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## IMPLEMENTATION OF AGILE MANAGEMENT IN CONSTRUCTION OF DIFFERENT INFRASTRUCTURE PROJECTS

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### ABSTRACT

Agile methodology is a type of project management process, mainly used for software development, where demands and solutions evolve through the collaborative effort of self-functional teams and their customers. During the past few decades, fundamental changes have taken place in project development, planning, and execution. This has taken from with embracing new techniques such as various agile project management, instead of using the traditional waterfall project management. . It is mainly suitable for complex project, where there is delay in construction projects & final deliverable in advance. Construction delays are a common phenomenon in civil engineering projects. There are many reasons to delay in construction as pre-design, design and execution phase. It leads to time overrun in the construction work. Completion of construction projects on time seems to be challenging tasks in large-scale construction. It has been observed that about 90% of government infrastructure projects fail to achieve on time completion in India. Time is a major factor in construction and on time completion will bring about many benefits to the client, contractor and the society. This thesis paper will discuss and finding out the reasons for delay in two different construction project and apply agile management methodology where the delay is identified in this construction works. Also will prove the scope of agile management in construction industry in future.

**KEYWORDS:** Agile project management, Scrum, Execution phase

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### I. INTRODUCTION

Agile project management has its roots in the software development industry, and it has developed through empirical progress. This methodology's uses are not limited to that industry. It defines values and principles that can be adopted by other industry as well. Moreover, it includes different tools and methods of conducting a project, which will lead to follow its values and principles. The agile methodologies are widely used by the software development industry where the customer recognized his need and improving it by repeated tests.

A traditional concept of management, the responsibilities and authorities are defined in a hierarchy so if a middle level chain is broken than the ground level subjects are failed. In agile concept, the basic belief is to keep all responsibilities & authorities on the same level such that even if there is a failure in single subject, the remaining subject can work efficiently in their sectors. Utilizing agile methods to develop and implement systems has improved the speed in which companies meet market demands. Given the relative newness of the agile project management approach, some research exists, but much more is needed to understand how the backbone components of agile project management can be used in a construction project development process.

#### 1.1. Agile project management in construction

Application of agile project management is mainly seen in software industry which follows an iterative and incremental method which assures efficiency in the project by reducing the delay. Many researchers have been done on the application of APM during the pre-design and design phases of construction projects. It seems application of APM is laborious in the construction phase. The concept of agility is applied by dividing the entire project into smaller manageable parts and completing each part.

Some basic concepts of agility include:

- Avoiding inflexible processes that can't be changed.
- Using short iterative processes allowing for improvements to be quickly implemented or failures to be identified before the end product.
- Emphasizing learning and continuous improvement.
- Identifying issues and weaknesses as soon as they occur.
- Implementing root cause analysis to determine the cause of problems.
- Changing processes to suit specific projects, goals.
- Focusing on continuous training and mentoring.
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## II. SCOPE AND OBJECTIVE

The objective of this paper is to study the different literatures about agile management and identify the utilization of agile management in construction industry

The scope of paper includes:

- To study the traditional project management and agile project management principles related to construction industry.
- To study the effect of agile management in construction industry
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## III. METHODOLOGY

Literature study, questionnaire survey and case study analysis methods are followed for this thesis. The step by step methodology for this thesis is

- Study of literature to identify delay causes in infrastructure projects
- Delay analysis and ranking by survey method
- Case study analysis to identify areas of delay
- Application of APM.

## IV. DATA ANALYSIS

There are many delay reasons were identified from various literatures and analysis and ranking was done by conducting survey from which the relative importance index was found. The delays were then grouped to each phases of the construction projects and the major causes were identified. This step forms the basis to know the major delay factors were APM can be applied.

Relative importance index (RII) was found using the formula

$$RII = \frac{\sum W A}{N}$$

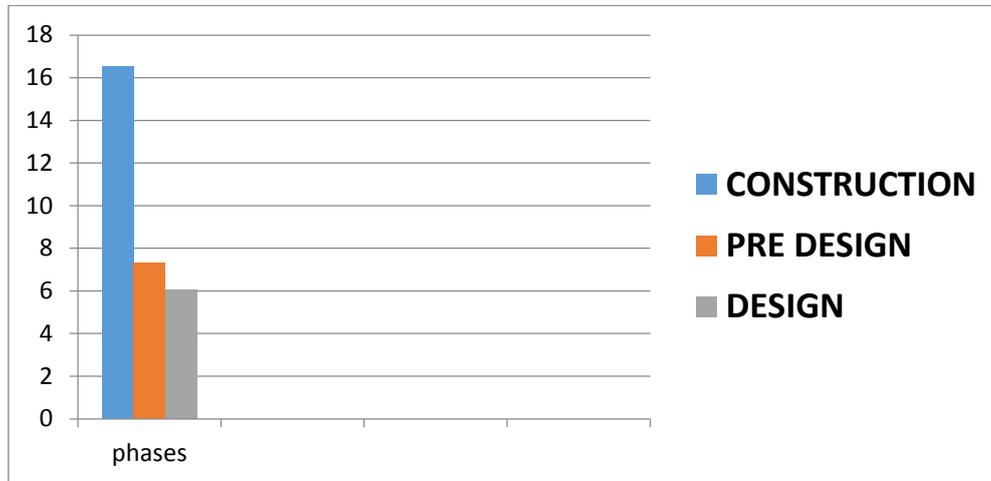
$\sum W$  – Weighting given to each cause by respondent ranges from 1 to 5 where '1' is not significant and '5' is extremely significant

A – Highest weight i.e. '5' in this case

N - Total No. of respondents

### ❖ Case study 1

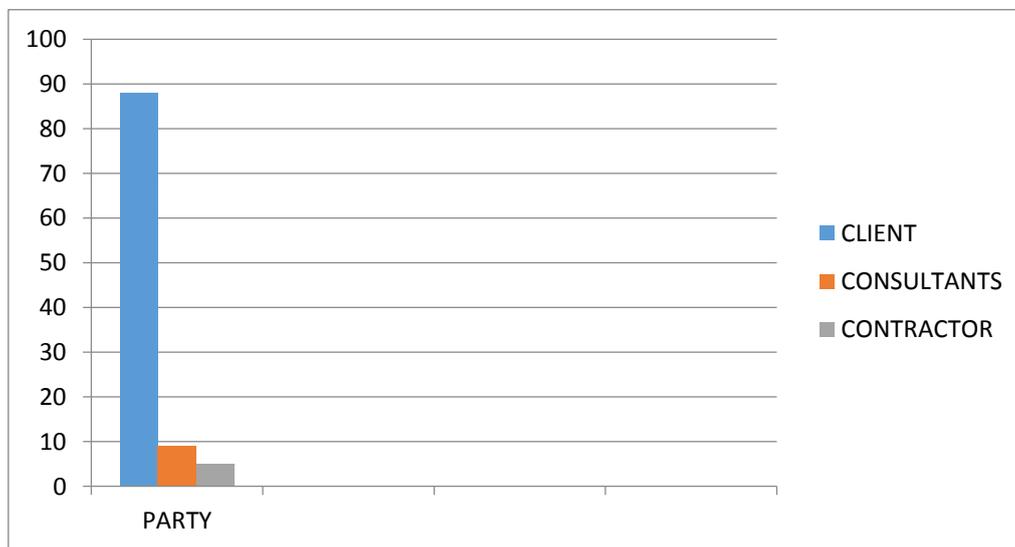
Based on the relative importance index delay due to owner's interference and owner's slow decision making topped the first rank with RII of 1. Based on grouping the delay causes to the phases of the project, it was found that delay reasons were major in construction phase.



**Chart-1:** Grouping of delay causes based on the phases involved in the project 1.

The parties that usually involve in construction projects are client, consultant and contractor. The level of party contribution to each phase for infrastructure projects were then identified by classifying the delay causes based on the contributor. It was seen that client contributed majorly to the delay during the pre-design phase followed by consultant and client majorly contributing at design and construction phases respectively.

This is a generic data analysis and the contribution level may vary for different projects based on the conditions and situations. It was observed that the client contributed for about 88% delay in the pre-design phase of the infrastructure project followed by consultant with 9%.



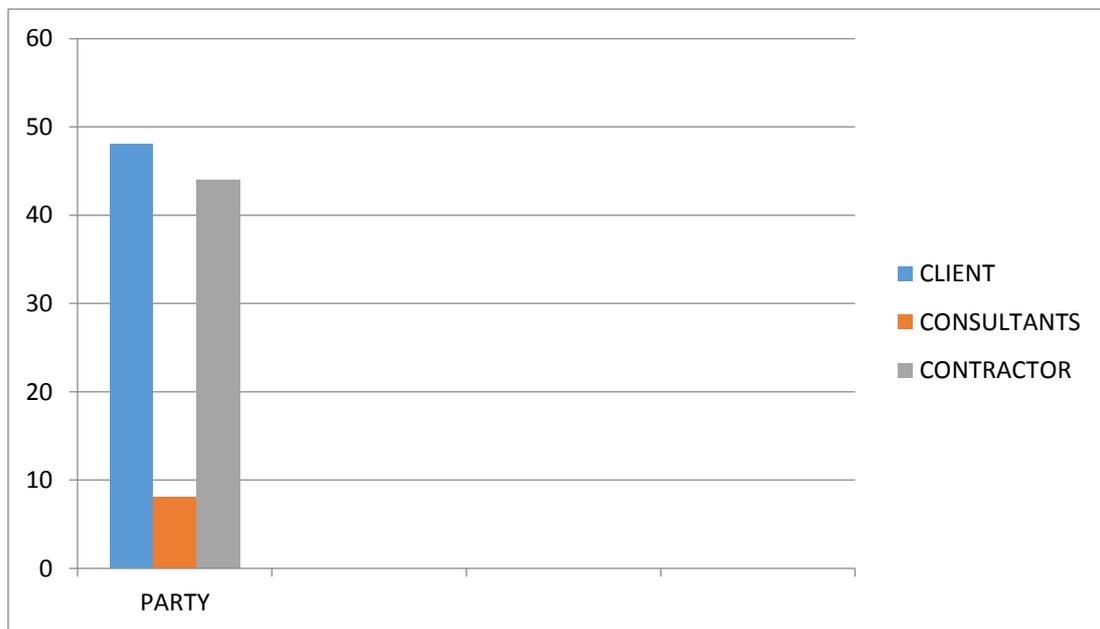
**Chart-2:** Party contribution in pre-design phase of an infrastructure project 1

During the design phase, the consultant seems to contribute to delay for about 52% followed by the contractor and client almost equally contributing by 48%.



**Chart-3:** Party contribution in design phase of an infrastructure project1

Finally for the construction phase it was observed that the client contributed the most to delay accounting to percentage contribution of 48% followed by contractor with 44% and consultant with almost negligible 8%.

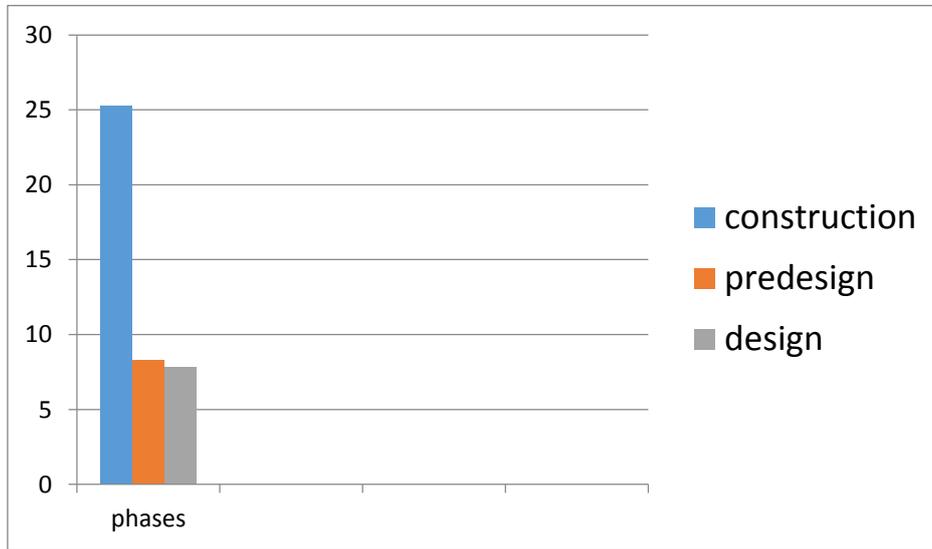


**Chart-4:** Party contribution in execution phase of an infrastructure project1

These analyses have helped to identify the areas where APM can be applied and the delay contributors in each level. It can be seen that client is the main contributor to delay during the execution phase. This is more of generic finding and further analysis is done by case study to check the real time delay factors and contributors and finally develop a framework for the application of APM.

❖ **Case study: 2**

Based on the relative importance index delay due to shortage of materials the first rank with RII of 0.94. Based on grouping the delay causes to the phases of the project2, it was found that delays reasons were major in construction phase.



**Chart-5:** Grouping of delay causes based on the phases involved in the project 2

The parties that usually involve in construction projects are client, consultant and contractor. The level of party contribution to each phase for infrastructure projects were then identified by classifying the delay causes based on the contributor. It was seen that client contributed majorly to the delay during the pre-design phase followed by consultant and contractor majorly contributing at design and construction phases respectively.

This is a generic data analysis and the contribution level may vary for different projects based on the conditions and situations. It was observed that the client contributed for about 59% delay in the pre-design phase of the infrastructure project followed by consultant with 41%.



**Chart-6:** Party contribution in pre-design phase of an infrastructure project2

During the design phase, the consultant seems to contribute to delay for about 43% followed by the contractor and client almost equally contributing by 39% and 18% respectively.



**Chart-7:** Party contribution in design phase of an infrastructure project2

Finally for the construction phase it was observed that the contractor contributed the most to delay accounting to percentage contribution of 46% followed by client with 32% and consultant with almost negligible 22%.



**Chart-8:** Party contribution in execution phase of an infrastructure project1

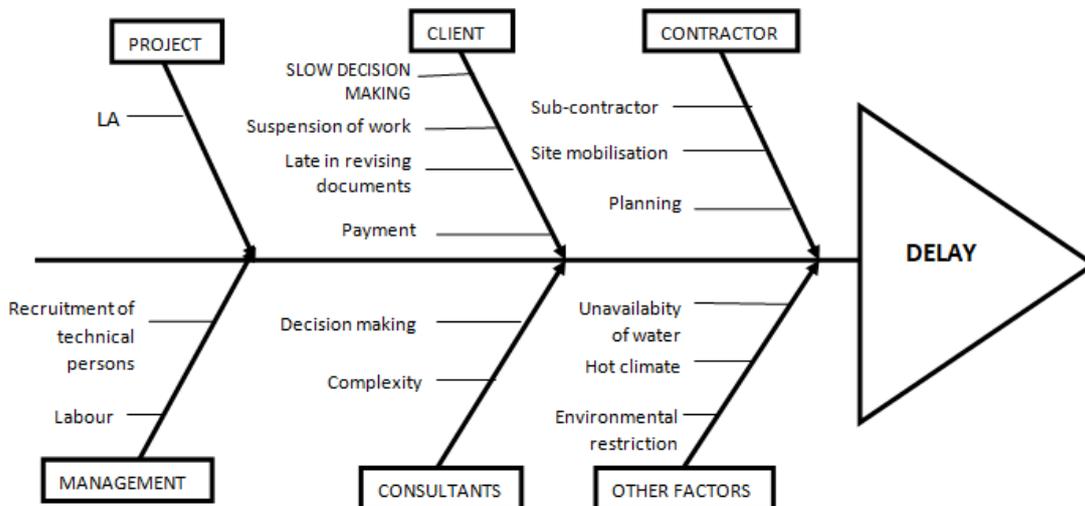
These analyses have helped to identify the areas where APM can be applied and the delay contributors in each level. It can be seen that contractor is the main contributor to delay during the execution phase. This is more of generic finding and further analysis is done by case study to check the real time delay factors and contributors and finally develop a framework for the application of APM.

## V. SURVEY ANALYSIS

The survey adopted for this construction work 1 is the grade separator at Kerala. The survey conduct in a hospital infrastructure project. The client for this project was The Kerala Government as it was a state infrastructure project and the department involved was the Kerala health Department. The fund was provided by NABARD. The project was completed with a delay period of two years and the delay reasons were identified as follows:

- Land acquisition
- Slow decision making
- Suspension of work
- Late in revising documents
- Payment delay from client
- Subcontractor problem
- Site mobilization
- Planning issues
- Labour problem
- Recruitment of technical persons
- Complexity in design documents
- Unavailability of water
- Hot climate Lack of advanced techniques in management aspects

These delay causes were found to be affecting the project during the execution phase. The major delay reason was land acquisition. Land acquisition was not made before starting of the project and issues were brought up by the people of that area regarding the governments land acquisition policy and thus the delay period extended for about two years. The other mentioned problems also aided to the major problem and the client is found to be the major contributor. This is in contrast to the data analysis finding that the client is the main contributor even during the execution stage but the main reason still remains to be land acquisition. It is found that land acquisition is a major delay contributor to most of the infrastructure projects. The fishbone diagram for the delay reasons of hospital infrastructure project is shown below.

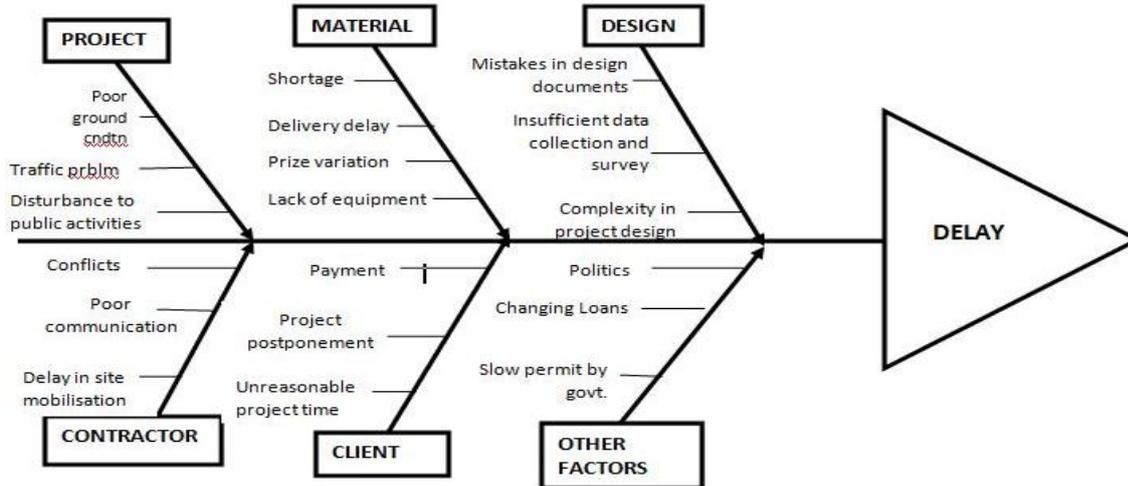


The survey adopted for this construction work 2 is the grade separator at Tamilnadu. The survey conduct in a road infrastructure project. The client for this project was a town panchayat in Tamilnadu. The project was completed with a delay period 8months before project starting15 days after project starting and the delay reasons were identified as follows:

- Shortage of materials
- Delay in material delivery
- Material prize fluctuation
- Lack of equipment efficiency
- Conflicts between contractor and other parties

- Postponement of project by owner
- Traffic control and restrictions at job site

The fishbone diagram for the delay reasons of road infrastructure project is shown below.



## VI. APPLICATION OF APM

From the Survey of project 1 and project 2, it was analysed that client contributed more to the delay reason during execution in contrary to the contractor from survey. The delay is mainly due to owner's slow decision making and owner interference which shows improper planning by the client. The overall delay causatives were identified as

- Lack of communication
- Improper management
- Incompetent staff
- Mistakes in designing
- Lack of equipment efficiency
- Shortage of material

Based on the data survey following agile enablers or activators can be applied which will reduce the delay or time overrun. These enablers were obtained from literatures and modified as per construction projects 1 and 2.

### ➤ Kick –off-meeting

- Face to face conversation with pre-qualified consultants and client.
- Drawings are made is discussed with other consultants.

### ➤ Scrum development

- Self-supporting team with a scrum leader/ head □ Team of skilled workers.
- Workers involved in planning, executing, controlling, monitoring and report to scrum leader.
- Scrum team should try to follow iterative method.

### ➤ Sprint meeting

- After bidding the contractor should be signed agreeing that the AM framework by accepting for weekly meeting (40-45min) with consultants and daily meeting (10-15min) with site people.

### ➤ Backlogs

- Frame backlogs-shows the milestone to achieve, which act as a base of sprint meeting.
- Status of each milestone should be updated in the meeting like open, closed and processed.

- **Fixed time**
  - Fix a restricted time limit within the time limit provided by the client.
  - The float between the restricted time limit and expected finishing time is flexible time.
  - Create fixed milestones following same restricted time limit for each milestone providing float.
- **Short cycle planning**
  - Prepare a flexible short cycle plan e.g for every milestone or major activity instead of detail full plan.
  - Expect uncertainties and plan.
- **Flexibility**
  - Flexible planning to achieve flexibility.
  - Proper forecasting of uncertainties.
- **Communication**
  - Develop proper communication flow between the client, contractor and consultant/designer.
  - Develop inter and intra department communication.
  - Matrix communication for easier and faster communication.
- **Integration**
  - Follow integrated pattern.
  - No department should work alone.
  - Client, contractor and consultant coordination and integration is of key importance.
- **Iteration**
  - Follow iterative approach using scrum team wherever possible to check the defects and apply corrections in order to avoid rippling effects.
- **Technology**
  - Use of computerization.
  - Use of software for design and management.
  - Use of building management systems.
- **Continuous learning and updating**
  - Continuous learning from each step to identify flaws and defects and apply in related methods in future.
  - Keep updated records of each work for future reference.

## VII. CONCLUSION

Agile project management is the advanced type of method used for construction project management instead of the traditional waterfall method. It can be reduce the construction delay and uncertainty in the construction projects and also give better customer satisfaction. It also reduces the time overrun in construction work. Agile project management is reduce the delay for about 70% to 80% as per the study based on survey in the two different infrastructure project. Further studies on actual implementation of the framework can be done. This modern management method can bring about reduction in delay achieving greater efficiency in construction projects.

## VIII. REFERENCES

- [1] Ajendra Kashikar Devansh Mehta Bhawesh (2016) "A Case Study On Agile And Lean Project Management In Construction Industry", IOSR Journals , Volume 13, Pp.31-39
- [2] Anand Jose Paul, Sherin K Rahman(2018) "Study On Agile Management In Construction Project Using Scrumban Methodology "IRJET, Volume 05, Pp.774-777
- [3] Alex Ekstom, Emma Patterson (2016) "Agile Project Management In The Design Stage", Royal Institute Of Technology, Pp.1-51

- [4] Blessie John,(2018)"Framework Of Agile Management's Sprint Planning Construction Projects – Afd Method"-Ijarnrd .Volume-03,Issue5.Pp.88-93
- [5] Brittany Auerbach And Richard Mccarthy(2014)" Does Agile + Lean = Effective :An Investigative Study "Journal Of Computer Science And Information Technology, Volume 2,Pp.73-86
- [6] Chen Jin(2017)" Agile In Construction Projects", Harrisburg University Of Science And Technology,Pp.1-17
- [7] Cory Peter Mcdermott (2009)"The Future Of The Construction Industry And The Implications Management And Education "Iowa State University, Pp.1-107
- [8] Derya Bacheri, Linnea Hilmgren(2014)"Agile Perspectives In Construction Projects-How To Improve Efficiency In The Design Phase"Kth,Abe,Real Estate And Construction Management.Pp.1-40
- [9] Dinnie Muslihat(2018) "7 Popular Project Management Methodologies And What They're Best Suited For",Zerkit,Pp.1-25
- [10] Fei Han (2013) Defining And Evaluating Agile Construction Management For Reducing Time Delays In Construction" Beijing University Of Technology, China.Pp.1-105
- [11] Firas Glaiel (2012)"Agile Project Dynamics. A Strategic Project Management Approach To The Study Of Large-Scale Software Development Using System Dynamics". Boston University.Pp.1-126.
- [12] Fransisco Loforte Riberio (2010)"Exploring Agile Method In Construction Small And Medium Enterprises: A Case Study", Journal Of Enterprise Information Management,Pp.1-3
- [13] Fred Wilson(2018)"Agile Construction Project Management –How To Be An Agile Construction Team?"
- [14] Hidaya Said Najmi(2011) "Project Management For Construction Projects "An-Najah National University, Nablus, Palestine.Pp.1-134
- [15] Jeff Totten (2017)"Critical Success Factors For Agile Project Management In Non-Software Related Product Development Team"Western Michigan University,Pp.1-140
- [16] Joao Carlos Ferreira ,"Agile Approach In Project Management", Instituto Superior Technico,Av Rovisco Pais, Portugal,Pp.1-6
- [17] Jonathan Adut (2016)"Applying Agile Approaches In Public Constraction And Civil Engineering Projects",Kth Industrial Engineering And Management.Pp.1-49
- [18] Juhary Alia(2004)" Knowledge Management In Agile Organizations ",Sunway College Journal 1,Pp.13-20
- [19] Khaled Al-Reshaid, Nabil Kartam, Narendra Tewari And Haya Al-Bader (2005)"A Project Control Process In Pre-Construction Phases" The Emerald Research Journals, Pp.351-372
- [20] Knoweldge Hund(2019) Blog Agile Project Management Vs Traditional Project Management,Pp.1-16
- [21] M. Naim1, J. Naylor2, And J. Barlow()" Developing Lean And Agile Supply Chains In The Uk Housebuilding Industry"Igic-7,University Of California,Usa.Pp.159-170
- [22] Mandeep Saini(2016) "Critical Factors For Transferring And Sharing Tacit Knowledge Within Lean And Agile Construction Processes",Emerald Journal,Volume 18,.Pp.64-89
- [23] Malik M.A. Khalfan, Peter Mcdermott And Michael Dickinson(2008) "Managing Risk And Uncertainty In An Agile Construction Environment: Application Of Agile Building Specialist Model ,International Journal Agile System And Management,Volume -03,Pp.248-262
- [24] Mattias Yllen, Johanson(2012)" Agile Project Management In The Construction Industry-An Inquiry Of The Opportunities In Construction Projects" Kth,Abe,Real Estate And Construction Management.P.1-59
- [25] Maulik Pareliya(2019)" Implementing Agile Project Management Approach In The Development Of Building Projects"Cept University, Ahmadabad.Pp.1-49
- [26] Members Of Apm North West Branch (2015)"The Practical Adoption Of Agile Methodologies"Apm Volunteer Research Report.Pp.1-32
- [27] Michael Jerrod Myers(2014)"Implementation Of Agile Project Management In Class Room", University Of South Carolina,Pp.1-43
- [28] Milind Padalkar "Using Agile In Construction Project: It's More Than Methodology", Iim,Kozhikode,Kerala,Pp.1-10
- [29] Mishkin Berteig."Agile Work Uses Lean Thinking,Berteig Consulting Inc,Pp.40-46

- [30] Nerija Banaitiene And Audrius Banaitis (2012) "Risk Management In Construction Projects" "Intech, Chapter 19, Pp.429-449
- [31] Pa Raviz Daneshgari , Michelle T.Wilson(2016) "The Profitability Of Agile Constuctio", Nort Hwestern University,Evaston,Il,Pp.1-8
- [32] Pavan Kumar Potdar(2017)"Agile Manufacturing A Systematic Review Of Literature And Implications For Future Research",Benchmarking :An International Journals,Pp.1-3
- [33] Prof.Divakar .K And Ashitha,Cit,Coimbatore(2016) " Application Of Agile Management To Reduce The Time Overrun In The Construction Of Infrastructure Projectp" -Irjet,Volume-3 ,Pp.3380-3384
- [34] "Project Management Institute"Agile Project Management Approach"
- [35] Qian Chen, Georg Reichard And Yvan Beliveau(2007)" Interface Management – A Facilitator Of Lean Construction And Agile Project Management".Pp.57-65
- [36] R.L Owen ,L. Koskela "Agile Construction Project Management"The Research Institute Of The Built And Human Environment, The University Of Salford.Pp.22-33
- [37] Rafaelcarlosanddanielc.Amaral ()"Frame Work For Continuous Agile Technology Roadmap Updating "São Carlos School of Engineering (EESC), University of São Paulo (USP), São Carlos/SP, Brazil.Pp. 321-336
- [38] Razie Qaravi (2018.)"Agile Project Management Within The Bim Based Common Data Environment", International Master Of Science In Construction And Real Estate Management,Pp.1-88
- [39] Robert Owen & Lauri Koskela.(2006)" Is Agile Project Management Applicable To Construction"- Scri, University Of Salford,Uk.Pp.51-66
- [40] Roy S.Morile (2017)"Feasibility In Applying Agile Project Management Methodologies To Building Design And Construction Industry" Harrisburg University.Pp.1-50
- [41] Selim Tugra Demir, David James Bryde, Introducing Agilean To Construction Project Management.
- [42] 42. Sherif Mostafa (2016)"Lean And Agile Integration With In Offsite C Onstruction Using Discrete Event Simulation", Journal Of Construction I Nnovation,Pp.1-3
- [43] Stephen A Leybourne(2009) "Imorovisation And Agile Project Management :A Comparative Consideration",International Journlas Of Managing Projects In Business.Pp.519-535
- [44] Stracusser (2015)"Agile Project Management Concepts Applied To Construction And Other Non –It Fields",Global Congress ,North America,Pp.1-8
- [45] Suhail Iqbal , "Leading Construction Industry To Lean-Agile Project Management",Lean Agile Construction Project Management Blog,Pp.1-11
- [46] Thomas Streule,Nino Miserini, Olin Bartlome(2016)" Implementation Of Scrum In Construction Industry"-Science Direct,Elsevier.Pp.269-276
- [47] Tomas Gustavsson "Benefits Of Agile Project Management In A Non-Software Development Context",Karlstads University
- [48] Yingchenliu(2018)" Scrum In Construction Industry To Imorove Project Performance In Design Phase"Harrisburg University Of Science And Technology.Pp.1-41
- [49] Yusuf Arayici, Ghassan Aouad (1999)"Building Information Modelling (Bim) For Construction Lifecycle Management",Uk School Of The Built Environment, The University Of Salford, Greater Manchester Uk ,Pp.1-170