ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Vol 9, Issue 4, April 2022

Inventory Management Practices in Manufacturing Industries during the COVID-19: A review

[1] Yeshwanth S*, [2] Bhavana U

[1] Department of Mechanical Engineering, JSS Science and Technology University, Mysore, India,
[2] Assistant Professor, Department of Mechanical Engineering, JSS Science and Technology University, Mysore, India.
Corresponding Author Email: [1] yeshwanths142@gmail.com*, [2] bhavana.umanath@jssstuniv.in

Abstract*— This paper focuses on effective inventory management procedures and techniques that can be incorporated in manufacturing sectors. Inventory acts as a backbone of every business operation. It serves as a link between distributors and production line, but because of the COVID -19 pandemic and lockdown imposed, it has disrupted industry operations and also seen disruptions in the availability of raw materials due to lack of supplies from outside vendors. There is a huge impact on production of goods due to delay in supply of raw materials. These disruptions have made companies to have a clear and efficient management of their inventories. This study focuses on several research that suggest various methods and techniques which industries adopt such as ABC, JIT, FSN etc. to manage their inventory in an effective manner and to suggest the best methods that can be used in the tough times of pandemic. Also, this study focuses on different case studies that were carried out in various industries and tries to conclude a best strategy that can be followed during these tough times of the pandemic to maintain a better and optimum inventory without disturbing the company's production and supply of finished goods.

Keywords*— Inventory, manufacturing sectors, ABC, JIT, HML

I. INTRODUCTION

The current assets of large number of companies are constituted by inventories It is necessary to have a proper maintenance of large size of inventory as there are appreciable funds required. Therefore, it becomes vital to have an efficiently managed inventory in order to eliminate non-essential expenditure and have a profitable run. Neglecting the inventory might end up jeopardizing a firm's long run profitability and may lead to failure. So it is important to have a better inventory planning, so that there can be significant reduction in inventory level without any adverse effect on production and sales. This can lead to improvement in company's profitability.

The manufacturing sectors in India have been largely impacted by the COVID-19 pandemic on its supply chain and availability of raw materials. Therefore, it is important to have a clear picture on the inventory held by the companies and have an efficient inventory management technique to balance the raw materials and also to have an optimal inventory cost. If not, the lack availability of raw materials will lead to loss in production and thereby impacting on company's performance in the market. It is also important to analyse the requirement of finished goods for the firm, as the supply and demand has been affected by the COVID-19 pandemic. On the other hand, having high production and storing high amount of finished goods in turn increases storage cost, thereby increasing the storage cost for the firms. In this paper we will have an overview of how different manufacturers can use several techniques to handle their inventory management problem that have occurred due to the pandemic. We will also have a look on how various techniques of inventory is followed by many manufacturing industries to have an efficient inventory management. A mixture of these techniques when followed can have a great benefit on the inventory of the organization.

Impact of COVID – 19

The global outbreak of COVID -19 has led to closure of industries due to lockdown and stoppage of production. Also, many nations had entered into a lockdown phase, which has also affected the supply chain management of raw materials, sales of products and overall operations for many industries such as automobile, electronics, pharmaceuticals etc.

The Order Books, Inventories and Capacity Utilisation Survey (OBICUS) conducted every quarter by the Reserve Bank of India (RBI) throws light on the impact the pandemic actually had on the manufacturing sector. The OBICUS survey of quarter April -June 2020 released in the month of October 20201 covering 462 manufacturing companies, provides us the demand condition of India's manufacturing sector.

The survey chart- 1 (Figure 1) below represents capacity utilization and De- trending Index of Industries. It is pretty clear from the chart that there is a sharp fall in Capacity Utilization (CU) from 69.9% in Q4 of 2019-20 to 47.3% in Q1 2020-21. This clearly is the impact of lockdown imposed during the quarter.

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Vol 9, Issue 4, April 2022

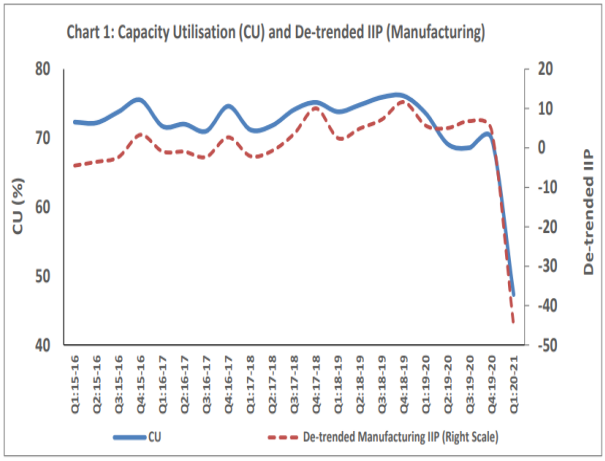

Figure 1 : Capacity Utilisation (CU) and De-trended IIP (Manufacturing)

Source https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20650#:~:text=The%20survey%20covered%20671%20manufacturing%20companies.&text=At%20the%20aggregate%20level%2C%20CU,per%20cent%20a%20year%20ago.

The chart – 2 (figure 2) shows the growth in new orders received. It is quite evident from the chart that manufacturing companies received lower order during Q1: 2020-21 compared to previous quarters.

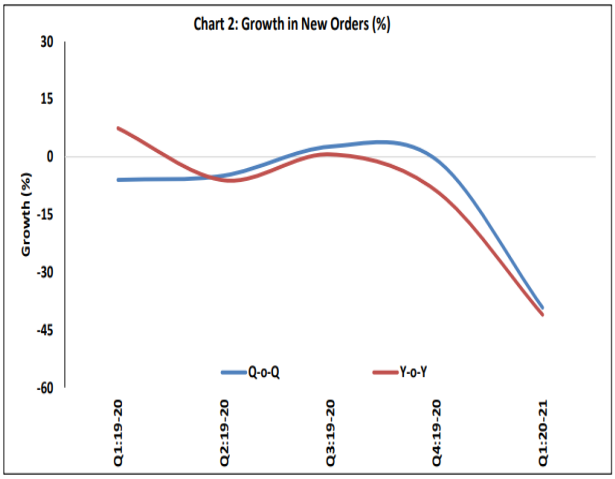

Figure 2: Growth in New Orders (%)

Source: https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20650#:~:text=The%20survey%20covered%20671%20manufacturing%20companies.&text=At%20the%20aggregate%20level%2C%20CU,per%20cent%20a%20year%20ago.

The chart – 3 (Figure 3) represents inventory to sales ratio. The effect of fall is however sharper than the RMI and FGI. As a result, the inventory to the sales ratio has increased in the quarter.

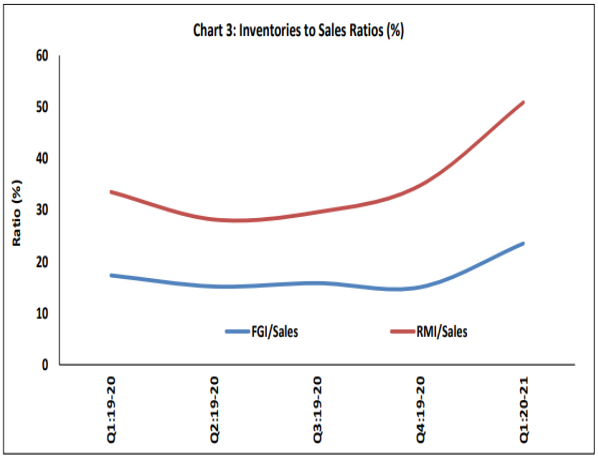

Figure 3 : Inventories to Sales Ratios (%)

Source : https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20650#:~:text=The%20survey%20covered%20671%20manufacturing%20companies.&text=At%20the%20aggregate%20level%2C%20CU,per%20cent%20a%20year%20ago.

In a study published on April 2020(Rakesh Kumar)2, the author speaks about how the March 2020 lockdown imposed has led to an unexpected shutdown and how many companies and factories were unprepared to face a lockdown. Also, the author throws light on how many different sectors, especially in East Asia were disrupted by the rupture in international supply chain. For example, a shortage of parts coming from China has forced Korea carmaker Hyundai to shut all its car plant in Korea. The Japanese firm Nissan closed a factory in Japan temporarily. This study also shows how supply chain management was impacted. A questionnaire was developed and was shared through online platforms. The response obtained was as follows –

When asked about export product, about 78.45 replied that the export product orders were either suspended or scaled down. When asked about import products, around 90.7% replied that import products were either suspended or scaled down. This data shows the impact the lockdown due to COVID – 19 on the supply chain management. This disruption of supply chain in turn impacts the inventory of the firms.

Another study published (PWC.com)3 shows how COVID-19 has affected across manufacturing value chain including issues with securing of raw materials, spare parts and machinery orders. Also, this study states that the production of finished goods has declined with the disruption of supply chain, also impacting inventories of numerous manufacturing firms. The disruptions of raw materials are mainly due to two reasons – 1) Due to shutdown of industries due to lockdown, 2) Due to strict restriction laws imposed by U.S and many other countries to stop export of raw materials to other nations. This disruption in supply chain have lowered industry's inventories and thereby leading to plant shutdown due to shutdown of operations and productions.

The above data and case studies show us how the pandemic has affected many fields of industrial operations. Manufacturing industries have taken a serious hit and it is important for these industries to have optimum operations. Therefore, this paper mainly focuses on the effective inventory management technique that industries can follow during the tough times to have an efficient operation.

II. PROCEDURE FOR PAPER

Literature review is a time-consuming process, many related research papers were analysed and we went through following stages for selecting proper set of literature.

Stage 1) Source

The primary source for searching literatures was through online resources such as Google scholars, various other websites such as IEEE, IJISRT, IRJET and many more. Discrete key terms were used in searching suitable literature.

Stage2) Identification

Numerous research papers were analysed and based on the year of publication. Papers post 2011 were selected and analysed.

Stage3) Selection of literature.

The identified papers were examined in detail and 15 different literatures were selected for the literature review under the guidance of our guide whose experience lie in the field of engineering management and operations research.

III. LITERATURE REVIEW

MasakhaliaOuma Christopher (2014)[4]

In a survey of a public sector in Nakura County, Kenya, MasakhaliaOuma Christopher (2014) found the role of every level of the organisation in successful implementation of IMIS (Inventory Management Information system) is very important. Training and business process re-engineering, lean management and top management support played major role in successful implementation of IMIS. Ouma also recommends more effective waste management necessary for strengthening inventory process.

Vignesh Ravichandran (2015)[5]

The author here writes about the Kanban system and its advantages of implementing them. The paper focuses on a pressure vessel manufacturing facility. The facility saw stoppage of production line due to non-availability in raw material. The facility had subcontracted inventory raw materials. The plant was unable to meet the demand of its customers due to frequent halt n production. The organisation faced difficulty in tracking of raw material. These problems were addressed using Kanban system. Kanban means signboard, which is a Japanese manufacturing system which relates through use of instruction card. Post implementation of Kanban system there was suitable raw materials available and frequent production stopping was avoided. Before implementing Kanban, the withdrawal of inventory from the subcontractor was done in random lot. Also, over and underproduction was observed. However, after the implementation of Kanban the withdrawal of inventory was in a fixed lot and due to good availability of raw material the underproduction or over production problems were overcame. After Kanban the inventory turnover ratio improved from 2% to 6%.

This study overall shows the importance of Kanban system in pressure vessel manufacturers. This system when expanded to other manufacturing industries, can help in improving inventory management.

Rudolf Kampf (2016)[6]

This paper focuses on inventory of an automotive industry in Slovakia and focuses on a better inventory management using the concept of ABC analysis. Here the industry focuses on manufacturing wide range of special tools, single purpose machine and technology components. The jigs designed for use in automotive industry, consist of around 14 components which was classified as A based on ABC analysis. Hence the A category materials were subjected to research. There were findings that showed inconsistency between the definite consumption and the quantity of materials purchased on an average every month. As a consequence of this inconsistency there was a highly unwanted proportion of capital tied up to inventories. A system was proposed where reorder point was indicated. If inventory level is dropped below this, then an order has to be placed. When comparison made between order placed in paste with that of the new system it was observed that the ordered quantity can be reduced which in turn can help the firm in releasing capital funds for other requirements.

Dieode CastroFettermann (2016)[7]

This paper focuses on finished goods inventory in a small electronic sector company. The study focuses on the problems the company faced such as loss in order, insufficient availability in raw material stock, problem scheduling of production and lack availability of reliable data. Only finished goods products that were produced in accordance of make - to- order (MTO) were selected. Among the MTO products, based on ABC analysis products with high revenues were selected, which can be classified as A group of products. Historical data were collected from company ERP system which include details of raw materials like name of raw material, raw material code, quantity used, billed amount, cost of raw material, and average selling price were collected. With these data demand forecast were conducted which were used for making a proper production planning.

Demand forecasting, the classification of criticality and the design of target stock level were observed by changing inventory information system on a quarterly basis. The database is fed with the stock planning that is used in keeping track of service level attained for the outcomes. This ensures repeated checking among products with monitored MTS

strategy whether there is shortage of finished products for customer delivery. Applying such strategies has helped the firm to organize and plan its production schedule and have better decision to manage inventory levels.

Vivek Kumar(2017)[8]

This paper explored the complications in inventory management and thrive the purchasing strategy in Lorman Technology Pvt. Ltd. Bangalore. The author uses the previous inventory data for his study. After analysing the relationship between purchasing activities and inventory level control, they found out issues like the gradual increase in non-active raw material cost due to undefined purchasing management system. Also, there were issues in keeping down capital investment in inventories, excessive carrying cost was also observed. They used ABC analysis and JIT (just in time) approach to overcome the issues.

Megha .B Kaloji (2018)[9]

This is a study that focuses on inventory of a Foundry industry. The author shows the impact of Economic Order Quantity (EOQ) in efficiently managing the inventory. Economic Order Quantity is a purchase quantity that can minimise the total holding costs and ordering costs of an inventory. Various raw materials were analysed and their Economic order Quantity was planned accordingly and specific reorder quantity was given. This ensured optimum procurement and maintain good stock level with less inventory holding cost.

NazarSohail (2018)[10]

NazarSohail, Tariq Hussain sheikh (2018) observed the importance of precise recording of ready to ship goods. This includes adding the newly produced goods(goods that have completed production) to the total and removing the recently shipped goods. Also for the returned goods under company's return policy there is another group within finished goods inventory for accounting them. Also, the EOQ calculated suggests to obtain inventory requirement on frequent basis. Accurate record keeping of inventory helps in better process of information to sales team about availability.

Hong Wai Tan(2018)[11]

Hong Wai Tan identify that the firm was lacking in identifying aggregate perspective in overall waste in product flow over an entire operation, waste was observed in handling of materials during work in progress inventory, inconsistency was observed in each shop floor with respect to Work In Progress inventory for sub part. After implementing different lean methods, they find optimal solution for this problem that by using VSM (value stream mapping) technique they can overcome the problems to certain extent.

Muchaendepi W(2019)[12]

Muchaendepi W, Mbohwa C., HamandisheT.,Kanyepe J studied the Inventory Management practices and its Performance on SMEs in the Manufacturing Sector of Harare were identified (2019). The study findings implies that a total majority of 70% of the respondents indicated that SMEs in the manufacturing sector of Harare used JIT (Just in Time) method of inventory management process in managing their inventories. The study also shows that a combined majority of 93% of the respondents agreed that inventory management strategies had a positive impact on the financial performance of SMEs. They agreed that if a proper method is put into place, it can increase the profit for the SME.

SupakornLimkhunthamma (2019)[13]

SupakornLimkhunthamma, RakkiaRojkunyapom, Jantanasansook, Sasiuranphoolsawat observed in ZZZ Printed Circuit Board manufacturing company that the storage system found difficulty with the raw materials. To overcome this, they carried out FSN analysis and rearranging the warehouse layout. After this they observed following improvement: Storage time was reduced from 37.47 to 27.07 minutes, Operators were reduced from 2 to 1, average volume of raw materials kept outside the warehouse was reduced from 14.40 to 11.16 cubic meters (22.50%), the process of raw materials storage was reduced from 9-6 steps (33.33%).

SakulthipPrajaksuwithee and ParamesChutima (2019)[14]

This paper examined the existing inventory management system for a flexible printed circuit board manufacturer in Thailand. Here the materials where initially classify based on ABC analysis in a combined criterion of classification. They found out the serious issues especially on excessive inventory and later adopted new inventory technique - Replenishment Quantity Policy. The results showed that a total savings of approximately 262.03 million baht of the total inventory cost were able to make in comparison with the existing one. For better inventory, there were redesign made in inventory procedure and documentation by analysing Class AAA materials and also demand pattern were analysed by the use of the Holt - Winters exponential smoothing technique and the Autoregressive Integrated Moving Average technique (ARIMA). Also, the order for raw material will be placed when the stock falls below reorder point.

Pragati Jadhav (2020)[15]

In this paper the author examines ABC and HML analysis in an assembling business of India. The raw materials were classified by ABC and HML (High, medium, low) analysis. Major difference between these two classifications is, ABC classification is based on yearly consumption and HML analysis is based on their unit cost. Post classification results were analysed and conclusions were made - From the ABC analysis of assembling organization, A sort things have more yearly utilization costs so here 2 things have characterized under A class out of 10 things and just A sort things have more yearly utilization costs and make more Inventory coming up. So Economic Order Quantity and re-request level will be determined for these A kind things consequently diminish Inventory and yearly utilization cost. HML analysis

is as like ABC examination, which implies that H & M things ought not to be requested more than the necessary amount.

Ravi Arora (2020)[16]

The report examines the ability of Kanban in the inventory management and the manufacturing processes. Kanban is a system used for scheduling in lean manufacturing. Kanban is popularly known as the Toyota nameplate system.

The focus of this paper is to briefly outline the pros and cons of implementing the Kanban system in an electric motor manufacturing company and define the theoretical and practical reasons behind these results. Also, this paper provides process in implementing Kanban. The advantages of implementing KANBAN in this review is – improve flexibility, increase in efficiency, improved ability of team to focus, improvement in continuous delivery to customers, elimination of waste in various process. The use of these systems can be further extended to PCB manufacturing firms accordingly.

Alok Kumar (2020)[17]

This research titled Sustainable Operations and Computers discusses the different operations and supply chain angle for handling disruptions during the pandemic like situation. Different recommendations are given or different operational domains. In supply chain and logistics domain, the author suggests on Digital Supply Networks (DNS) which can help in end – to -end visibility, collaboration and responsiveness of supply chain and logistics. Also, the author suggests the inclusion of robots and automated guided vehicle that can reduce human intervention in managing inventories and warehouse. This ensures better management of inventory and also avoids the spread of virus. More focus should be given on developing manufacturing network strategy that can fit into alternate sources of raw materials.

PorntepKaewchur (2021)[18]

This study focuses on the inventory management factors affecting the competitive advantage. In this study quantitative data were collected from 280 small and medium companies from in Thailand. The author studied 3 factors mainly information technology, inventory control system and inventory control practices and their impact on competitive advantages.

The competitive advantage here refers to creating values that are unique and higher compared to your business challenges. Competitiveness focuses on 3 main components – 1) Price, 2) Quality and 3) Delivery.

The analysis done in this research states that the information technology had no impact on competitiveness. This is because in spite of use of Information technology, the effective operations cannot be performed without guideline for inventory practice to be profitable. But the author concludes that information technology had a major role in inventory control practices. Information technology played a role in accurate resourcing of material, selection of low-cost material and to find raw materials in real time. In return inventory control practices impacted the competitiveness; this is because inventory control practices focused more on cost managing and profit availability. This helped in gain on competitive advantage. Next factor noted was inventory control system. Here inventory control system helped in focusing quality and delivery time. This helped in reducing cycle time and also in delivering finished goods efficiently.

IV. SUMMARY OF LITERATURE REVIEW

From the literature review above, we have come across diverse inventory management methods that several organisations related to manufacturing sectors have followed. Also, we have come across inventory management techniques followed by other industries such as automotive industries, where many similar methods such as ABC analysis and JIT (Just in Time) were followed. Other methods such as FSN analysis (Fast moving, slow moving and Non-moving) was used to overcome storage of raw materials. This analysis further helped in reduction of man power for the management of inventory.

Mixture of two methods can also be helpful in efficient inventory management. Other research published showed us how classification of materials under ABC and HML analysis can improve in a better material management and better raw material classification. Other methodology that was seen was Kanban. This paper speaks about advantages pf implementing Kanban in inventory of electric motor manufacturers. The advantages noted were: flexibility reduction of wasted work and increased productivity.

Other methods such as demand forecasting can help in improving better material planning of inventory. These inventory management techniques can be extended to PCB manufacturing firm, which in turn can help in better and efficient inventory management. Further these techniques can help during uncertain times of pandemic and can lead us to have a better inventory management to overcome any shortage of supply of raw materials.

V. CONCLUSION AND FUTURE SCOPE

This study shows inventory management techniques followed by variety of industries. Numerous papers were analyzed based on different years of publications and diversified methods followed.

Inventory management techniques such as ABC, JIT, HML etc were come across. These methods were followed by PCB manufacturers and manufacturing sectors of various fields. During tough times of lockdown imposed due to COVID-19, operating inventories by using a mixture of these methods can help in having an efficient inventory system. Such as using ABC analysis for classifying items and use of JIT to procure materials which are easy and quick to get can help in better management of inventory and also help in better storage availability for high-risk materials.

Further it is impossible to predict rise and fall of the current pandemic peak and the number of lockdowns that may occur. Also, such pandemics can occur in near future and therefore having proper planning regarding management of inventory can help us deal with future calamities.

Hence this review can help us in dealing with future issues that may occur instantaneously. Further this study can serve as a reference for future studies and research that can take place in inventory and supply chain management and provide brief and decent insight of the current trends and problems.

REFERENCES

[1] https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=20650#:~:text=The%20survey%20covered%20671%20manufacturing%20companies.&text=At%20the%20aggregate%20level%2C%20CU,per%20cent%20a%20year%20ago.

[2] Kumar, R. and Mishra, R.S., 2020. COVID-19 global pandemic: impact on management of supply chain. International Journal of Emerging Technology and Advanced Engineering, 10(4), pp.132-139.

[3] https://www.pwc.com/ng/en/publications/covid19-and-the-supply-chain-industry

[4] Christopher, M.O. and Kwasira, J., 2012. Determinants of Successful Implementation of Inventory Management Information System in Public Sector in Kenya: Survey of Nakuru County.

[5] Ravichandran, V., and N. G. Kumar. "Implementation of Kanban System for Inventory Tracking and Establishing Pull Production." Inernatinal Journal of Advance Production and Mechanical Engineering 1.3 (2015): 31-37.

[6] Kampf, R., Lorincová, S., Hitka, M. and Caha, Z., 2016. The application of ABC analysis to inventories in the automatic industry utilizing the cost saving effect. NAŠE MORE: znanstveničasopis za more ipomorstvo, 63(3 Special Issue), pp.120-125.

[7] de Castro Fettermann, D., Tortorella, G.L. and Fries, C.E., Inventory management: a small enterprise in the electronics sector case study.

[8] https://www.irjet.in/volume-4-issue-05-may-2017

[9] Gokhale, Prayag, and M. B. A. Kaloji. "A study on inventory management and its impact on profitability in foundry industry at Belagavi, Karnataka." International Journal of Latest Technology in Engineering, Management & Applied Science 8.9 (2018).

[10] Sohail, N. and Sheikh, T.H., 2018. A study of inventory management system case study. Journal of Adv Research in Dynamical & Control System, 10(10), pp.1176-1190.

[11] Tan, Hong,Jamaludin, KhairurAU Hamzah, H 2018/06/25 181 Work-in-Progress Inventory Control Case Study in Lean Management 7 - 10.14419/ijet.v7i3.4.16770 International Journal of Engineering & Technology.

[12] Muchaendepi, W., Mbohwa, C., Hamandishe, T. and Kanyepe, J., 2019. Inventory management and performance of SMEs in the manufacturing sector of Harare. Procedia Manufacturing, 33, pp.454-461.

[13] Limkhunthammo,SupakornRojkunyaporn, RakkiatSansook, JantanaPhoolsawat, SasiwanKaewchur, PornthepRuensook,PinyadaAmsa-Ard,PhongsakorSudjit, ThitipatYamklebbuv,NamtipKoonpraneit, NichapaToomphol, Aeknaree 2019/01/24 Optimizing Warehouse and Inventory by FSN , Analysis: Case Study of ZZZ Printed Circuit Board Manufacturing Company.

[14] Prajaksuwithee, S. and Chutima, P., 2019, April. Inventory Management System Development in a Flexible Printed Circuit Board Manufacturer. In 2019 IEEE 6th International Conference on Industrial Engineering and Applications (ICIEA) (pp. 246-250). IEEE.

[15] Jadhav, P. and Jaybhaye, M., 2020. A Manufacturing Industry Case Study: ABC and HML Analysis for Inventory Management. International Journal of Research in Engineering, Science and Management, 3(9), pp.146-149.

[16] https://www.ijser.org/researchpaper/POTENTIAL-OF-KANBAN-IN-THE-MANUFACTURING-PROCESSES-OF-CUSTOMIZED-PRODUCTS.pdf.

[17] Kumar, Aalok, et al. "COVID-19 impact on sustainable production and operations management." Sustainable Operations and Computers 1 (2020): 1-7.

[18] Kaewchur, Pornthep. "Role of inventory management on competitive advantage of small and medium companies in Thailand." Turkish Journal of Computer and Mathematics Education (TURCOMAT) 12.8 (2021): 2753-2759.