



**SPARE PARTS MANAGEMENT (SPM):
AN INVENTORY CONTROL THROUGH JIT PHILOSOPHY**

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Abstract

Objective: The objective of this article is to effectively determine the adaptability of Just-In-Time (JIT) philosophy in spare parts management and control in ALABA INTERNATIONAL MARKET Lagos State metropolis. To determine how JIT can be meaningfully applied in order to avail the advantage of economy of large-scale stocking of spare parts. To ensure that obsolescence due to time preference and fashion are taking into consideration for effective implementation of JIT.

Methodology/Approach: A theoretical concept and framework of JIT was empirically reviewed in related literature books in order to comprehend its philosophical advantage. Questionnaires were prepared based on this knowledge to allow the respondents develop insight to its conceptual utility. On-line questionnaires, as well as personal interviews were also adopted. Data collection was done on time schedule determined between the respondent and researcher based on agreement. Both primary and secondary data were used in the work presentation.

Findings: JIT is a "Supra" system that encompass the conventional techniques of inventory management and control philosophy. It has greater scope, which includes the historical method in addition to its conceptual frame work. Its utility is more advantageous when absolutely applied systematically. Adjustment is required in its adaptability based on the nature of individual organizational and its business environment. Under practical wisdom, its meritorious advantage outweighs its limitations, hence the researcher advises the business organizations to embrace the philosophy of JIT as absolute means and remedy to spare parts management and control.

Implications: JIT philosophy is a cost effectiveness when adopted. It has no time barred in application. It can be adopted by any size of business organization (small, medium and large). Financial implication and its advantages are never of par. Its utility is overwhelmingly at confidence limit always.



Original/Value: This work highlights the use of JIT philosophy in spare parts management and control, an advert of neo-scientific methodology in inventory management. It is a computer integrated system (CIS), harnessing its cost effectiveness to the advantage of the users. Advantages, notwithstanding, has come to stay perpetually.

Keywords:

- JIT – (Just-In-Time).
 - Throughput Time.
 - AMT – (Advanced Manufacturing Technology)
 - JIT Production.
 - JIT Purchasing.
 - Non – Value-Added-Time.
 - JIT Philosophy.
 - JIT Vs EOQ guided Decision models.
 - Internal-Lead-Time.
 - External-Lead-Time.
 - CIS-Computer Integrated System.
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INTRODUCTION:

When JIT philosophy is implemented throughput-time is minimized, inventory holding costs are almost eliminated and large gains are realized by improvement of quality and productivity. The non-value added –time represents the time in waiting, being moved or being inspected. The JAPANESE manufacturers refer to non-value added-time as waste time to highlight that no-value is being created for the customer, when the product is not being processed. JIT purchasing is implemented by developing closer relationship with suppliers, so that the company and the suppliers can work together co-operatively. JIT production leads to a total supplantation of production process, so that only essential activities are conducted.

HISTORICAL BACKGROUND:

JIT (Just-In-Time) philosophy is dedicated to eliminate of waste (Sexena & Vashist 1996). In the context of JIT, waste is anything that does not add value. In an ideal JIT system, throughput time exactly equals its processing time. Throughput time is the interval between the first stage of production and the point of which the finished product comes out of production line. This goal just like zero defects may be unattainable, but it sets target, by which progress can be measured.

The throughput time is the aggregate of processing time, inspecting time, conveyance time and waiting time (Khan & Jain 2007). In many factories, processing time is less than 10% of throughput time. The JAPANESE manufacturers, who led the course in devising and implementation of JIT system emphasis the importance of reducing throughput times by rewriting the throughput equation as:

$TPT = \text{Added-Value-Time (+) non-Added-Value-Time.}$

Value added time is the time during which work is actually performed on the product (Ronald Hilton & Michael Matherg, Selto 1998). The non-value-added-time represents the time in waiting, being moved or being inspected. The time has been wasted by inefficiencies in manufacturing process. In JIT, inventory is viewed as a form of waste, cause of delays and a form of production inefficiencies. In JIT system, main emphasis is on quality factor, set-up-times, factory layout, uncertainty in suppliers delivery and quality etc (Ronald W. Hilton 2001). JIT philosophy is used in purchasing and production respectively.



ADAPTABILITY:

JIT Purchasing: JIP purchasing is the purchasing of materials and supplies in such a manner that delivery immediately precedes the demand of use. This will ensure that stocks are as low as possible. JIT purchasing is implemented by developing closer relationship with supplier so that the organization and the supplier can work together co-operatively. In JIT purchasing, arrangement is made with supplier for more frequent deliveries of smaller quantities of materials so that each delivery is just sufficient to meet immediate production requirements. Stocks are cut to a minimum. Considerable savings in material handling expenses is made by requiring the suppliers to inspect materials and guarantee their quality. This improved service is obtained by giving more business to fewer suppliers, who can provide high quality and reliable delivery.

Encouragement is given to employers to render good service by placing with them long-term purchasing orders. When a supplier has assurance of long-time sales, he is able to plan and meet the requirements with reference to more frequent deliveries of smaller quantities for buyer. Organizations which has implemented JIT purchasing has subsequently reduced their investment in raw materials and WIP stocks. Other advantages from JIT purchasing include saving in factory space, large quantity discount and reduced paper work arising from issuing blanket long-term orders to fewer suppliers instead of purchase orders. As blanket order is placed, ordering cost are reduced. Traditionally, EOQ formula guides the ordering level and quantities. In JIT purchasing, policy is not always guided by EOQ decision models. At minimum, the EOQ model assumes a constant order quantity. JIT purchasing policy may require different quantities for each order if demand fluctuates.

JIT Production: JIT is a system in which each component on a production line is produced immediately as needed by the next step in the production line. It has the following features.

- Production line is run on a demand pull bases.
- Emphasis is placed on minimizing the throughput time of each unit.
- The production line is stopped if parts are absent or defective work is discovered.
- JIT production leads to a total supplication of production process so that only essential activities are conducted.

The JIT manufacturing has been successfully applied to reduce optimal number of units, which should have been scheduled for each production run (ie the batch size). The



production of large batch size results in large stocks of WIP and finished goods being hold. By introducing Advanced Manufacturing Technologies (AMT), set up times and cost is dramatically reduced.

Reducing set-up costs causes the economic batch size to fall until eventually it is unnecessary to produce more than the quantity needed for current consumption. The effect of setting up time to a limit of zero is to produce an economic batch size of one unit. In this situation, the need to maintain stocks would be eliminated.

Ideally, JIT philosophy operates with zero inventory. Many related terms describes the JIP approach such as MAN (material as needed), MIPS (minimum inventory production system) and ZIPS (zero inventory production system).

VALUE ADDED/NON-VALUE ADDED COST ANALYSIS:

Most of the organizations use cost as a competitive weapon and in this context, value added/non-value added analysis gains special importance. Value added/non-value added classification of cost is used by several organizations who aggressively seek out ways to become cost competitive. The cost classification focuses whether a cost can be eliminated without functional loss to the customer or quality or product or deterioration of performance. This stress is on cutting non-value added costs. Often this analysis involves following steps which are the hybrid of JIT:

- Identification of attributes of products that customers perceive to be valuable. These attributes are quality, reliability and price.
- Identification of those activities that cause work in the production line. An attempt is made to asses whether each activity add value or not. At the time of selection, activities are divided into three categories as:

Category	Example
Value added.	Machining time.
Non-value added.	Rework time.
Grey area.	Work assignment.

- Identification and elimination of non-value added activities eg., change in layout may result in reduced material movement.

BACK FLUSH ACCOUNTING VERSUS JIT:

This term was introduced in CIMA terminology published in February 1991. CIMA defines “back flush accounting as accounting system”, which focuses on the output of an



organization and then works back to attribute costs to stock and cost of sales". Traditional/conventional accounting system use sequential tracking ie, accounting methods are synchronized with physical sequences of purchases and production. Back flush accounting, which is also referred to as delayed accounting or post-deduct accounting, focuses on output and then works back to apply manufacturing costs to units sold and to inventories. The term back flush came into existence because in "back flush accounting", costing of inventories is delayed as late as the time of sale. Costs are then finally flushed back through the accounting system. It is especially attractive in organizations having low inventories resulting from JIT. Back flush accounting eliminates need for a separate WIP account. There are two basic justifications for this purpose:

- To remove the incentive for managers to produce for inventory. In conventional system managers try to add to operating income by producing units not sold. In absorption costing, fixed overhead costs, which would otherwise be expenses for the period get inventoried.
- To increase the focus of the managers on plant-wide goal rather than on individual subunit goals. For example, a production manager may be interested in increasing machine utilization at an individual work centre and this step may not be compatible to overall organizational objective.

The organization adopting back flush accounting often meet the following three conditions.

- Management wants a simple accounting system and no detailed tracking of direct material and direct labor through a series of operations is required.
- Each product has a set of standard cost.
- Material inventory levels are either low or constant.

If inventories are low, the bulk of manufacturing costs will flow into costs of goods sold and it is not deferred as inventory cost. Back flush accounting is specially attractive in organizations, that have low inventories resulting from JIT.

LIMITATIONS OF BACKFLUSH ACCOUNTING VICE VERSA JIT:

- Back flush accounting does not strictly adhere to generally accepted accounting principles of external reporting.
- The critics of back flush accounting primarily emphasize on the absence of audit trails.



- It does not pinpoint the use of resources at each step of the production process.
- Back flush accounting is suitable for JIT production system with virtually no direct material inventory and minimum WIP inventories. It is less feasible otherwise.

OVERVIEW:

Inventory control and management is one of the functions of material management, which deals with the process of deciding what and how much of various items are to be kept in stock. It also determines the time and quantity of various items to be procured. The basic objective of inventory control is to reduce investments in inventories and ensure that production process does not suffer at the same time. The objectives are:

- To reduce financial investment in inventories.
- To facilitate production operation.
- To avoid losses from inventories obsolescence.
- To improve customer services.

Besides cost of items kept as inventory, following recurring expenses are involved:

- Bank interest on capital employed X% compounded quarterly or X% flat = XX%
- Handling, losses, damages etc = XX%
- Total carrying cost XX%

The inflation rate may be around 10% which maybe 1/3 of inventory carrying cost. Carrying inventory on inflationary ground cannot be justified. In this case, we have to ignore considering the traditional method of determining the inventory carrying cost, by not adding the manpower cost and paper work cost. In an ideal condition inventory should not be maintained. This would have been possible, if items required can be made available exactly when needed, at an economic cost. We can think of developing an inventory system which can be delivered exactly when the maintenance department wants it, exactly what the maintenance wants, and in the exact quantity wanted to avoid waste. Under practical condition it seems difficult to design such a mistake proof system for the continuous process plant, where the down time cost is very high and one cannot afford the down time cost due to want of spares.



JIT Philosophy: JIT philosophy has been introduced and successfully implemented in many manufacturing organizations to eliminate waste. The concept of JIT in relation to inventory control is to avail the necessary spare as and when maintenance department wants and at exact quantity. That means there may not be need to keep the inventories. All the same, there can be possibility of substantial saving by adopting JIT concept in spare parts management.

Limitation of JIT: JIT seems to be difficult to adopt due to following draw backs: Internal and external lead time. Internal lead time is the time taken for the processing of documents, against which item is to be secured. This time can be eliminated/reduced by the organization by improving the productivity of office work. Organization and methods (OQM) also help to enhance the office productivity and reduce the delay. External lead time is the time taken by the spares/items to reach to the right place after placing the orders. This time vary from item to item.

The items/spares which are easily available and items are off the shelf in nature, can be arranged within a few hours. The items which cannot be available easily and the nature is fabrication or tailor made, the external lead time is always very high. The external lead time is the only bottleneck to apply JIT concept and to reduce waste. If our inventory system is designed in such a manner so that external lead time for every spares/items is zero, only then one can think of implementing JIT concept successfully.

Steps to Adopt JIT Concept: On the basis of availability of spares/items, the inventory has been segmentised into three, termed S, D and E items.

S – Scarce Items: These are items/spares which cannot be made available within the country and required importation. This category should contain only those items which are imported.

D – Difficult Available Items: These are items which can be procured within the country, but which their availability is very rare and the external lead time is very high, for example fuel supply.

E – Easily Available: These are items which can be procured as and when needed, items which can be procured from the local suppliers/vendors, can be classified under E-type. The items which can be procured from regional states and can be made available within 24 hours of requisition.



Similarly, on the basis of nature of spares/items, inventory is can be classification as 'O' and 'T'.

O – Off The Shelf Items: These are items/spares which are readily available in the market like general purpose bearings – welding electrodes, belt conveyor, standard tyres, V – belt etc. For these items, external lead time is always less and depends upon the place of procurement.

T – Tailor made Items: These are items which are to be prepared by the other industries on the basis of requirement like casting, refractory bricks, special purpose motors, shafts etc. For these items, external lead time is very high.

The items/spares which are easily available and off the shelf in nature, JIT concept can be applied. Many organizations have developed vendors/suppliers for scarce items. For scarce items and difficult available items/spares, local suppliers/vendors can be developed, which can adopt JIT concept easily, to control inventories and items/spares which cannot be made available to maintenance department in a right time and at a right quantity, to ensure production and reduced losses, lead time should be determined on organizational basis.

CONCEPTUAL OPINIONS, INTERVIEW QUESTIONNAIRE AND JIT PHILOSOPHY:

Research question 1: JIT is a concept based on elimination of waste, do you adopt it your organization successfully?

Respondent 1: Any measure which can reduce waste is a welcome idea in any sizeable organization. The objective of every enterprise is to minimize loss and maximize profit. The concept JIT philosophy is quite advantageous to business environment in the era of cut-throat competition. Waste is adverse to organizational prosperity and progress. JIT is a welcome philosophical concept.

Respondent II: An organization is not compatible in the business environment with trend of loss which is the By-product of mismanagement due to inefficiency. JIT can be a “test” match on management of the organization whereby a manager is put to action and the organization stands to benefit, which will result in bonus to employees and the public as a whole.

Research Question II: How effective is JIT applied in your organization in terms of inventory management and control?



Respondent I: JIT philosophy is the hybrid of business success, if it is well implemented systemically. This is because waste and business successes are always in opposite direction. They never meet and will never meet. It is a secret of any successful business organization and its managers. It is a sword of two edges at par. Inventory is the bulk of Current Asset tied up, which may result in lack of working capital. Inventory management and control should be studied in order to avail the stabilized liquidity position of the business enterprise otherwise.

Respondent II: Success is a spring, flexible or elastic in content. It can be static when management is faulty. Implementation of JIT is the management responsibility which may result in either favourable or adverse trend of the organization. JIT is cost effectiveness and cost reduction. Any effort by the management tailored to this direction will invariably reduce waste and enhance profitability.

DEPICTING THE ACCEPTABILITY CONFIDENCE LEVEL OF JIT PHILOSOPHY

Data Presentation and Analysis

Testing the validity of the hypothesis held: In order to test the validity of the alternative hypothesis, the question asked was:

- Is JIT philosophy has a positive impact on inventory management and control?

OBSERVED FREQUENCY TABLE

SEX	SA	A	SD	D	TOTAL
Male	13	32	1	1	47
Female	14	9	2	1	26
Total	27	41	3	2	73

Expected Frequency (EF) = $\frac{CT \times RT}{CT}$

CT

Male:

$$SA = \frac{27 \times 47}{73} = 17.4$$

$$A = \frac{41 \times 47}{73} = 26.4$$

Female:

$$SA = \frac{27 \times 26}{73} = 9.6$$

$$A = \frac{41 \times 26}{73} = 14.6$$



$$SD = \frac{3 \times 47}{73} = 1.9$$

$$SD = \frac{3 \times 26}{73} = 1.1$$

$$D = \frac{2 \times 47}{73} = 1.3$$

$$SA = \frac{2 \times 26}{73} = 0.7$$

Calculation of Chi-Square (X^2)

		Observed	Expected	(O-E)	(O-E) ²	$\frac{(O-E)^2}{E}$
Male	SA	13	17.4	-4.4	19.36	1.113
	A	32	26.4	5.6	31.35	1.188
	SD	1	1.9	-0.9	0.81	0.426
	D	1	1.3	-0.3	0.09	0.069
Female	SA	14	9.6	4.4	19.36	2.017
	A	9	14.6	-5.6	31.35	2.148
	SD	2	1.1	0.9	0.81	0.736
	D	1	0.7	0.3	0.09	0.129
				0		7.826

With two (2) rows and four (4) columns, the degree of freedom will be $(R-1)(C-1) = (2-1)(4-1) = 3$. The X^2 value at 5% level of significant and 3 degree of freedom is 7.81. Based on this determination, the alternative hypothesis is accepted which states that JIT has a positive impact on inventory management and control, which validates the initial assumption. But then, the figure from the X^2 determined and the X^2 table value are closely related as to arrive at conclusion that JIT has impact on inventory control.

The above issue, however raises a fundamental investigation. That is, how to determine the level and depth of influence that JIT has on inventory control and management. Therefore, considering the very deep influence the JIT has made and expected additional merits, one is compelled to assert that such an influence could not have been achieved without the establishment of JIT. 37 or 46.25% agreed on the one hand that JIT has influenced the inventory management. 2 or 2.5% strongly disagreed, while 5 or 6.35% disagreed with the above hypothesis. The result is that a total of 66 or 82.5% believe that JIT philosophy has influenced the inventory control and management favorably, while total of 7 or 8.75% claimed that JIT philosophy has no such impact. This shows that majority of the respondents believe that JIT philosophy has viably influenced inventory control system positively and advantageously.



The next step is to determine the area in which JIT affect the inventory system.

Is JIT Philosophy a Positive Impact on Inventory Management and Control?

Respondent	No	%
SA	27	33.75
A	41	51.25
SD	3	3.75
D	2	2.50
No response	7	8.75
Total	80	100.00

The above table depicts that 27 or 33.75% out of 80 respondents (SA) believe that JIT system is a positive impact on inventory control and management. On the other hand 41 or 51.25% (A) that JIT is a viable application. 3 or 3.75% (SD), while 2 or 2.5% (D). The entire result shows that a total of 68 or 85% out of 80 respondents believe that JIT philosophy is a positive impact on inventory control.

- **Has JIT Philosophy Revolutionized the Inventory Control and Management?**

Respondent	No	%
SA	28	35.00
A	42	52.50
SD	3	3.75
D	2	2.50
No response	5	6.25
Total	80	100.00

The table shows that of the 80 questionnaires 70 or 87.5% of respondents rightly agreed that JIT philosophy has revolutionalised the operation of inventory management. 5 or 6.25% were of the opinion that JIT has not revolutionalised the inventory control system.

- In order to understand the extent to which JIT has infused changes and better management, this question was asked:

- **Has JIT attracted attention of business environment**

Respondent	No	%
SA	23	28.75
A	43	53.75
SD	3	3.75
D	3	3.75
No response	8	10.00
Total	80	100.00



The table shows that of the 80 questionnaires, 23 or 28.75% (SA) that JIT has attracted the attention of business environment in its adaptability, 43 or 53.75% agreed that JIT philosophy has attracted business environment, 3 or 3.75% (SD) on JIT attention in industry. Based on the total response, 82.5% believed that JIT has yielded a tangible result in application. This is not to say that JIT does not have its own challenges and problems.

- To investigate the challenges in the implementation of JIT philosophy, the following question was asked.

Is JIT a Debacle in Inventory Management?

Respondent	No	%
SA	8	10.00
A	11	13.75
SD	22	27.50
D	34	42.50
No response	5	6.25
Total	80	100.00

The table shows that of the 80 questionnaires 75 were returned with valid response. 8 or 10% (SA) that JIT is debacle in inventory management, 11 or 13.75 agreed that JIT is a failure in inventory control system. Whereas 22 or 27.50% (SD) that JIT is a debacle as far as inventory management is concerned. 34 or 42.50% believed that the implementation of JIT has many outstanding merits if its concept is well administered. 5 or 6.25% provided no answer to the question probably due to lack of the knowledge of the concept and its methodology. Generally, 56 or 70% of the respondents agreed that JIT is a useful concept, not a failure in implementation of inventory control and management.

Comments: The business environment should endeavour to imbibe the philosophy which has enormous merits in inventory control and management. Unlike conventional inventory management systems, JIT is a tool dedicated to the elimination of waste. In this context, waste is anything that does not add value. It is a supra-system.

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