International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 07 | July 2021 www.irjet.net p-ISSN: 2395-0072

Integrating Lean Techniques on Quality Management Practices in Ernakulam: An Analytical Study using RII

Basil Benoy[1], Varsha Susan Thomas[2]

[1]M-Tech Student, Structural and Construction Management, MGM College of Engineering and Technology,
[2]Asst. Professor, Department of Civil Engineering, MGM College of Engineering and Technology, Kerala, India

---

Abstract - *The construction sector in Kerala is growing day by day. Ernakulam, the construction dominant city in Kerala, has the highest GDP per capita in the state. Therefore, the construction industry and infrastructure projects play an important role in this, so there are many opportunities to study and analyze construction management here in the city. As there is a very competitive market today, construction companies focus only on budget-oriented factors and principles, and not on schedule completion and quality management. Focusing on budget factors often compromises quality, but while customers expect lower costs, they also expect better quality and better value delivery from companies. This work aims to analyze and evaluate the factors affecting quality management practices on building construction sites in the Ernakulam district with a view to improve the quality management. It involves selection of construction sites including infrastructural and residential projects conducting a quality study of the site through questionnaire surveys and analysis of the collected data by using Relative Important Index (RII) model.*

Key Words: **Quality Management, Lean Techniques, Productivity, SPSS, RII**

1.INTRODUCTION

In India, the construction sector is the driving force for Indian economic growth and employment generation. The construction industry is a major contributor to India's Gross Domestic Product (GDP), both directly and indirectly. In the competitive construction market, due to changing characteristics of recent design, it seems that good management is taking the place of time management which was generally adopted by the construction industry in the past decade. The increasing complexity and competitiveness in construction projects around the world have necessitated the use of mechanized equipment for their speedy and accurate execution. Unfortunately, the management of this industry has not improved to the specified extent of several constraints. There is a need for improvement by the proper organization, planning, decentralization, and adoption of improved management techniques. The construction sector in Kerala is growing day by day. Ernakulam, the construction dominant district in Kerala, has the highest GDP per capita in the state. Therefore, the construction industry and infrastructure projects play an important role in this, so there are many opportunities to study and analyse the construction management here in the city.

1.1 Quality Management in Construction

Although construction industry is of great economic importance, construction industry is plagued by many issues like low productivity, severe skill shortage and limited mechanization. Performance of a construction project can be measured as compliance to time, cost and quality, and it is a very complex process. With the increasing size of the project, the number of project participants also increases and the objectives of all participants need not be the same. Time, cost and quality are the widely used performance measure of a construction project. Out of the three fundamental constraints, quality is the most important criteria of project success and these three factors of the construction project performance is generally expressed in terms of cost and its variance from the budget. The definition of quality is the performance to standards or value purchased the worth. For construction, firm quality is nothing but the satisfaction of consumers and fulfilling their requirements within a specified budget.

Under the increasingly competitive environment today, construction companies focus only on budget-oriented factors and principles, and not on schedule completion and quality management that specialize in budget factors often compromises quality, but while customers expect lower costs, they also expect better quality and better value delivery from companies.

1.2 Lean Construction

Lean Construction is an efficient technique that aims at eliminating the wastes in construction. The goal of Lean construction is to understand customer satisfaction by using less of everything, i.e. materials, money, and resources. This construction method is best fitted to complex and speed projects. It focuses on process improvement through the reduction of duration for every activity. The principles of Lean construction contain seven keys that are specific value, identify and map the price stream, flows, pull, perfection, transparency, process variability. Currently, several construction companies from other countries are beginning to implementing lean construction with nebulous hopes of obtaining better results from their current projects. In India, the implementation of lean management in the construction

industry could also be a serious task. Hence, Indian construction industry possesses to familiarize lean practices and adopt them into the application. Other font types may be used if needed for special purposes.

2. OBJECTIVE

The objective of this study is to identify the critical factors impacting quality across the design consultants, contractors, and client perspectives who are involved in public works in Ernakulam. This study also aims to integrate Lean tools to improve the management practices and delivering better quality projects.

3. METHODOLOGY

This study involves identifying various lean construction tools and techniques that are prevalent in the construction industry from the productivity field study and literature survey. The factors of some popular lean techniques are derived, and a questionnaire was formulated. The construction industry experts are asked to rate the factors with five-point scale in the questionnaire. The collected data are analysed by using Statistical Package for Social Science (SPSS) Software. The most rated factors were ranked on the basis of Relative Importance Index (RII) and key lean techniques were identified.

2.1 Productivity Study – Muda Walk

Many terms are identified to describe productivity within the construction industry: performance factor, production rate, unit person-hour rate, etc. Traditionally, productivity is considered as the ratio of input/output. The objective of the productivity study is to find the factors affecting the quality and productivity enhancement of the construction projects. The study was conducted on a construction project of SKR Builders, Perumbavoor. The selected project is a G+2 apartment building at Perumbavoor town with a total area of 1390.4 sq.m.

Measuring waste is an efficient way to assess the performance of the production system. The seven waste activities or 'muda' are overproduction, overstocking, excessive motion, waiting time, extra processing, motion and rework. The inefficiency of labour due to these seven wastes was identified and quantified by collecting data through direct observations. The inefficiency of labour was evaluated using work sampling. Random work sampling was carried out for a period of one month at the construction site from 25 February 2021 till 26 March 2021. Main activities monitored include RCC concreting and reinforcement work as well as PCC work. An average of 22 labourers was employed on the site during the period, whose performance was tracked and identified as Direct work (working), Indirect work (Supporting) and Delay (non–working). These are denoted as Value Adding (VA), Non-value-adding but required (NVAR) and Non-value-adding (NVA) activities respectively.

The significant activities were monitored and average non-value adding time in percentage was then calculated and the cost of the inefficiency of labour was obtained from the equation below.

$$\text{Cost of labour inefficiency} = \frac{T\ N\ D_d\ W}{100}$$

Where, D_d = project duration in days
N = average no. of labour per day;
T = average non-value adding time of labour in % and
W = average daily wage of labour

Table -1: Labour work sampling results

Labour work sampling results		
Activity	Type	Project
Direct work	VA	57.3
Supportive works	NVAR	29.03
Waiting for pre-requisite work	NVA	1.32
Waiting for materials	NVA	2.05
Waiting for instruction	NVA	4.35
Additional inspection	NVA	0.93
Travelling with materials	NVA	3.96
Idle tradesman	NVA	1.07

The site productivity was measured to be 57.3% which is fairly good. Non-value adding activities which included both supportive and non-productive works had a share of 42.7% (29.03+13.68). The main delays were attributed to the material handling difficulties, waiting for instruction and personal breaks. The construction work estimate amounts to a total of Rs.24480350. The labour inefficiency was quantified in terms of cost using the cost inefficiency equation and was found out to be Rs. 68,498 which amounts to 0.28 % of the total budget.

Table -2: Cost of inefficiency

Cost of inefficiency	
Parameter	Labour
Average % of VA time	57.3
Average % of NVAR time	29.03
Average % of NVA time	13.68

Sample activity duration in days	14
Total cost of inefficiencies (Rs)	68,498
Waste in % of project cost	0.28

It is found that the cost of labour inefficiency put together amounts to about 0.28% of the total project cost. This implies that there is a large scope to improve the performance of the project through proper lean management techniques. So this productivity field study and other factors like weather variables, material shortages, lack of experience, and restrictive union rules, etc. helped to find the factors affecting the quality and the productivity enhancement of the construction projects.

2.2 Development of Questionnaire Survey

The research uses carefully designed a questionnaire to collect the perceived opinions of the most possible causes of quality management among the three key stakeholder groups. Many past pieces of research have been conducted on quality management, especially in developed countries, and therefore, an initial list of the attributes affecting the quality of the construction was formulated from these literatures including journals. From the field study and the study of the literature, a list of 50 attributes was obtained.

Using the attributes collected from the literature and the field study, a questionnaire was then framed to get respondent's views on the impact of these attributes on quality management. The questionnaire contains two sections. The Section A contains a questionnaire on the impact of each attribute on the quality management of the project. Section B is the questionnaire about general information of the given project and respondents. The respondents were asked to provide their opinions on the impact of all the attributes affecting quality management from one of their past or current projects on a five-point Likert scale.

Table -3: Impact Rating Scale

Impact Rating Scale		
Impact Ratings	Description	Number
Negligible	Negligible impact on quality management of the project	1
Marginal	Marginal impact on quality management of the project	2
Moderate	Moderate impact on quality management of the project	3
Major	Major impact on quality management of the project	4
Nil	No impact on quality management of the project	0

Based on the literature survey and research various lean techniques are identified. Some lean tools have adopted for implementation are visual stream mapping, Kanban, 5s, just in time, huddle meeting, last planner system, PDCA (Plan, Do, Check, Act), muda walk, reduce cycle time etc.

2.3 Data Collection

Respondents are selected from a wide range of professionals engaged in Ernakulam construction projects (contractors, clients and engineers). Table 4 shows a brief description of respondent's profile in terms of professional role and experience who participated in the study. Data are collected from construction professionals of Ernakulam through online survey. A total of 50 questionnaires were mailed both by hard copy and via email, out of which 42 valid responses were obtained with a response rate of 84%. The respondents include 9 clients, 22 contractors and 11 consultants. Since the consultants were employed by the clients to take care of the client's interests, the consultant's responses were not significantly different from that of clients. They were merged with client's responses. Amongst the respondents, the highest proportion (52%) was from the contractors involved in construction activities followed by the clients (26%). Respondents from the roles of consultants were 22%. The average experience of the respondents was about 10 years.

Table -4: Impact Rating Scale

Impact Rating Scale					
Category of stakeholder	Experience (years)			Total	% responses
	0-10	10-20	>20		
Client	6	3	2	11	26
Contractor	16	4	2	22	52
Consultant	6	2	1	9	22
Total	28	9	5	42	100

2.3 Data Analysis

The survey is conducted by asking the construction professionals to rate the factors on five-point scale. Number of experts participated in the survey is 42. Based on the ratings given by the professionals, the rating is analysed using SPSS. Relative Importance Index (RII) is used to determine the relative importance of quality factors involved. To assess the likelihood of each identified factor of various techniques of lean five point Likert-scale of 0-4 was used, where scale of 0-No impact ;1-Negligible impact; 2-marginal impact; 3-Moderate impact; 4-Major impact. All the respondents were asked to rank each factor as per degree of importance. The identified factors were then ranked on the

basis of Relative Importance Index (RII). The equation used for RII is:

$$RII = \frac{\Sigma (P_i \times U_i)}{(N \times n)}$$

Where,
P_i = Respondent's rating
U_i = Number of respondents placing identical rating
N = Sample size
n = Highest value on Likert scale

The RII for all factors was calculated by the equation given above. The mean of RII of various factors leading to each technique where calculated as shown in the following tables given below.

Table -5: Mean of RII for factors of lean technique Huddle meeting

Lean Technique : Huddle meetings			
No.	Attributes	RII	Mean
1	Do you share your previous experience with employees on the project?	0.523	0.592
2	Is there a guiding quality plan that defines staff duties and responsibilities for identifying defects within any project?	0.559	
3	Lack of coordination among project stakeholders	0.647	
4	Uniqueness of the project activities requiring high technical know-how	0.562	
5	Fraudulent practices and corruption	0.585	
6	Are training programmes given to the labour force prior to construction?	0.678	

From the Table 5 shown above it is observed that the mean of RII obtained is 0.592 for the questions derived from factors of huddle meetings technique. This tool is similar to the lean manufacturing concept of employee involvement, which ensures rapid response to problems through empowerment of workers, and continuous open communication through the tool box meetings. Two-way communication is the key of the daily huddle meeting process in order to achieve employee involvement. With awareness of the project and problem solving involvement along with some training that is provided by other tools, employee satisfaction will increase.

Table -6: Mean of RII for factors of lean technique Standardization

Lean Technique : Standardization			
No.	Attributes	RII	Mean
1	Is there a proper communication channel between the contractor and the customer?	0.577	0.602
2	Are customer needs studied and properly understood throughout a project and does the required production take into account the said needs?	0.571	
3	Is the institution flexible? Can it adapt to environmental change using relatively less resources?	0.660	

From the Table 6 shown above it is observed that the mean of RII obtained is 0.602 for the questions derived from factors of standardization technique. Standardization is one of the main features of lean construction since it adopts the philosophy of keeping things consistent for the workers. A clean, organized, and logical jobsite will lead to shorter cycle times and increased productivity. It systemizes operations and materials so that movements between operations and needed resources are efficiently used. The overall construction cost decreased as well as construction time on-site.

Table -7: Mean of RII for factors of lean technique Reduce Cycle Times

Lean Technique : Reduce Cycle Times			
No.	Attributes	RII	Mean
1	Are the employees aware about waste elimination goal of the organization and its projects?	0.642	0.619
2	Is there a measurement system to quantify the unused ordered material on site?	0.630	
3	Are the materials, prior to their use, stored anywhere near the construction site?	0.547	
4	Does the firm have planning and control departments?	0.529	
5	Do projects use risk management techniques?	0.660	
6	Has there ever been a situation whereby an activity was delayed due to non-availability of resources on time?	0.642	
7	Are measures deployed to measure labour productivity on site?	0.702	
8	Pilfering and waste on site	0.604	

From the Table 7 shown above it is observed that the mean of RII obtained is 0.619 for the questions derived from factors of reduced cycle time technique. Cycle time can be progressively reduced through elimination of non-value adding activities and variability reduction. The shorter the cycle time, the more cycles are affordable. For the point of view of improvement, the cycle time from becoming conscious of a problem or an opportunity to the implementation of a solution is crucial. In traditional organizations, this cycle time sometimes goes infinite due to

lack of communication where no message is passed, or in case long channel of communication where the message gets distorted

Table -8: Mean of RII for factors of lean technique Visual Management

Lean Technique : Visual Management			
No.	Attributes	RII	Mean
1	Do you thoroughly review the design drawings at early stages to avoid late variations?	0.678	0.708
2	Do you use visual management system on site, such as electronic status board, mobile signs or safety signs?	0.738	

From the Table 8 shown above it is observed that the mean of RII obtained is 0.708 for the questions derived from factors of visual management technique. Visualization in general, and particularly in construction projects, is a convenient and intuitive way of conveying project information among various project parties. One of the major causes of accidents is unsafe site conditions, which basically is due to inadequate supervision with poor visualization. The increased visualization lean tool is about communicating key information effectively to the workforce through posting various signs and labels around the construction site

Table -9: Mean of RII for factors of lean technique Last Planner System

Lean Technique : Last Planner System			
No.	Attributes	RII	Mean
1	Mistakes or changes in project design or scope	0.519	0.591
2	Inadequate contractors experience	0.752	
3	Financial difficulties of client	0.642	
4	Financial difficulties of contractor	0.582	
5	Poor financial control on site	0.552	
6	High interest rate	0.601	
7	Unexpected site conditions	0.571	
8	Frequent breakdown of construction equipment	0.566	
9	Rework required due to poor work or the wrong materials used by contractors	0.619	
10	Adverse effect of weather	0.622	
11	Political issues	0.533	
12	Suspension of work	0.533	

From the Table 9 shown above it is observed that the mean of RII obtained is 0.591 for the questions derived from factors of Last Planner System. The Last Planner System (LPS) is a collaborative planning process that involves trade foremen or design team leaders in planning in greater and greater detail as the time for the work to be done gets closer. In the UK it is sometimes known as Collaborative Planning and, in the USA, sometimes called Pull Planning. It systemizes operations and materials so that movements between operations and needed resources are efficiently used. The overall construction cost decreased as well as construction time on-site

Table -10: Mean of RII for factors of lean technique PDCA (Plan, Do, Check, Act)

Lean Technique : PDCA (Plan, Do, Check, Act)			
No.	Attributes	RII	Mean
1	Inaccurate cost estimation	0.685	0.644
2	Improper planning and scheduling	0.619	
3	Availability and supply of labour and materials	0.642	
4	Size and complexity of projects	0.652	
5	Schedule Delay	0.623	

From the Table 6.7 shown above it is observed that the mean of RII obtained is 0.644 for the questions derived from factors of PDCA (Plan, Do, Check, Act). Plan-Do-Check-Act is a scientific method used to manage change, and is also known as the Deming Cycle. The PDCA cycle involves four parts:

- Plan – Recognize an opportunity or process that needs improvement.
- Do – Create a small test.
- Check – Analyse the results of the test.
- Act – Move forward based on those results.

PDCA is used to create a more efficient process in material management. One of its award-winning achievements was its ability to reduce the time to move parts from the receiving department to the stock department. Initially, this process took 30 days, but the entire process was shortened to four hours. PDCA framework works well in all types of organizations. It can be used to improve any process or product, by breaking them down into smaller steps or development stages, and exploring ways to improve each one.

Table -11: Mean of RII for factors of lean technique Muda Walk

Lean Technique : Muda Walk			
No.	Attributes	RII	Mean
1	Effective monitoring and feedback process	0.757	0.701
2	Regular budget update	0.661	

From the Table 11 shown above it is observed that the mean of RII obtained is 0.701 for the questions derived from factors of Muda Walk. Muda in Japanese means waste. The idea of of Muda walk is that the problems are visible, and the best improvement ideas will come from going to the gemba. The muda walk, is an activity that takes management to the front lines to look for waste and opportunities to practice. Muda walks purpose is to develop "eyes for waste". The Muda Walk is a simple tool any manager can use. Invest the time in watching what is happening, and it will payback dividends. Muda walk helps the manager to identify the potential areas of improvement (waste is identified). The important thing is that it drives action and engages the people in the workplace (at all levels) on removing waste from your business.

Table -12: Mean of RII for factors of lean technique Just in Time

Lean Technique : Just in Time			
No.	Attributes	RII	Mean
1	Do you rely on the schedule look-ahead to improve the work flow?	0.619	0.654
2	Do you ensure that the information flows smoothly between all the departments on the project?	0.589	
3	Do you procure materials just before the requirement during process to decrease the volume of inventory on site?	0.642	
4	Do you consider the importance of the smooth and efficient flow of information, materials and equipment on site?	0.619	
5	Do you prefer work flexibility on site (e.g., Assigning of multi-skilled labour to different activities on site)?	0.678	
6	Methods and techniques of construction	0.714	
7	Price fluctuations of raw materials	0.638	
8	Long period between design and time of bidding/tendering	0.555	
9	Shortening in project period	0.702	
10	Timely decision making by consultant	0.792	

From the Table 12 shown above it is observed that the mean of RII obtained is 0.654 for the questions derived from factors of Just in Time. Construction JIT will be advanced by implementing demonstrated techniques and industry research to test theories and develop new tools and techniques. Construction and manufacturing are different types of production; nonetheless a form of JIT is applicable to construction, in which physical buffers may ultimately be replaced by better managing uncertainty and eliminating the causes of flow variation. As the implementation of plan buffers propagates certainty throughout projects, productivity will improve from better matching labour to work flow, and project durations will shorten as physical buffers shrink with the flow variation they are designed to absorb. A new way of conceiving the tasks and tools of construction project management has been proposed. Instead of relying simply on schedule push, managers are advised to systematically employ plan-pull as a means of adjusting to uncertainty and insuring that resources are employed to maximum advantage at each point in time.

Table -13: Mean of RII for factors of lean technique Value Stream Mapping

Lean Technique : Value Stream Mapping			
No.	Attributes	RII	Mean
1	Mode of financing and payment of completed stages	0.652	0.623
2	Poor site management and supervision	0.595	

From the Table 13 shown above it is observed that the mean of RII obtained is 0.623 for the questions derived from factors of value stream mapping technique. The ultimate goal of VSM is to identify all types of waste in the value stream and to take steps to try and eliminate. Waste is anything that creates no value for the parties involved in the process namely owner, customer, and consumer. Therefore, waste is defined in terms of value and there is no absolute definition of waste, it is all relative. Therefore, the definition of value stream map should be extended as a tool which uses to identify the waste and waste causes exist in current process and find appropriate process design for removal of wastes which only add value to the process. Value stream map is identified as an essential tool because it helps to visualize the process, waste and its sources, information and material flow.

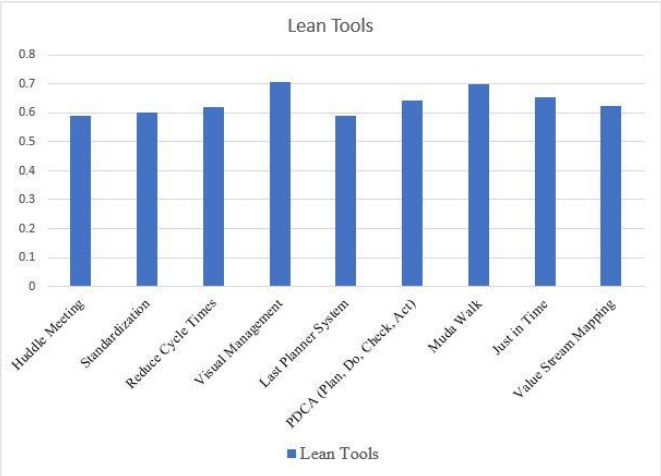

Chart -1: Ranking of Lean tools according to their RII mean values

From the chart 1, it can be observed that the technique Visual Management has the highest RII mean value and considered as the key priority technique. other techniques in the order of ranking are Muda Walk, Just in Time, PDCA, Value Stream Mapping, Reduce Cycle Times, Standardization, Huddle meeting, Last Planner System.

3. CONCLUSIONS

In the field study, Muda walk was selected for measuring the productivity of the site. It was carried out for a period of one month at the site from 25 February 2021 till 26 March 2021. Their performance was tracked and significant activities were monitored. Muda walk, as lean tool has helped to quantify the labour inefficiency in terms of percentage of project cost and revealed that the inefficiency accounted to 0.28% of the estimated project cost for a period of one month. This throws light on the scope for improvement and helped to find the factors affecting quality and hence developing the questionnaire survey. Focusing on the three major stakeholder groups namely, consultant, client and contractor, this study investigated the critical factors affecting quality management on construction projects. Based on the analysis, it is found that lean construction has influenced Indian construction industry meagrely and on comparing the traditional methods and lean construction techniques, still construction industries rely upon traditional methods for various processes in the implementation stage. Various factors derived from lean techniques were ranked on the basis Relative Importance Index (RII). The factors with higher RII value were identified and the respective lean techniques were determined.

From the ranking obtained the key lean techniques prioritized are Visual Management, Muda Walk, Just in Time, PDCA, Value Stream Mapping, Reduce Cycle Times, Standardization, Huddle meeting, Last Planner System. Visual Management has the RII mean value of 0.708 which is the highest and considered as the key priority technique. The findings of the RII validate the fact that the use of Visual Management tool is not that much popular among the construction industry professional as a Lean tool. The application of visual management is gaining its presence in the construction industry due to its value increasing the potential of the project. but still many of the sites lack visual management due to lack of knowledge about visual management, they were not aware of the pros of visual management and its role in increasing value to the project and benefiting the organization. Visual management will contribute a lot to the construction industry in the future, as contractors are nowadays becoming aware of visual management and its role in increasing the value of the project. Hence I conclude by saying that visual management helps a lot in enhancing the value increasing factors of the construction site

REFERENCES

[1] O Z Oni L M Amusan, J D Owolabi and B F Akinbile, "Factors affecting quality management practices on building construction sites in Nigeria," International Conference on Science and Sustainable Development, 2019, doi:10.1088/1742-6596/1299/1/012009.

[2] Rustam Khayrullin, "Quality Management of Building Materials and Building Productions Based on the Using of Real Estimates of Measurement Accuracy", IOP Conference Series: Materials Science and Engineering, 2019, doi:10.1088/1757-899X/661/1/012127.

[3] Archana M, Renuka S, and KarthigaiPriya T., "Identification and Analysis of Lean Techniques in Indian Construction Projects", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), 2018, Volume 14, Issue 2, doi: 10.9790/1684-1402046269.

[4] Weiqi Xing, Jian Li Hao, Liang Qian, Vivian W.Y. Tam, and Karol S. Sikora, "Implementing Lean Construction Techniques and Management Methods in Chinese Projects: A Case Study in Suzhou, China" Journal of Cleaner Production, Elsevier, 2019, JCLP 124944.

[5] Devika Vijayan Minu and Anna Johny, "A Study of Implementing Lean & Fast Tracking in Construction Project Management" International Research Journal of Engineering and Technology (IRJET),2019, Volume 06 Issue 06

[6] Harsh Shah, Karan Asnani, Rishabh Shah, and Aliasgar Chasmawala, "Last Planner System" International Research Journal of Engineering and Technology (IRJET), 2019, Volume 06 Issue 11

[7] Ganesh Digambar Maid and Gaurav Desai, "Enhancement of Productivity and Minimization of Waste using Lean Construction Techniques", International Research Journal of Engineering and Technology (IRJET), 2019, Volume 06 Issue 05

[8] Krishna P. Kisi, Nirajan Mani, Eddy M. Rojas and E. Terence Foster, "Estimation of Optimal Productivity in Labor-Intensive Construction Operations: Advanced Study", American Society of Civil Engineers, 2018, (ASCE), 1943-7862

[9] Nor Syahirah Azman, Mohd Zakwan Ramli, Ruzaimah Razman, Mohd Hafiz Zawawi, Iszmir Nazmi Ismail, and Mohd Rashdan Isa, "Relative importance index (RII) in ranking of quality factors on industrialised building system (IBS) projects in Malaysia" AIP Conference Proceedings, 2019, doi/abs/10.1063/1.5118033

[10] Mamata Rajgor, Chauhan Paresh, Patel Dhruv, Panchal chirag, and Bhavsar Dhrmesh (2016), "RII & IMPI: Effective Techniques for Finding Delay in Construction Project", International Research Journal of Engineering and Technology (IRJET), Volume 03 Issue 01