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An Introduction to Lean Construction/Visual Management tool in Construction Projects

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Abstract

Visual Management (VM) is a method for informing the board solidly related to one of the inside thoughts of Lean Production Philosophy, the development of methodology straightforwardness. This paper highlights how “Effective Visual Management” in India has the potential to transform the Indian construction industry, providing golden opportunities to the project managers and the other stakeholders associated with the project. It explains the benefits and effectiveness of visual management tools/lean tools in transforming construction projects. This study has been carried out to find the effectiveness of visual management best practices on construction sites in India. The study approach is to a great extent based on the literature review of secondary data taken from existing lean tools/visual management tools and practices based papers and case studies. The theoretical and practical application of visual management tools has been understood and observed while collecting primary data from sites. This paper intends to explain the activity of a great deal of visual management best practices to help new generation building projects, understanding the features that perceive these practices as bleeding edge once, for instance, the reasons for the adequacy of some visual management structures.

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Keywords: Visual management; continuous improvement; Lean construction, India; visual hindrance.

1. Introduction

This paper researches the VM acknowledgement implies (visual tool) and properties in the construction process in the building site, which mostly incorporates mechanical and electrical development exercises. An exploration of visual

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management on the construction site of a specific office will demonstrate a hole in the field and investigate the comprehension of the visual management applications in an alternate development works and its building development/redesign. In spite of the fact that the development of a building gave the greatest section in the development business, modern technology development with exceedingly innovative ventures. It generally forms around a critical 10 % of the business with its procedures, strategies and specific exchanges (Halpin, 2010).

Visual Management (VM) is an important managerial strategy which is a fundamental element of the Toyota Production System that generate highly visual information in fields from the people, who can pull the information for an augmented self-management and control (Ohno, 1988; Shingo, 1989; Greif, 1991). There are one immediate results of VM is to an increment in the communication ability in process components between teams and workers, which is characterized as process straightforwardness. Its different impacts may incorporate expanded construction work environment discipline, and enhancement the employment assistance (Tezel & Aziz, 2017).

Construction sites are normally complex and dynamic situations where teams move around the construction site, the format of the practical application of visual management, a few changes all through the undertaking, and the development itself may turn into a visual management boundary. In contrast with assembling, these properties represent a major challenge to implement Lean Production techniques, for example, process straightforwardness. As India's population keeps on increasing, more residents will move to urban areas. Relocation from rural areas to urban cities Indian urban areas in search of a superior job, better livelihood and way of life is a common issue. A rise in forced evictions, homelessness, inequality, and impoverishment are some of the consequences of this dominant urbanization paradigm, which accepts the 'inevitability of urbanization' as an indisputable reality without addressing its structural causes or impacts on the global ecosystem (Agrawal & Doshi, 2016; Pandey & Pandey, 2018; PWC India, 2017).

2. Literature review

Many of countries spend the time on visual management for applying it on site, I study those case study and analyze it that it is a quick and efficient tool of lean construction which pass the information among team members very accurately. Although the main objective of visual management is to increase the transparency in the process, and also helps to a reduction in viability for improving the continuous improvement other than the core principles of lean constructions. According to the (Koskela, 1992), visual management simplifies the production control and allow faster understanding and also quick response to the problem (Brioso, 2015; da C., Milberg, & Walsh, 2012; Gosling, Naim, Fearn, & Fowler, 2007; Khodeir & Othman, 2016).

Despite the challenges of implementing visual management in construction sites, multiple practices, tasks used in manufacturing have been adapted to the construction industry. In fact, some of visual management practices are usually simple to visualization the information through devices, such as information boards that contain task procedure, multiple drawings, or performance metrics, while towards to another approach which has many types of practices that as usually complex in nature and also require planning stability within the production system.

So likewise it has worth to considering the idea of implementation of visual management beyond the idea of routine that is socially sustain the actions in the construction site. I and we know very well that this lean technique is easy to adopt in our construction industry, however successfully implementation will be done when, how people interact with visual management in ground and how to process is designed to understand the visual management and how much the people will support this technique, through which we can decide how much we success to adopt this lean technique. Is it require to deep understand within the industry management and how will we treat them in context of visual management (S. Dixit, Mandal, Sawhney, & Singh, 2017b; S Dixit, Mandal, Sawhney, & Singh, 2017a; Howell, 1999; Marhani, Jaapar, Bari, & Zawawi, 2013; Sweis, Hiyassat, & Al-Hroub, 2016).

Currently, the existence of visual management literature review from the further case study and a research paper in the construction sector, either conceptual and reviewing the qualitative benefits of the visual management system. And it reflects in site work, it hasn't any limited area to use can also be used in the transportation sector which basically used in construction and any other logistics supply system. (Patel, Karia and Pandit, 2018)

3. Research methodology

The study approach is to a great extent based on a literature review of secondary data taken from journal papers targeting lean construction/visual management in mind. This study analyses all types of visual management tools and their applicability in construction sites. This paper highlights how “Effective Visual Management” in India has the potential to transform the Indian construction industry, providing golden opportunities to the project managers and the other stakeholders associated with the project. It explains the benefits and effectiveness of visual management tools/lean tools in transforming construction projects. This study has been carried out to find the effectiveness of visual management best practices on construction sites in India. The study approach is to a great extent based on the literature review of secondary data taken from existing lean tools/visual management tools and practices based papers and case studies.

4. Discussion

There are many Visual Management Tools available and some of them are,

- I. Standard Signs with Specific Colors (Display Boards)
 - II. Colour Coding
 - III. Visual Display of Data in the form of Graph
 - IV. 5S
 - V. Augmented Construction Field Visualization
 - VI. BIM
 - VII. Collaborative Process Mapping/LPS
 - VIII. End Product Sampling
 - IX. Heijunka
 - X. Big Room
 - XI. Signalling (Andon)
 - XII. Response Guiding (Kanban)
 - XIII. Mistake Proofing (Poka-yoke)
- (Patel, Karia, & Pandit, 2018)

4.1 Standard Signs with Specific Colors (Display Boards)

These are signboards with a combination of standard signs along with specific colour. Some of the types of signboards are as follows (Aziz & Hafez, 2013),

Table *Error! No text of specified style in document.*..1 Sample Components and Purpose of Display Boards

Purpose	Sign Shape	Colour
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Communicating Order	an	Circle	a. Red & Black on White (Prohibition)	b. White on Black (Mandatory)	Example: a. Don't Cross b. Wear Helmet
Communicating Warning	a	Triangle	a. Black on Yellow (Caution)	b. White on Red (Danger)	Example: a. High Voltage Electricity b. Danger for Life
Communicating Information	an	Rectangle	a. White on Blue (General Information)	b. White on Green (Emergency)	Example: a. Process Description b. Fire Exit

4.2 Color Coding

It is a reliable and efficient way to organize different items present in the workplace and visually locate them if something is being misplaced, few examples are,

1. Colour Coding for Pipes (Different colours for different pipes based on their function, example Water pipes can be coded with blue colour)
2. Coloured Sticky Notes or Colored Magnets are used in Visual Management Boards like production boards in order to monitor, track, notify and update the process and project status. A sample format is described below,

Table *Error! No text of specified style in document.* 2 Color Coding

< one week	One – four weeks	> one month	
Red Color Tag			High Priority
Yellow Color Tag			Medium Priority
Green Color Tag			Less Priority or Completed

3. The successor can pull the information from the predecessor by viewing the updated Visual Management Board. This makes the entire workplace more transparent thereby eliminating the chances of delay in conveying of information and moreover any of the stakeholders can understand the situation that is prevailing in the workplace by examining the Visual Management Board for 5 minutes (Ballard, Tommelein, Koskela, & Howell, 2002; Issa, 2013).

4.3 Visual Display of Data in the form of Graph

Representing information's in the form of numbers will be very vague, it makes difficult for everyone to understand the data represented. Hence these data should be represented in the form of graphs for a better and

quick understanding. Some forms of graphs with their functions are listed below (Jamil & Fathi, 2016; Salvatierra-Garrido & Pasquire, 2011),

Table **Error! No text of specified style in document.** 3 Type and Purpose of Graph and Chart

Type	Purpose
Line Chart	To represent the nature of data over a period of time
Column Chart	To compare the data in order to identify the performance

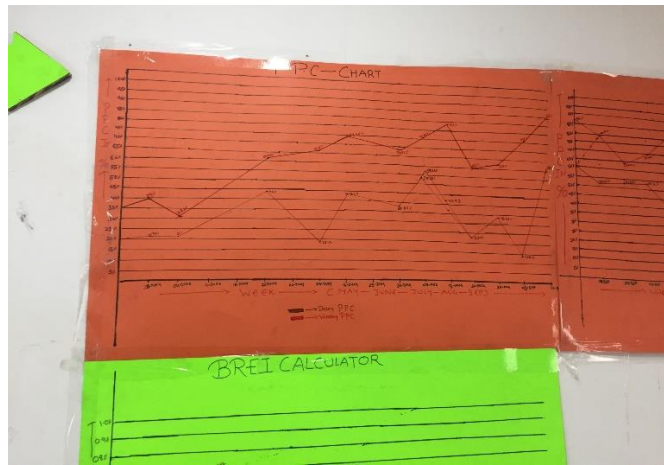


Figure **Error! No text of specified style in document.** 1: Sample Project Performance Chart

4.4 5S

5S is a workplace organization technique, used for organizing and setting up the quality of the workplace. It is a tool for cleaning, sorting and arranging the workplace. 5S helps in improving efficiency by eliminating waste. 5S was initially developed in Japan means (Dunlop & Smith, 2004; Mostafa, Chileshe, & Abdelhamid, 2016; S. Singh et al., 2018)

1. Sort
2. Set in Order
3. Shine
4. Standardize
5. Sustain

(Sowards, 2012)

4.5 Augmented Construction Field Visualization:

Augmented Construction Field Visualization is all about projecting a 3D model of the proposed

design of the upcoming structure with all functions in the proposed site with the help of a mobile device, virtual reality, etc., with the help of Augmented Construction Field Visualization contractors can emphasize on the project progress, method of execution to achieve the desired output. The contractors can also motivate their employees and labours by displaying the virtual prototype of the proposed structure which is going to be stable in the future. So, the stakeholders will get a clear picture of the structure which is going to be constructed. If any changes are supposed to be made by the client on seeing the output of Augmented Construction Field Visualization, it's easy to make in this stage as not much manpower, the cost will occur in this stage when compared to the execution stage (Ansah & Sorooshian, 2017; Meiling, Backlund, & Johnsson, 2012).

4.6 BIM:

BIM is a 3D model which helps Architecture, Engineering, Construction (AEC) professionals to plan, design and construct on a common platform and manage them effectively. For example, a software called Navisworks can take output from various software's like Revit, MEP consultants etc. and feed them in a common platform where quantification can be done, and clash detection can be done which helps in sorting the errors in a design stage through effective design, which ultimately results in increasing the value of the project (Khodeir & Othman, 2016; Poirier, Staub-French, & Forgues, 2015a, 2015b).

4.7 Collaborative Process Mapping/LPS:

Last Planner System is a holistic system that involves the planning team to prepare a plan for the work that needs to be performed in the fore coming weeks. It has five major parts namely

1. Master Planning
2. Phase Planning
3. Make Ready Planning
4. Weekly Work Planning
5. Learning

(Process, System, Management, & Pmo, 2015)

The planning team should be ready with the above-mentioned plan/schedule so that the possible hindrances can be identified, and proper mitigation measure can be taken in order to perform the work seamlessly thereby increasing the value of the project. The LPS is also called as Pull Planning.

4.8 Heijunka:

Heijunka helps in reducing overproduction, it helps in producing according to the customer needs, which helps in the reduction of inventories and facilities. This helps in increasing the value of the project. Heijunka can be done with the help of LPS as the quantity of inventory required is been determined with the

help LPS and that much inventory can be procured and stored in the facility if required. Heijunka also promotes the Just in Time procurement practice, which helps in reducing the facility space for storing the inventories. This also reduces the risk of damages in the inventory when stored in the facility.

4.9 Big Room:

The big room is an important lean tool where all the information regarding the project is displayed with the help of display boards, colour coding, LPS, everything is displayed there. Hurdle meetings take place in the big room which is a 15-minute standup meeting, where construction professionals come and discuss the problems, schedule, cost etc., which they are facing in the site with the help of the various visual tools displayed in the big room. The big room helps to a greater extent in improving the efficiency of the project. The big room is made available to all the respective stakeholders and all the information about the project, LPS, status, the progress of the project etc., every detail is made visible, so that the organization becomes more transparent and risks can be avoided, resulting in increasing the value of the project (S. Dixit, Mandal, Sawhney, & Singh, 2017c; S. Singh et al., 2018; Subhav Singh, Dixit, & Varshney, 2018).

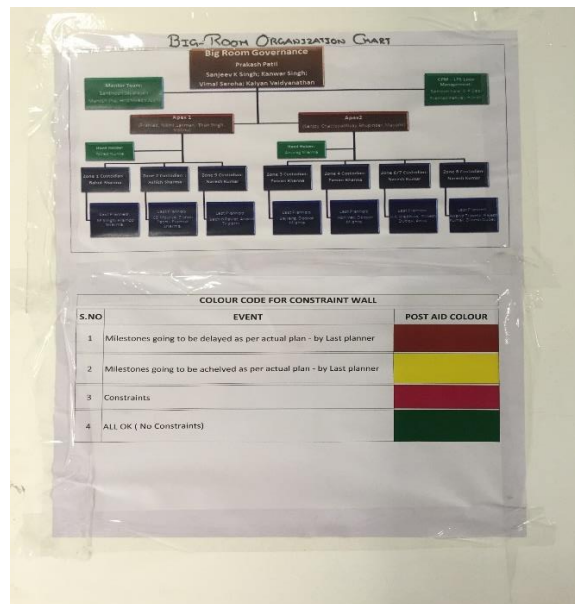


Figure Error! No text of specified style in document..2: Sample Big Room Organizational Chart

4.10 Andon:

Andon is a visual aid which helps in throwing light on areas where action to be taken. If any flaw is identified in a construction process the work should be stopped and proper attention should be given there so as to encounter the issue. This is done with the help of caution lights in the place which is turned on when a

flaw is encountered. So that proper action can be taken by the responsible or authorized person in order to stop further progression of the flaw and to mitigate the flaw.

4.11 Poka-Yoke:

Poka-Yoke is also called mistake-proofing. It helps in reducing the mistake at the origin, rather than taking a mitigation plan after encountering the risk. This helps in reducing the cost, time and resources which is been incorporated to mitigate the risk. In other words, poka-yoke is making sure that all attributes which are required to start a process are readily available and a proper mitigation plan to mitigate if any risk arouses during the process. It helps in preventing errors that are supposed to happen in a process.

5. Conclusion and recommendations

Visual management makes the organization more transparent (Tezel & Aziz, 2017) by making the information available to every stakeholder involved in the project. Through visual management, all the information that every stakeholder required to know is displayed so that it helps in increasing the self-management (Tezel & Aziz, 2017), as one can go through the displayed information and understand the situation in an effective manner (Saurav Dixit, Mandal, Thanikal, & Saurabh, 2019, 2018b, 2018a). Visual management also increases the team coordination (Tezel & Aziz, 2017), as daily meetings were conducted including the necessary stakeholders so that everyone can raise their own demand to increase the value of the project and an effective solution can be drawn with the help of those meetings, it also helps in increasing the relation/understandings among the involved stakeholders. Visual management helps in maintaining better promises (Tezel & Aziz, 2017) as a proper monitor is been kept on the schedule and necessary timely steps are taken in order to prevent all possible risks and delays associated with the project. The control for the management is also made easier (Tezel & Aziz, 2017) through visual management, as because the workplace is very well organized with the help of visual management tools. The workplace environment can be improved through the help of visual management (Afifi, Al-hussein, Abourizk, & Fotouh, 2016; Ansah & Sorooshian, 2017; Bernstein & Jones, 2010; Dunlop & Smith, 2004; Koskela, Ballard, Howell, & Tommelein, 2002; Meiling et al., 2012; Zhang & Chen, 2016).

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