Impact of Management Competencies and Complexities on Performance in Public Sector Infrastructure Projects of Pakistan

*Muhammad Sajid Khattak **Usman Mustafa
***Atiq Ur Rehman ****Inayat Ullah Khattak

*PhD Scholar, Engineering Management, CASE, Islamabad
** Pakistan Institute of Development Economics, Islamabad
***Asian Center for Organization Development, Islamabad
****PhD Scholar, Agriculture University, Peshawar

Abstract

The management competencies and complexities have vital role in achieving projects objectives. The uses of management competencies improve project performance while the existences of complexities create hindrance in achieving project objectives. The management competencies can overcome role of complexities. Therefore, it is imperative to know and quantify the association of management competencies, complexities and project performance. In order to empirically find their relations in public sector engineering infrastructure projects of Pakistan, this study was carried out. Quantitative approach of study was adopted and eighty five "Project Directors" were surveyed to get feedback about their recently completed such projects in Pakistan. All questionnaires were based on PMCD and IPMA framework for competencies while TOE model was adopted for complexities to collect the data. The study showed that there is significant positive relation of competencies and significant negative association of complexities with performance. The mean value of performance is highest in the projects in which high levels of project management competencies were exercised. It also showed that there is a significant main impact of project competencies and complexities on project performance. The technical complexities have highest role in affecting the performance and then the organizational complexities are involved, while the environmental complexities have least contribution in overall complexities. Good results of projects can be achieved by adopting and applying dimensions of project management competencies. By this way different elements of project complexities can also be countered and project performance can be improved. The technical complexities of projects require top attention to be addressed.

Keywords: project management competencies, project complexities, project performance, public sector infrastructure projects

Introduction

Project management competencies result in success (Dias *et al*., 2014; Othman, 2013) while, the complexities leads in difficulties to manage the projects (Ejaz *et al*., 2013). Complexities are increasing with the passage of time because of projects implementation in dynamic atmospheres, including several stakeholders with diverse point of views and fast hi-tech challenges characterized by uncertainties (Shah *et al*., 2011; Shenhar & Dvir, 2007b; Williams, 1999). However, a manager of appropriate competencies as per the type, context, nature and complexity of projects can make them successful and can improve performance (Bosch-Rekveldt *et a*l., 2011; Shenhar, & Dvir, 2007a).

In developing countries like Pakistan, the project management applications, expertise and its competencies level are extremely low (Ali, 2010; Rehman, 2007). Improper planning and a lot of other management related problems in Pakistan is resulting delay in many projects (Mubin *et al*., 2011; Sambasivan, & Soon, 2007) and also lack of competencies slowed down progress of mega projects in emergent nations (Othman, 2013). The non-availability of suitable human resources, weak planning and management abilities also have resulted in time and cost overruns (Farooqui *et al*., 2008). New Islamabad International Airport Project is such example, having lot of issues due to numerous factors regarding project management (Ejaz *et al*., 2013).

In Pakistan, the high levels of challenges about construction projects require use of modern project management approaches and techniques to handle performance (Nawaz *et al*., 2013). And use of these standardized and globally accepted project management methodologies can add in successful achievement of project purposes (Shah *et al*, 2011). Therefore, performance of public sector development projects in Pakistan can be improved by engaging a competent and qualified project manager / project director (Pasha *et al*., 2012).

The above literature confirms that the project management competence and project complexities have greater influence on project success and in other term on project performance. This study is an effort to shows empirically that how the project management competencies and project complexities affect project performance in public sector engineering infrastructure sector of Pakistan. This study contributes to existing body of knowledge by empirically establishing relations among Project Management Competence, Complexity and Performance in public sector engineering infrastructure projects of Pakistan. Infrastructure sector

includes road, building, rail, water supply, sewerage, waste disposal, oil & gas and transportation network related projects, which are typically owned and financed by federal/provincial governments (Mubin & Ghaffar, 2008). Project management aspects of projects being the focused area of this study are considered only.

Literature Review

Project Management Competence

Project is a short-term endeavor undertaken to build an exclusive creation or service (PMI Report, 2000). It is characterized by its temporary nature, in which a (unique) range of job is undertaken, within certain constraints and for a particular cause (Bosch-Rekveldt, 2011).

The notion of project management has derived in 1930s, in the chemical industry and then it turned into well defined concept in 1950s (Williams, 2002). *It is the application of knowledge, skills, tools and techniques to project activities to get project need (PMI, 2000)*. It is the application of set of tools and techniques to direct the utilization of diverse resources toward the achievement of an exclusive, complex, one-time job within time, cost and quality constraints (Atkinson, 1999). It is the planning, organizing, directing, and guiding organizations resources for a rationally short-term goal that has been established to get definite aims and objectives (Kerzner, 2009). Project management is process-oriented and it consists of a series of steps to get utmost effectiveness (Casais, 2002).

The term competence is derived from a latin word 'Competentia' which indicates "is authorized to judge" and also "has the right to speak" (IPMA, 2006). The words 'competencies' or 'competence' or 'competent' means to have a state or quality of being able and fit (Palan, 2003). A competence is a set of knowledge, personal attitudes, skills and relevant experience required to be successful in a certain function (IPMA, 2006). International Project Management Association (IPMA) (IPMA, 2006) described competent project management in three different ranges i.e. Technical Competence, Behavioral Competence and Contextual Competence. Each range is further divided in elements of competencies.

The Project Manager Competence Development (PMCD) framework, sponsored by the Project Management Institute (PMI) was first released in 2002 and it was developed with the objectives to present guidance on assessment, planning and managing the professional development of project manager (PMI 2007). This framework defines three dimensions of competencies i.e. Project Manager Knowledge Competence, Project Manager Performance Competence and Project Manager Personal

Competence. Each dimension of PMCD framework is further divided into sub-dimensions or units.

Similarly, some other standards are also established and defined regarding project management competencies. However, in this research study the personal / behavioral competence dimensions of PMCD (PMI, 2007) and IPMA (IPMA, 2006) Frameworks are used to assess the management competencies of project managers and to relate these competencies with different elements of project complexities of TOE Framework of Bosch-Rekveldt *et al*. (2011) for improved project performance.

Project Complexities

Oxford online dictionary explains the term 'complex' as comprising of lots of diverse and connected parts and not simple to understand; complicated or intricate. The word "Complex" originated from a Latin word *complexus*, which refers to entwined or twisted together and can be explained as; an collection of parts, an item having two or more components – or two or more variables (Ireland, 2007). And Complexity is the amount of *'manifoldness'*, *'interrelatedness'* and *'consequential impact of a decision field'* (Girmscheid & Brockmann, 2007). It is a system believed to have structure with variations (Harvett, 2013).

On the basis of above explanations, complex refers to something which has many parts that are interrelated or connected; and has an element of difficulty, obscurity and complication. Complex project is one that shows a number of features to a degree, or level of severity, that result in difficulties to manage, control and assess the expected outcomes of project (Remington et al., 2009). Research in the area of project complexity is becoming more recognized (Geraldi & Adlbrecht, 2007).

Usually the managers are using the word "complex projects" while describing their projects, even when it is not known that what are the elements contributing to project complexity and how they can be quantified (Williams, 1999). Practical experts describe projects as being "complex" or "simple" when they discuss management issues (Baccarini, 1996). It is reflecting that complexity does have an influence on project management methods and practices. Therefore, it is vital to know the elements contributing to project complexity ahead of just size of projects. As it is a common feeling among project managers that a "complex" project is more than just a "big" project (Williams, 1999).

Project Performance

Measuring performance against cost, time and quality in a project is project management success while its measurement against overall project objectives is project success (Cooke-Davies, 2002). Project management success represents to know about the desired outputs i.e. deliverables, n the other hand project success refers to determine the desired outcomes i.e. purpose or objectives (Dosumu & Onukwube, 2013). This means that project management success is a measure of immediate output i.e. measuring performance against cost, time & quality and the project success is about outcomes and impact.

Project success is defined as completion of project according to original scope as per approved plan and within the approved budget, timeline, and technical specifications (Pasha et al, 2012). It means that the key success criteria of project are time, cost and quality, however it varies for different stakeholders (Shokri-Ghasabeh & Kavousi-Chabok, 2009). But still some criteria of project success are common, like time and cost (Saqib *et al*., 2008).

It is cleared that project success is mainly concerned with management success i.e. immediate output. It is measurement of performance against dimensions of cost, time, scope and quality indicators. So in this research project management success is considered i.e. measuring the project performance against time, cost and scope.

In this research three main variables are taken i.e. management competence, complexity and project performance. The independent variables are management competence and complexity while project performance is the dependent variable. Project management competencies result in success of projects while dealing with their complexities (Muller & Turner, 2007; Thomas & Mengel, 2008). The characteristic of a manager affects successful completion of a project (Bakhsheshi & Nejad, 2011). Therefore, a strong relationship exists between competence of a project manager and project success (Muller & Turner, 2007). So, it is assumed that project management competencies have positive relationship with performance of project. Complexity is one of a cause of project's failure (Williams, 2002). Hence, it is assumed that negative relationship exists between complexity and project performance. Different competencies are required as per nature and complexity of projects to get good results (Khattak & Usman, 2014; Muller *et al*., 2007; Muller & Turner, 2007; Vonk-Noordegraaf, 2011). An appropriate project manager as per type and context of a project should be appointed to achieve objectives (Bakhsheshi & Nejad, 2011). The application of different dimensions of management

competencies is important for dealing with different complexities and to improve project performance (Khattak *et al*., 2016). On the basis of these findings it is also assumed that project management competence acts as the moderator and affects the relationship of complexity and project performance. Looking into these assumptions, following research questions are developed to be answered:

- How the project complexities relate to project performance?
- How does Project Management Competencies relate to project performance?
- How do the project management competencies affect the relation of project complexities and project performance?

Methodology

The research method adopted in this study is survey of recent completed public sector infrastructure projects of Pakistan. All questionnaires were based on Project Manager Competence Development (PMI, 2007) and International Project Management Association (IPMA, 2006) frameworks for competencies while Technical, Organizational and Environmental (TOE) model of Bosch-Rekveldt *et al*. (2011) was adopted for complexities.

A self-administered survey was carried out to take feedback from 85 project directors about their recently completed public sector engineering infrastructure Projects of Pakistan. The survey was conducted with the aim to find empirically the relations among variables of research as used by Bosch-Rekveldt (2011).

Ministry of Planning & Reforms in Pakistan is responsible for public sector planning. A defined mechanism is developed for identification, planning, monitoring and evaluation of projects. Implementations of projects are required to be carried out as per approved plan. All the line departments are responsible for execution of projects sponsored by them. For survey sample only infrastructure subsector of Public sector projects are selected having cost at least Rs. 100 million.

The questionnaire of survey was tested from experts prior to collection of data, so that to ensure internal validity as per recommendation of Tashakkori & Teddlie (1998) referred by Bosch-Rekveldt (2011). Necessary amendments were made in questions in light of feedback of experts.

The questionnaire of survey was mainly based on personal competence dimensions of PMCD (PMI, 2007) & IPMA (2006) frameworks and TOE frame work of complexities of Bosch-Rekveldt *et al*.

(2011). It also included newly identified dimensions of competencies and elements of complexities through expert interviews in other phase of study. The survey had four categories of questions related to:

i. *Respondent Background*: it includes questions regarding age, length of experience, education and association etc of respondents.
ii. *General Characteristics of the Most Recent Completed Project*: It includes questions about approved cost, actual cost, approved time, actual time, approved scope and actual scope of recent completed projects of respondents.
iii. *The Project's Complexities*: It includes questions about observed elements of complexity and also scoring each element. This category, allowed respondents to state their thoughts on project complexity and whether or not they found listed elements as a source of complexity for projects or not. The Technical, Organizational and Environment (TOE) framework of complexity of Bosch-Rekveldt *et al*. (2011)) was introduced and it was enquired which element of complexity contributed to overall complexity of project. In case of Yes response, the respondents were asked to assess its contribution to the overall project's complexity on a 1 to 7 scale (1 = least complex, 7 = most complex).
iv. *Project Management Competencies:* This category included questions that asked the respondents that what project management competencies were exercised or adopted for successful completion of project. And also if any dimension of project management competence were exercised, the respondents were asked to assess that competence on a 1 to 7 scale (1 = lowest, 7 = Highest) as exercised.

The performance variable of study was calculated from responses of "general characteristics of recent completed projects" category of questionnaires. Cost, time and quality criteria are used to assess the performance and success of development projects (Chan, Scott, & Lam, 2002). These performance measures are comparatively simple and objectively measurable and also still normally accepted (Bosch-Rekveldt, 2011). In this research, project performance variable is based on indicators (cost, schedule, scope). Cost is based on gap between approved cost and actual cost. If gap is 1 to 3% then the project cost performance score=7. If Gap is greater than 3 and up to 6% then cost performance score = 6. And if Gap is greater than 6 and up to 9% then score=5. If Gap is greater than 9 and up to 12% then cost performance score=4. And if Gap is greater than 12 and up to 15% then score=3. Median of All the remaining projects having cost gap is more than 15% is taken. Project cost score is 2 of all the projects

having cost gap greater than 15% and upto median. And project cost score of all the projects having cost gap greater than median=1. Similar procedure is adopted to rank time gap from 1 to 7. And also similar method is adopted to rank scope gap from 1 to 7. However it is in opposite direction as compared to cost and time score. Then following formula is used for calculating accumulative performance score:

- **Accumulative Performance Score**=Cost Score+Time Score+Scope Score.
- Maximum Accumulative Performance Score can be 7+7+7=21
- In order to simplify the calculations with the independent variables project management competence and project complexity which were measured through 7-points likert scales, the accumulative performance score was divided by 3 to get highest point 7 and lowest point as 1 in project performance score.
- If a project has got score 4 in cost, time and scope then its accumulative score is 12. And dividing the 12 with 3 we got 4. It means the project is successful in all three dimensions. So we make a division here that all the projects having accumulative score 12 or above or on 7 points scale is 4 or above are successful or having **good performance** while all the projects having accumulative score less than 12 or less than 4 on 7 points scale is having **poor performance**.

Bi-variate methods in SPSS were used to find the relations between each two variables i.e. project complexity, project management competence and project performance. As all of the questions ask were by means of 7-point Likert scale, therefore, Spearman's coefficient method is adopted being a suitable representative measure for ranks correlation and to have monotonic link between variables (Hauke & Kossowski, 2011). It is also considered more appropriate to reduce the effect of outliers by replacing the observations by their rank, if the data is non-normal and contains outliers in both variables (Chok, 2010). This coefficient was used in this research to find correlations among variables.

Univariate general linear modeling i.e. two-way (also called factorial) ANOVA test was used to quantify the effect of Management Competence and Complexity on project Performance. In order to get the results, the data was divided into two project competence groups (low and high competency) and two complexity groups (low and high complexity). So for data analysis there will be total following four groups:

- low complexity, low level competence
- low complexity, high level competence

- high complexity, low level competence
- high complexity, high level competence

Hierarchical regression technique was also used to test the moderated effect of project competencies on relation between project management competencies and project performance.

Results and Analysis

The sample size consists of 85 respondents which is reasonable as Bosch-Rekveldt (2011) used a sample of 67 respondents which was considered a sufficient sample size for exploratory analysis by Field (2009). The majority of the respondents fall in the category of male which are 94%. Only about 6% female respondents completed the survey questionnaire. Most of the respondents were holding masters degree, which covers 65% of the total respondents. Second main category from education point of view falls in the group of MS / MPhil degree holders, which cover 30% of the total sample. Regarding working experience greater part of respondents had working experience of 11-15 years which covers 53% of the total respondents. Second key category was of 6-10 years experience, which covers 40% of the total sample size (Table 1).

Table 1: *Demographic Details of Sample*

Variables	Characteristics	Frequency	Percent	Cumulative Percent
Gender	Male	80	94.11	94.11
	Female	5	5.89	100.0
	Total	85	100.00	
Education	Masters	55	64.7	64.7
	MS/M.Phil	25	29.4	94.1
	Doctorate	5	5.9	100.0
	Total	85	100.0	
Experience	No Experience	-	-	-
	Less than 6 Years	2	2.3	2.3
	6-10 Years	34	40	42.3
	11-15 Years	45	53	95.3
	Above 15	4	4.7	100.0
	Total	85	100.0	

The frequencies of performances of all 85 sample projects of survey results are given at Figure 1. As per the study criteria it is cleared that most of the projects included in the sample have showed good performances.

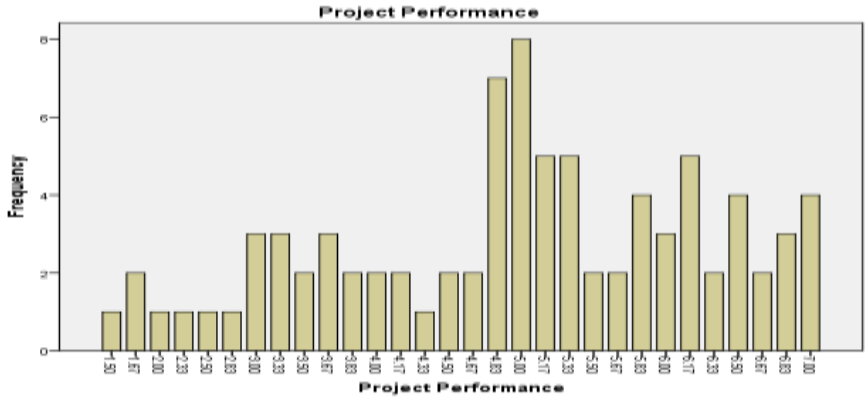

Figure 1: Frequencies Distribution of Project Performance Results.

Correlation between Project Complexity & Performance

The TOE Framework of complexity consist of three main categories of complexities i.e. technical, organizational and environmental complexities. These categories have further total of 50 elements of complexities. In this research, 50 elements of TOE framework of project complexities and five other elements i.e. adverse law & order situation, political instability, land issues, energy crisis and weak authorization of project managers were tested against the project performance through SPSP using Spearman tests to know the association / relation between each element of complexity and project performance. Almost all of the elements of project complexities showed significant negative correlation with project performance.

After testing the relations of individual elements of complexities with project performance, the associations of three main categories i.e. technical, organizational and environmental complexities with project performance was also tested using Spearman Correlation test. The technical complexity has cumulative effect of elements of complexities which are included in technical category of TOE Framework. The Technical complexity showed significant negative relationships (r = -0.704) with project performance at 0.01 levels. It means that with increase in technical complexity, the project performance is decreases. The results are shown in Table 2.

The organizational complexity has cumulative effect of elements of complexities included in organizational category of TOE Framework. The organizational complexity showed significant negative relationships (r = -0.602) with project performance at 0.01 levels (Table 2). It means that with increase in organizational complexity, the project performance is decreases.

The environmental complexity has cumulative effect of elements of complexities which are included in environmental category of TOE Framework. This complexity also showed significant negative relationships (r = -0.476) with project performance at 0.01 levels (Table 2). It means that with increase in environmental complexity, the project performance is decreases.

Table 2: *Correlation between TOE Complexities and Project Performance*

Variable 1	Variable 2	Correlation Coefficient
Project Performance	Technical Complexity	-.704**
	Organizational Complexity	-.602**
	Environmental Complexity	-.476**

**Correlation is significant at the 0.01 level (2-tailed).

At the end, relationship of overall complexity was tested with project performances. The overall complexity has cumulative effect of all 55 elements of complexities. The overall complexity showed significant negative relationships (r = -0.660) with project performance at 0.01 levels. It means that with increase in project complexity, the project performance is decreases.

Correlation between Management Competency & Performance

Total of 23 personal / behavioral project management competencies were considered in this study. Out of these 23 dimensions of competencies, 20 dimensions were taken from PMCD (PMI, 2007) and IPMA (2006) frameworks. And three other dimensions of competencies i.e. honesty, enthusiasm and dedication were also included. The relation of each dimension of competence with project performance was measured using Spearman correlation test. All of the dimensions of project management competencies showed significant positive correlation with project performance. At the end the relationship of overall project management competence with project performance was tested. The overall competence takes cumulative effect of all 23 dimensions of project management competencies. The overall competence showed significant positive relationships with project performance (rs = 0.793). This is a very strong positive relationship and is significant at 0.01 levels. It means that with increase in exercising project management competencies, the project performance is also increases.

Effect of Project Management Competencies & Complexities on Performance

The 85 projects in the sample were allocated to a group based on the median value for the calculated total complexity and the median value of the sum of all (investigated) project management competence. This way, the data was divided in two complexity groups (low and high complexity) and two project management competence groups (high competence and Low competence), based on the middle values in the current data set.

It was investigated whether the project performance varied significantly between these groups, using univariate general linear modeling i.e. two-way (also called factorial) ANOVA. In these tests, the fixed factors were the complexities (low=1, high=2) and the project management competencies (low=1, high=2).

Descriptive statistics for the group analysis of project management competencies and technical complexities on project performance are shown in Table 3. It shows that the mean value of project performance is highest in the group in which high levels of project management competencies were exercised and having low level of complexities. It also illustrates that the mean value of project performance is lowest in the group where low level of project management competencies were exercised and having high level of complexities.

Table 3: *Descriptive Statistics (Competency, Technical Complexity, on Project Performance)*

High or Low Competence	High or Low TC	Mean	Std. Deviation	N
Low Competence	Low Technical Complexity	4.9000	.94673	10
	High Technical Complexity	3.8118	1.19237	31
	Total	4.0772	1.22139	41
High Competence	Low Technical Complexity	5.9020	.96323	34
	High Technical Complexity	5.1667	.73703	10
	Total	5.7348	.96067	44
Total	Low Technical Complexity	5.6742	1.03925	44
	High Technical Complexity	4.1423	1.23915	41
	Total	4.9353	1.37005	85

Dependent Variable: Project Performance

Means of project performances against groups of competence and technical complexity are shown in Figure 2.

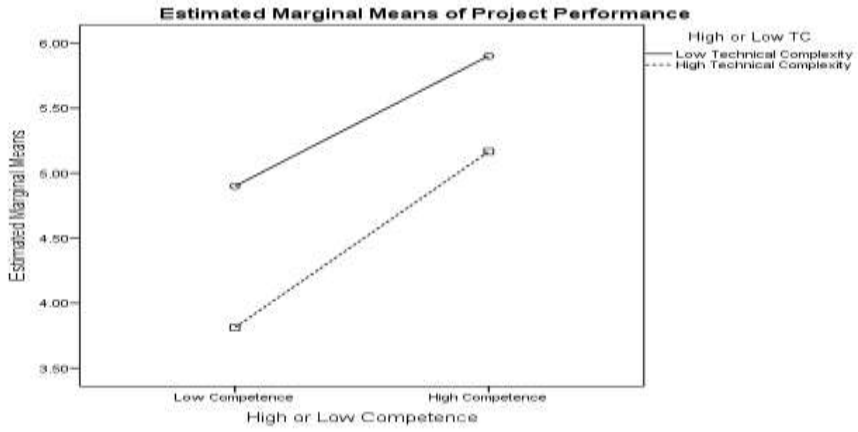

Figure 2: Means of Performance against Groups of Competence and Technical Complexity

From two-way ANOVA corrected model i.e. F=22.372; $p < 0.001$, it got cleared that project management competencies and project technical complexities have main effect on project performance. The project management competencies have main effect on project performance i.e. F = 19.941; $p < .001$. Similarly the project's technical complexities have main effect on project performance i.e. F = 11.937; p = .001. However the interaction term of project management competence and project technical complexity did not play any role.

Descriptive statistics for the group analysis of project management competence and organizational complexity on project performance are shown in Table 4. It also shows the similar trend as has been found in earlier group analysis of project management competence and technical complexity on project performance.

Table 4: *Descriptive Statistics*

High or Low Competence	High or Low OC	Mean	Std. Deviation	N
Low Competence	Low Organizational Complexity	4.4815	.57400	9
	High Organizational Complexity	3.9635	1.33383	32
	Total	4.0772	1.22139	41
High Competence	Low Organizational Complexity	5.8535	.83204	33
	High Organizational Complexity	5.3788	1.25187	11
	Total	5.7348	.96067	44
Total	Low Organizational Complexity	5.5595	.96400	42

	High Organizational Complexity	4.3256	1.44106	43
	Total	4.9353	1.37005	85

Dependent Variable: Project Performance

Means of project performances against groups of competence and organizational complexity are shown in Figure 3.

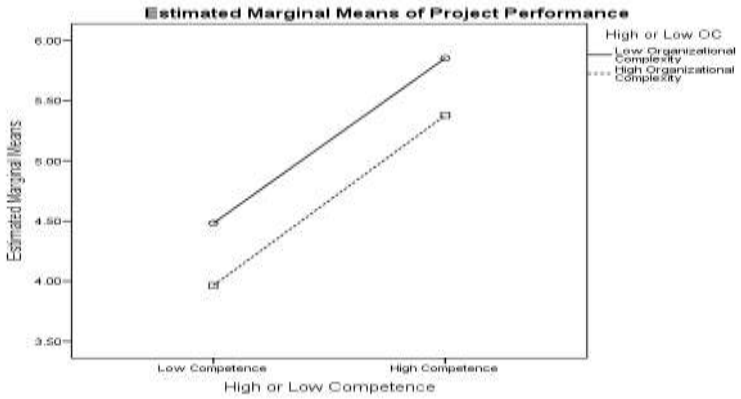

Figure 3: Means of Performance against Groups of Competence and Organizational Complexity

From two-way ANOVA corrected model i.e. F=17.525; $p < 0.001$, it got cleared that project management competencies have significant main effect on project performance while organizational complexities have effect near to significance. The project management competencies have main effect on project performance i.e. F=24.971; $p< .001$. Similarly the project's organizational complexities have near to significant effect on project performance i.e. F=3.167; p= .079. However the interaction term of project management competence and project organizational complexity did not play any role.

Descriptive statistics for the group analysis of project management competence and environmental complexity on project performance are shown in Table 5. Again it shows the similar trend as has been found in earlier group analysis of project management competence and technical complexity, organizational complexity on project performance.

Table 5: *Descriptive Statistics*

High or Low Competence	High or Low EC	Mean	Std. Deviation	N
Low Competence	Low Environmental Complexity	4.1000	.89993	10
	High Environmental Complexity	4.0699	1.32132	31
	Total	4.0772	1.22139	41
High Competence	Low Environmental Complexity	5.8586	.95299	33

	High Environmental Complexity	5.3636	.92742	11
	Total	5.7348	.96067	44
Total	Low Environmental Complexity	5.4496	1.19608	43
	High Environmental Complexity	4.4087	1.34859	42
	Total	4.9353	1.37005	85

Dependent Variable: Project Performance

Means of project performances against groups of competence and environmental complexity are shown in Figure 4.

From two-way ANOVA corrected model i.e. F=16.740; p < 0.001, in this case only project management competencies have main effect on project performance. The project management competencies have main effect on project performance i.e. F = 30.590; p < .001.

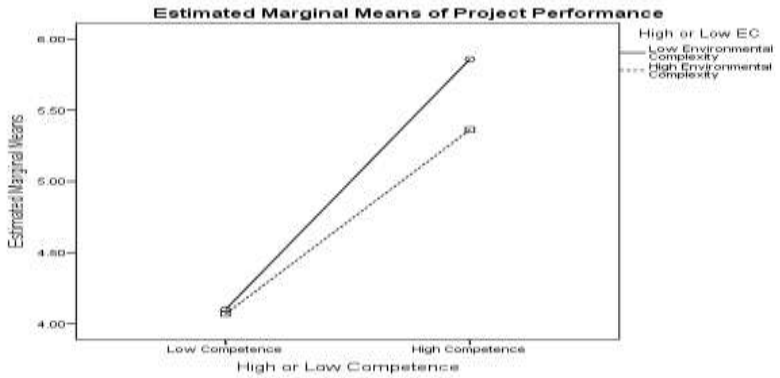

Figure 4: Means of Performance against Groups of Competence and Environmental Complexity

And finally the descriptive statistics for the group analysis of project management competence and overall complexity on project performance are shown in Table 6. It shows that the mean value of project performance is highest in the group in which high levels of project management competencies are exercised and having low level of complexities. It also reflects that the mean value of project performance is lowest in the group where low levels of project management competencies are exercised and having high level of complexities. Further it illustrates that the mean value of project performance is higher in a group having high level of complexities and having high level of project management competencies are exercised than the group having high level of complexities and having low level of project management competencies are exercised. This confirms the assumption that exercising project

management competencies against project complexity can improve the project performance.

Table 6: *Descriptive Statistics*

High or Low Competence	High or Low Complexity	Mean	Std. Deviation	N
Low Competence	Low Complexity	4.595	.90194	7
	High Complexity	3.971	1.26163	34
	Total	4.077	1.22139	41
High Competence	Low Complexity	5.884	.86080	36
	High Complexity	5.062	1.15449	8
	Total	5.735	.96067	44
Total	Low Complexity	5.674	.98262	43
	High Complexity	4.179	1.30269	42
	Total	4.935	1.37005	85

Dependent Variable: Project Performance

Means of project performances against groups of competence and environmental complexity are shown in Figure 5.

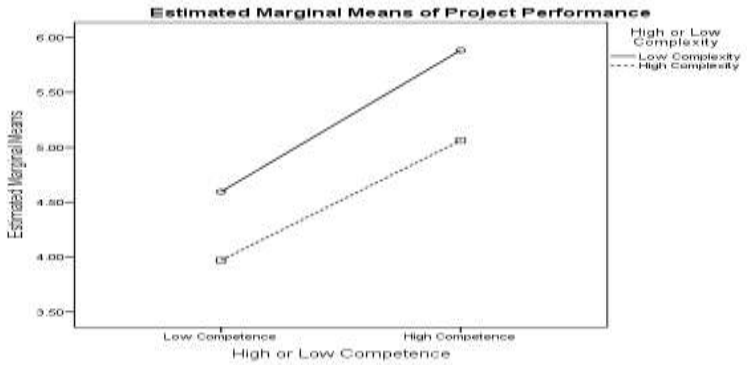

Figure 5: Means of Performance against Groups of Competence and Overall Complexity

From two-way ANOVA corrected model i.e. F=18.938; $p < 0.001$, it is cleared that project management competencies and project complexities have main effect on project performance. The project management competencies have main effect on project performance i.e. F = 15.244; $p < .001$. Similarly the project complexities have main effect on project performance i.e. F = 5.626; p = .02. However the interaction term of project management competence and project complexity did not play any role.

To test the hypothesis that whether project management competence moderates the relationship between complexity and performance, a hierarchical multiple regression analysis was also carried out. In first step, two variables i.e. overall management competence and overall complexity were included. These variables accounted for a significant amount of variance in project performance, $R^2 = .647$, F (2, 82)

= 75.006, p < .001. Next, the interaction term between overall competence and overall complexity was added to the regression model. With the interaction the model is significant and the R^2 = .648, F (3, 81) = 49.734, p <.001 (Table 7).

Table 7: *ANOVA of Regression Test of Overall Competence, Overall Complexity, their interaction and Performance*

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	101.946	2	50.973	75.006	.000[b]
	Residual	55.726	82	.680		
	Total	157.672	84			
2	Regression	102.193	3	34.064	49.734	.000[c]
	Residual	55.479	81	.685		
	Total	157.672	84			

a. Dependent Variable: Project Performance
b. Predictors: (Constant), Total Complexity , Avg Competence
c. Predictors: (Constant), Total Complexity, Avg Competence, Interaction Term

With the interaction between management competence and complexity accounted for more variance than just competence and complexity by themselves i.e. R2 change = .020. It shows that there is moderation between project management competence and complexity on project performance. From this test it is depicted that competencies are affecting relation of complexities and project performance.

Discussion

From the results it is derived that complexities negatively correlate with project performances. And the management competencies associates positively with performances. It means that with increase in complexities, the project performances are decreases while it increases with increase in management competencies.

The results also shows that performance is high in projects where high level of management competencies are exercised and having low level of complexities while the performance is poor in projects where low level of management competencies are exercised and having high level of complexities. It means that the performance is high where high level of management competencies has been exercised and the performance is poor in projects having high level of complexities.

The results further illustrates that the mean value of performance is higher in a group having high level of complexities and in which high level of management competencies are exercised than the group having high level of complexities and where low level of management competencies are exercised. And from the hierarchical regression analysis it is also concluded

that the interaction of management competencies and complexities cause more variance in project performance than just management competencies and complexities. This reflects the moderation effect of management competencies on the relation of complexities and performance. It means that with increase in exercising the competencies, the effect of complexities on performance can be minimized.

Varying variables and unpredictable issues originating from diverse sources, influence the projects (Arain & Tipu, 2009). The change-management and their transformational features make these projects very complex (Shah *et al*., 2011). The level of complexity of projects has effect on all project management activities (Baccarini, 1996). The intrinsic complexity, uncertainty and dynamic nature of the infrastructure projects result in severe issues for authorities to manage them efficiently and effectively (Ejaz *et al*., 2013). This increase in complexity of projects is one of the causes of their malfunction (Williams, 2002). So, it is established that project complexity negatively affects the project performance.

Adoptions of standardized and globally accepted project management techniques are important for successful execution of projects (Shah *et al*., 2011). Therefore, highly trained and expert project team is needed to manage engineering projects (Othman, 2013). A project manager use knowledge, expertise, tools and techniques to project activities to get the project needs (PMI, 2007; Barna, 2013). A manager is liable to preserve equilibrium among different project knowledge areas (Gokhale, 2005). Therefore, manager's competence is an aspect that influences project success (Crawford, 2000).

A strong association exists between project success and the project managers' competencies (Muller & Turner, 2007). This competence has vital role in planning, execution, and governance of projects (Pasha *et al*., 2012). And different competencies of leadership are needed in projects having diverse nature of complexities for their success (Muller *et al*, 2007). So, qualities of project manager have effect on project success and it is recommended that appropriate project manger must be selected as per nature and background of a project (Bakhsheshi & Nejad, 2011). Dimensions of project management competencies i.e. "project planning & scheduling" and "decision made by the project manager" play key role in success of mega construction projects of Pakistan (Ejaz *et al*, 2013).

Similarly, major obstacles to get improved project performance in the construction industry of Pakistan is the lack of expertise and resources in construction project management and ultimately lack of use of project management tools, techniques and practices (Farooqui *et al*., 2008). This

lack of appropriate human resources, weak planning and management expertise has resulted in time and cost overruns of infrastructure development projects (Ahmed *et al*., 2013). Also, improper and inefficient planning & scheduling is one of the causes of cost and time overrun in highway's project in Pakistan (Choudhry *et al*., 2012). So it is confirmed that project management competencies positively affects project performance and by exercising high levels of competencies in complex projects, their performance can be improved.

From the two-way ANOVA group analysis, while looking at the overall complexity, the project management competencies and project complexities have significant main effect on project performance. However the interaction term of project management competence and project complexity do not have any effect. Similar situation exist in a two-way-test in only technical complexities. In test with organizational category the complexities have near to significant effect while in test with environmental category, the complexities have no significant role on project performance. It shows that the technical complexities have the highest effect on project performance. After that the organizational complexities have the main effect on performance. And the environmental complexities have least effect on performance.

Conclusion

It is established from the analysis that project management competencies in public sector engineering infrastructure projects of Pakistan positively affects the project performance while the complexities have negative effect on it. It is also derived that the use of high level of project management competencies does improve performance in projects. Furthermore it is found that with the use of management competencies against complexities, the project performance can be improved by overcoming these complexities. The application of management competencies reduces the negative effect of complexities on performance of projects.

From the group analysis it is concluded that technical complexities have the highest effect on project performance and then the organizational complexities do contribute. The environmental complexities have least effect on project performance.

Recommendations

It is recommended that defined and appropriate project management competencies should be adopted to achieve the project

objectives. And a competent project director or manager having strong project management skills should be assigned to projects to get good results. The project directors can improve performance of projects by applying dimensions of management competencies. They can overcome different elements of complexities by using management competencies and can improve performance of projects. The project directors are required to give top attention to technical complexities of projects to resolve. After technical complexities, the organizational complexities are of high concern and then environmental complexities needed to be addressed.

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