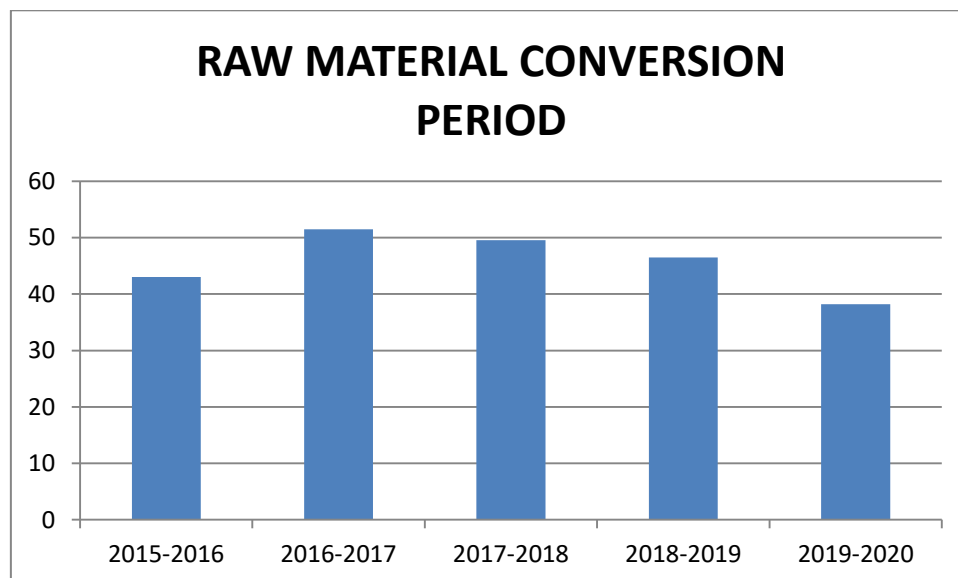
YEAR	DAYS IN A YEAR (DAYS)	RAW MATERIAL RATIO (TIMES)	RAW MATERIAL CONVERSION PERIOD (DAYS)
2015-2016	365	8.48	43.02
2016-2017	365	7.09	51.50
2017-2018	365	7.37	49.56
2018-2019	365	7.85	46.50
2019-2020	365	9.56	38.20

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

From the above table it is inferred that, the raw material conversion period is increased in the year 2016-2017 with 51.50 days, exceptionally low in the year 2019-2020 with 38.20 days, therefore it is inferred that it is decreasing trend.

CHART NO.: 4.16



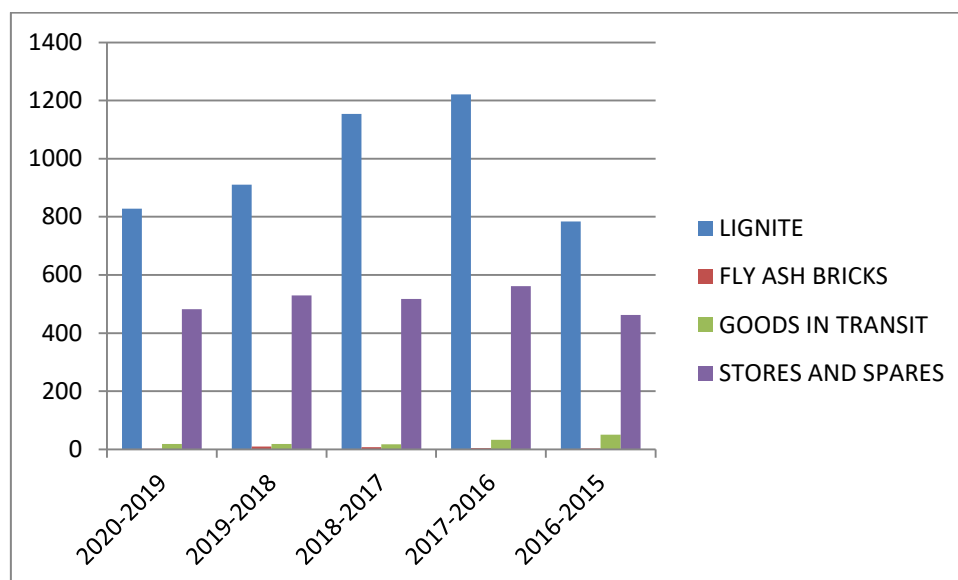
4.17 RAW MATERIALS

TABLE NO.:4.17 RAW MATERIALS

YEAR	2020-2019	2019-2018	2018-2017	2017-2016	2016-2015
LIGNITE (IN Cr)	828.42	910.41	1153.53	1220.77	784.06
FLY ASH BRICKS (IN Cr)	2.67	10.35	7.43	4.73	3.36
GOODS IN TRANSIT (IN Cr)	19	18.65	17.53	32.84	50.42
STORES AND SPARES (IN Cr)	482.36	529.75	517.83	561.02	462.25

Source of data: Company Annual Report from 2015-2016 to 2019-2020

CHART NO.:4.17



4.18 CURRENT ASSET

TABLE NO.:4.18 CURRENT ASSET

CURRENT ASSETS (IN Cr)	2020-2019	2019-2018	2018-2017	2017-2016	2016-2015
Inventories	1324.55	1464.38	1688.9	1813.24	1294.6
Financial Assets					
a) Trade Receivables	6691.83	4606.19	3366.15	3750.09	3010.9
b) Cash and Cash Equivalents	12.97	13.82	12.63	22.07	2780.7
c) Other Bank Balances	360.3	303.34	266.02	451.63	377.29
d) Loans	37.98	716.6	1989.74	638.49	575.72
e) Other Financial Assets	65.13	48.71	48.93	54.78	185.93

Income Tax Assets	832.28	692.96	777.72	645.29	0
Other Current Assets	1226.7	1187.41	1984.77	1333.17	464.11
Total Current Assets	10551.74	9033.41	10134.86	8708.76	8689.3

Source of data: Company Annual Report from 2015-2016 to 2019-2020

4.19 CURRENT LIABILITIES

TABLE NO.:4.19

CURRENT LIABILITIES (IN Cr)	2020- 2019	2019- 2018	2018- 2017	2017- 2016	2016- 2015
Financial Liabilities					
a) Borrowings	3641.42	3668	1457.8	1546.09	14.61
b) Trade Payables	1830.89	1988.07	495.24	707.44	970.61
c) Other Financial Liabilities	1886.53	1218.49	1222.6	383.17	385.18
Other Current Liabilities	587.64	701.75	1915.98	1403	753.88
Provisions	748.26	510.1	657.78	249.66	182.35
Total Current Liabilities	8694.74	8086.41	5749.4	4289.36	2306.6

Source of data: Company Annual Report from 2015-2016 to 2019-2020

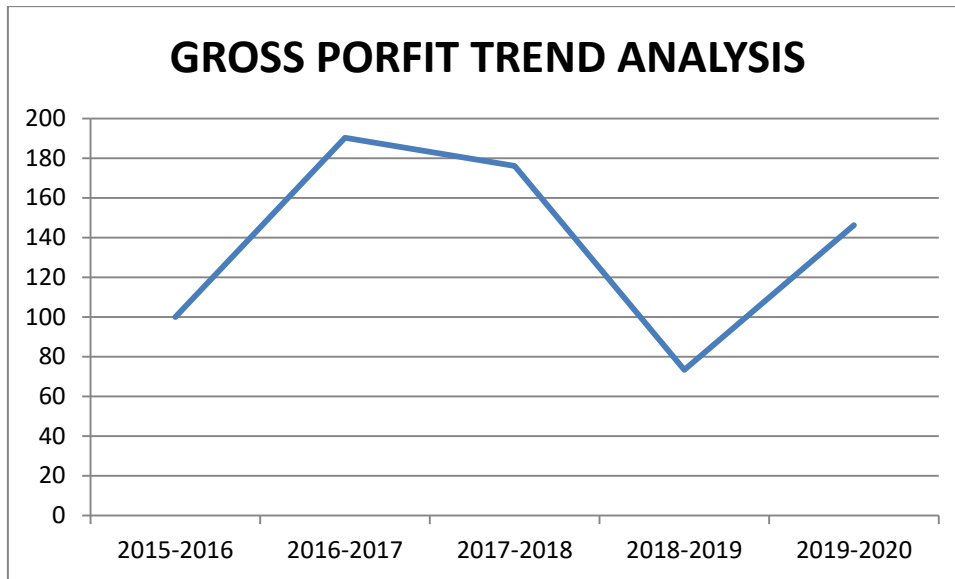
GROSS PROFIT TREND ANALYSIS

YEAR	GROSS PROFIT (IN Cr)	TREND (%)
2015-2016	1455.97	100
2016-2017	2770.94	190.32
2017-2018	2562.82	176.02
2018-2019	1068.75	73.40
2019-2020	2130.45	146.33

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

It can be inferred from the above table that the gross profit was increasing from 2015-2018 but decreased during 2018-2019, but now increasing gradually. On the whole, the graph shows a fluctuating movement of slope, portraying an upward growth in the gross profit.



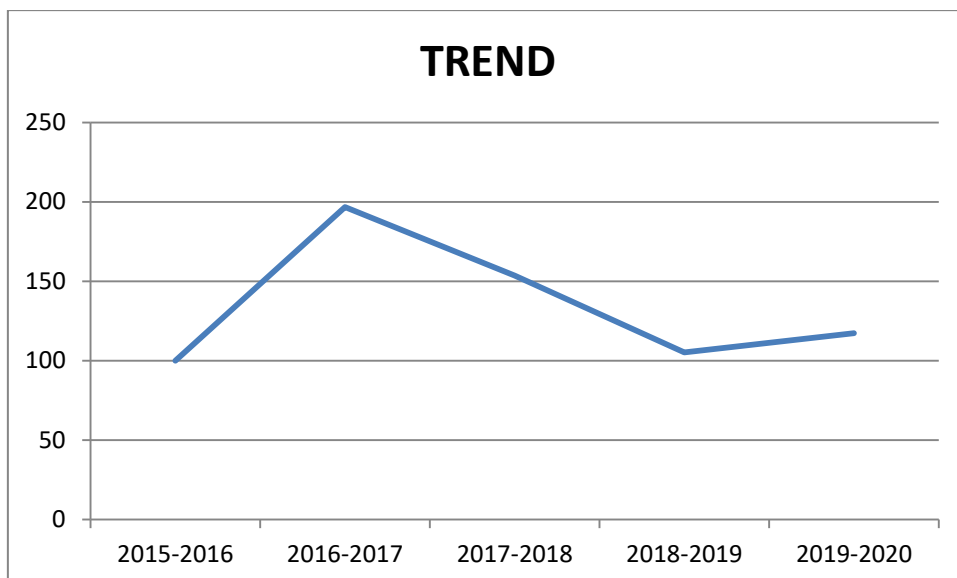
NET PROFIT TREND ANALYSIS

YEAR	NET PROFIT (IN Cr)	TREND (%)
2015-2016	1204.15	100
2016-2017	2368.81	196.72
2017-2018	1848.78	153.53
2018-2019	1266.97	105.22
2019-2020	1413.85	117.41

Source of data: Company Annual Report from 2015-2016 to 2019-2020

INTERPRETATION

It can be inferred from the above table that the net profit was increasing from 2015-2017 but decreased during 2017-2020, but now increasing gradually. On the whole, the graph shows a fluctuating movement of slope, portraying an upward growth in the net profit.



COMPARATIVE BALANCE SHEET 2020 & 2019

PARTICULARS	2020	2019	COMPARISION	
	Amount (Rs)	Amount (Rs)	Amount (Rs)	%
NON-CURRENT ASSETS				
Property, Plant and Equipment	18298.74	11678.18	6620.56	56.692
Right Of-Use Asset	3.06	0	3.06	0
Intangible Asset	6.36	6.25	0.11	1.76
Capital Work-In-Progress	4083.58	8735.64	-4652.06	-53.25
Asset under Development	127.67	117.8	9.87	8.3786
Financial Assets				
a) Investments	3519.4	2823.58	695.82	24.643
b) Loans	30.88	42.6	-11.72	-27.51
Other Non-Current Assets	1260.48	1124.95	135.53	12.048
Total Non-Current Assets	27330.17	24529	2801.17	11.42
CURRENT ASSETS				
Inventories	1324.55	1464.38	-139.83	-9.549
Financial Assets				

a) Trade Receivables	6691.83	4606.19	2085.64	45.279
b) Cash and Cash Equivalents	12.97	13.82	-0.85	-6.151
c) Other Bank Balances	360.3	303.34	56.96	18.778
d) Loans	37.98	716.6	-678.62	-94.7
e) Other Financial Assets	65.13	48.71	16.42	33.71
Income Tax Assets	832.28	692.96	139.32	20.105
Other Current Assets	1226.7	1187.41	39.29	3.3089
Total Current Assets	10551.74	9033.41	1518.33	16.808
Regulatory Deferral Account Debit Balances	1237.18	1119.93	117.25	10.469
Total Assets	39119.09	34682.34	4436.75	12.793
EQUITY AND LIABILITIES				
EQUITY				
Equity Share Capital	1386.64	1386.64	0	0
Other Equity				
a) Retained Earnings	8942.89	8843.46	99.43	1.1243
b) Other Reserves	2309.98	2281.23	28.75	1.2603
Total Equity	12639.51	12511.33	128.18	1.0245
LIABILITIES				
NON-CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	11370.16	8316.51	3053.65	36.718
b) Lease Liability	3.3	0	3.3	0
Deferred Tax Liabilities	2779.94	2093.47	686.47	32.791
Other Non-Current Liabilities	1066.39	1235.81	-169.42	-13.71
Total Non-Current Liabilities	15219.79	11645.79	3574	30.689
CURRENT LIABILITIES				

Financial Liabilities				
a) Borrowings	3641.42	3668	-26.58	-0.725
b) Trade Payables	1830.89	1988.07	-157.18	-7.906
c) Other Financial Liabilities	1886.53	1218.49	668.04	54.825
Other Current Liabilities	587.64	701.75	-114.11	-16.26
Provisions	748.26	510.1	238.16	46.689
Total Current Liabilities	8694.74	8086.41	608.33	7.5229
Regulatory Deferral Account Credit Balances	2565.05	2438.81	126.24	5.1763
Total Equity and Liabilities	39119.09	34682.34	4436.75	12.793

COMPARATIVE BALANCE SHEET 2019 & 2018

PARTICULARS	2019	2018	COMPARISION	
	Amount (Rs)	Amount (Rs)	Amount (Rs)	%
NON-CURRENT ASSETS				
Property, Plant and Equipment	11678.18	10567.85	1110.33	10.50668
Right Of-Use Asset	0.00	0.00	0.00	0
Intangible Asset	6.25	6.26	-0.01	-0.15974
Capital Work-In-Progress	8735.64	6876.12	1859.52	27.04316
Asset under Development	117.80	199.05	-81.25	-40.8189
Financial Assets				
a) Investments	2823.58	2421.37	402.21	16.61084
b) Loans	42.60	67.45	-24.85	-36.8421
Other Non-Current Assets	1124.95	1165.10	-40.15	-3.44606
Total Non-Current Assets	24529.00	21303.20	3225.80	15.14233
CURRENT ASSETS				
Inventories	1464.38	1688.90	-224.52	-13.2939
Financial Assets				

a) Trade Receivables	4606.19	3366.15	1240.04	36.83852
b) Cash and Cash Equivalents	13.82	12.63	1.19	9.422011
c) Other Bank Balances	303.34	266.02	37.32	14.02902
d) Loans	716.60	1989.74	-1273.14	-63.9852
e) Other Financial Assets	48.71	48.93	-0.22	-0.44962
Income Tax Assets	692.96	777.72	-84.76	-10.8985
Other Current Assets	1187.41	1984.77	-797.36	-40.1739
Total Current Assets	9033.41	10134.86	-1101.45	-10.8679
Regulatory Deferral Account Debit Balances	1119.93	1068.35	51.58	4.828006
Total Assets	34682.34	32506.41	2175.93	6.693849
EQUITY AND LIABILITIES				
EQUITY				
Equity Share Capital	1386.64	1528.57	-141.93	-9.28515
Other Equity				
a) Retained Earnings	8843.46	9551.61	-708.15	-7.41393
b) Other Reserves	2281.23	2254.40	26.83	1.190117
Total Equity	12511.33	13334.58	-823.25	-6.1738
LIABILITIES				
NON-CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	8316.51	6050.29	2266.22	37.45639
b) Lease Liability	0.00	0.00	0.00	0
Deferred Tax Liabilities	2093.47	1877.42	216.05	11.50781
Other Non-Current Liabilities	1235.81	1010.64	225.17	22.27994
Total Non-Current Liabilities	11645.79	8938.35	2707.44	30.29015
CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	3668.00	1457.80	2210.20	151.612

b) Trade Payables	1988.07	495.24	1492.83	301.4357
c) Other Financial Liabilities	1218.49	1222.60	-4.11	-0.33617
Other Current Liabilities	701.75	1915.98	-1214.23	-63.3738
Provisions	510.10	657.78	-147.68	-22.4513
Total Current Liabilities	8086.41	5749.40	2337.01	40.64789
Regulatory Deferral Account Credit Balances	2438.81	4484.08	-2045.27	-45.6118
Total Equity and Liabilities	34682.34	32506.41	2175.93	6.693849

COMPARATIVE BALANCE SHEET 2018 & 2017

PARTICULARS	2018	2017	COMPARISION	
	Amount (Rs)	Amount (Rs)	Amount (Rs)	%
NON-CURRENT ASSETS				
Property, Plant and Equipment	10567.85	9622.39	945.46	9.8256
Right Of-Use Asset	0.00	0.00	0.00	0
Intangible Asset	6.26	2.64	3.62	137.12
Capital Work-In-Progress	6876.12	4962.69	1913.43	38.556
Asset under Development	199.05	151.96	47.09	30.988
Financial Assets				
a) Investments	2421.37	2421.37	0.00	0
b) Loans	67.45	99.42	-31.97	-32.16
Other Non-Current Assets	1165.10	1289.45	-124.35	-9.644
Total Non-Current Assets	21303.20	18549.92	2753.28	14.843
CURRENT ASSETS				
Inventories	1688.90	1813.24	-124.34	-6.857
Financial Assets				

a) Trade Receivables	3366.15	3750.09	-383.94	-10.24
b) Cash and Cash Equivalents	12.63	22.07	-9.44	-42.77
c) Other Bank Balances	266.02	451.63	-185.61	-41.1
d) Loans	1989.74	638.49	1351.25	211.63
e) Other Financial Assets	48.93	54.78	-5.85	-10.68
Income Tax Assets	777.72	645.29	132.43	20.523
Other Current Assets	1984.77	1333.17	651.60	48.876
Total Current Assets	10134.86	8708.76	1426.10	16.375
Regulatory Deferral Account Debit Balances	1068.35	250.69	817.66	326.16
Total Assets	32506.41	27509.38	4997.03	18.165
EQUITY AND LIABILITIES				
EQUITY				
Equity Share Capital	1528.57	1528.57	0.00	0
Other Equity				
a) Retained Earnings	9551.61	8463.80	1087.81	12.853
b) Other Reserves	2254.40	2206.25	48.15	2.1824
Total Equity	13334.58	12198.62	1135.96	9.3122
LIABILITIES				
NON-CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	6050.29	5040.62	1009.67	20.031
b) Lease Liability	0.00	0	0.00	0
Deferred Tax Liabilities	1877.42	1538.38	339.04	22.039
Other Non-Current Liabilities	1010.64	632.85	377.79	59.697
Total Non-Current Liabilities	8938.35	7211.85	1726.50	23.94

CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	1457.80	1546.09	-88.29	-5.711
b) Trade Payables	495.24	707.44	-212.20	-30
c) Other Financial Liabilities	1222.60	383.17	839.43	219.08
Other Current Liabilities	1915.98	1403.00	512.98	36.563
Provisions	657.78	249.66	408.12	163.47
Total Current Liabilities	5749.40	4289.36	1460.04	34.039
Regulatory Deferral Account Credit Balances	4484.08	3809.55	674.53	17.706
Total Equity and Liabilities	32506.41	27509.38	4997.03	18.165

COMPARATIVE BALANCE SHEET 2017 & 2016

PARTICULARS	2017 Amount (Rs)	2016 Amount (Rs)	COMPARISION	
			Amount (Rs)	%
NON-CURRENT ASSETS				
Property, Plant and Equipment	9622.39	9654.11	-31.72	-0.329
Right Of-Use Asset	0	0	0	0
Intangible Asset	2.64	0.12	2.52	2100
Capital Work-In-Progress	4962.69	2253.03	2709.66	120.27
Asset under Development	151.96	204.44	-52.48	-25.67
Financial Assets				
a) Investments	2421.37	1949.12	472.25	24.229
b) Loans	99.42	82.91	16.51	19.913
Other Non-Current Assets	1289.45	702.92	586.53	83.442
Total Non-Current Assets	18549.92	14846.65	3703.27	24.943
CURRENT ASSETS				
Inventories	1813.24	1294.64	518.6	40.057
Financial Assets				

a) Trade Receivables	3750.09	3010.88	739.21	24.551
b) Cash and Cash Equivalents	22.07	2780.68	-2758.61	-99.21
c) Other Bank Balances	451.63	377.29	74.34	19.704
d) Loans	638.49	575.72	62.77	10.903
e) Other Financial Assets	54.78	185.93	-131.15	-70.54
Income Tax Assets	645.29	0	645.29	0
Other Current Assets	1333.17	464.11	869.06	187.25
Total Current Assets	8708.76	8689.25	19.51	0.2245
Regulatory Deferral Account Debit Balances	250.69	151.31	99.38	65.68
Total Assets	27509.38	23687.21	3822.17	16.136
EQUITY AND LIABILITIES				
EQUITY				
Equity Share Capital	1528.57	1677.71	-149.14	-8.889
Other Equity				
a) Retained Earnings	8463.8	9221.02	-757.22	-8.212
b) Other Reserves	2206.25	2026.77	179.48	8.8555
Total Equity	12198.62	12925.5	-726.88	-5.624
LIABILITIES				
NON-CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	5040.62	3165.65	1874.97	59.229
b) Lease Liability	0	0	0	0
Deferred Tax Liabilities	1538.38	1733.43	-195.05	-11.25
Other Non-Current Liabilities	632.85	719.39	-86.54	-12.03
Total Non-Current Liabilities	7211.85	5618.47	1593.38	28.36
CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	1546.09	14.61	1531.48	10482
b) Trade Payables	707.44	970.61	-263.17	-27.11
c) Other Financial Liabilities	383.17	385.18	-2.01	-0.522
Other Current Liabilities	1403	753.88	649.12	86.104

Provisions	249.66	182.35	67.31	36.913
Total Current Liabilities	4289.36	2306.63	1982.73	85.958
Regulatory Deferral Account Credit Balances	3809.55	2836.61	972.94	34.299
Total Equity and Liabilities	27509.38	23687.21	3822.17	16.136

COMPARATIVE BALANCE SHEET 2016 & 2015

PARTICULARS	2016	2015	COMPARISION	
	Amount (Rs)	Amount (Rs)	Amount (Rs)	%
NON-CURRENT ASSETS				
Property, Plant and Equipment	9654.11	6427.37	3226.74	50.20312
Right Of-Use Asset	0	0	0	0
Intangible Asset	0.12	0.29	-0.17	-58.6207
Capital Work-In-Progress	2253.03	4304.81	-2051.78	-47.6625
Asset under Development	204.44	99.23	105.21	106.0264
Financial Assets				
a) Investments	1949.12	1830.86	118.26	6.45926
b) Loans	82.91	104.49	-21.58	-20.6527
Other Non-Current Assets	702.92	372.37	330.55	88.76923
Total Non-Current Assets	14846.65	13139.42	1707.23	12.99319
CURRENT ASSETS				
Inventories	1294.64	907.4	387.24	42.67578
Financial Assets				
a) Trade Receivables	3010.88	2257.36	753.52	33.38059
b) Cash and Cash Equivalent	2780.68	2947.18	-166.5	-5.64947
c) Other Bank Balances	377.29	318.29	59	18.53655

d) Loans	575.72	1083.37	-507.65	-46.8584
e) Other Financial Assets	185.93	191.35	-5.42	-2.83251
Income Tax Assets	0	103.2	-103.2	-100
Other Current Assets	464.11	347.45	116.66	33.57605
Total Current Assets	8689.25	8155.6	533.65	6.543357
Regulatory Deferral Account Debit Balances	151.31	76.56	74.75	97.63584
Total Assets	23687.21	21371.58	2315.63	10.83509
EQUITY AND LIABILITIES				
EQUITY				
Equity Share Capital	1677.71	1677.71	0	0
Other Equity				
a) Retained Earnings	9221.02	9730.5	-509.48	-5.23591
b) Other Reserves	2026.77	1841.97	184.8	10.03274
Total Equity	12925.5	13250.18	-324.68	-2.45038
LIABILITIES				
NON-CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	3165.65	2792.46	373.19	13.3642
b) Lease Liability	0	0	0	0
Deferred Tax Liabilities	1733.43	1010.1	723.33	71.60974
Other Non-Current Liabilities	719.39	397.78	321.61	80.85122
Total Non-Current Liabilities	5618.47	4200.34	1418.13	33.76227
CURRENT LIABILITIES				
Financial Liabilities				
a) Borrowings	14.61	0	14.61	0
b) Trade Payables	970.61	631.41	339.2	53.72104

c) Other Financial Liabilities	385.18	382.67	2.51	0.655918
Other Current Liabilities	753.88	832.23	-78.35	-9.41446
Provisions	182.35	219.23	-36.88	-16.8225
Total Current Liabilities	2306.63	2065.54	241.09	11.67201
Regulatory Deferral Account Credit Balances	2836.61	1855.52	981.09	52.87413
Total Equity and Liabilities	23687.21	21371.58	2315.63	10.83509

CHAPTER-V

5.1 FINDINGS

1. The current ratio is increased in the year 2015-2016 with 4.21 times, whereas exceptionally low in the year 2018-2019 with 1.12 times, therefore it is inferred that it is fluctuating trend.
2. The gross profit ratio is increased in the year 2016-2017 with 32.02%, exceptionally low in the year 2018-2019 with 14.96%, therefore it is inferred that it is fluctuating trend. In the year 2018-2019 there is decrease in gross profit ratio because there was decrease in production and sale of power.
3. The net profit ratio is increased in the year 2016-2017 with 27.38%, exceptionally low in the year 2018-2019 with 17.73%, therefore it is inferred that it is fluctuating trend.
4. The inventory turnover ratio is increased in the year 2015-2016 with 6.04 times, exceptionally low in the year 2018-2019 with 4.53 times, therefore it is inferred that it is fluctuating in trend.
5. The inventory conversion period is increased in the year 2018-2019 with 80.53 days, exceptionally low in the year 2015-2016 with 60.41 days, therefore it is inferred that it is fluctuating trend.
6. The inventory to current asset ratio is increased in the year 2016-2017 with 0.21 times, exceptionally low in the year 2019-2020 with 0.13 times, therefore it is inferred that it is decreasing trend.
7. The inventory to total asset ratio is increased in the year 2016-2017 with 0.066 times, exceptionally low in the year 2019-2020 with 0.034 times, therefore it is inferred that it is decreasing trend.
8. The inventory to working capital ratio is increased in the year 2018-2019 with 1.55 times, exceptionally low in the year 2015-2016 with 0.20 times, therefore it is inferred that it is fluctuating trend.
9. The inventory to capital employed ratio is increased in the year 2016-2017 with 0.145 times, exceptionally low in the year 2019-2020 with 0.056 times, therefore it is inferred that it is decreasing trend.
10. The inventory to sales ratio is increased in the year 2016-2017 with 0.210 times, exceptionally low in the year 2019-2020 with 0.167 times, therefore it is inferred that it is fluctuating trend.

11. The raw material turnover ratio is increased in the year 2019-2020 with 9.56 times, exceptionally low in the year 2016-2017 with 7.09 times, therefore it is inferred that it is increasing trend.
12. The raw material conversion period is increased in the year 2016-2017 with 51.50 days, exceptionally low in the year 2019-2020 with 38.20 days, therefore it is inferred that it is decreasing trend.

5.2 SUGGESTIONS

1. Inventory turnover ratio was in decreasing till 2018 but now it is gradually increasing so the company should maintain this inventory management and use some of the inventory management tools to increase its inventory management effectively.
2. In the fixed asset turnover ratio it is in decreasing trend so the company has to increase the sales price, to increase its fixed assets.
3. Inventories conversion period which shows fast movement of goods.
4. Raw material conversion shows fast movement of materials, therefore the company should maintain it.
5. The company can adopt the various inventory management tools in order to control its inventory management level.
6. In inventory to total asset and current asset is in decreasing trend so the company has to maintain its liabilities effectively.
7. Raw material turnover ratio is increasing therefore it should be maintained.
8. The company should increase its current asset and decrease its liabilities, to effectively and efficiently run its company.

5.3 CONCLUSION

Inventory management is important for keeping costs down, while meeting regulation. Supply and demand is a delicate balance, and inventory management hopes to ensure that the balance is undisturbed. It can be concluded that the inventory turnover ratio is a key indicator of a company inventory management. Therefore the company's inventory management is fluctuating it means that the company should manage its inventory efficiently and clears its inventory frequently in given period of time and use various tools to improve its inventory management

effectively; therefore proper inventory management is pertinent to the success and growth of the company.

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APPENDIX

BALANCE SHEET

PARTICULARS	2020	2019	2018	2017	2016
NON-CURRENT ASSETS					
Property, Plant and Equipment	18298.74	11678.18	10567.85	9622.39	9654.11
Right Of-Use Asset	3.06	0.00	0.00	0.00	0.00

Intangible Asset	6.36	6.25	6.26	2.64	0.12
Capital Work-In-Progress	4083.58	8735.64	6876.12	4962.69	2253.03
Asset under Development	127.67	117.80	199.05	151.96	204.44
Financial Assets					
a) Investments	3519.40	2823.58	2421.37	2421.37	1949.12
b) Loans	30.88	42.60	67.45	99.42	82.91
Other Non-Current Assets	1260.48	1124.95	1165.10	1289.45	702.92
Total Non-Current Assets	27330.17	24529.00	21303.20	18549.9	14846.65
CURRENT ASSETS					
Inventories	1324.55	1464.38	1688.90	1813.24	1294.64
Financial Assets					
a) Trade Receivables	6691.83	4606.19	3366.15	3750.09	3010.88
b) Cash and Cash Equivalents	12.97	13.82	12.63	22.07	2780.68
c) Other Bank Balances	360.30	303.34	266.02	451.63	377.29
d) Loans	37.98	716.60	1989.74	638.49	575.72
e) Other Financial Assets	65.13	48.71	48.93	54.78	185.93
Income Tax Assets	832.28	692.96	777.72	645.29	0.00
Other Current Assets	1226.70	1187.41	1984.77	1333.17	464.11
Total Current Assets	10551.74	9033.41	10134.86	8708.76	8689.25
Regulatory Deferral Account Debit Balances	1237.18	1119.93	1068.35	250.69	151.31
Total Assets	39119.09	34682.34	32506.41	27509.4	23687.21
EQUITY AND LIABILITIES					
EQUITY					
Equity Share Capital	1386.64	1386.64	1528.57	1528.57	1677.71
Other Equity					
a) Retained Earnings	8942.89	8843.46	9551.61	8463.80	9221.02
b) Other Reserves	2309.98	2281.23	2254.40	2206.25	2026.77
Total Equity	12639.51	12511.33	13334.58	12198.62	12925.50

LIABILITIES					
NON-CURRENT LIABILITIES					
Financial Liabilities					
a) Borrowings	11370.16	8316.51	6050.29	5040.62	3165.65
b) Lease Liability	3.30	0.00	0.00	0	0.00
Deferred Tax Liabilities	2779.94	2093.47	1877.42	1538.38	1733.43
Other Non-Current Liabilities	1066.39	1235.81	1010.64	632.85	719.39
Total Non-Current Liabilities	15219.79	11645.79	8938.35	7211.85	5618.47
CURRENT LIABILITIES					
Financial Liabilities					
a) Borrowings	3641.42	3668.00	1457.80	1546.09	14.61
b) Trade Payables	1830.89	1988.07	495.24	707.44	970.61
c) Other Financial Liabilities	1886.53	1218.49	1222.60	383.17	385.18
Other Current Liabilities	587.64	701.75	1915.98	1403.00	753.88
Provisions	748.26	510.10	657.78	249.66	182.35
Total Current Liabilities	8694.74	8086.41	5749.40	4289.36	2306.63
Regulatory Deferral Account Credit Balances	2565.05	2438.81	4484.08	3809.55	2836.61
Total Equity and Liabilities	39119.09	34682.34	32506.41	27509.38	23687.21

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