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Comparison of Different Project Management Systems in Terms of Project Life Cycle Assessment in The Construction Industry

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Abstract*—Assessment means to evaluate how effective a process is. For this, a proper framework has to be developed such that the process can be managed, its products can be measured and areas needing improvements can be identified. Such a framework will have to be developed for all processes that considerably affect the execution of a project. This paper proposes a comparison between Lean management, 5S process, Six-Sigma, Value Management and Value Engineering framework for the Construction project life cycle process in the construction industry, which will assist in assessment and finding improvement opportunities in the application of management system in managing the construction project life cycle.

***Index Terms*—Project management, Construction industry, Project Life Cycle.**

I. INTRODUCTION

The Project planning fundamentally means creating the course of project execution. Project planning involves outlining a course of action, deciding on what is to be done, who will do it, how it will be done, when will it be done, and how much it will cost [15]. Planning being the first step of the construction management functions, it decides the success of all the following functions. If planning and managing is not done meticulously, execution and control becomes difficult. The success of a construction project is determined on how well it is executed in comparison with the plan. A good and trustworthy plan will exude confidence in the construction project team. Construction projects have been the subject of common reviews and reports. A significant number of these, including the [1], [3] and [10] recognized recurring themes:

1-The adversarial nature of operation and contractual relationships;

2- A need for combination of the supply chain;

3- A need for simplicity in votive language and arrangements;

4- A need to move away from the cheapest option towards the 'best value' option.

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In this paper, a comparison between different management systems has been performed based on the experts' opinion. According to this comparison, all the management systems have been evaluated and rated in terms of different aspects.

A. Project Life Cycle Assessment

Project Life Cycle Assessment (PLCA) has since been applied to any number of states with variable degrees of success, from smaller industrial products, as in a for the Coca-Cola company [7], to larger, more complex systems, such as cities [14] and regional economies [5]. PLCA has also been applied to Construction. However, the application of the PLCA to construction systems has significant and unique challenges. The five main phases of the project life cycle are: *1-Startup, 2-Explanation, 3-Planning, 4-Executing and 5-Closeout*. It is important to ensure the project life cycle used on your project is appropriate to the work being carried out and split into different and manageable phases. The project life cycle also allows for the gate procedure to be used. This is a tried and tested method for delivering projects on time, within budget and to the expected quality targets. At each stage, approval is generally required from outside the project team before proceeding to the next stage.

B. Lean Management

Though lean production theory was settled for manufacturing, the similarities between craft manufacturing and the construction process makes the lean production theory ideal for application in the construction sector also. The main aim of lean production theory is to decrease or eliminate the share of flow activities in a project while increasing the efficiency of conversion activities. The key principle of lean production theory discussed in detail by [9]. Operation of the Lean management methodologies in construction requires a shift from the way work done in the past. Lean managing methodologies in construction are powerful, but they require support and maintenance. The benefits received from the implementation of the Lean management will be in direct proportion to management's commitment while use of Lean line design decreases the supervision requirements.

C. 5S Process

The 5S process "a place for everything and everything in its place". Five levels of managing that can help in eliminating wasteful resources [8]: Seiri, Seiton, Seiso, Seiketsu, Shitsuke. Spoore [16] indicates that 5S is an area-based system control and improvement.

The benefits of implementation of 5S in the construction industry include improved safety, productivity, quality, and set-up-times improvement, creation of space, reduced lead times, cycle times, increased machine uptime, improved morale, teamwork, and continuous improvement Though production theory was developed for manufacturing, the similarities between craft.

D. Six-Sigma

The potential of Six-Sigma tools to improve processes should be tapped and used in sectors of the construction industry. The application of Six-Sigma Methodology to the construction industry processes is new and not much literature exists in this area. Growing industries like the construction industry should rely on processes that are built to achieve no-defect outputs. This system focuses on detecting and removing process performance variability and uses various statistical methods and tools to achieve close to zero-defect' product [4]. The methodology used to achieve Six Sigma goals is known as DMAIC (Define, Measure, Analyze, Improve, and Control). Using the Six Sigma metrics provided a more thorough understanding of the process and reflected a true picture of its performance. According to [1] the advantage of finding the sigma quality level is not only limited to assessing the capability of the process to produce perfect products, but also in assessing the efficacy of the production planning process in terms of its ability to maintain a reliable workflow between production or construction processes.

E. Value Management

Value management (VM) is a team-based approach used to define the client's objectives and ensure that best value, whole-life solutions are selected to satisfy those objectives. It is not necessarily about cost cutting. To achieve maximum benefit, value management should be carried out from the very early stages of a project, not simply introduced when problems occur. The benefits of a value management review are often perceived in terms of improved quality and reduced cost. Consensus and mutual understanding between stakeholders, clear objectives, reduced risk of changes in scope and improved communications will help to ensure that the project meets the objectives of the client and is delivered within the relevant parameters. The application of value management in construction projects will largely depend on the value of a particular construction project and the level of the risks involved. A key difference between the value management concept and many other processes is that value management focuses on the expected outcome of a project. Only once the outcome is clearly established, understood, agreed and defined, does the process address the question of how it will be delivered.

F. Value Engineering

Value Engineering (VE) is an organized and innovative way for discovering unnecessary costs. It usually manages the costs which are never likely to increase the quality as well as performance, and also not very important from the customer's opinion. Instead, value engineering refers to the repetition of successes" [12]. VE has been considered as a systematic and advanced multidisciplinary method that examines the functional needs of a product design, service design, project design, facility and system in achieving greater value and optimum cost without affecting the level of performance in the program and project [6]. Therefore, it seems very essential in order to utilize this methodology in the construction industry of several countries [11]. VE has been experienced for half a century in the construction industry with a purpose to produce innovative ideas and solutions for improving the value of the project [17]. The ultimate prospective for the application of value engineering exists during the planning and design stage, because its usage in the later stage will greatly increase the level of effort/investment to implement any significant changes which will result in large cost savings [1].

II. METHODOLOGY

During the current study, researchers have been used quantitative method in order to collect the required data. Quantitative method is used in understanding opinions and thoughts and constructing a basis for decision making. It should be noticed that SPSS software version 22 has been used to analyze the collected data. In order to examine the validity of the questionnaire, before starting the main study, researchers distributed a questionnaire among a subsample of 15 participants and factor analysis has been run to see the validity of the questionnaire. The required data have been collected by questionnaire by means of mailed-questionnaire online, which is most economical and convenient way for data collection. Questionnaires of the current study have been sent to36 participants. For the data analysis, descriptive statistics method has selected [13].

A. Research Questions and Objectives

Throughout the last two decades a number of industries, primarily manufacturing and construction, have introduced new methods and techniques to shift traditional paradigms in order to improve their performance. This has led to the creation of new philosophies and management systems. The main objective of this study is to figure out the best management system in the construction project life cycles and identify the vantage of each one compare to the other system in terms different aspects.

III. RESULTS AND DISCUSSION

To investigate about the mentioned objectives of the study, a questionnaire has been used for the data collection procedure. In this chapter the collected data of the study and the results of their analysis based on the mentioned objectives has been presented. In the questionnaire experts were asked to rate the each competency, using a 5-point scale: from 1 rated as poor to 5 meaning excellent. In order to measure the level of consensus among the experts for the factors proposed, the Kendall's Coefficient of Concordance (W) was measured based on the completion of Kendall's Coefficients Concordance and P-value for scoring ranking was 0.812 and 0.000 respectively. In Table 1, the results of questionnaires are shown.

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Table 1: Summarized results of questionnaire and expert's opinions

Lean	5S	6σ	VM	VE	Type of Management / Subject
Mean value					
4.20	4.0	3.12	3.75	3.80	Team Work
4.56	4.21	3.33	4.78	4.46	Improving Design and Planning
3.77	4.60	4.54	4.44	4.79	Improving quality
3.76	3.65	3.31	4.88	4.90	Budget control
3.88	3.43	3.25	3.74	3.56	Improving Working efficiency
2.98	3.88	3.57	3.12	3.01	Development of Information
4.01	4.23	4.55	4.78	4.63	Reducing errors in planning and engineering correction
3.65	4.77	3.88	4.75	4.86	Reducing Time
3.54	3.21	3.65	3.55	3.72	Simplifying of the process
3.61	3.88	4.10	3.66	3.51	Innovation and Technology
4.15	3.65	3.98	4.21	4.34	Easy to apply on Project LC
3.82	3.95	3.75	4.14	4.15	=Average
4	**3**	**5**	**2**	**1**	**Ranking**

IV. CONCLUSION

According to the current research, Value Engineering (VE) management system is the most practical system among the prescribed systems followed by Value Management (VM). Furthermore, the experts believe that 6σ is not an applicable management system in the construction project life cycle based on the outcomes of the current study. The construction organization needs positive thinking and top management support to start on the Value Engineering and Value management implementation. They have to make fundamental changes in their strategic of production, quality improvement and adaptation of new technology.

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