International Journal of Modern Trends in Engineering and Research
www.ijmter.com
e-ISSN No.:2349-9745, Date: 2-4 July, 2015

Value Stream Mapping Tool in Construction Sector to Increase Productivity and Minimising Waste

Pooja Bhosale[1], Hemant Salunke[2]
[1]*Civil Department, Dr.D.Y.Patil Institute of Engineering,Ambi,Pune,bhosalepooja25@gmail.com*
[2]*Civil Department, Dr.D.Y.Patil Institute of Engineering,Ambi,Pune,hemant.salunke@gmail.com*

Abstract-Value Stream Mapping (VSM) has been widely used in construction sector, as a way to use a systemic implementation of Lean Production. Because VSM represents the main principles of Lean Production makes it possible to identify the value flow the main problems and process wastes. It also takes action for improvement. Our aim is introduce the ideas of Lean Production in construction in a more systematic way also identifying its main problems and proposing actions for improvement throughout the value flow. Here we describe the modifications and application of the VSM in a residential construction sector. Modifications of VSM were necessary due to the difference between manufacture and construction. It is possible to identify problems and to consider some actions for improvement and turning it into a more fluid production with minimum stops and increasing the planned flow versus the accomplished one.

Keywords- Value stream Mapping, Lean Construction ,Construction activities Simulation, Cycle time,Waiting time

I.INTRODUCTION

Lean Construction can be defined as handling a construction project as a temporary production system while delivering the product with maximum value and minimum of waste. This can be achieved by developing a value stream that eliminates waiting time and ensures a level schedule and to do so organizations have at their disposition a tool called Value-Stream Mapping (VSM). VSM documents graphically every stage concerned by the material and information flows starting from the reception of an order and ending with the delivery to the end customer.VSM is different than conventional recording techniques, as it collects the information at each stations about station cycle time, up time of resources or utilization of resources, set-up time or change over time of activities. It also collects information about work in process inventory such as list of all content of building, man power requirement and the information flow from raw material to finish goods. It covers both value adding activities as well as non-value-adding activities. It is important to note that value stream mapping is a relatively recent addition to the slate of Lean tools. A value stream is described as all activities and events (both value-added and non-value added) that a product or service passes through on its way from vendor to customer. In a manufacturing facility these activities include shipping, waiting (in inventory, in a queue to be processed, or even in an oven waiting for adhesives to cure), packaging, inspection, rework, and both manual and automated processing. A VSM includes both the flow of product and information.

II. VALUE STREAM MAPPING

Value Stream Mapping (VSM) is one solution to the problem of understanding and improving Value Streams. It follows a product's production path from start to end, and draw a visual representation of every process in material and information flows. Value stream mapping has connective methods that are often used in lean environments to analyze and design flows at the system level .Although value stream mapping is often associated with manufacturing, it is also used in logistics, supply chain, service related industries, healthcare software development, product development and administrative and office processes .the value-adding steps be drawn across the centre of the map and the non-value-adding steps be represented in vertical lines at right angles to the value stream. Thus, the activities become easily separated into the value stream, which is the focus of one type of attention, and the

'waste' steps, another type the value stream the process and the non-value streams the operations..Value stream mapping is part of six sigma methodology

III.OBJECTIVE OF PROJECT

- Study of Lean Construction as a new technique applied for construction industries to increase productivity & minimising waste.
- Collection of data –in site and outsite data for residential building and also Analysis of collected data by Value Stream Mapping tool.
- Preparation of the current state map- Understanding how the project currently operates.
- Preparation of future state map Result will calculate the improvement by comparing current state map and future state map.

IV. METHODOLOGY

The following is a brief description of vsm steps:

- Preliminary decisions: The product families to be analyzed and the indicators needed are chosen.
- Data collection on-site: Data are collected by direct observation and interviews.
- Data processing: Data collected on-site were processed to calculate the defined indicators.
- Design of the current state maps: Using the calculated indicators and observations, the current state maps were elaborated.
- The current state map is to be analyzed and diagnosed: The current state maps were analyzed in order to detect production and environmental waste in the value stream.
- Prepare the future state maps: Using a green-lean approach, the desired future state of the value stream was created.
- Suggestion for achieving the future state: Suggestion were made to establish an implementation plan to produce future plan.

V.DATA COLLECTION

For data collection we have selected a 54 duplex bungalows and Three G + 3 apartments at Wagholi, pune.This is residential project site taken as case study. The data collected from site regarding the activity of construction.

Sr. No.	Name of Activity	Quantity of Work	Work done per day	Diff. type & no. of Workers employed	Duration
1	Line out & Earthwork in excavation.	64.23 m^3	28.30 m^3	Belders-5, Mazdoor-4	3
2	PCC Work.	20.11m^3	8.50 m^3 Per person	Mason-1, Mazdoor-2, Bhisti-1	3

33	Foundation.	44.95 m^3	1.25 m^3	Masons-7, Belder-7, Coolie-5, Bhisti-2	6
4	Murum filling.	47.5 m^3	4 m^3	Belder-3	4
5	Damp proof course.	24.76 m^2	35 m^2	Mason-1	1
6	Brick work in superstructure.	66.59 m^3	2.83 by 3-Masons, 5-Mazdoor, 1-Bhosti	Masons-5, Belder-3, Coolie-5, Bhisti-2	14
7	Lintel work.	20.40 m^2	9.6 m^2	Belder-4, Carpenters-4	3
8	Concrete work for Lintel.	3.01 m^3	2.83 m^3	Belders-2, Mazdoor-3, Bhisti-1, Masons-1	1
9	Cutting & Bending, Centering, Shuttering & Binding steel for slab.	167.27 m^2	9.6 m^2	Belder-10, Carpenters-2	6
10	Concrete work for Slab	25.9 m^3	2.83 m^3 by 3-Belder, 1-Masons, 3-Mazdoor, 2-Bhosti	Masons-4, Mazdoor-12, Coolie-20, Bhisti-6	10
11	Plumbing.	Lump Sum		Plumber-2	3
12	Internal plastering & Dado work.	437 m^2	40 m^2 by Masons-3, Mazdoor-3, Bhisti-1	Masons-10, Belder-15, Bhisti-1	8
13	External plastering.	150.5 m^2	40 m^2 by Masons-3, Mazdoor-3, Bhisti-1	Masons-5, Belder-8, Bhisti-1	3
14	Flooring.	143.35 m^2	40 m^2 by Masons-5, Mazdoor-3, Belders-4	Masons-5, Belder-8, Bhisti-1, Mazdoor-3	4
15	Wood work.	2.52 m^3	0.5 m^3	Carpenters-2, Beldar-1	6

16	White wash.	587.5 m^2	60 m^2 by	Whitewasher-4,	
			Whitewasher-1,	Mazdoor-2	5
			Mazdoor-1		
17	Colouring.	587.5 m^3	35 m^2	Painter-4,	7
				Mazdoor-2	
18	Electric work.	Lump Sum		Electrician-4	3
19	Excavation for compound wall.	19.66 m^3	28.30 m^3	Belders-5,	1
				Mazdoor-4	
20	Compound wall construction.	52.50 m^3	1 m^3 per Mason	Masons-12,	
				Mazdoor-10,	5
				Coolie-7,	
				Bhisti-2	
21	Painting for compound wall.	350 m^2	10 m^2	Painter-5, Mazdoor-3	6
22	Cleaning.	Lump Sum		Belder-2, Mazdoor-3	1

VI.DATA ANALYSIS C.T. ,W.T. ,YIELD OF ACTIVITIES

There Are 16 Pit of Foundation
1 .Earthwork- Total 9 Workers

Total Qt = 64.23m3 Qt For 1 Pit = 4.014 M3 Work Contributed By Per Worker For Per Pit = 4.014/9 =0.446 Work Qt Per Day =28.30 M3

Per Person Work Done Per Day=28.30/9 = 3.14 M3 8 Hr = 3.14 M3:: Ct=0.446 M3
C.T.= 1.136 Hr Waiting Time = 15 Pit X 1.136 Hr = 17.04 Hr Yield = 15 / 16 X 100 =93.36%

2.Pcc

Total Qt = 20.11m3 Qt for 1 Pit = 1.26 M3

Work Contributed By Per Worker For Per Pit = 1.26 /4 =0.315 M3 Work Qt Per Day = 8.50 M3

Per Person Work Done Per Day=8.50 /4 = 2.125 M3 8 Hr = 8.50 M3:: Ct=0.315 M3
C.T. = 0.30 Hr Waiting Time = 15 Pit X 0.30 Hr = 4.5hr Yield = 16 / 16 X 100 = 100 %
3.Foundation
Total Qt = 44.95m3 Qt For 1 Pit = 2.81 M3

Work Contributed By Per Worker For Per Pit = 2.81 /7 =0.401 M3 Work Qt Per Day = 1.25 M3

Per Person Work Done Per Day=1.25 M3 8 Hr = 1.25 M3:: Ct=0.401 M3
C.T. = 2.57hr Waiting Time = 15 Pit X 2.57 Hr = 38.5hr Yield = 14 / 16 X 100 = 87.50 %
4. Murum Filling

Total Qt = 47.05m3 Qt For 1 Dumper = 4 M3 No Of Dumper = 12 (11.88 No) Work Contributed By Per Worker For Per Dumper = 4 M3
Work Qt Per Day = 4 M3

Per Person Work Done Per Day=4 M3 8 Hr = 4 M3:: Ct=4 M3
C.T. = 8hr Waiting Time = 0hr Yield= 75 % App
5. Dam Proof Course

Total Qt = 24.76 M2 Qt For 1 Day = 35m2 Work Contributed By Per Worker = 35 M2 Work Qt Per Day = 35 M2

Per Person Work Done Per Day=24.76 M2 8 Hr = 35 M3:: Ct=24.76 M3
C.T. = 5.66hr Waiting Time = 0hr Yield = 75 % App
6. Brick Work

Total Qt = 66.59 M3 Qt For 1 Day = 2.83m3

Work Contributed By Per Worker Per Day = 283 / 3 = 0.94 M3 Brick Qt Per 1m3 = 450 Bricks
1m3 = 450 Bricks :: 0.94 M3 = 423 Bricks ..... 8 Hr = 423 Bricks :: Ct= 1 Bricks
C.T. = 0.02hr Waiting Time = 599.31hr Yield = 90 % App
7.Lintel Work
Total Qt = 20.40 M2 Qt For 1 Day = 9.6 M2 Work Contributed By Per Worker = 9.6 / 4 =2.4 M2 8 Hr = 9.6 M3:: Ct=2.4 M3

C.T. = 2hr Waiting Time = 20.40 / 2.4 X 2 Hr =17hryield = ((9.6 X 3) – 20.40) / 9.6 = 87.50 %
8.Concrete Work For Lintel

Total Qt = 3.01 M2
Qt For 1 Day = 2.83 M2

Work Contributed By Per Worker = 2.83 / 2 =1.42 M2 8 Hr = 2.83 M3:: Ct=1.42 M3
C.T. = 4.02hr Waiting Time = 3.01 / 2.83 X4.02hr = 4.28hr Yield = 100 % App
9.Bar Cutting & Bending For Slab

Steel Required For 1 M2 Slab = 12 Kg Total Qt = 167.27 M2
Qt For 1 Day = 9.6 M2

Work Contributed By Per Worker = 9.6 / 12 = 0.8 M2 1 M2 =12 Kg :: 0.8 M3 = 9.60 Kg

For 1 M2area Required Steel = 12 Kg 8 Hr = 0.96 M2:: Ct= 1 M2
C.T. = 8.33hr Waiting Time = 167.27 / 9.6 X8.33hr = 145.14hr Yield = 83 % App
10.Concret Work For Slab
Total Qt = 25.9 M3

Qt For 1 Day = 2.83m3
Work Contributed By Per Worker = 2.83 / 3 = 0.94 M 1 M3 =3.4 Bags :: Qt M3 = 1 Bag

For 1 Bag Required Concrete = 0.3 M3 8 Hr = 0.94 M3:: Ct= 0.3 M3
C.T. = 2.55hr Waiting Time = 25.9 / 0.3 X2.55 Hr = 220.15hr Yield = 95 % App

VII. CONCLUSION

The result of current state map and implementing map produce future state map to analysis the productivity with minimizing waste. Value stream mapping is used to minimize the overproduction of goods, excess inventories, unnecessary processing etc.It also improve vendor management, cost benefit analysis, push pull process isolated to continuous etc.

VIII. REFERENCES

[1] Abdulmalek F. A., and Rejgopal J, "Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study", Production Economics, vol. 107, pp. 223-236,2006

[2]Ballard. G., and Arbulu, R, "Making prefabrication lean", Proc., IGLC-12, Copenhagen, Denmark,2004

[3]Gregory A. Howell, Glenn Ballard,Iris D. Tommelein, Lauri Koskela,''Reducing Variability to Improve Performance as a Lean Construction Principle''@ASCE March/April 2002, Vol. 128, No. 2, pp. 144–154,2002

[4]Haitao Yu, Tarry Tweed, Mohamed Al-Hussein, & Reaz Naseri,"Development of Lean Model for HouseConstruction Using V.S.M."@ASCE, Vol 135, No 8, pp. 782-790,2009

[5]Höök, M., and Stehn, L, "Connecting lean construction to prefabrication complexity in Swedish volume element housing", Proc., IGLC-13, July 2005

