



A STUDY OF WIP INVENTORY MANAGEMENT WITH REFERENCE TO NON-OPERATION TIME

i) Gangadhar D. Dukare

International Institute of Mgmt.

science, Pune,

Email: gangadhardukare@gmail.com

ii) Dr. Pushpraj Wagh

International Institute of Mgmt.

science, Pune,

Email: pushprajwagh864@gmail.com

iii) Mahesh Mahankal

International Institute of Mgmt.

science, Pune,

Email: Mahesh.mahankal@gmail.com

Abstract :

This research proposes to get exposure in inventory and it is very important to the company. It is to ensure quality in business that control the transaction between the consumer goods. It is important to do proper inventory management and control in the production company. This project is to analyze the inventory control in the rubber manufacturing company (Viscon Rubber Pvt Ltd). This study analyzes ABC items in the inventory with reference to non-operation time, encompassing the entire process carried out in the inventory department. It was observed that there is no proper demand forecasting by the company; instead, it is solely conducted by suppliers who supply materials to the company along with the forecasted demand, leading to non-operation time and affecting the production process. It is recommended to enhance communication between suppliers and develop proper demand forecasting to manage inventory efficiently and allocate manpower according to demand, thereby increasing production and controlling inventory space, ultimately reducing finished product inventory. ABC analysis indicates that management should exert more control over C items compared to A & B because C items are more numerous and occupy more inventory

space. This can be achieved through regular order checks and improved forecasting to reduce dead stock in inventory.

Keywords: Inventory, WIP, Stock, ABC, Materials

Introduction:

The purpose of this study is to investigate the impact of WIP inventory management on non-operation time in the manufacturing industry. This study will focus on the processes of WIP inventory management, such as material planning, forecasting, and inventory control. The study will evaluate the effectiveness of these processes in reducing non-operation time and identify areas for improvement. The results of the study will be presented in the form of a literature review, which will provide an overview of the current state of WIP inventory management and its impact on non-operation time. Additionally, the study will provide insight into best practices for improving WIP inventory management, and recommendations for further research.

WIP Inventory Management is the process of managing the flow of work-in-progress (WIP) inventory from raw materials to finished goods. It is an important part of the overall supply chain management process.



Brief Description of the WIP Inventory Management:

WIP Inventory Management is the process of managing the flow of work-in-progress (WIP) inventory from raw materials to finished goods. It is an important part of the overall supply chain management process.

Types of Inventories :

There are five common types of inventories are:

- 1) Raw materials & purchased parts.
- 2) Partially completed goods called *work in progress*.
- 3) Finished-goods inventories:
 - a. (Manufacturing firms) or b. merchandise, (retail stores)
- 4) Goods-in transit to warehouses or customers.
- 5) Replacement parts, tools, & supplies.

Objectives :

- To understand the concept Management.
- To study the importance Management in warehouse.
- To identify the benefits Management & used it in shop.
- To study the impact of Non-Operation Time on WIP Inventory Management.

Importance of WIP Inventory Management:

- **Improves Productivity:** WIP Inventory Management helps to reduce the amount of time and resources needed to move products from one step in the production process to the next.
- **Reduces Costs:** WIP Inventory Management helps to reduce the costs associated with carrying large amounts of inventory. This includes freight and storage costs.
- **Enhances Quality:** WIP Inventory Management helps to ensure that products are produced to the highest standards and

that any quality issues are identified and addressed quickly.

Observations :

- a) By the observation of the Sept & Oct NOT data, the production loss suffered maximum due to material not available.
- b) Material NA NOT in Sept-22 was 23%, in Oct-22 was 25%. Material NA is avoidable NOT. But other NOT like m/c downtime & breakdown are not avoidable.
- c) By avoiding material NOT, we can maximize the production.
- d) To avoid material NA NOT we applied corrective actions as explained below. FIFO inventory check sheet
- e) Building return material record sheet
- f) Using limit & size over material inventory sheet
- g) Dead stock check sheet
- h) Using small reels first check sheet
- i) After using all above corrective actions as mentioned above in Nov-22 it is found that, the Nov- 22 material NA NOT was 21%. Also, the production achievement was good.

Research Methodology:

The research methodology chosen for this study is a combination of both quantitative and qualitative research techniques.

Quantitative research involves collecting numerical data or information that can be analyzed statistically. The primary data collection techniques that can be used in this study include surveys, interviews and Focus groups.

Qualitative research involves collecting descriptive data or information that can be used to understand the context and the meanings associated with the topics being studied. The primary data collection techniques used in this study include observation, document analysis and case studies. Observation of the inventory management process can provide insights into



how it is being managed. Document analysis can be used to analyze existing documents related to the inventory management process. Case studies can be used to gain an in-depth understanding of the WIP inventory management process and to identify possible improvements.

Overall, this research methodology will provide a comprehensive understanding of the WIP inventory management process and any potential areas for improvement.

Research design is the conceptual structure within which research should be conducted. A research design specifies the methods and procedures for conducting a particular study. The function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money. A research project conducted scientifically has a specific framework of research from the problem identification to the presentation of the research report. This framework of conducting research is known as research design. A research design is simply the framework or plan for a study that is used as a guide in collecting and analyzing the data.

The Research Design used for this Research is applied and experimental/casual research design method. A research design is the detailed blueprint used to guide a research study towards its objectives it helps to collect, measure and analysis of data.

The present study seeks to find out the productivity of existing methods of production and stander cycle time for the production of product, which is require for management decisions to increase setup to achieve future production target.

Type of research:

Nature of research :

Applied and experimental research is quantitative research design. They use a standard format, with a few minor inter-disciplinary

differences of generating a hypothesis to be proved or disproved.

This hypothesis must be provable by mathematical and

Statistical means and is basic around which the whole experiment is designed. Following are the characteristics and nature of this research design:

a) It is based upon numerical measurements and thus to use number and statistical method as key research indicators and tools.

b) It is associated with analysis.

c) It is done considering information from a large number of specific occurrences to search for general description.

d) It is associated with producing objective numerical data.

SOURCES OF DATA :

Data or information is of two types: primary data and secondary data. Primary data is information collected by researchers or person himself whereas secondary data is collected by others but utilized or used by researcher. In this research also there are two types of data are there as follow:

1. Primary Data :

1. Observations.
2. Interviewing with supervisors and workers to understand the manufacturing process.

2. Secondary sources:

In the study secondary data is collected from the following sources.

1. Company website.
2. Report of the company.
3. Books on manufacturing, operations, and research methodology.

ABC Inventory System :

1. Identify the Problem
2. Define the Objective
3. Generate Alternatives



4. Analyze the Alternatives
5. Select the Best Alternative.

JIT Inventory System :

- a) Analyze the current production process to identify any inefficiencies or bottlenecks that lead to an increase in WIP inventory. This could include studying the flow of materials, analyzing the manufacturing process and

Identifying any areas where delays or disruptions may be occurring.

2. Determine the root cause of any delays or disruptions that are identified. This could include analyzing the equipment used in the production process, examining the production scheduling, and investigating any potential labor or material shortages.
3. Develop strategies to reduce the amount of WIP inventory in the system. This could include introducing new technologies to automate the production process, streamlining the workflow, and implementing a Just-in-Time (JIT) inventory system.
4. Implement the strategies developed to reduce WIP inventory. This could include improving the layout of the plant, introducing new technologies, and changing the production schedules.
5. Monitor the effectiveness of the strategies implemented. This could include tracking the amount of WIP inventory in the system on a regular basis, as well as tracking the number of delays or disruptions that occur during production.
6. Make adjustments to the strategies as needed. This could include reevaluating the production process, analyzing the effectiveness of the JIT. Non-operational time due to in process material shortage was the main source of data.

The Reason for Choosing Problem :

1. This problem is contributing for loss of production & waste of all the resources due to non-availability of material, resulting in increased idle time of both man & machine.
2. Due to non-availability of one component production of other components is also affected as all the components are used simultaneously at assembly area affecting the inventory levels of other components resulting in production stopped after a particular inventory level is achieved.
3. As tackiness (sticking capacity of component) is an important consideration in NVH Pads manufacturing no availability of one component leads to not usage of other components which when kept for long time can affect the properties of component.

Data Analysis & Interpretation:

1) **ACTUAL PRODUCTION, TARGET & Not Data** is collected from the building process for two months:

Data shows non-operation time due to material shortage and its month wise comparison of two months Sept & Oct 2022.

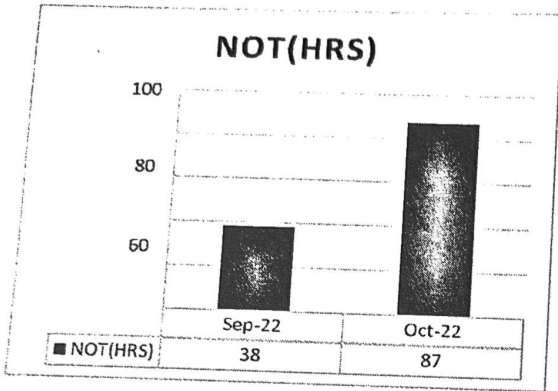
Table-1-ACTUAL PRODUCTION, TARGET & NOT

| MONTH | SEPT-22 | OCT-22 |
|-------------------|---------|--------|
| PRODUCTION(PCS) | 105437 | 121099 |
| PRODUCTION TARGET | 111291 | 137093 |
| NOT(HRS) | 38 | 87 |

| | Sep-22 | Oct-22 |
|-------------------|--------|--------|
| PRODUCTION(PCS) | 105437 | 111291 |
| PRODUCTION TARGET | 121099 | 137093 |



Graph-1-ACTUAL PRODUCTION GRAPH OF SEPT & OCT-22



Graph-2-NOT MONTHWISE

Analysis & interpretation :

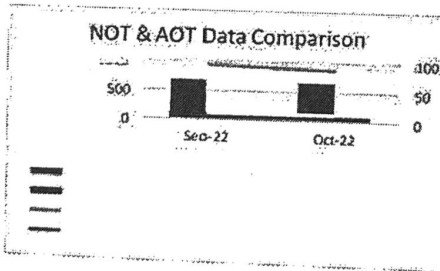
The table-1 shows data of Production in the month of Sept & Oct 22 in pieces, result is taken from BSIDp Daily-DAC report. Second row shows NOT (non- operation time) in the corresponding months in Hours. Source of data is the NOT report generated by BISDp monthly report.

NOT is more in the month of Sept as the temperature increases tackiness (sticking capacity) of component increases resulting in loss of time due to material trouble. Graphical representation of data is shown in Graph-1.

Table-2-NOT AND AOT DATA MONTHWISE

Data shown non-operation time and actual operation time month wise comparison of two-month Sept & Oct 22.

| MONTH | SEPT-22 | OCT-22 |
|-----------------------------|---------|--------|
| ACTUAL OPERATION TIME (HRS) | 682 | 657 |
| NON-OPERATION TIME (HRS) | 38 | 87 |
| PERCENTAGEWISE (AOT) | 94.7 | 88.3 |
| PERCENTAGEWISE (NOT) | 5.3 | 11.7 |



| | Sep-22 | Oct-22 |
|------------|--------|--------|
| AOT (HRS) | 682 | 657 |
| NOPT (HRS) | 38 | 87 |
| (AOT)% | 94.7 | 88.3 |
| (NOT) % | 5.3 | 11.7 |

| | Sept-22 | Oct-22 |
|---------------------|---------|--------|
| M/C TROUBLE | 25 | 24 |
| MAT NOT AVAILABLE | 23 | 25 |
| MATERIAL NG | 22 | 20 |
| M/C BREAKDOWN | 14 | 15 |
| SIZE CHANGE | 13 | 15 |
| M/C ADJ. TO COUNTER | 3 | 3 |



Data Table- shows Data of actual operation time (i.e. Time utilized for production) & Non-operation time (i.e. time lost during production due to various troubles). And their comparison in terms of percentage. Graphical representation of data is shown in Graph-3

Analysis & interpretation :

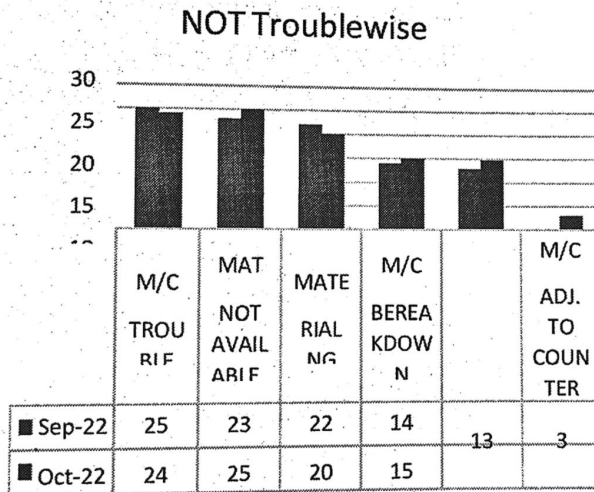
The analysis NOT & AOT is compared to study the percentage contribution of NOT which is responsible for the production loss. The above graph gives the details of percentage of AOT & NOT. So, by minimizing NOT we can increase AOT. If we achieve maximum AOT then the production will be more, and the target of production will be achievable.

Table-3- NOT TROUBLEWISE MONTHWISE (% OF Total NOT)

Data Table-shows data of segregation of Total NOT trouble wise in Percentage (%) comparison to Total NOT. Data shows that there are Three major trouble which comprises 70% of total NOT Machine trouble, Material NG i.e. cannot be used for production & Nonavailability of material. Since machine trouble is the responsible of maintenance and they are taking care of that, so we have chosen the second major NOT

i.e. material not available which comprises of 23% of total NOT in Sept & 25% in Oct. most of the reason of material shortages are because of production can effectively be removed Graphical representation of data is shown.

Graph-4-TROUBLEWISE NOT (% of Total NOT)



Analysis & interpretation:

From above data & graph it is found that, NOT due to the material not available in Sept is 23% & in Oct is 24%. So, if we can decrease the NOT due to material shortage. Other NOT cannot be minimized as all are related to m/c downtime.

Table-4-MATERIAL NOT AVAILABLE (%)

Data Table-1,4 shows material non-available in percentage pf Total NOT. Material non-availability is 23% and is second major cause of NOT. Graphical representation of data is

shown in Graph-5

| | SEPT-22 | OCT-22 |
|------------------------|---------|--------|
| MATERIAL NOT AVAILABLE | 23 | 25 |

GRAPH-5-MATERIAL NOT AVAILABLE (%)

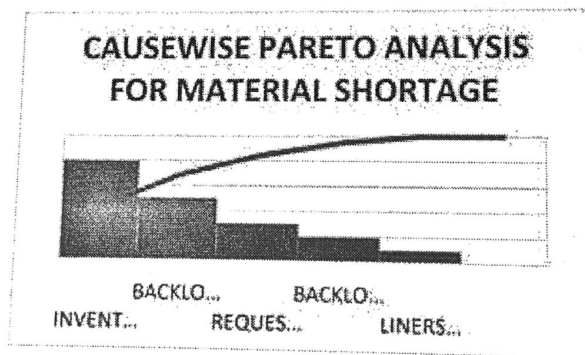
Analysis for material not available.

Table-5-MATERIAL NOT AVAILABLE CAUSEWISE

| MATERIAL CAUSEWISE | NOT | AVAILABLE |
|-------------------------------|-------------|-------------|
| | EFFECT IN % | CUMMULATIVE |
| INVENTORY DISCREPANCY | 40 | 40 |
| BACKLOG NOT TRANSFERRED | 25 | 65 |
| REQUEST TIME N.G. | 15 | 80 |
| BACKLOG | 10 | 90 |
| LINEARS & REELS NOT AVAILABLE | 05 | 100 |

Data Table-1.5 shows the Pareto analysis cause wise of material not available. Data shows that three main causes of material not available are inventory discrepancy: backlog not transferred & request time for material not correct. They together comprise of 80% of total not due to material not available. Graphical representation of data is shown in Graph- 6

Graph-6-MATERIAL NOT AVAILABLE CAUSEWISE



Analysis & interpretation by all data & graphs:

By observation of all data of two months, we found some mistakes actually done by production or shop floor working employees. After doing meeting with all Quality circle members and managers we come to some solutions to minimize that material shortage NOT by making some standards for shop floor technician, supervisor and contract labor.

Corrective Action :

After analyzing reasons of Non-operation time due to Material shortage all the main caused were listed and Three month corrective action plan was made which included following points.

- Training
- Training to all operator's and transporter's regarding following of FIFO which is used for the materials & assembly section.
- Development of new procedures and system



- Daily material inventory check.
- Shift wise updating of FIFO board.

It is unbearable if material shelf life gets over without using it due to material handling and using mismanagement, resulting in material scrap and loss of investment. To prevent this, expired material scrap FIFO system is introduced. In which first made material is used, first i.e. material lots are used in serial order of its production or receiving lots. This system also helps in checking and minimizing the material inventory. Online inventory status can be kept as material is used in serial order of its production lot.

- Information about bad material both size and quantity.
Change in method of inventory check for giving building material request
- Backlog calculation check by both Production & planning department.
- Kaizen
- Improvement in windup condition of material.
- Display of quantity of windup of material to digital type.
- The formats introduced in present system for improving material inventory managements are listed below and attached in next sheets.
- FIFO inventory check sheet

In this format the inventory of material lying in material section (area-1) is given to assembly section with size and quantity of material mentioned in sheet. Building return material record sheet

In this format record of out of spec. Material that cannot be used which is returned to material section is kept. Copy of this sheet is also provided to planning section.

Using limit & size over material inventory sheet.

In this format record of material whose using limit & size is over kept so that after treatment of material inventory can be adjusted accordingly.

Dead stock check sheet :

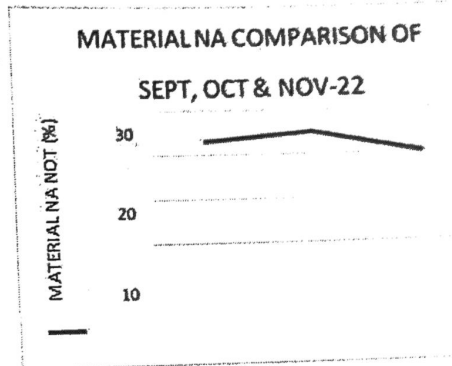
In this sheet record of material that is ok but not used by NVH section is kept.

Table-6-AFTER CORRECTIVE ACTION MATERIAL NA NOT IN NOV 22

| MONTH | SEPT-22 | OCT-22 | NOV-22 |
|---------|---------|--------|--------|
| NOT (%) | 23 | 25 | 20 |

Graphical representation of before and after data of non-operation time due to material shortage is sn in Graph-7

Graph-7-MATERIAL NA NOT COMPARISON OF SEPT, OCT & NOV (%)



From above graph it is observed that, after applying the corrective action as mentioned above are effective. The material not available NOT is minimized as shown in above graph in Nov 2022.

Hence above-mentioned corrective actions are important for minimizing material not available NOT for achieving the production target.

Findings:

ABC Analysis: This firm has to buy more of C Category items rather than AB, but at the same time, it has to keep a close watch on Focused goods, which are high valued goods kept in low volume. However, close assistance is given since the value of these goods is high.

Material management department plays a vital role in the success of an enterprise. A significant portion (around 70%) of capital invested in materials and well planned and considerable saving in the capital expenditure. The advantages or benefits from effective materials management operation can be outline as –

- 1) Regular supply of the materials is ensuring reduces the chances and any interruption in the production process.
- 2) Efficient stock control minimizes wastage of materials.
- 3) Inspection of materials at the time and procurement minimized of material at the time and procurement minimized the possibility of finished product being

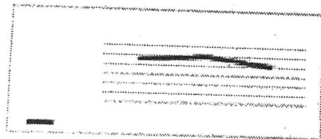
rejected by the customers.
Timely supply of raw material and other inputs can be assured.

Observations :

- A) By avoiding material NOT, we can maximize the production.
- B) To avoid material NA NOT we applied corrective actions as explained below.
FIFO inventory check sheet
Building return material record sheet
Using limit & size over material inventory sheet
Dead stock check sheet
Using small reels first check sheet
- C) After using all above corrective actions as mentioned above in Nov-22 it is found that, the Nov-22 material NA NOT was 21%. Also, the production achievement was good.

Table No-7 ACTUAL PRODUCTION & NOT IN NOVEMBER

MATERIAL NA NOT (%)



MATERIAL NA
NOT
COMPARISON

| | Sep-22 | Oct-22 | Nov-22 |
|---------|--------|--------|--------|
| NOT (%) | 23 | 25 | 20 |

Suggestions & Recommendations:

Recommendations:

Following recommendations are made for implementing materials management system.

- Each person concerned with the in-process material inventory must be educated to handle the system without any error.

Functions :

Viscon Rubber Pvt Ltd should adopt sophisticated techniques to manage its inventory in a better manner.

After analyzing reasons of Nonoperation time due to material shortage all the main caused were listed and Three-month corrective action plan was made included following points.

(252)

- Training
- Training to all operator's and transporter's regarding following of FIFO which is used for the materials & assembly section.
- Development of new procedures and system.
- Daily material inventory check.
- Shift wise updating of FIFO board.

It is unbearable if material shelf life gets over without using it due to material handling and using mismanagement, resulting in material scrap and loss of investment. To prevent this, expired material scrap FIFO system is introduced. In which first made material is used, first i.e. material lots are used in serial order of

its production or receiving lots. This system also helps in checking and minimizing the material inventory. Online inventory status can be kept as material is used in serial order of its production lot. Following methods must use.

- FIFO inventory check sheet
- Building return material record sheet
- Using limit & size over material inventory sheet
- Dead stock check sheet
- Using small reels first check sheet.

We must find at what extent we manufactured machines per month or what is our capacity. We must

- Every production section must follow the production order to keep the balance in inventory of each component.
- Shop floor layout must be such that FIFO system is followed and no mistake is made in inventory checking.
- Information flow from bottom to top is mandatory.
- There is a need to develop good communication system between various departments like marketing, planning, procurement and production and distributions.

Know the yearly targets and at least next two months scheduling.

We must concentrate on lead time and monthly consumption so that we kept stock economically suitable and at right time delivery of materials to the production department.

The customer's service is much more important because back orders are costly to the company and time consuming.

Here the production is batch production and not mass production because parts are manufactured according to the orders of machines.

Our main target is how the accuracy we achieved and how rejected. Then the process of recording of reworking the materials followed concentrated on this activity particularly.



Actually, here we manufactured machines are according to monthly target. If we pay attention towards the daily targets, then we can find out where we can find out where we late. From which department the material is not come on time.

For important and critical parts, we manufactured in overtime or in shift.

Work order must give on time to the workers according to the time required for manufacturing that part.

SUGGESTION :

Under the ABC analysis, the management must have more control on C items than on A & B items because C class constitutes more of higher values. To avoid deterioration, there should not be tight control exercised on stock levels. This is achieved through maintaining low safety stock levels, continuously checking schedules, and ordering frequently in inventories to avoid overinvestment of working capital.

Improving communication between staff members is essential for prompt action during orders. The company must update data in SAP in a timely manner. There is a necessity to enhance communication between staff and departments. Not only by suppliers in forecasting demand has company also needed to maintain communication with suppliers in order to know the demand so company can manage inventory and helpful in manpower sourcing.

Conclusion of the study:

This study contains proper observation of inventory management in the company. A better inventory management can solve all the problems occur in inventory and helping the company to face the problems by following proper techniques and controlling. This will reduce the huge money investment problems and it will lead the way for avoiding such circumstances.

Material handling, layout modification and flow of materials will reduce the input cost and

ensure the organizations to bring profit, prosperity, and commitment to global standards.

The material NOT due to material NA is minimized after applying corrective actions as mentioned above, so the NOT due to material NA is minimized in November-2022 as compare to September & October-2022.

Inventory is timely changing physical asset which is sold or being a dead stock have by the company. It creates way for the production process if shortage occurs in the production and Also it gets more even after the production.

Companies always concentrate on domestic as well as international trends to increase their business globally. Efficient inventory management can control and enable the company to grow, while an inefficient approach can ruin the company's business. This study is on leading NVH & Rubber manufacturing company conducting ABC analysis for items predicting the future demands which should be forecasted by the company.

From the study it is shown that buying of materials and shortage occurs due to improper way of forecasting the demand.

ABC analysis is carried to find out the materials which are quickly moves fast and important to the company and which is differs from sales and volume in the inventory.

Hence the corrective actions are useful for minimizing material not available NOT for achieving the production target.

Learning Outcomes:

Reasons for keeping stock:

There are five reasons for keeping an inventory.

1. **Time-** The time lags present in the supply chain, from supplier to user at each stage, requires that you maintain some amounts of inventory to use in this lead time. However, in practice, inventory is to be maintained for consumption during

'variations in lead time'. Lead time itself can be addressed by ordering that many days in advance.

2. **Seasonal Demand-** demands vary periodically, but producer's capacity is fixed. This can lead to stock accumulation; consider for example how goods consumed only in holidays can lead to accumulation of large stocks on the anticipation of future consumption.
3. **Uncertainty-** Inventories are maintained as buffers to meet uncertainties in demand, supply and movements of goods.
4. **Economics of scale-** Ideal condition of "one unit at a time at a place where a user needs it, when he needs it" principle tends to incur lots of costs in terms of logistics. So bulk buying movement and storing brings in economics of scale, thus inventory.
5. **Appreciation in Value-** In some situations, some stock gains the required value when it is kept for some time to allow it to reach the desired standard for consumption, or for production. For example, beer in the brewing industry.

Typology :

1. Buffer/safety stock
 2. Reorder level
 3. Cycle stock (Used in batch processes, it is the available inventory, excluding buffer stock 2015)
- **Everette E Adam and Ronald J Ebert**, production and Operations management (5th edition 2011) Page no.152
 - **Amitava Mitra**, Quality Control and Improvement (3rd edition 2009) Page no. 211
 - **C.G Andrew and G.A Johnson**, The Crucial Importance of Production and Operations management



- S.C Narsimhan and D.W Mcheavy, production Planning and Inventory Control (second Edition 2004)
 - Prof. L. C. Jhamb, (Everest Publishing House Second edition) Manufacturing and Operation Management, Page No.320
 - C. R. Kothary, Research Methodology. Page no. 76
 - S. Chary, Anil Kumar, production & Operations Management
4. De-coupling (Buffer stock held between the machines in a single process which serves as a
 5. buffer for the next one allowing smooth flow of work instead of waiting the previous or next machine in the same process)
 6. Anticipation stock (Building up extra stock for Inventory)
 7. periods of increased demand – e.g., ice cream for summer)

8. Pipeline stock (Goods still transit or in the
9. process of distribution – have left the factory but not arrived at the customer yet).

Reference :

- “WIP Inventory Management in Job Shop Production: A Review” by Song and Jain (2020)
- “Optimal WIP Inventory Management for a Make-to-Order Production System with Capital Constraints” by Chen et al. (2018)
- “An Integrated WIP Inventory Management Framework for Lean Production Systems” by Lu et al. (2017)
- “WIP Inventory Management in a Hybrid Flow Shop with Different Due Dates” by Zhang et al. (2016).
- “WIP Inventory Control in Assembly Systems with Multiple Component Types and Dynamic Lead Times” by Wei et al.

