An Investigation into Performance Appraisement of Commercial Buildings Construction Projects in Pakistan by Integrating Earned Value Management (EVM) and Risk Management

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Abstract

The success of a project is partly dependent on accurately forecasting the performance of future states of current projects. Earned Value Management and Risk Management are two different approaches used for forecasting the project performance. By separately using these two approaches in commercial buildings construction projects in Pakistan do not add enough project value in forecasting current project performance. The timely and precise feedback is of crucial importance for the success of these projects that help keeping the initially planned costs and time of the project on schedule. The paper is supported by questionnaire survey that was responded by 120 project leaders in the field of commercial buildings construction projects in Pakistan who have good experience of using the techniques of EVM and RM. The results of this research significantly support the belief that integration of EVM and RM adds value to a project. The research provides project managers with several recommendations potentially benefiting their projects success and improving project performance by providing evidence for use of an integrated EVM and RM.

Keywords: Earned Value Management, Risk Management, Planned Value, Earned Value, Actual Cost, Project Performance, Cost Index, Schedule Index, Economic Risk, Technical Risk

Introduction

Construction is a process that consists of building or assembling of infrastructure. Construction industry is considered as one of the major sources of economic growth, development and economic activities. It plays an important role in the economic uplift of a country. Millions of skilled, semiskilled and unskilled employees are associated with the construction industry. The construction industry is an important sector of the economy and has multiple backward and forward linkages with other sectors. The industry contributes significantly to socio-economic development and employment. It includes hospitals, schools, townships, offices, houses and other buildings; urban infrastructure (including water supply, sewerage, drainage); highways, roads, ports, railways, airports; power systems; irrigation and agriculture systems; telecommunications etc. It deals with all economic activities directed towards the creation, renovation, repair or extension of fixed assets in the form of buildings, land improvements of an engineering nature. Besides, the construction industry generates substantial employment and provides a

growth impetus to other sectors through backward and forward linkages. It is therefore essential that this vital activity is nurtured for the healthy growth of the economy. Foreign exchange earnings are received by the trade of construction material and engineering services. Development of the construction sector has not been at par with market demands. With the recent rapid economic growth of the country, Pakistan now offers a growing market for the construction industry. According to Survey Reports of 2014-15, the share of construction in industrial sector is twelve percent and is one of the potential components of industries.

Problem Statement

Projects normally are not completed in time and their current performances are not assessed accurately. Projects fail because of funds, unspecified scope of work, lack of senior management support, poor teamwork etc. Monitoring performance is also mandatory for in time and within budget cost completion of the projects. Normally the performance of the projects is evaluated by traditional methods like Gantt chart in developing countries. Performance measurement is a project planning and control system that goes beyond the traditional concept of comparing the amount of project time elapsed against the amount of actual cost spent to give a comparison of actual value of work accomplished against the planned value of work scheduled. It does this by incorporating the earned value methods into the more widely used management principles of organizing, planning, monitoring and controlling work within a project. For construction project, managers strive to deliver successful projects, there is often an absence of standard benchmarks for evaluating the project's performance and success. The success of a project has been defined and the project's performance gauged in a plethora of ways by the different clients over the course of time. While some use the conventional performance measures, such as time, quality and cost of the projects for project evaluation, others turn towards non-conventional measures, such as stakeholders' interests, environment, health and safety, etc.

A literature review of many studies conducted in many countries to investigate performance appraisement by integrating EVM and RM reveals that such integration techniques can be used for monitoring project performance data, having an insight into project, gaining maximum benefits for projects and organizations , mitigation of risks etc. According to Georgieva,S.B.,(2014), both Earned Value Management and Risk Management are directed towards measuring project performance by providing the data that is used for making decisions and taking actions and there is a possibility of integration between these two approaches to explore the project performance. Earned Value Management (EVM) and Risk Management (RM) can be integrated in an organization to provide powerful insights into factors affecting the project performance and gaining maximum benefits for the projects and organizations (Hillson,2004)). EVM is used to monitor progress to date and consider the forward plan, make predictions of actual spend and schedule completion while Risk Management System on the other hand is forward looking and based on predictions on potential risk and opportunity impacts and the anticipated effects of mitigation actions (Welch, 2003).In these studies the performance of different organizations and projects has been assessed by using the EVM and RM integration techniques. Organizations and projects like IT projects,

telecommunication projects, procurement projects who have adopted such models reported improvement in performance. These are the different projects other than construction projects in different countries which have used the EVM and RM integration techniques. Such techniques are not used in building construction projects for evaluating the performance of these projects. In this study the practice for assessing performance of commercial buildings projects in Pakistan will be investigated by integrating EVM and RM. A comparison will be conducted to assess the performance by using the traditional methods and the earned value methods. Moreover, a comparison will be made for identifing any differences in the assessment of performance by using EVM and by integrating EVM and RM.

Performance measurement is defined as the process of evaluating performance relative to a defined goal. It provides a sense of where we are and, more importantly, where we are going (Rose, 1995).The construction industry has numerous problems to deliver quality construction projects because it comprises of a multitude of professions, occupations and organizations. The quality of service delivered by consultants has often been a subject of thorough investigations. Some clients have underestimated the impacts of substandard consultancy service to the success of a construction project (Barber et al, 2000). Many delays, cost overruns, reworks, variations, claims and disputes can be traced back to erroneous design, poor contract administration or lax supervision of the client's representative (Chini and Valdez, 2003).There are many potential measures for evaluating the performance measurement of the projects. Project managers have used Earned Value Management (EVM) for over 40 years to track actual schedule progress and actual costs against project plans. Earned Value Management has traditionally been applied to individual projects on which the manager is accountable for both schedule and cost variances. The crisis of performance evaluation in construction projects requires innovative solutions. One innovative solution is integrating earned value management and risk management.

This research intends to show that Earned Value Management (EVM) and Risk Management (RM) can be integrated to predict the final effects on project performance by using the current trends of cost, schedule and performance of the commercial building construction projects in Pakistan.It will also be helpful to identify and quantify the risks and assess that the project is following the plan.

Research Objectives

The objectives of this study are

1. To assess the possibility of using both EVM and RM in integrated approach for commercial buildings construction projects in Pakistan.
2. To investigate the relationship between using both EVM and RM techniques in integrated approach and project performance assessment for commercial buildings construction projects in Pakistan.

Scope of the study

Both EVM and RM tend to forecast the outcome of projects. For EVM, output is

achieved by means of calculated performance indices. RM predicts a range of possible results by analyzing the combined effect of known risks and uncertainty on project. This research outlines practical steps to coalesce EVM and RM in order to strengthen the performance appraisement ability of the organization for commercial buildings construction projects in Pakistan. Project management is the application of knowledge, skills, tools, and techniques for project activities to meet the project requirements (PMBOK guide, 5th ed.). In project management, for the successful completion of any project the triple constrains also known as the Project management triangle has a significant importance for the overall success of the project. The three main constraints, which are also interdependent for any project, can be classified into, time, cost and scope. Traditionally, any project is called 'successful' if it meets the standard criteria of scope, time and cost (Meredith & Mantel, 2011). As the scope is dependent upon time and cost, therefore time and cost matrices will be quantified for investigating the performance appraisement of projects. The study looked for commercial buildings construction projects in Pakistan that had run from initiation stage all through the closure stage of a project life cycle. In this study initial spend baseline will be determined by using both risk and earned value data. The expected outcome will provide the clear insight into the project performance. The study will deal with negative (threats) and positive (opportunities) aspects of risks by displaying it in EVM-RM model. It will facilitate the project team to carry out more in depth assessment of project status and predict future project trends as well.

Research Questions

1. What is the possibility of using both EVM and RM techniques in integrated approach for commercial buildings construction projects in Pakistan?
2. How using both EVM and RM in integrated approach does impact project performance for commercial buildings construction projects in Pakistan?

Significance of the Research

Commercial construction includes a huge variety of projects including building restaurants, shopping centers , hospitals, private schools and universities etc. Firstly this research can provide better support for decision making by integrating EVM and RM into a single project tracking approach. By applying EVM techniques for projects current trends can be extrapolated for predicting their probable final effect on commercial buildings construction projects in Pakistan. EVM is developed to account better for schedule and time aspects. Risk Management is used primarily within project as an aid in controlling or managing the project. Project Managers can use the research to monitor and control project execution. Secondly, it provides an understanding of EVM and RM as discrete disciplines as well as identifying and understanding the linkages between them, particularly in the appraisal stage and at different organizational levels. Thirdly, it provides a comprehensive approach to integrate them within the appraisal stage at different organizational levels.

Literature Review

Earned Value Management

Earned Value Management (EVM) is a tool used to measure projects' performance and progress by integrating scope, schedule and cost. Traditionally the measurement of progress in construction industry is done by surveying practice and by Gantt Charts by maintaining physical and financial accounts. Alternatively EVM is used as tool for integrating planning, control and definition of project scopes into a single tool and focusing on final cost and duration. EVM is a planning and control technique for the measurement of physical, financial and time progress which shows the actual and planned performance. According to Khamidi, M. et al (2011) ,Earned Value Analysis provides a clear insight into the project progress by facilitating the project team to carry-out more in-depth assessment of project status and predicts future performance trends as well. Bhosekar, S. K. & Vyas ,G. (2012), in their research compared MS Project, Prima Vera and Developed Software and found out that in the case of cost overrun, project management team may decrease cost either by reducing scope and quality in some sections of project or providing additional budget to cover overrun cost, and for time overrun case, they may plan some program such as fast tracking or time-crashing for time reduction. EVM shows the project manager where the project is, by connecting work completion, costs incurred and time taken and supplies the arithmetic for predicting cost and time parameters at completion.(Padalkar,M & Gopinath, S.)

Risk Management

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project. The objectives of project risk management are to increase the likelihood and impact of positive events, and decreasing the likelihood and impact of negative events in the project." (2013 PMI,PMBOK Guide,5th Edition). Uncertainties in the construction projects in terms of time , cost and quality can be managed by utilizing the risk management concept in the project life cycle. Construction project managers can minimize the risk factors by prioritizing the risk factors. (Gohar,A.S et al ,2012). Choudhry, R. M. and Aslam,M.A . , divided the potential risks related to bridge construction projects into seven categories in descending order of importance which are financial risks, external risks, design risks, management risks, construction risks, contractual risks and health & safety risks. Practices and procedures that enable managers to identify, assess, categorize, monitor, control, and mitigate risk before or while it is transitioning to a problem.

Earned Value Management and Risk Management Integration

EVM is not suitable tool for workflow which addresses data useful for constructors and final clients and is too time consuming ,heavily dependent on standardized procedures ,difficult to implement and bureaucratic for documentation , prone to failure for in long term predictions and is unreliable at the early stage of project (Cândido, L.F et al . 2014).Both Earned Value Management and Risk Management evaluate the project performance by providing the data used for making decisions and taking actions and to create a set of curves by integrating these two techniques that provide a baseline of plans

called Planned Value curves. (Georgieva,S.B.,2014) . EVM and RM can combine their strengths so that by using the data from the EVM we can provide more information to the RM techniques. Earned Value Management (EVM) and Risk Management (RM) can be integrated in an organization to provide powerful insights into factors affecting the project performance and gaining maximum benefits for the projects and the organizations (Hillson.D.,2004).Both EVM and RM move from analysis to management and provide basis for decision and action. A combined EVM-RM approach can address weaknesses of both of these techniques. According to Mehdintu.A. et al, Earned Value Management (EVM) integrates technical performance requirements & resource planning to schedules, while taking risk into consideration and provides valuable quantifiable performance metrics for forecasting at-completion cost and schedule for their project. EVM is based on the baseline plan derived from a budgeted and resourced project plan, including fixed and variable costs arising from financial and human resources of expected spend over time. It creates the profile of "Budgeted Cost of Work Scheduled" (BCWS) or "Planned Value" (PV) against which project performance is measured. PV exists as a benchmark upon which project performance can be measured. Degree of uncertainty can be measured by RM . RM can make EVM to consider the uncertainty and risk for constructing the baseline PV. Qualitative risk analysis can be used to evaluate the degree of risk in the baseline project plan. The results of the risk analysis can provide the cheapest and quickest way to reach project completion. To ensure that results are realistic and feasible; dependency and correlation issues in the risk model must be carefully considered. For EVM, future outcome of the project can be achieved by using the indices with the range of formulae for calculating estimate at completion (EAC). An amount into the EAC calculation is added to account for risk-weighted management reserve. Risk analysis results can also be used to show the effect of specific risks (threats or opportunities) on project performance as measured by earned value. EVM performance indices (CPI, SPI) measure deviation from plan and they can be used to indicate whether the risk process is being effective in addressing uncertainty and controlling its effects on project performance or not both techniques share a focus on project performance, by developing effective actions to correct unwelcome trends in order to maximize the likelihood of achieving project objectives.

Welch (2003) haspropounded that EVM requires a Work Breakdown Structure which is combined with organizational breakdown structure for identifying the risks to program objectives, deciding ownership, and formulating and managing mitigation plans. It will be used to monitor progress to date and consider the forward plan, make predictions of actual spend and schedule completion. The Risk Management system on the other hand is forward looking and based on predictions on potential risk and opportunity impacts and the anticipated affects of mitigation actions.

The manager can choose the Planned Value Curve not only based on his assessment but also on quantitative methods and simulations. Three areas for accomplishing a synergy between EVM and RM are creating a baseline Planned Value ,predicting future outcomes and evaluating risk process effectiveness. Gutiérrez,J.P. & Paredes,A.L. (2008), have researched when the project was close to its end, all the planned activities will be nearly finished, so the budgeted cost of work planned will equal to the budgeted cost of work done, and EV will tend to PV, and as a consequence, SV will converge to zero and SPI

will tend to 1, even if the project has serious delays from planned schedule. This means that SV and SPI do not work properly during the late stages of the project. Project risk management is crucial for project success. However, EVM does not take into account project risk. EVM focuses on the history of the project, whereas risk management procedures look forward. To integrate EVM and project risk management methodologies in order to improve project control, first we define the concept of Project Risk Baseline; then we propose new performance indexes for monitoring how far the project is executed from this baseline. Project managers compute measures of project risk (variances, impact, probabilities, etc) before project start-up.

Performance Appraisement

Integration of EVM and RM provides greater benefits for Commercial Buildings Projects in Pakistan and is an important step towards achieving this goal. Both EVM and RM give their different perspectives towards the past and future and divert the management attention to achieve the objectives.

Theoretical Framework

From the review of literature and the variables under study it has been found that the future performance of a project can be predicted from its past performance and EVM and RM can be incorporated to strengthen the performance appraisement ability of a project. The dependable concept was project performance and the independent concept was

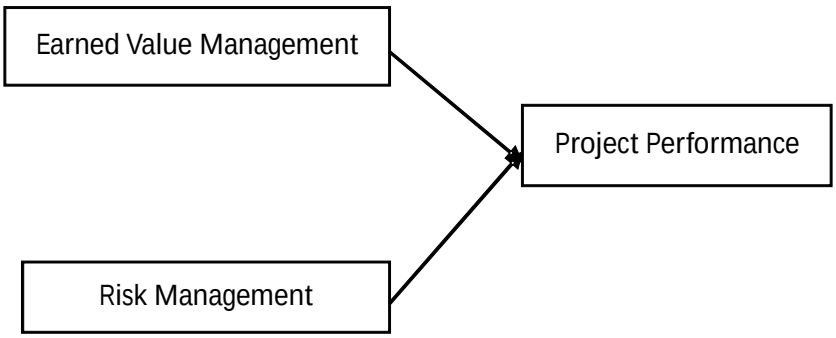


Figure1: Theoretical framework

Operationalization of Variables

In research terminology, change variables are called independent variables and outcome/effect variables are called dependent variables. The independent variable is a combination of subcomponents from each individual technique. The following three components represent Earned Value Management

a) Planned Value

b) Actual cost

c) Earned Value

The actual cost (AC) is the cost that was expended in the project activities as per the original closure date. It is known as Actual Cost of Work Performed (ACWP). Planned Value (PV) is the sum of the budgets for all work packages, planning packages, etc., scheduled to be accomplished (including in-process work packages), plus the amount of level of effort and apportioned effort scheduled to be accomplished within a given time period. It is also known as Budgeted Cost of Work Scheduled (BCWS). Earned Value (EV) is the sum of the budgets for completed work packages and completed portions of open work packages, plus the applicable portion of the budgets for level of effort and apportioned effort. It is also known as the Budgeted Cost of Work Performed (BCWP).

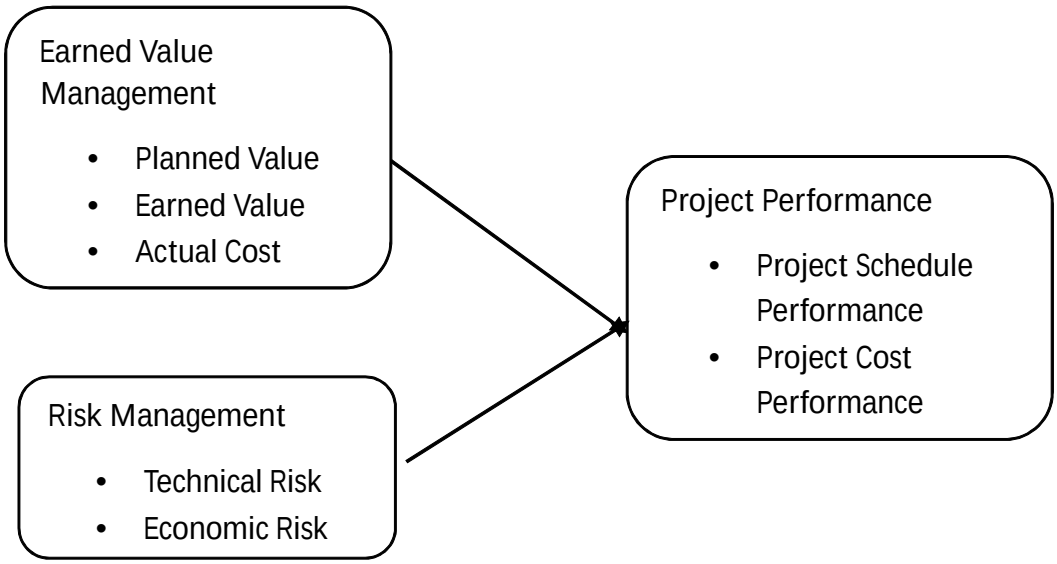


Figure 2: Model for Variable Operationalization

Research Methodology

This part consists of two parts; the research theory and its process principles are reviewed and examined through the literature in the first part. Whereas, the research methodology, which is appropriate to the research problem, was adopted, argued and justified in the second part.In this study the dependent concept is the project performance while the independent concept is the model of EVM and RM integration. Project performance has been shown by cost performance and schedule performance while EVM has been represented by the variables Actual Cost, Planned Value and Earned Value and RM has been represented by the variables like technical risks and economic risks. Literature review was conducted for identifying the set of hypothesized variables that were used for the questionnaire for the study.The research methodology consists of the following steps:

1. Development of a questionnaire to elicit information about EVM , RM, Project Cost Performance and Project Schedule Performance
2. Development of Integration model of EVM and RM

3. Development of a Project Performance.
4. Conducting questionnaire survey through postal mail and personal interviews.
5. Assessment of feedback from questionnaire survey to identify the overall perspective, the group perspective, as well as the relative difference in importance of EVM and RM needed by an effective project manager.

This study is based on the assessment of performance which is based on variables of cost and time. These independent and dependent variables were measured in the questionnaire in order to predict the performance of the commercial buildings construction projects in Pakistan. Questionnaire was prepared for the project leaders working in different cadres in the commercial buildings construction projects in Pakistan that constitute the population of this study. This research covers the companies involving commercial buildings construction projects in major cities of Pakistan like Lahore, Karachi, Islamabad, Quetta , Peshawar etc. Random sampling technique was used for this study as it specifies various issues and characteristics of the sampling process.

A careful sample of 120 project leaders of major construction companies is selected which is the reflection of commercial buildings construction projects in Pakistan. Most of construction companies selected for sample have completed the mega projects of commercial buildings construction projects in Pakistan and have their project management units and they normally plan their projects by keeping in view the project management techniques for the execution of their projects. We used the multistage sampling technique by taking into account the organizational size (number of employees), type of projects and size of these projects completed by the organization type of manpower engaged by the firms and their academic background. These firms are enlisted in Pakistan Engineering Council as unlimited contractors. The questionnaire responds to research objectives, hypothesis and variables. The respondents are dispersed geographically and the questionnaire was forwarded through email and most of the respondents were contacted telephonically. These questions are self explanatory but any ambiguity from the respondent was clarified about the questions of research. We obtained a list of contractors from CDA, Pak PWD, PEC , inter internet and project managers who are known to me . A long list 650 companies were scrutinized and it was found that most of them have not even proper units of project management. After confirming their business scope and skill of project management 120 firms were selected. This approach increased the chances of the respondents in construction industry in Pakistan that could evaluate and possessed the perception about the project management techniques. Random sampling procedure was adopted that acts as the representative sample of the population. The questionnaires were sent through email to different respondents and only a small group out of it responded immediately while others took some time to respond. Those who did not respond were sent the questionnaire again through email.

Data Collection

In order to build a full understanding of the EVM and RM tool, its applicability, use and limitations, and exploring the prospect of developing an efficient framework for the application of EVM and RM, it was important to conduct a double-phased study, including, at the first stage; an extensive review of the existing literature related to the

subject, and at the second stage: a Pakistan market field related data collection through questionnaire. A questionnaire was sent to 550 professionals from different construction contracting companies operating in the Pakistan. The opinions of respondents were sought and classified with regard to the performance assessment integration of techniques EVM and RM by using the software SPSS 17. The instrument used to measure the Project Performance as dependent variable and independent variables includes Earned Value Management (EVM) and Risk Management (RM). EVM, RM, Project Performance contained 9, 8 and 4 questionnaires respectively. A ?vepoint Likert rating scale was used to measure their responses. The scale ranged from Strongly Disagree to Strongly Agree. The data was then collected based on the criterion above and tabulated. The survey and questionnaire methods are used to collect the data in order to measure the variables and testing hypotheses. A web-based questionnaire form was developed. There are many web-based questionnaire hosting websites available on the internet. We chose https://surveymonkey.comwebsite to develop and host our survey due to its affordable cost and a variety of options available to develop the questionnaires.

A total of 120 professionals completed the survey, at a return rate of 26.67%. It is noteworthy that 38% (46),40% (49),19%(23) and 2 % (3) of the companies were based in Islamabad, Lahore, Karachi and Peshawar respectively). Most of the respondents (86%) had above 6 years of professional experience . Only 14% of the respondents had less than 6 years of professional experience. It is assumed that more the respondents are experienced, the better they would be able to answer the questionnaires. A sample of more experienced respondents strengthens the quality of the responses. Experience of using the project management has been shown. 57% of the respondents have the experience more than 5 years in their commercial buildings construction projects. 48% respondents have experience less than 5 years and the respondents having experience of above 25 years are just 5 percent of the total population. It shows that the use of EVM techniques in commercial buildings construction projects in Pakistan is not being used on large scale.57% respondents have experience of using the risk management less than 5 years out of which 33% have the experience of less than one year which shows that the majority of the respondents have very less experience of using the technique of risk management in commercial buildings construction projects. It can been seen that 64% of the respondents have the experience less than 5 years for using both the EVM and RM in integrated approach and a large portion of 45% respondents have their experience of using this technique less than one year. Respondents having experience of above 25years are only 2 % showing the technique of using both the EVM and RM in an integrated approach for commercial buildings construction projects in Pakistan is rare. Techniques of using EVM, RM and using both the EVM and RM in an integrated approach in commercial buildings construction projects in Pakistan are applied. 55% respondents never or rarely used the technique of earned value management in commercial buildings construction projects in Pakistan and 29% used sometimes this technique. Only 14% use it usually and 2% always use it. It shows that the use of earned value management in commercial buildings construction projects in Pakistan is rare.60% respondents have never or rarely used this technique in commercial buildings construction projects in Pakistan, 21% use it sometimes, 17% use it usually and only 2% always use it.Nearly 88 % respondents never ,rarely or sometimes use both the EVM and RM in an integrated

approach ,only 12 % use it usually and no respondent use it always(Tables 01-04,Figures 07-11)

Results and Discussion

This section presents research findings, analysis and interpretation of the data collected from the respondents. It presents findings on the relationship between the integration of EVM and RM and performance assessment. The study carried out a descriptive statistics analysis on the independent and dependent variables. Respondents were asked to indicate the extent of use of various earned value management, risk management , using of both EVM and RM in an integrated approach and project performance on a scale of 1-5 (where 5 is “Strongly agree”, 4 is “Agree”, 3 is “Uncertain”, 2 is “Disagree” and 1 is “Strongly Disagree” . Results from analysis of their responses are summarized in table below.

Earned Value Management

Earned value management was estimated by actual cost, planned cost and earned value. Respondents were asked about the degree of use of these variables for the measurement of earned value management.

No missing values were found in the valid sample of 120. Taking a look at the minimum and maximum for EVM, the mean value ranges from 2.33 to 3.51 which shows respondents ' response towards the agreement about these questionnaires. AC is most important item in having mean value of 3.51 which means that actual cost in accomplishing the work performed is the very important aspect of the EVM method. On planned value the respondents agreed somewhat with a mean of 3.26, which shows that this is the second important EVM tool to be applied for assessment of projects performance. On whether the Earned value management is applied to projects on which cost and schedule values are accounted, scored means of 2.83 and 2.74 indicates that respondents in agreement for applying these tools for assessing the project performance. This indicates that the considering of cost and schedule for the assessment of project performance of commercial buildings construction projects in Pakistan are important for application of EVM techniques. The results shows that all EVM variables are playing a very important role in assessing the projects performance, which supports the whole concept as also indicated in the literature review .From the table we can see that the tools having the description of cost have somewhat more mean values than the tools mentioning the schedule. It indicates that the respondents are more agreed to the cost than the schedule.From the Fig. 3-10, it is indicated that the respondents were mostly agreed for the role of these variables for earned value management and for assessment of projects performance for commercial buildings construction projects in Pakistan.

Risk Management

Independent variable risk management was measured by two factors: economic risks and technical risks; which have been taken in research for cost and time variables relating to the project performance.

The statement, identification and assessment of technical risks, adds project value in project completion cost scores. The mean value of 3.78 indicates that the respondents are

highly agreed to take the technical risks as most important aspect of risk management for assessing the project completion cost. The statement, identification and assessment of economic risks, adds project value in predicting project completion time for commercial buildings construction projects in Pakistan, scores of the mean value of 3.68 indicates that the respondents are agreed to take the economic risks as very important aspect of risk management for completion of project according to schedule. The two statements relating to technical and economic risk analysis for cheap completion of projects secure mean values 3.67 and 3.63 respectively which show that analysis of risks are very important for economical completion of projects. The statement, identification and assessment of technical risks, adds project value in project completion time, scores the mean value of 3.62 indicate that the respondents are somewhat agreed to take technical risks as important aspect of risk management for predicting project completion time. The statement, identification and assessment of economic risks, adds project value in project completion cost, scores of the mean value of 3.60 indicate that the respondents are somewhat agreed to take technical risks as an aspect of risk management for assessing the project completion cost. Both time and cost are considered for the assessment of project performance of the commercial buildings projects in Pakistan. The results show that all economic and technical risks play a very important role in assessing the projects performance strongly, which supports the whole concept as also indicated in the literature review.

Project Performance

Project performance of the commercial buildings construction projects in Pakistan can be evaluated by variables, completion time and completion cost. Whether EVM & RM increase accuracy of project schedule performance reports and cost performance reports or not for commercial buildings construction projects in Pakistan score a mean of 4.08 and 4.07 respectively an indication that the respondents are strongly agreed to have these as most important aspects of the project performance. Project schedule and cost performance reports are increased by EVM and RM integration. On whether integration between EVM and RM is helpful in improving schedule and cost of commercial buildings construction projects in Pakistan or not scored mean values 3.99 and 3.72 respectively; an indicate that respondents are agreed to have these as very important aspect of project performance. Schedule and cost controls are improved by EVM and RM integration. As these two variables; completion time and completion cost show the project performance and the strong agreement of respondents with these variables show concept revealed by the literature review. In integration of EVM and RM the factor of improving of schedule performance is slightly greater than the aspect related to cost performance.

Reliability and Validity

In this study reliability is evaluated using internal consistency technique.The items of a questionnaire are measuring different constructs, and Cronbach alpha value for each of the subscales has been calculated separately . The Cronbach alpha values for each of the four constructs are shown in the table below (Table 1).

Table 1: Internal Consistency

Construct	Alpha (a)
Earned Value Management (EVM)	0.749
Risk Management (RM)	0.801
Project Cost Performance	0.714
Project Schedule Performance	0.628
Project Performance	0.580

Validity is considered as the strength of research conclusions and somehow ensures that there are no alternative explanations or errors within the research. Hence, validity can be considered as an evidence for the correctness of the study and that there exists a causal relationship between the predictors and outcomes. Issue of maintaining validity is a very important consideration in quantitative studies (Richards, 1999). In this study, validity is estimated by calculating correlations among the predictors and outcome variables. Correlation and regression analysis are related in the sense that both deal with relationships among variables. The correlation coefficient is a measure of linear association between two variables. Values of the correlation coefficient are always between -1 and +1. A correlation coefficient of +1 indicates that two variables are perfectly related in a positive linear sense, a correlation coefficient of -1 indicates that two variables are perfectly related in a negative linear sense, and a correlation coefficient of 0 indicates that there is no linear relationship between the two variables.

Regression Analysis

SPSS is used for regression in which Y variables are from dependent variables of project performance while X variables are taken from the dependent variable related to the cost.

The regression model is: $y = \beta_1 + \beta_2 x_2 + \beta_3 x_3 + u$

Hypothesis Testing

H1. There is a possibility of using both EVM and RM techniques in integrated approach for commercial buildings construction projects in Pakistan.

EVM-RM Integration

Table 2: Model Summary

Model	R	R Square	Adjusted R Square
1	.991[a]	.983	.982

a. Predictors: (Constant), Risk Management, Earned Value Management

Table 2 depicts what percentage of variability in the EVM-RM Integration is accounted for by the variables EVM and RM together. Finally, here are the beta coefficients—one to go with each predictor. Based on this table (Table 3), the equation for the regression line is:

Table 3: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.322	.037		8.624	.000
	Earned Value Management	.487	.008	.719	58.097	.000
	Risk Management	.407	.009	.576	46.512	.000

a. Predictors: (Constant), Risk Management, Earned Value Management

EVM-RM Integration = .322+.487(EVM)+.407(RM)

Using this equation, given values for EVM and RM we came up with a prediction for the EVM-RM Integration variable. The R-squared is 0.983, meaning that approximately 98.30 % of the variability of EVM-RM Integration is accounted for by the variables EVM and RM in the model. The coefficients for each of the variables indicates the amount of change one could expect in EVM-RM Integration given a one-unit change in the value of that variable, given that all other variables in the model are held constant.

H2. There is a positive relationship between using of both EVM and RM techniques in integrated approach and project performance assessment for buildings construction projects in Pakistan.

Project Performance

Table 4 depicts the percentage of variability in the ProjPerf as accounted for by Integration of EVM &RM together (it's a multiple R-square). The footnote on this table tells us which variables were included in this equation.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square
1	.027[a]	.001	-.008

Finally, here are the beta coefficients—one to go with each predictor. Based on this table, the equation for the regression line is:

Project Performance = 3.886+.024 (EVM &RM Integration)

Using this equation, given values for EVM , RM and Integration we came up with a prediction for the ProjPerf variable.

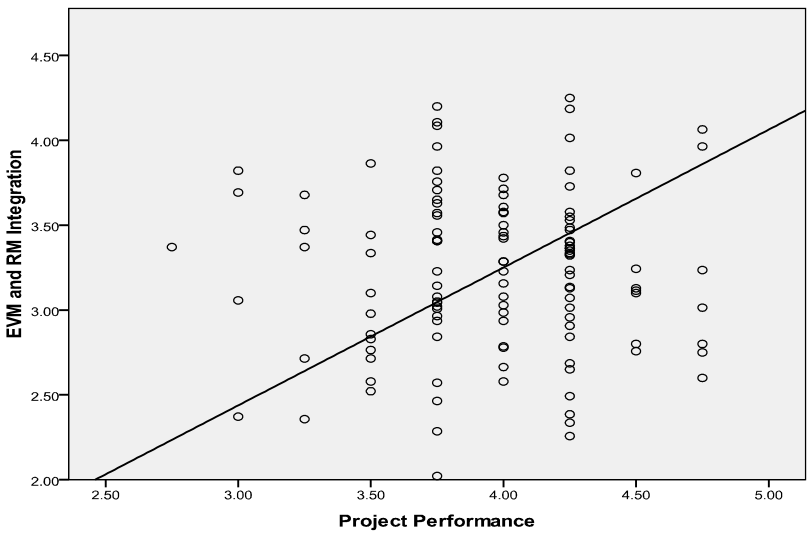
Table 5: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.886	.263		14.778	.000
	EVM and RM Integration	.024	.081	.027	.295	.003

a. Dependent Variable: Project Performance

The R-squared is 0.001, meaning that approximately .10 % of the variability of Project Performance is accounted for by the variables in the model. The coefficients for each of the variables indicates the amount of change one could expect in Project Performance given a one-unit change in the value of that variable, given that all other variables in the model are held constant. For example, consider the variable RM. We would expect a .024 in the Project Performance increase for every one unit increase in EVM &RM Integration.

We have also drawn scatter plot .This plot is drawn to test the project performance with the integration of earned value management and risk management . The straight line in this plot represents a normal distribution and the points represent the observed residuals. It is quite clear from the figure that the distribution for the residuals is approximately normal. Hence, the assumption is met.



Conclusion

For EVM related questions, it is identified that construction professionals take a good position with respect to familiarity with data collection for EVM. For completion cost and time questions, the answerers are positive and/or active. These findings show that although EVM is relatively new area compared to traditional cost/time management; respondents agreed that EVM can be a new tool for assessing project performance. For assessment about Risk Management, the response about tools for measurement was very positive and respondents consider the incorporating of technical and economic risks for performance assessment as very important. After the analysis of the results it was found that Earned Value Management and Risk Management can be integrated for commercial buildings construction projects in Pakistan. Performance assessment of commercial buildings construction projects in Pakistan by using the model of EVM-RM Integration has less impact than the individual impacts of EVM and RM for the prediction of project performance. The two main constraints cost and time, are quantified for investigating the performance appraisement of projects. The expected outcome of commercial buildings construction projects provide the clear insight into the project performance. Monitoring the performance is also mandatory for in time and within budget cost completion of the projects. Both time and cost are considered in the model of EVM-RM Integration. EVM-RM Integration model for performance appraisal of commercial buildings construction projects should be taken instead of traditional methods like Gantt chart in developing countries.

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