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Feasibility Study of Just in Time Inventory Management on Construction Project

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Abstract: ***Just in time philosophy has lot of Potentional for managing movement of construction material from manufacturing yard to construction site. The traditional approach to material delivery has been used in construction industry for many years. It is imbedded in the corporate structure as the way to procure materials. Major Construction Industries have been trying to adopt new business initiatives in order to stay alive in the new competitive market place. Companies must strive to create high quality, and Low cost products that can get to the customers in the shortest time possible. Just-in-time production system is one of these initiatives that focus on cost reduction by eliminating non-value added activities. This Paper Deals with Implementing Just in Time Inventory Control Approach on Highway Construction. JIT has Tremendous Effect on Material Delivery Operation. During implementation of JIT organization is required to put desired efforts on all levels of the work.***

Keywords: just in time, Cost Reduction, Non value added activity.

1. Introduction

Increasing Global competition has forced the Indian construction Industries to look for some new techniques to meet the challenges in Construction Industry. During last two or three decades construction environment all over the world has experienced more changes, particularly, the construction environment has become one of the most important elements in creating the value added contents for the products and service [1], [2]. The traditional approach to material delivery has been used in construction industry for many years [3]. The approach created lot of problem to construction industry. Fast development in communication, better quality material and fast material transportation systems has become global in nature. Construction industry also demands more product variety that means reduced lot size and high flexibility in construction work. Manpower cost has also risen [4], [5]. All these factors tend to increase the material and project cost. But the industry has to maintain the cost at a reasonable level. To overcome material delivery problem just in time method is used for large projects [6[, [7]. Just in Time method application on delivery of concrete is done in Japan. Ready mix concrete is prototypical example of batch process where a customer process releases an order to batch for the supplying process and receives product as a result. This batch process does not allow any inventory of product to be maintained because the product is perishable [8]. Precast concrete supplier examine if contractors are ready to adopt the JIT philosophy for receiving and installing precast concrete components on-site. Lessons are drawn from the empirical findings to determine how contractors can prepare for JIT management of precast concrete components [9].

JIT principle was introduced by Toyota Company in Japan. JIT is a system that produces the required item at the time and in the quantities needed. By using JIT principle we can maintain quality of the entire project and increase efficiency of the workers. JIT principle says that inventories are not more important and should be considered as waste [10], [11].

Conceptually, JIT is an approach that combines difficult objectives of low cost, less space requirement for material stock, high quality and delivery dependability [12].

JIT Implementation depends on supplier. The character of every supplier is strongly related to the success or failure of any materials-management system. Thus, selection of vendors is the critical initial step, because selection of vendors affects the construction itself. Therefore, good vendor selection is important for an effective materials-management system, which leads the successful completion of a project [13].

2. Concept of Just in Time

Just in Time (JIT) production is a manufacturing philosophy which increases speed of production. JIT Concept is, "Company produces only what is needed, when it is needed and in the quantity that is needed". The company produces only what the customer requests, to actual orders, not to forecast. JIT can also be defined as producing the necessary units, with the required quality, in the necessary quantities, at the last safe moment. It means that company can manage with their own resources and allocate them very easily

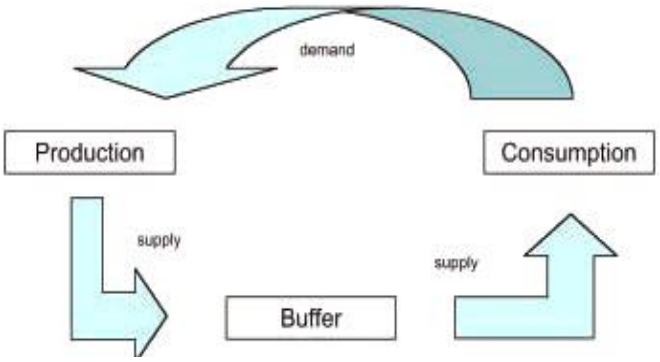


Figure 1: Shows JIT Concept

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JIT Implementation steps:
One of the major objectives in implementing JIT System is to achieve a common goal of the whole company.

First step:
I) Material Quantity Calculation.
II) ABC analysis.
III) Selection of Material.

Second Step:
I) Vendor Selection Process.

Third Step:
I) Material Procurement Plan Preparation
II) Equipment Productivity Calculation.

Case study

Introduction about company:
Place: Aland (Gulbarga)
Type of work: Road Construction
Type of Road: Black Top Road (Flexible Pavement)
Length of Road: 63KM
Cost of Project: 37Cr
.Name of Company: Patil and Company
State-Maharashtera, Dist-Solapur,
Country-India
Name of Incharge: Vijay Patil
Mo No: 9036450000.

3. JIT Implementation Process

Step 1:

3.1 Material Quantity Calculation
Total monthly target= 3.5 km
GSB required for 1 km = 660 cum. (lxbxh)
For 3.5 km GSB required = 3.5x660=2310 cum.
WMM required for 1 km=979 cum.
For3.5kmWMM Required=979X3.5=3426.5
BM required for 1 km=297 cum.
For 3.5 km BM Required=297X3.5=1039.5 cum

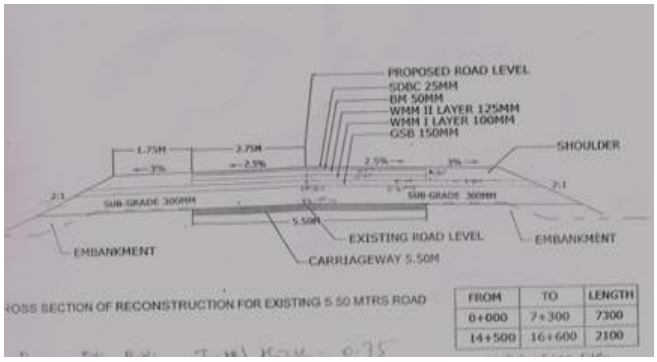


Figure 2: Shows road cross section

Sample material calculation for BM:
1000X5.5X0.054 (LXBXH) = 297 Cum

3.2 ABC Analysis

ABC Analysis was performed in order to select major materials for JIT application. Chart and Graph below Highlights the A, B and C items.

Table 1: Shows ABC Analysis

Item	Annual consumption	Cumulative Cost	% cum items	% Cum Cost	Category
GSB	32445	3,37,36,311	4.88	23.66	A
BM	5775	6,49,19,578.5	8.1	45.54	A
WMM I&II LAYER	26460	9,44,88,628.5	9.9	66.28	A
MURUM	71820	12,04,87,468.5	38.7	84.52	B
SDBC	2887.5	14,25,46,813.5	100	100.00	C
	Total Cost				

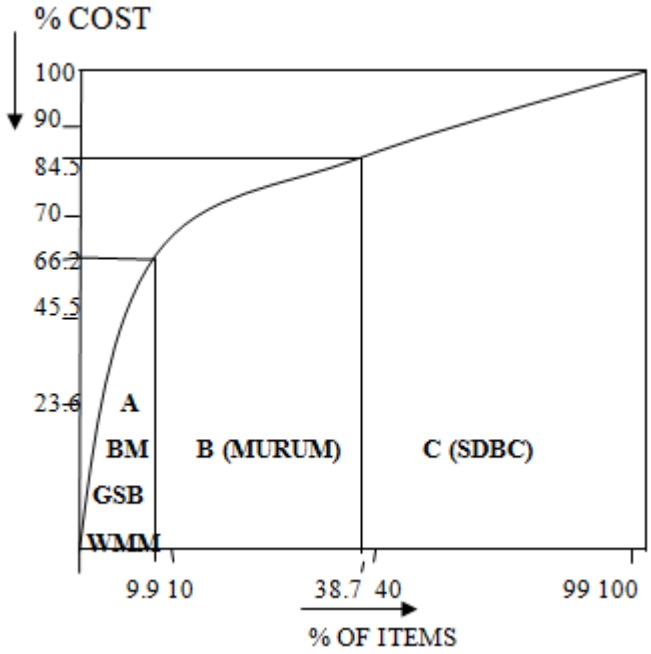


Figure 3: Shows ABC Analysis Graph

3.3 Material Selection

For JIT application BM, GSB and WMM Material Selected.

Step 2:
3.4) Vendor Selection Process
One of the important parameter which may have High influence an success of JIT is Vendor Selection. Five criteria's were selected for vendor evaluation they are cost, quality, providing document in time, service and cooperation. Based on the material following vendors were Primarily Shortlisted.

i) Murum
a) Hindustan Company b) Trimurti Company C) Moraya Company.

ii) GSB and WMM
a) Paranjape Company

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iii) BM and SDBC

a) Rudra Company

Analytical Hierarchy Process was used for vendor selection and following vendors are selected.

i) Murum- Hindustan Company
ii) GSB and WMM- Paranjape Company
iii) BM and SDBC- Rudra Company

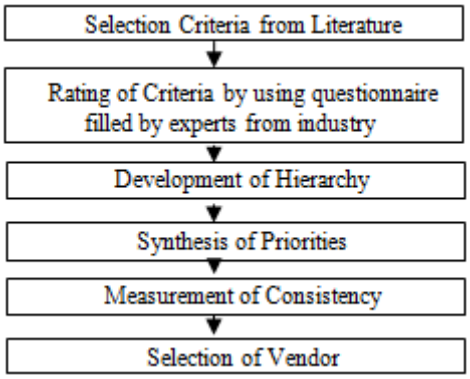


Figure 4: Shows AHP Process

Step 3:

3.5 Monthly Material Procurement Plan

JIT, calls for material procurement when required, so based on equipment productivity and fleet management from available equipment, procurement plan is developed.

Fleet required for laying GSB layer includes: 1) Loader 2) Hauling Unit 3) Grader and Paver's. Sample production is stated below and base on the same procurement plan is tabulated in below.

Table 2: Shows Material Procurement Plan

Name of Item	*Quantity of Item (cum)*	*Month*	*Vendor name*	*Equipment Required Capacity= 13.44 cum*
GSB	231	June	Paranjape company	HYWA-4
GSB	231	June	Paranjape company	HYWA-4
GSB	231	June	Paranjape company	HYWA-4
GSB	231	June	Paranjape company	HYWA-4
GSB	231	June	Paranjape company	HYWA-4
WMM	285.54	June	Paranjape company	HYWA-4
WMM	285.54	June	Paranjape company	HYWA-4
WMM	285.54	June	Paranjape company	HYWA-4
WMM	285.54	June	Paranjape company	HYWA-4
WMM	285.54	June	Paranjape company	HYWA-4
WMM	285.54	June	Paranjape company	HYWA-4
BM	259.7	June	RUDRA company	HYWA-4
BM	259.7	June	RUDRA company	HYWA-4

3.6 Equipment Productivity Calculation

I. Hindustan front end loader Production

$$\text{Loader Output} = \frac{3600 \times Q \times F \times E \times V.C.}{T}$$

$$= \frac{3600 \times 3.1 \times 0.95 \times 0.85 \times 1}{86} = 104.78 m^3/hr$$

II. Tipper Production

$$\text{No. of bucket loads} = \frac{Tipper\ volume}{bucket\ volume \times Fill\ factor}$$

$$= \frac{13.44}{3.1 \times 0.95} = 4.56 \approx 5 \text{ buckets}$$

Loading time=Loader cycle time X No of Buckets= 86X5=430sec=7.16min

Cycle time = Loading Time = 7.16 min
+ Haul Time = 31 min
+Dump Time = 2 min
+Return Time = 18.84 min
Cycle Time = 59 min

$$\text{Output} = \frac{Tipper\ volume \times 60}{Tipper\ cycle\ time} = \frac{13.44 \times 60}{59} = 13.40 \text{ x e} = 13.40 \text{ x } 0.76 = \mathbf{10.38 m^3/hr.}$$

III. Grader $= \frac{\text{no of passes x distance}}{\text{Speed x efficiency}}$

$$= \frac{6X\ 0.385\ (mile)}{2.3x\ 0.84}$$

= 1 hour= 34 cum

IV. Paver: $= \frac{\text{Quantity x 60}}{\text{TIME}}$

$$= \frac{13.44X60}{22.4}$$

= 36 cum

3.7 JIT Implementation Plan

For better Control and ease in operation and for the benefit of vendor procurement plan was prepared on daily basis. Sample of GSB Stated In table:

Table 3: JIT Implementation Plan

Type of item	quantity	Type of equipment	Cost of Material (per cum)	Total cost of equipment
GSB	2310	GRADER	24,01,938	1,05,000
WMM	3426.5	GRADER	38,29,113.75	1,26,000
BM	1039.5	PAVER	56,12,988.15	42,000
All 3 Material		HYWA		4,16,000
		Total cost=	1,18,44,039.5 1,25,33,039.5	6,89,000

4. Feasibility Analysis

In order to check the feasibility of the proposed application of JIT procurement plan, economic analysis was carried out for comparison, two stretchers were selected.

1) Where JIT was not applied and other (3.5Km) Where JIT was applied.

Following table gives detailed economic analysis

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4.1 JIT Method Cost

Table 4: shows cost of equipment and material in JIT method

Description	Date	Time of delivery of material	Quantity (cum.)	Place (chainage)	Equipment Required
GSB	1.6.2015	9:00 to 1:00 2.00 to 5:30	124.2 108.2	2+400 to 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1
GSB	2.6.2015	9:00 to 1:00 2.00 to 5:30	124.2 108.2	2+400 to 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1
GSB	3.6.2015	9:00 to 1:00 2.00 TO 5:30	124.2 108.2	2+400 to 5+900	Hywa=4 Grader=1 Hywa=4 Grader=1

4.2 Conventional Method Cost

Table 5: Shows cost of equipment and material in Conventional Method

Type of item	quantity	Type of equipment	Cost of Material (per cum)	Total cost of equipment
GSB	2310	GRADER	24,01,938	1,89,000
WMM	3426.5	GRADER	38,29,113.75	2,31,000
BM	1039.5	PAVER	56,12,988.15	73500
All 3 material		HYWA		920000
		Total cost = =	1,18,44,039.5 1,32,57,539.5	14,13,500

JIT Procurement Plan has reduced cost required to complete 3.5 km road construction work by Rs-7, 24,500

5. Conclusions

1) Above analysis shows that application of JIT procurement plan has reduced cost required for completing 3.5 km road work by Rupees 7, 24,500. Also time required is reduced by 21 days
2) Overall saving in contribution through application of JIT comes to be 5%.
3) Due proper procurement plan; equipment utilization is also improved

6. Acknowledgments

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