

# SECM/15/132

# Adoption and Scope of Building Information Modelling (BIM) in Construction Industry of Pakistan

# A. Adil<sup>1\*</sup>and A. Fatima<sup>2</sup>

<sup>1</sup>National University of Sciences and Technology, Islamabad, Pakistan

<sup>2</sup>University of Engineering and Technology, Lahore, Pakistan \*E-Mail: anam.ae17@yahooo.com, TP: +923124062013

**Abstract:** Project management is today a current and highly discussed area. How projects within the construction industry are managed has not changed significantly during the last decades. The construction market, the number of different actors and the way that projects are procured today has however changed. This has led to a gap between the managerial view on how construction projects should be conducted today and how they actually are executed. This is reason enough to question this conservative industry and look into what possibilities there might be in the future. The Agile project management approach evolved from the software industry where it has grown and developed through empirical progress.

The objective of the research is to identify and understand the challenges and opportunities confronting the Pakistani construction sector and to investigate ways to implementing the agile approach. The research will identify the changes that are necessary to meet the industry's performance requirements. The Agile approach almost forces the client to increase their participation in the project compared to the situation today. It can also decrease uncertainty and improve risk management.

Keywords: Agile Management, Construction Management, Dynamically complex projects, Traditional Project Management

# 1. Introduction

"Project management is today a current area undergoing intensive development."

(Tonnquist, 2006, Preface), (Author's translation) Discovering the prime method for overseeing, observing and synchronizing the undertakings is a persistent errand (Tonnquist, 2006). Conforming working systems, expressive parts and imagining the task distinction through new easy to understand administration instruments are instances of how this test can be.met. Today, Project administration frequently upsets the entire association whether it involves a little private association or a greater open corporate.

There are two general techniques that can be utilized to deal with a task (i.e. either an procedure methodology) arrangement or highlighted in customary undertaking administration by Turner (1999) and Boehm (2002). Though this conventional methodology is observed to be valuable for activities with less instabilities. complexities and all around characterized (Chin, 2004). extension The suspicions that dangers and instabilities are unsurprising. (Alleman, 2008) was of late fiercely slated (Atkinson et al, 2006).

The traditional way of handling construction projects is still the same since half a century on

which CI relies. Project execution methods have been changed now. The distance between an old and new practices of managing construction projects creates an unease and uncertainty within the industry and its employees. With a specific end goal to examine the probabilities of utilizing an effectively expressed and checked administration approach, which is the point of this proposal, the prime need is to scrutinize the development's conventions industry and take a gander at the future's possibilities.

#### 2. Literature Review

#### a. Background

There are two general methodologies that can be employed to manage a project (i.e. either a plan or process approach) highlighted in traditional project management by Turner (1999) and Boehm (2002). Contrary to the reality on the ground shows that projects are becoming more complex and the business atmosphere is also changing at unprecedented levels making it difficult to predict project behavior (Rodrigues and Bowers, 1996; Nobeoka and Cusumano, 1997; Hauc and Kovač, 2000; Chin, 2004; Shenhar, 2004; Gallo and Gardiner, 2007; Fernandez and Fernandez, 2009; Papke Shields et al, 2009;)

One of the developing project management approaches is agile project management, which provides diversified benefits complex projects to different organizations, however others believe it is applicable on all projects whether complex or not (Chin, 2004; Aguanno, 2004; Cicmil *et al*, 2006;

Owen et al, 2006; Weinstein, 2009;).

Costly and timely last minute changes that were the prime part of traditional project management has been eliminated by employing agile project management approach that works on iterative process throughout project lifecycle (Schuh, 2005). The above objectives can only be achieved in some projects if organizations are able to adopt agile project management methodologies that are perspective specific and incorporate rigidity and variation within them (Sharifi and Zhang, 2001; Sharifi and Zhang 2000). This is thus as a result of in contrast to traditional project delivery methods that depends on costly additional rework, scope and demand changes as project progresses, dexterous undertaking administration is particularly intended to set up these sudden changes through its significance on planned thinking further as prioritization on task learning.

#### b. Traditional/Waterfall Management

Several management strategies are used now a days and quite a few of them are old. The brief introduction to one of the traditional management method (TPM) is given below which is known as Waterfall management, as shown in Figure 2.1. This introduction is given to understanding the standard method during which the development business is managed nowadays.

There are different phases during the course of the project life cycle in TPM (Hass, 2007). Controlled planning and methods are important part of this approach. The events are performed in strategic and organized ways. The project's future is assumed to be predictable in order to perform such extensive planning. When a stage is finished it ought not be reexamined. There are obviously both advantages and disadvantages of this methodology. One of the preferences is that it is systematized and simple to take after. It additionally offers accentuation to the customer's significance prerequisites. On the other side it is exceptionally uncommon that a venture can completely take after the grouping as arranged, following the conditions for the most part change with time furthermore it is

troublesome for the customer to indicate in detail all necessities toward the begin.



# 3. Benefits from Implementing Agile Technique

# a. Client Contribution

The guideline advantage, with applying Agile, organization in the, setup time of an, improvement endeavor shows up, to be the, client's advantage. Finally, it slips, to the client's joy, and satisfaction with, the completed result so if the client, is relentlessly included, and prepared to make, changes to the thing, while the endeavour is creating, it would lead, to more gainful, endeavours.

The Agile procedure, lets the client think, about the idea, and the objective, and specifically, about the unobtrusive components, and specific responses for the endeavour in the midst of it's empowering.

b. Reduction of Uncertainties in Project Composed organization, work in cycles that, last from one week, to four weeks. Within these cycles, there are each day, stand-up social affairs, to starting now get, a fast and successful enrolment on the, present day and, the things that, ought to be done, on the next day, produces. Exactly when scrutinizing the respondents, depictions, it is all in all completely like the Agile Strategy. You can set up cycles, for case, 2 weeks and toward the end of each cycle have, evaluated a meeting, an arrangement meeting, at which the headway, is discussed and the late cycle. By then, either another design, meeting to mastermind the, accompanying cycle or two occasions this, be solidified in a lone, meeting of the Evaluation, or Planning held.

# c. Communication

Questioners frequently needed, to pass the correspondence, by the task, director or outline chief. That is on account of, they have to in, all matters emerging, in the undertaking furthermore on the grounds that it, might be inquiries, that can be replied, rapidly by the administrator himself be invigorated.

#### d. Program and Product Backlog

Period of the system is the serious time. On the off chance that the projects for the ventures analyzed were consummated or not is difficult to say, but rather when they figure out that the time when the most extraordinary, there are great motivations to trust that they have a considerable measure of exertion into it. Then again, they don't hold in a few tasks to the timetable, in spite of the fact that it creates a point by point program. They say it could have been brought on by the absence of interior correspondence. assets and poor This demonstrates the significance of dispersing data and correspondence, as they had a careful system is not ready to impart the accessibility's significance of assets sooner rather than later. The hypothesis of Agile Management clarifies the significance of building up the item buildup or program. A build-up that is always upgraded and actualized gradually in the venture can help more exact calendars.

# e. Initial Phases

Toward the starting, of a venture, the coordinated, methodology is to adding to, a strong vision for the task, and a very much created, correspondence arrange for, that incorporates the organized gatherings, such that the, undertaking starts to fabricate a strong establishment.

# f. Constant Improvement

Nimble methodology is, going to get some, an opportunity to get ready for, the future, do a subsequent later, gain from it and afterward they, will enhance later on. The Agile methodology is beneficial, in a manner that a task begin, with just, a portion of the methodologies systems and after that, amid the venture's advancement, either, begin with few of his techniques, modify ,the a utilization cycle were one, in the middle of, evaluated , enhanced and change

the procedure that is at present being used, the task empowers the consistent change of effectiveness.

#### g. Time management

Agile approach may be of value in the construction industry, is the way it uses timemanagement, and with time as the most important factor that cannot be changed. Many construction projects today use time management as well, but it is the specific way in which the agile approach uses the ones who can benefit the construction industry. Through skilful planning at different levels with different time frames, it all boils down to small tasks just take a couple of hours to perform. This gives you a tool to evaluate efficiently, as the project progresses, it lags behind when, or if it is better than expected.

# h. Differences

Something that needs to be considered is that the agile approach in a way, quite a lot of the way different projects carried out today. For example, the decision-making process will change if you switch to agile management. Some of the authority under which certain decisions will be transferred from the project manager on the project members. This change may not agree with some of the projects. However, this is only a matter of trust, and it takes some getting used to. Hopefully, the project manager, the company will have the best interest in mind and should therefore do what it takes to improve results.

The employees are motivated by giving a proper level of responsibility. The Agile project management handovers part of the decision making to members of the project team from the project manager and according to literature they are dedicated and motivated for the project. This approach can attract anyone because it shows respect and trust

# 4. Evaluation of KPI's In Construction

# a. Overview

APM is proposed as a conceivable administrative thought to manage complex situations in undertakings. One discriminating part of the structure, the KPI, investigates conceivable systems to accomplish deft execution all through task administration. Among all proposed KPIs, this study embraces the five KPIs as recognized by Fei Han (2013) to be more qualified for development ventures. These KPIs were hauled out from both other lithe building controls like coordinated assembling, and existing development related speculations and practice which could have the potential as main impetus to advance dexterity thoughts. These five KPIs are:

"Real time resource monitoring and productivity measurement."
"Self-autonomous work teams with multi-functional crews."
"Short-term planning along with concurrent execution of activities."
"Continuous improvement based on learning organization."
"Information technology integration."

"APM" is a way to deal with overseeing ventures that permits the task to flourish under persistent and eccentric changes. At the point when contrasted with conventional and incline development administration, lithe administration has three noteworthy qualities:

- 1. It empowers both proactive and receptive reactions to up and coming changes.
- 2. It requires profoundly agreeable, level and self-persuaded working structures rather than extremely various leveled and successive structures.
- It is a redundant and incremental procedure in light of nonstop learning and enhancing instead of a quick and streamlined procedure.

In light of the three's criteria qualities, five KPI's specified above are proposed for focusing on postponements and expense invade created by dubious changes, and eventually enhancing general project performance.

#### 5. Research Methodology

#### a. Introduction

Research methodology demonstrates how the scientists are going to do their study to accomplish and answer research targets (Saunders et al., 2007). The examination was begun with broad writing survey as past studies, exploration papers, books on the subject and few contextual analyses. The strategies for gathering and producing examination information are the poll study and meetings. This exploration is led with an intend to think about for investigating the potential utilization of proposed deft KPIs in development.

#### b. The Questionnaire

The questionnaire was distributed in hard form as well as it was uploaded through "google Drive" for online filling and submission. Since the online submission through "google drive" is a paper free method, it provides more and speedy responses.

The questionnaire form consisted of two parts. Part I of the questionnaire was designed to make prioritized effect of key performance indicators on project management in construction industry of Pakistan. For this purpose 5 key performance indicators were chosen through extensive literature review and 16 parameters were identified to gauge their internal effects that are explored in part II of questionnaire.

Part II was designed to study the key performance indicators in construction industry of Pakistan. It consisted of five sections. Each section covers factors effecting each KPI.

First section covered general considerations for KPI's in construction industry and their effect based on their priorities. Second section, comprised of 16 questions covered the specific parameters regarding Key performance indicators. The third section consisting of 5 questions explored about some views of construction industry professionals who are implementing agile project management techniques in their projects.

A five-point likert scale, with 1 being very low and 5 being very high, was utilized to judge the performance parameters. All the stakeholders of CI including clients, consultants and contractors/subcontractors are made part of this survey.

#### c. Agility Framework

To make a system for the administration of coordinated development, an exhaustive survey of the current writing is utilized as a first approach. The audit secured the field writing of administration of the development and additionally spryness in programming improvement and assembling. Since spryness envelops different implications and standards, the first errand was to give a reasonable and particular clarification what it implies deftness in the development and propose a dexterous administration system to take out instability.

Since the light-footed administration idea is as yet rising in development, a theoretical system is regarded fitting as a sort of middle of the road hypothesis that endeavors to associate all parts of exploration hobby. In this manner, diminishing the time may be more like a "critical thinking "issue procedure" beginning from ID" (postponement causes). "improvement arrangements" (hypothetical information/experimental and down to earth) on "assessment of results" and "lessons learned" (acceptance delay lessening systems). In addition, the proposed casing goes about as a guide which gives a consistency by any means "turning points" amid the deferral diminishment forms.

#### 6. Data Collection and Analysis

#### a. Respondent Profile

The questionnaires were distributed to group of four stakeholders working in project management units with construction professionals and professional consultancy firms in the construction industry of Pakistan and theses firms belongs to different sectors. Tables-1 shows the number of respondents and percentage of returned questionnaires whereas Table-2 shows the number and percentage of responses from different sectors like private, government and semi governments.



Figure 1 Type of Organization

# b. Solicitation Of Key Performance Indicators in Recent Construction Industry Setup

It can be seen from the results that Resource Monitoring and Productivity Measurement is best commonly used KPI in projects.



Figure 2: Application of KPIs in current CI scenario

Same pattern will be followed for each KPI and there sub questions. Each question will be dealt separately and result will be shown in form of histograms and pie charts.

# c. Analysis of Factors Affecting Key Performance Indicators

# 1. Resource Monitoring and Productivity Measurement



Figure 3 Main causes of schedule overruns





It has been found that productivity loss and unexpected change are main grounds for schedule plunders (Lee et al., 2006). Keeping daily records of resources of invested works effectively help to detect the productivity loss and unexpected changes which will effect responsiveness of project performance as shown in Figure. Incessant recording of productivity helps in tracking the alteration of productivity regularly as shown in Figure (Daneshgari, 2010).



Figure 5 Methods to Implement Resource Monitoring

Resource monitoring has been applied in Earned Value Management (EVM) to provide a quantitative forecasting, of schedule (Nassar et al., 2005), as shown in Figure.

# 2. Self-autonomous and Multi-functional Work Teams



Figure 7: Organizational Breakdown Structure Being agile should be reflected in organizational breakdown structure. Breaking down traditional hierarchies structures at crew level will provide freedom to the workers ti make their own decisions. The results show that most of the organizations based on hierarchal system. As they give more importance to the system in which members of an organization or society are ranked according to relative status or authority as shown in both figure.



Figure 8: Efficient type of Professionals

# 3. Short-term Planning with Concurrent Activity Execution



Short interim arranging, encourages "without a moment to spare" asset supply approach, hence decreased conceivable defers and enhanced efficiency



the Project

Overlapping activities actually tries making the schedule flexible also called as fast tracking. To speed up the project there are many different methods. Different organizations use different techniques. The results show application of different techniques, for speeding up the project. The most commonly used technique for speeding up the project is fast racking and work over time as shown in Figure.

4. Continuous Improvement based on Learning Organization



Surveyed result also giving same result that lack of communication is one of the main cause of delay in projects as shown in Figure-4.18



Figure 12 Project Tracking Techniques

Results shows that there are a lot of project tracking techniques out of which the most commonly used techniques are Primavera Ms project and project planning tools (Different organizations use different tools) a**36** bar charts. So there is a range of techniques and tools used by construction industry professional for tracking their projects in order to avoid delays as shown in Figure.

#### 5. Information Technology Integration



Figure 13 Methods of reviewing and maintaining information

Data innovation has changed the way individuals oversee and actualize the venture development exercises, yet there is still space to coordinate them completely into the regulatory procedure. In light of the steadily changing specialized necessities and administration, empowers experts in the building itself recognize and programming apparatuses to to productively oversee ventures. Adaptability is another advantage when data is transmitted and surveyed by pumping information, Internet and Building Information Modeling (BIM) continuously.

# 7. Traditional Versus Agile Project Management

Traditional Project Management	Agile Project Management
Focus on process and plan	Focus on people
Focus on developing all parts of the scope	Focus on the most important part of the
first .	scope first and then proceed to the next.
Regulation of changes is based on rigid Procedures.	Regulation of changes depends on flexible and adaptable procedures.
Members work individually within teams i.e. less collaboration.	Team members collaborate in all aspects.
Order establishment is facilitated by hierarchical organizational structures.	Order is established as a result of continuous and voluntary interaction in complex systems
Increased order is a result of increased control.	Self-organization, interaction and simple rules result in increased order.
Organizations must be rigid and static	Organizations must be flexible and eliminate
Hierarchies.	unnecessary bureaucracy.
Controlling type of management.	Management role is to facilitate and give support.
Employees are interchangeable 'parts' in the organizational 'machine'	Employees are an important part of the organization whose contribution is necessary.
Customer is mainly involved during	Customer is continuously involved
requirements gathering and delivery phases	throughout the project lifecycle
The reductionist task breakdown and allocation is necessary for solving problems (e.g. Work Breakdown Structure (WBS) and the Project Breakdown Structure (PBS)).	Iterative approaches to selected tasks with continuous feedback from team members and stakeholders result in valuable incremental progress in a short time.
Projects and risks are adequately predictable and it is possible to manage them through detailed and complex advance planning.	It is impossible to control the future because projects and risks are unpredictable due to uncertainties; therefore there is no need for detailed advance planning.

#### 8. Conclusions

This research work clearly directed towards analyzing and quantifying the KPIs as well as development of conceptual frame work that works in fluid environment of agile project management and aims at reducing delays and cost overruns. Following conclusions are made.

- The major pros by applying "APM" are the increased client involvement because for development of project team client will continually keep in touch with the project throughout its life cycle.
- It has also been prominent that both project management approaches can be applied on the same project at different times.
- Traditional project management approach mainly focus on the rigid and detailed planning, task and sub tasks distributions and preset stakeholder necessities, while the agile project management conform to soft and human side of projects.
- It has been noted that iterative working approach of small independent teams are vital for agile project management system.
- Iterations in project applications and meetings in case of complex projects are more frequent and used as next step for improvement of

projects.

Traditional project management approach focuses on detailed planning which consumes more time while planning is done progressively, in case of agile project management.

Both project management approaches are good.

# References

- [1]. Baker, R.F Taylor and D.C(1981); Conceptual А Framework The Analysis of for Proposed Effectiveness Cost Industry; in the Construction Transactions AACE. Barthet, P.C and Wasserstein, D. (2010) — "The 3 Ps of price adjustment clauses".
- [2]. Castillo, J.E.A., Al-Jibouri, S.H.S., and Halman, J.I.M.(2009) — "Risk-based decision making in construction: a case of planning and risk assessment of construction alternatives".
- [3]. Blair, A. N., Lye, L. M., & Campbell,W. J. (1993). Forecasting construction cost escalation. Canadian Journal of Civil Engineering, 20(4)
- [4]. Cha, H. S. (2004). Examination and suggestions to improve the base date for calculating escalation cost in a construction project, CERIK, Korea.
- [5]. Choi, M., Kim, J. and Kim, M. (2006)"Study on the price escalation system in a construction contract". KSCE Journal of Civil Engineering. (pp 227-232)
- [6]. Cormack, D., (2000)."The Research Process in Nursing".4th edition, Blackwell Science.
- [7]. Datta B. (2002) Management of Infrastructure Projects in Urban Local Bodies: Case Study of Kanpur Development Authority, India Infrastructure Report, pp. 207 – 211.
- [8]. Dillman, D. A. (2000) "Mail and Internet Surveys: The Tailored Design Method". New York: John Wiley &

Sons, Inc., 178-180.

- [9]. Dinku, A. (2003); Construction Management and Finance; AAU Printing Press
- [10]. Dowdy, S., Weardon, S. and Chilko, D. (2004). "Statistics for Research; John Wiley & Sons, Inc.", 3rd edition.
- [11]. Farooqui R.U, Ahmed S.M. and Lodi S.H. (2008) — "Assessment of Pakistani Construction Industry – Current Performance and the Way Forward", Journal for the Advancement of Performance Information and Value VOL. 1 NO. 1
- [12]. "Federal Bureau of Statistics".http://www.pbs.gov.pk
- [13]. Fellows R. and Liu A. M.
  (2003). "Research Methods for Construction". 2nd edition, John Wiley & Sons.
- [14]. Flyvbjerg, B., Holm, M. K. S., and Buhl, S. L. 2003. "How commonand how large are cost overruns in transport infrastructure projects?"
- Rev., 231. [15]. Transport 71 -88.Frimpong Y., Oluwoye J., and Crawford L., (2003), Causes of delays and cost overruns in construction of groundwater projects in a developing country; Ghana as a case study, Journal of International Project Management. 21, 321 pp (1997)326GAO/RCED
- [16]. Transportation Infrastructure Managing the Costs of Largedollar Highway Projects, Washington, D.C