



Project Management Practitioners' Conference 2018

ARCHITECTING PROJECT MANAGEMENT for Value Creation

July 12th – 14th, 2018

NIMHANS CONVENTION CENTRE, BENGALURU

The central graphic is a black rectangular banner. In the top left corner is the PMI Bangalore India Chapter logo. In the top right corner is the PMPC 2018 logo, which is a white geometric design of a globe with latitude and longitude lines. The main body of the banner features a nighttime photograph of the NIMHANS Convention Centre, a large, ornate building with a central dome and multiple wings, illuminated with warm lights. Below the photograph, the conference title 'Project Management Practitioners' Conference 2018' is written in a yellow, sans-serif font. Underneath that, the subtitle 'ARCHITECTING PROJECT MANAGEMENT for Value Creation' is written in a smaller, white, sans-serif font. The dates 'July 12th – 14th, 2018' and the location 'NIMHANS CONVENTION CENTRE, BENGALURU' are written in the same yellow font as the title.

Agile Project Management for Construction Projects

Capability Enhancement

PMIBC-18-1-001

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ABSTRACT

The objective of Project Management is to deliver a Project which complies with the client's needs and objectives in the most efficient manner. However, it often arises, that the client's objectives might still be unclear or though the objectives clear, the requirements fluctuating. Such scenarios limit the application of traditional project management principles to address changing Project scope, specifications or even final objectives. Identifying this concern, new principles like Agile Project Management were developed, specifically for IT Projects, to address such dynamic scenarios.

The purpose of this study is to introduce key principles of agile approaches into construction projects where projects are more physical in nature and repercussion of changes more irreversible compared to IT projects. The study focusses on 'windows of change' for construction projects by introducing the concept of 'delaying the point of differentiation'. The study is not aimed at replacing waterfall methods as used currently but to integrate predictive and adaptive principles developing an agile approach customized for construction projects.

The application of such an approach to construction projects have proven to be a disruption in the industry by amicably addressing the aspects of change management in a time and cost efficient manner, while additionally providing a structured approach for stakeholder management.

An early adaptation and understanding of this approach has the potential to minimize cost of re-engineering, rework, and completion by ~5 % of the total project budget, when compared to conventional Project Management approaches.

1. INTRODUCTION

Project Management has traditionally focussed on the triple constraints of Time, Scope and Cost referred as **Iron Triangle** which decides the overall success of the Project. *Project Management is the science that enable the stakeholders involved in the Project to balance these three constraints most effectively and efficiently.* Project Sponsors or Customer aspires the Project to be delivered at the least cost and the best quality at the earliest time possible, while Contractors and Consultants manage these constraints to realise their profits and minimise overheads.



Figure 1: Iron Triangle

However, it is not only delivering the required scope, at a reasonable quality, within the established budget and schedule that defines the Project success. Such an approach omits crucial dimensions of success including impact on Project Stakeholders and Customer Satisfaction. Therefore, more recently, the Iron Triangle has given way to a **Project management Diamond: cost, time, scope, and quality**¹ are now the four vertices, with Customer expectations as the main focus. Every Customer will have different expectations, hence while the triple constraints



Figure 2: Project Management Diamond

still remain the core foundation of the Project, ***managing Customer expectations has been the key paradigm shift that Project Management has undergone.***

This paradigm shift requires Project Management to systematically incorporate the voice of the customer and create a disciplined way of prioritising effort/deciding trade-offs while working concurrently on all aspects of the Project in multi-functional teams. Studying the concept of Agile Project Management and applying them to construction Projects allows Project Teams to create this disciplined approach to manage customer expectations.

2. DETAILS OF THE PAPER

2.1 Key Challenges:

2.1.1 Change Management in Construction Projects

The dynamic nature of the economy has pushed the envelope for businesses to constantly measure business goals with the evolving user requirements. In the age of fast information and connectivity, project goal defined months or even years ago might not be relevant by the time the project is delivered resulting in change of requirements. The very nature of construction projects is fixed, time taking and irreversible. While on the other hand, IT projects may have limited repercussions of undergoing a change as per the customer requirements during any of the phases of the Project.

Therefore, it is this approach to change management during the phase of the project is what separates the traditional methods (*eg. waterfall*) from the latest methods like agile project management. While change management focusses on documentation, scope management and change implications, the concept of customer collaboration and effective Project functionality is missed through these methods.

2.1.2 Application of Agile Project Management in Construction Projects:

Where traditional project management will establish a detailed plan and detailed requirements at the start then attempt to follow the plan, agile starts work with a broad level idea of what is required and thereby delivering a representative solution in a short period of time, while incorporating the detailed requirements as the project progresses.² These frequent iterative processes are a core characteristic of an agile project and, because of this way of working, collaborative relationships are established between stakeholders and the team members delivering the work.

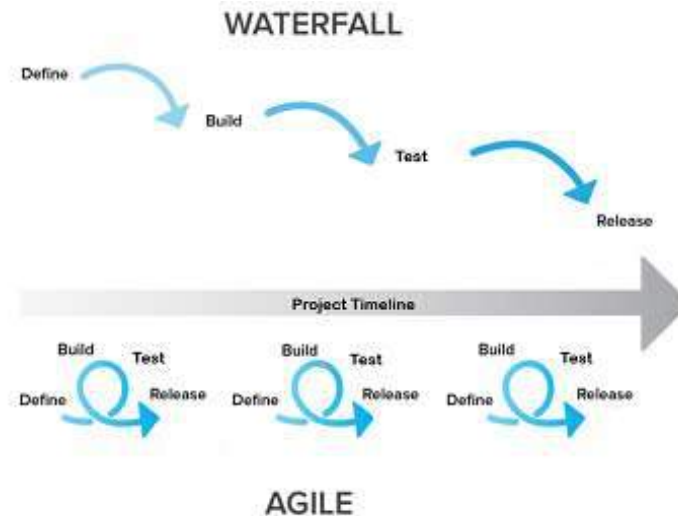


Figure 3: Waterfall and Agile Methods³

However the current nature of Agile Project Management finds limited application in construction projects. The methodology of providing deliverables/Beta versions is not entirely possible in construction industry. This in turn limits visibility to the customer of the end product and at the same time reduces feedback opportunity during project lifecycle. Primarily due to these concerns application of agile project management in construction has not yet found complete acceptance as against its application for IT Projects.

2.2 Methodology:

2.2.1 Core Ideology/Concept Differentiation:

Construction projects are physical in nature and require a long gestation period to be put to use. Heavy infrastructure projects like roads, highways and power plants are created for basic functionality like transportation and power by public or private entities. Medium/light infrastructure projects such as factories or warehouses have more specific business need driven by market expectations, consumer insights and are more prone to changes than large infrastructure projects. Similarly residential and commercial projects have even smaller target segments which determine the shape, size, look-feel etc. and in turn define project success.

Today's customer requires stakeholders who can provide additional insights and information that help them make better decisions for the benefit of the project. In a construction project, the cost of change is huge if not taken at the right time. After studying the core ideology of agile project management and applying them, it has provided a shift in the way construction projects have to be executed, the ones where customer has unclear scope or changing requirements.

The study formulates the relationship between Customer Value and the Frequency of Requirements, Interactions, Deliverables for a Project. This concept of “Customer Value Pyramid” as developed during this study forms the **core methodology** of this study and is intrinsic to the integration of Agile Project Management in construction projects. It is based on interviews with Customer, Senior Project Managers, Project Management Experts and the collective experience of Authors in the domains of construction industry.

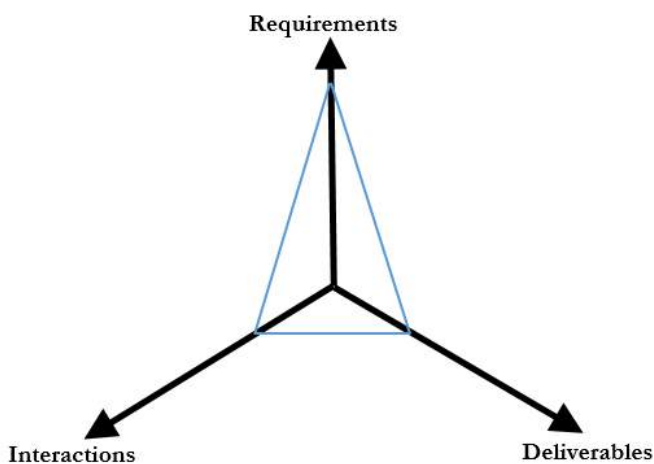


Figure 4: Frequency and Customer Value (Customer Value Pyramid) Traditional Approach

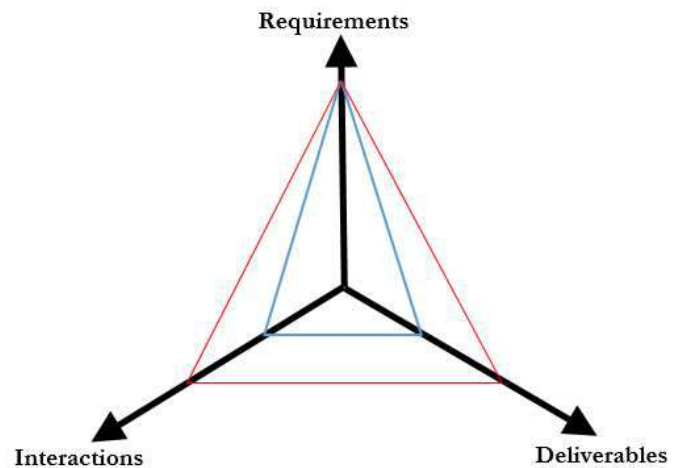


Figure 5: Frequency and Customer Value (Customer Value Pyramid) Proposed Approach

Figure 4 and Figure 5 explain this shift that agile approaches focuses on. It plots the projects into three main categories of scope, communication and customer value generated. Project Teams gather all requirements from customer and then complete engineering to construct and deliver the project as a whole but this method involves lesser feedback loop from the customer on the value that has been created in smaller time cycles of months or days. As shown in Figure 4, user involvement is limited and frequency of interactions compared to the frequency of requirements from the customer is far lesser. It focusses on delivering complete project on a whole at the end, there by representing the customer value generated as area under the blue pyramid.

On the other hand, proposed approach in Figure 5 shows us that by increasing the frequency of interactions proportional to the frequency of requirement from the customer, we are more involved in the creation of the project as smaller parts that sums up to be the entire project. By doing this we are also delivering more of the project in regular intervals and not only once in the end, while enabling customer to have more control creating additional value

as represented by area under the red pyramid. Thus through traditional means Project Teams takes advantages of things that are known and proven which allows them to segment work into a sequence of predictable groupings, while by adopting agile approaches Project Teams gains early feedback, and provide customer visibility, confidence and control of the project.

2.3 Integration of Agile Principles in Construction Projects:

This section elaborates the applicability of each of the selected principles from the Agile Manifesto in a construction project set-up to overcome the challenges as described above.

2.3.1 Customer Collaboration & Face to Face Meeting

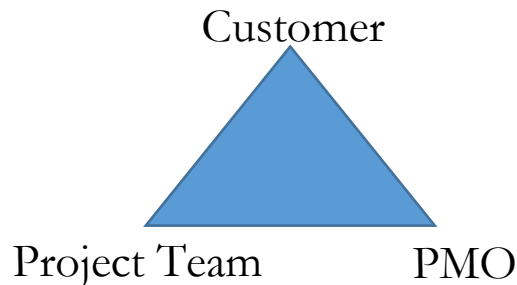


Figure 6: Major Stakeholders

As the first part of the Value Pyramid described above, agile encourages project teams to increase the frequency of interactions. This is largely enabled by having face-to-face meetings with stakeholders of the Project at shorter, regular intervals. Increase in communication enables all stakeholders to have real time updates of the projects as well higher involvement. Face to face meetings helps all stakeholders to grasp each other's sentiments and enables to nurture more bonding for understanding project and business priorities. It also helps team to make better decisions when the business and technical team are aligned.

2.3.2 Responding to Change

Changes are part of any project where during the course of the Project the customer realigns and revalidates its project goals. As part of the agile principles, it is endorsed to **welcome any kind of change** at any stage of the project to help build the right product/project for customer. This ideology of welcoming change is far to the contrast to what is standard industry practice. Due to the huge cost of changes associated with the physical nature of construction projects, frequent changes become a bottleneck for the Project Team and the Stakeholders. Reengineering and rebuilding results in additional time and quality issues as well. It is here where the agile manifesto enables project to adopt a more **proactive approach to change than a reactive one**, which sights a change as an opportunity than a liability. In line with frequency vs. customer value pyramid, the approach promotes the project

teams to increase the frequency of deliverables, detailing and building parts of the whole project such as by dividing the entire project life cycle in sprints of shorter cycles at **20%, 40%, 60% & 80%** of the project progress and setting identifiable deliverables for the sprint (Figure 7). At the start of each sprint providing the customer with a **window of change** (Sec. 2.4.1) giving various scenario analysis of the physical, financial and schedule impacts of the changes to help customer make an informed decision.

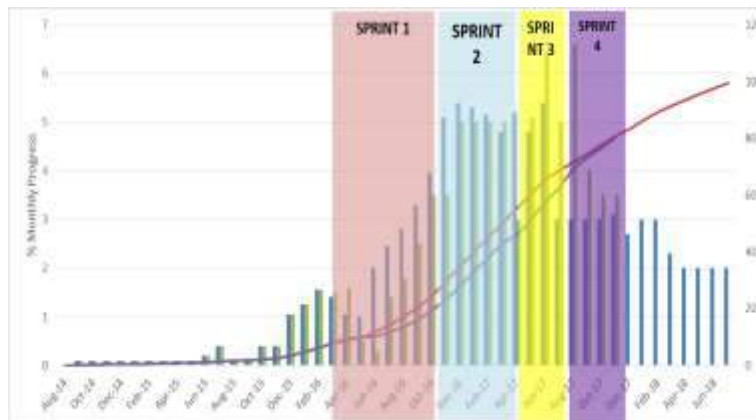


Figure 7: Sprints for a Construction Project

2.3.3 Early and Continuous Delivery

Project teams have to increase the frequency of communication by using the sprints as means to communicate commencement, completion or progress status of key milestones that constantly provide visibility of the project to customer. Linking of Procurement timelines with Business Usage at a Sub-system level and providing only those utilities/ systems that the customer might put to use while extending the commissioning and warranties of equipment that the customer might require now. Align installation/commissioning with the business plans and enable a handing over with complete assistance thus providing the customer in a smooth transition between completion of the project and success of the project.

The liability of the project team being not only at building the said infrastructure but also to provide the means to utilise the same in the most efficient manner. It is in these aspects that the customer feels that the project team adding value at every stage of the project and feels satisfied with not only the time, cost and quality but also the operations of the project.

2.3.4 Agile Processes for Consistent Pace

The study focuses on “Agile” as a process that fosters Communication, Collaboration and Customer Focus. Driven by these levers, target is to enhance the ‘Customer Value’ in the value triangle by increasing frequency of interactions and deliverables.

To actualise such an environment, the study posits the following processes that create a consistent and sustainable agile set-up:



Figure 8: Agile Processes

a. Empowering Project Team for Decision Making:

The study proposes to assign a proportionate level of authority to Project team as in line with the responsibilities assigned to the team. It has been observed that in the construction projects, the majority of the control is exerted by the Project Management Office. This is primarily driven with the intent of enabling standardisation as well as economies of scale in procurement. Only the limited matters such as labour issues, quality assurance, safety monitoring are left to the discretion of the Project team.

The study proposes to devolve authority to the Project teams in the domains of making procurement decisions, communication to the stakeholders and prioritising the activities at the Project level.

While the procurement has to be driven by the Project Management Office, certain low ticket items should be procured at the site level. The study based on the interviews with the senior Project Managers and experts in this area, presents that the procurement amounting **to 0.5% of the Project Cost or ₹ 50 lacs** (whichever is lower) should be attributed to the Project team with complete authority at the team level. This will not help in providing flexibility to the Project teams thus helping in managing timelines, but also enhances the level of accountability of the Project team.

b. Increasing Customer Visibility

As compared to a software project where-in a beta version can be released and can be shown to the customer for review and feedback, the construction projects does not offer such a flexibility. Such a scenario limits the ability of the user to relate to the Project during the execution phases and comprehend the impact of changes.

For a construction project the customer should be able to visualise the current status as well as the future of the Project. To enable this, the study bring to the forefront the use of **Building Information Modelling (BIM)** software with an integration to the real-time planning and monitoring at the construction site level.

The BIM model would be **overlaid with the schedule** and actual **site progress photographs** which enables the customer to visualise and understand the current status of the project. Also, visualising the Project in such a manner is expected to act as trigger point for the customer which might help him relate to the Project and introduce the changes, if any, during early stages or at the designated “*windows of change*” (Sec. 2.4.1) in line with the long term usage requirement of the Project.

c. Structured Interactions and Review

This process builds on that aspect and brings to life the concept of frequent but structured interactions with the customer. The concept of structured interactions stems from the discussions with many project professionals who have expressed the experiences of fruitless meetings, deadlocks etc.

Therefore, a meeting where-in the empowered Project team approaches the customer with the current scenario and probable changes during the windows of change, helps the customer to make an informed decision and analyse the various scenarios during the construction project due to the enhanced visibility of the Project and proactive nature of the Project team. The study proposes to have such interactions at least **once per month** over and above the change windows which will be scheduled at **20%, 40%, 60% and 80% of the Project Progress**.

2.3.5 Simplicity

The study introduces the concept of “**Delay in Point of Differentiation**” for construction projects. Delay in point of differentiation means to provide maximum flexibility by providing standardised solutions that are differentiated at the last point. For example, a shirt manufacturer to keep in line with market trends, would focus on getting all the shirts manufactured in white colour. This approach allows the manufacture to get the shirt dyed into different colours at a

later date in line with the market trends and thus avoiding any loss on the inventory. This approach of the shirt manufacturer exemplifies the delay in point of differentiation.

It is this approach that the study focuses on bringing to the forefront in the construction industry. This approach is focussed on providing customer an option to decide at a later date the exact specifications and usage of the facility as compared to the understanding on the day of the launch of the Project. For example, a company that is focusing on setting up an industrial facility might not be very clear on what variants of product it may like to keep on day one. It may evolve in line with the requirements of the market or the growth strategy of the company. Therefore, to provide flexibility to the customer, it is important that the construction is conducted in such a manner that it enables the ability to migrate from one product line to another with least changes. To enable this, it is required that the Project is initiated with the broad level requirements of core-and-shell and the Project should evolve in such a manner across these requirements. This is similar to the commercial projects where-in the core-and-shell is done primarily and the interiors are taken care of at a later date to meet the specific requirement of the client. However, there are some specific issues that come across in such industrial facilities such as the aspects of utilities, design of services etc. In this sense it differs from the commercial projects and hence the concept of “**Delay in Differentiation**”.

2.3.6 Reflections on Enhancing Effectiveness

The success of any process/communication/interaction is a function of the effective feedback mechanism. The strength of these feedback mechanisms is based on the ability to reach out to varied stakeholders.

With this perspective, the study focuses on strengthening the Agile Project Management in Construction Project by making it a continual improvement process at the level of Project Management Office (PMO).

To achieve this, the study proposes to have in place a **Single Point of Contact (SPOC)** at the PMO to maintain and enable the shared culture. The SPOC will have the complete comparative of the Projects being run by organisation and will communicate to Project team about various scenarios that can be incorporated in the “*Windows of Change*”. This approach will enable the Project team to develop varied scenarios for the Project and communicate with the customer effectively at the windows of change @ 20%, 40%, 60% & 80%, thus providing customer an opportunity for “*Delaying the Point of Differentiation*”.

2.3.7 Individuals and Interactions

All the processes and methodologies are as good as the individuals who work around them and deliver the results. The study recognises this universal fact and therefore believes that while an empowered team provides agile set-up, it is the empowered individual that makes empowered team. While there have been extensive research conducted towards motivating the team members and empowering individuals, the study would like to highlight the following concepts that should be duly followed and addressed to promote and develop *self-organising teams*:

- Skilled and motivated team members who have decision-making power, take ownership, communicate regularly with other team members, and share ideas that deliver quality products
- Structured Approach for Cross Functional Interactions
- The Responsibility should be contiguous to Authority

2.4 Critical Success Factor:

2.4.1 Windows of Change:

This is the flagship concept that the study focuses on introducing for the construction Projects providing customer the visibility of the real-time status of Project coupled with the impact of the changes on Project time and cost. The study doesn't intend to create a disruption but aspires for an evolution that brings to life the impactful application of Agile Project Management in Construction Projects.

The concept of windows of changes merges the concepts of schedule and cost baseline with the project progress monitoring coupled with the scenario analysis to provide a customer with a realistic focus on assumptions of change

| Task Name | % Complete | Specification: Initial | | SCENARIO 1 | | | | SCENARIO 2 | | | | SCENARIO 3 | | | |
|---|------------|---|---|---|---|--------------------|-----------------|---|---|--------------------|--------------|----------------------------|---|--------------------|-----------------|
| | | Specification (Material) | Specification (Dimension) | Scenario 1: Specifications | | Scenario 1: Impact | | Scenario 2: Specifications | | Scenario 2: Impact | | Scenario 3: Specifications | | Scenario 3: Impact | |
| | | | | Specification (Material) | Specification (Dimension) | Cost | Time | Specification (Material) | Specification (Dimension) | Cost | Time | Specification (Material) | Specification (Dimension) | Cost | Time |
| Present Status: Project XXXX | | 20% | | | | | | | | | | | | | |
| Concept Layout | 10% | NA | Built Up Area Block Dimension Max-Material Flow | NA | Increase in Built Up Area Change in Block Dimension Location of Blocks | Low (5%-5%) | Low (5%-5%) | NA | Decrease in Built Up Area Change in Block Dimension | Very Low (0%-5%) | Low (5%-10%) | NA | NA | NA | NA |
| Scheme Design - Civil, MEP | 10% | + Buildings (RCC/PFB) + Panel Type (P/F) + Utilities Type (Gas/Water/Boiler/SF/F) + Panel Type (P/F) + Utilities Type (Gas/Water/Boiler/SF/F) | Built Up Area Building Dimension Load Capacity Utility Sizing Pipe Sizing | + Change in Type of buildings (RCC/PFB) + Change in SSMS Pipelines | + Increase in Building Dimension + Increase Utility Sizing + Change in Pipe | Low (5%-5%) | Low (5%-5%) | + Panel Type (P/F) + Changes in SSMS Pipelines | + Increase in Load Capacity + Increase in Building Dimension | Low (5%-5%) | Low (5%-10%) | No Change | + Decrease in Building Dimension + Decrease in Load Capacity | Very Low (0%-5%) | Low (5%-10%) |
| Detailed Design GFC Drawings | | 73% | | | | | | | | | | | | | |
| Design of Structure & Details (Plan) | 10% | RCC/PFB | Built Up Area Room Sizing Mezzanine Height | + Change in Type of Building (RCC/PFB) | + Increase in Built Up Area + Increase Room Sizing | Medium (5%-10%) | Medium (5%-10%) | No Change | + Increase in Mezzanine Height | Medium (5%-10%) | Low (5%-10%) | No Change | + Change in Number of Doors/Windows | Very Low (0%-5%) | Low (5%-10%) |
| CONSTRUCTION | | 6% | | | | | | | | | | | | | |
| Main Civil Works | | 7% | | | | | | | | | | | | | |
| Cover, Structure & Details | | 8% | | | | | | | | | | | | | |
| B/S: Excavation (incl. Rock, Shoring) | 35% | NA | Foundation Dimension corresponding to Load Condition | NA | + Increase in Foundation Dimension | Very Low (0%-5%) | Low (5%-10%) | NA | - Decrease in Foundation Dimension | Very Low (0%-5%) | Low (5%-10%) | NA | NA | NA | NA |
| B/S: Foundation Works -RCC, MCC, Water proofing | 35% | RCC | Foundation Dimension corresponding to Load Condition | RCC | + Increase in Foundation Dimension | Low (5%-5%) | Medium (5%-10%) | RCC | - Decrease in Foundation Dimension | Very Low (0%-5%) | Low (5%-10%) | RCC | - Change in Location of Foundation | Low (5%-5%) | Medium (5%-10%) |
| B/S: Pedestals / Facet for FEB, Yards | 10% | RCC | Dimension corresponding to Load Condition | RCC | + Increase in Dimension | Very Low (0%-5%) | Low (5%-10%) | RCC | - Decrease in Dimension | Very Low (0%-5%) | Low (5%-10%) | NA | NA | NA | NA |

Figure 9: Scenario Appraisal at Window of Change

impact on time and cost. The following figure shows the concept of windows of change review that would be conducted at the stage of 20%, 40%, 60% & 80%

Such an approach enables a culture where Agile Project Management is overlaid on the Predictive Project Management approach and doesn't intend to disrupt the existing methodologies. The responsibility matrix for "Windows of Change" would be as follows:

| | |
|--|-------------|
| Project Manager | Guide |
| Package Engineer | Own |
| Planning Engineer | Assist |
| Quantity Surveyor | Computation |
| PMO SPOC: Support and Suggest Scenarios | |

Working with such an approach provides customer the menus of change that will ensure that the customer is updated and can take call with respect to the changes in a more informed and proactive manner.

2.5 Benefits

This study when applied across real time execution of the Projects has revealed to have the potential to demonstrate the tangible and intangible aspects of integration of Agile Project Management in construction projects. While the benefits of such an approach is extended all across the value chain of the Project ranging from the client to the construction labor, some of the important aspects are summarized below:

- **Pre-empting Changes:**
 - o The proposed approach enables Project Teams to adopt a Proactive Approach, thus forecasting and being in a state of readiness to accept changes. Results of application of windows of change have shown a reduction potential in cost of reengineering, rework, completion **by 5% of the Project cost for project size of ₹ 200-300 crores.**
- Promotes a **Value Driven** Approach
 - o Application of these agile principles **embodies the commitment and value creation** provided by project teams in line with the customer business needs and economic returns.
 - o This is centred in the Customer Value creation as reflected in the enhanced "*Customer Value Pyramid*" which in turn drives the customer satisfaction.
- Creates a **culture that is Agile and welcomes changes in Construction projects.**
 - o Empowered Project teams which are connected with Customer helps in quick decision making of key issues by the customer from time to time.
 - o The continued engagement creates a culture of ownership among the stakeholders of the project bringing a positive momentum rooted in **project delivery rather than completion.**

3. CONCLUSION

Building on the study conducted, the avenues of application and the possible integration of the proposed solution, the study has shown a promise towards the incorporation of the Agile Project Management Principles in construction projects.

The introduction of novel concept of “*delay in point of differentiation*” and “*windows of change*” have shown an increased acceptance among the varied stakeholder base comprising of the customers, project management experts and project teams.

The study has demonstrated that a successful implementation of such an approach will not only provide intangible benefits of customer satisfaction, empowered teams but also a tangible benefit that can range up to **5% of the Project cost** resulting a win-win scenario while also creating a culture of **welcoming change in construction projects**.

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