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Impact of Project Complexity on Cost Overruns with the Moderating Effect of Contractors' Financial Attributes in Construction Projects

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This study selected the financial attributes of the contractor working on a construction project as a moderator on the strength of the relationship between project complexity and cost overruns in a project after the completion of a project. The population includes project managers, senior engineers, project owners and contractors employed on infrastructure projects. After testing the validity and reliability of the instrument through a pilot study, a full scale survey was conducted to collect data from 230 respondents. SPSS, AMOS were used to test the measurement models and structural model. Hayes' Model (2009) of moderated regression was used to see the moderated relationship between project complexity and cost overruns for each type of project complexity separately, which showed that the financial attributes of contractors have a negative impact on the strength of the relationship between project complexity and cost overruns in construction projects. The impact of each type of complexity on cost overrun was found significant using ANOVA and through standardised coefficients in multiple linear regression. The impact of project complexity on cost overruns was significant and project complexity predicted a significant proportion of cost overrun in the construction projects in Pakistan. Financial attributes of the contractors played a vital role in the construction projects when it came to the relationship between project complexity and the cost overrun. The study was limited to analyzing the effect of dimensions of the project on cost runs in the construction projects. The results are relevant for

project managers, especially contractors to consider the importance of financial attributes in reducing the risk of cost overrun. The role of contractor's financial attributes on positive relationship between project complexity and cost overrun has been empirically tested. The study included infrastructural projects in Pakistan, with unique settings.

Key words: *project complexity, cost overruns, moderating effect, contractors' financial attributes, construction projects*

Introduction

According to a survey that was conducted involving practitioners and researchers, it was reported that only 32% of projects have been delivered on time, within budget and with all features and specifications. 44% projects were over budget with schedule overruns and didn't fulfil their scope as required. The rest of 24% projects were the hunt to pre-mature termination (Standish Group Report, 2018). These statistics include all projects either complex or not. A perception was generated that the failure rate of complex projects may be high as compared to other projects (Flyvbjerg & Rothengatter, 2010).

The concept of complex projects is widely associated to the construction industry, but it is not the rule of thumb. Complex projects are being done in all the industries like IT, Engineering (Bosch-Rekveldt et al., 2011), Aerospace and many others. Moreover, the concept of complexity is not only associated to the size or cost of the projects which is a main attribute of mega projects, rather complexity may be associated to innovation which may demand lot of toil and other dimensions like this (Williams, 2005).

The fulfillment of a project within budget is the most important criteria of project success (Kerzner, 2017). The estimation of cost for a project is a hard agenda to address and if this is done accurately, the probability of cost overrun is very low. The estimation of cost for complex projects is very crucial.

Management of the stake holders of the project may also give a dimension of complexity to projects. In the construction industry, clients, consultants, and contractors are the stakeholders who must be on a single page to get the project done successfully and if there is harmony between them, most of the other issues get resolved sooner or later. The selection of contractors is yet another issue in the industry which is being worked on extensively and many techniques are being developed for the selection of a suitable contractor to ease the stress that must come later. Many attributes of the contractors are considered and then contractors are being selected for a specific project using a multi-criteria decision approach. The impact of attributes of contractors on project outcomes is significant (Alzahrani & Emsley, 2013).

There is a lot of literature available on project complexity (Baccarini, 1996; Vidal & Marle, 2008) and the factors of project complexity (Shenhar & Dvir, 2007; Remington & Polack, 2007; Kerzner & Belack, 2010) but the lack of study on the impact of project complexity on various project management processes is quite visible. Keeping this in view, this research has been structured to review the impact of project complexity on cost estimation process with the moderating effect of financial attributes of the contractor in construction projects.

The increase in urbanisation has caused a raise in the complex projects all over the world with a lot of investments (He et al. 2015). Lack of knowledge with the project managers regarding the complexity of a project has caused poor performance, cost, and schedule delays (Kennedy et al. 2011) and every project manager's goal is success (Chan et al. 2003). Project management practices are well incorporated in all the industries, still many projects have failed to give the desired results. Above 50 % projects have been a prey to cost overruns according to the Standish Group report, 2018. The complexity of a project has been reported as a common reason for failure of projects. There are several factors which effect the relationship between complexity and cost overruns out of which contractors' attributes have been referred to by many authors. This study tends to highlight the impact of project complexity on the cost overruns of construction projects with the impact of financial attributes of the contractor on the strength of the relationship using the responses from the clients, engineers, consultants, project managers and contractors in the construction industry using structural equation modelling, regression and following the Haze model for moderation.

Studies have shown that project complexity has an impact on the project performance but detailed studies on direct impacts are missing (Luo et al. 2017). He et. al (2015) has provided a framework of measuring project complexity based on 6 dimensions; however, the impact of the project complexity on various project outcomes is still under research. The study was based on the survey that will be conducted against a questionnaire to address the various types of complexity, financial attributes of the contractor and cost overruns. The survey will be validated by a pilot study including interviews and survey on a smaller population. The study not only will highlight the impact of different types of project complexity on cost overruns but also put a light on the role of contractors' financial attributes as moderators for the said relationship which is unique and will provide a new vision to the decision-making of selection of a contractor as well as managing cost overruns of complex projects.

Literature Review

Till the 19th century, projects of construction were managed by architects and engineers themselves. Then the discipline of project management started to get strengthened by their application in different fields of engineering, the defense sector and construction as well due to the efforts of the two students of Winslow Taylor: Henry Gantt whose work in planning

and control techniques is exemplary and Henri Fayol who has created the five functions management. Many institutions are working today in the field of project management to list the best practices in the field which are as the benchmark for everyone associated to any project anywhere in the world. The Project Management Institution (PMI) – PMBOK Guide defines projects as "A temporary endeavor undertaken to create a unique product, service, or result" (PMI, 2012, p.3)

After the concept of a project has been constructed, the next thing to follow is the process of project management. The bodies of project management have come up with different definitions of Project Management which have been cited by many researchers. The definitions of project management proposed by the Project Management Institution (PMI) – PMBOK Guide is "The application of knowledge, skills, tools and techniques to project activities to meet the project requirements" (PMI, 2012, p.554) ,

2.1. **Complexity Theory & Complex Adaptive System**

Complex adaptive systems can be referred to as a framework to understand complexity in natural systems which is a result of multiple interactive but adaptive elements. Complex adaptive systems are the main concepts defining the complexity theory and a complex project is complex adaptive system (Remington & Polack, 2007). According to Levin & Ward, 2011, a complex project is a CAS if it has the following features:

- Elements are working in parallel and are not controlled hierarchically.
- Elements are changing to create a multilevel organisation and systems to support them.
- The system owns entropy and when no external energy enters the system, it must shut down.
- It follows a pattern so the future results can be predicted.

2.2. **Multi-Criteria Analysis**

In a complex system multi-criteria analysis is necessary to make decisions. According to the authors, deciding can be based on MCA such as selection of a car. The same goes for projects where scope, time, cost & quality are majorly considered for the decision of a project to be successful along with other goals such as customer satisfaction etc. (Marques, Gourc, & Lauras, 2011). The use of multi-criteria analysis to measure complexity are used by many researchers where different studies include various dimensions of complexity based on the context of the projects (Luo et. Al, 2017). Shenhar & Diver (2007) introduced 'The Diamond Approach' which was an adaptive model including four dimensions: complexity, technology novelty & pace to analyse a project. Complexity is one of the dimensions to analyse a project which is the main variable under study. A multi-dimensional model is proposed in this study to measure complexity of a project.

2.3. **Complexity**

The theory of chaos gave birth to the theory of complexity in the start of 20th century (Levy,1994). The complexity theory is widely used in disciplines like mathematics, social sciences etc. but this theory is being referred to in management sciences now as well (Curlee & Gordon 2011). How the concept of the complexity theory is related to project management is explained by Cicmil & Marshall (2005). The authors state that the definition of the concept of complexity is based on modifying systems, non-linearity between variables, self-structuring, and exposure. Self-structuring is the property of a system to organise on its own if there is no external force. Emergence considers how things are evolving (Cicmil & Marshall, 2005) and non-linearity in a system is itself a risk which can create chaos because a small change in a variable may become reason of an impact which is unpredictable (Aritua et al., 2009). The concept of self-structuring may not be applied on project management as there is no evidence that these two concepts may work together.

2.3.1. Project Complexity

The research objective to find the dimensions of complexity of a complex project demands that the features of complex projects are understood. The number of complex projects is growing day by day; these projects are given more importance, these projects have a high failure rate, and the number of such projects will increase day by day (Merrow, 2011). Some projects are complex but are not considered so because the definitions of complexity are not yet clear with many project managers (Geraldi, 2008). The complexity of a project is usually a reason for failed projects (Ivory & Alder Man, 2005). Understanding and measuring complexity is important because it is served a reference for decision-makers involved in such projects (He et al., 2015). The International

Centre for Complex Project Management states: “Complex projects are open, emergent and adaptive systems that are characterized by recursive nature and non-linear feedback loops”. There are many variables in project complexity which are unpredictable and inter-related (Baccarini, 1996). Size and budget, interactions, culture, uncertainty & risk, and stakeholders are the elements which can help to identify a complex project (Kerzner & Belack 2010). But Levin & Ward (2011) state that complex projects may have variables like project management maturity level, politics, technology and innovation, quantity of information and interaction with other organisations.

According to the Project Management Institute, “complexity is a characteristic of a program or project or its environment that is difficult to manage due to human behavior, system behavior, and ambiguity” (PMI, 2014, p.12). This statement emphasises the role of stakeholder’s management and ambiguity on project complexity.

2.3.2. Complexity Dimensions

Project complexity is considered as one of the most central properties of a project and is a result of dynamic, structural & uncertain properties (Luo et. Al 2017). Complexity of a project is hard to be quantified precisely though many authors have written about its measuring factors & categorisation (Gransberg, 2013; He et al. 2015). Organisational & technological complexities are the two categories mentioned by Baccarini (1996). Mission, stakeholders, organisation, delivery, and team were mentioned as the key elements of project complexity by Maylor et al. (2008). Complexity has five dimensions: task, culture, society, operation & cognition complexity (Girmscheid & Brockmann, 2010).

He et al. proposed a six-category framework of project complexity consisting of the following dimensions:

1. Technological Complexity
2. Organisational Complexity
3. Goal Complexity
4. Environmental Complexity
5. Cultural Complexity
6. Information Complexity

These 6 categories of project complexity are explained and measured by several indicators which have been cited by various researchers in their studies.

2.4. Cost Overruns

Spending more than the budget of the project is termed as cost overrun in a project. Despite the evolution and progress of the discipline of project management, cost overrun is a common cause of projects being called a failure, specially those which are considered as complex ones (Flyvbjerg et al., 2002; Ashaolu & Olaniran, 2015). The reason for this overrun may be improper schedule management, scope creep, novelty, and pace of market, all referred to as dimensions of complexity (Shenhar & Dvir, 2007). Cost overrun is associated with getting a project approved in unreal conditions as well (Flyvbjerg et al., 2005). Issues related to the contractor, material, labour, client, contract relationship, contract management, and consultant & external environment (Sambasivan & Soon, 2007). Cost overrun is considered as the most important problem that contractor's face as this reduces their profit margin and leaves the projects in great trouble (Flyvbjerg et al., 2018). Morris (1990) considers cost overruns as the regular feature of construction projects. Aljohani (2017) relates project cost overrun to the extent final costs exceeds the estimated cost.

2.4.1. Cost overruns in complex projects

It is reported that the original cost estimate of the London Olympics project in 2003 was £ 4 billion. The estimate was revised in 2007 to be more than double of the initial estimate i.e., £ 9.3 billion. The project still needed £ 5 billion for associated projects of transport (Rolstadås et al. 2011).

Shell Sakhalin II project had an original estimate of USD 10 billion and latest estimate of USD 28 billion.

The Eurotunnel between France and UK used 80% more budget for construction and 140% for finance.

The International Space Station ran USD 5 billion over cost.

Boston's Central Artery-Tunnel project was 275 % over budget.

There was a 200% cost overrun in The Denver International Airport project. These all examples show that cost overruns are encountered by all the complex projects of high fame (Demirkesen & Ozorhon, 2017). There are certain areas which are still unaddressed which need to be addressed to avoid cost overruns in our projects.

So, the literature suggests that cost overruns are caused in complex projects more often.

2.4.2. Cost Overrun Calculation

Cost overrun may be calculated for a project by investigating the initial estimate and final cost (Sridarran, 2017). The difference between these two costs may be used to find variation %. If the initial and the final cost is the same, there is zero cost overrun (França & Haddad, 2018).

2.5. **Contractors' Attributes in Construction Projects**

The success of construction projects is highly related to contractors (Alzahrani & Emsley, 2013). Selection of contractors is done after a lot of research and efforts increase the likelihood of success of construction projects (Baykasoglu et al. 2009; Ng et al. 2009). Appointing a right contractor for a project will enhance quality and save cost. Contractor failure has resulted in a high rate of project failure in the construction industry. 37% construction businesses flopped in 1972 and the percentage of failed construction business in 1987 was 57% (Russel 1991).

Initially contractors were selected based on lower bids and that was the criteria (Doloi, 2009). Later it was found out to be the reason for failed projects (Walraven and Vries, 2009). Nowadays different organisations use different evaluation methods to appoint a contractor. Following are the attributes which should be considered while selecting a contractor (Alzahrani & Emsley, 2013).

1. Financial Attributes
2. Management Attributes
3. Technical Attributes
4. Experience Attributes
5. Past performance Attributes
6. Organisation Attributes
7. Environmental Attributes
8. Health and Safety Attributes
9. Quality Attributes
10. Resources Attributes

All these 10 attributes are latent variables which can be calculated with the help of observed variables. Each attribute is important, and the context of the project may decide the impact of each attribute on the project (Alzahrani & Emsley, 2013).

2.5.1. Financial Attributes of the Contractors

Out of all the attributes mentioned by authors Doloi, 2009; Holt et al., 1994; Hatush & Skitmore, 1997, the financial attributes have been selected to study the moderating effect on the relationship of project complexity and cost overruns.

12 critical factors for financial attributes of contractors were studied; 4 variables turned out to show significant factor loading in the pilot study out of which after the study survey was completed, 4 variables namely turn-over history, credit history, cash flow forecast showed significant factor loading in Confirmatory Factor Analysis (Alzahrani & Emsley, 2013).

2.5.2. Turn-over history:

This represents the record of business the contractor has done in his tenure. The capacity to carry out business depends upon the resources the contractor has. (Isik et al.,2009). The turnover history of a contractor brings him more business and lets the market have some faith in him. Turn-over is a measure of long-term capacity (Isik et ak.,2009).

2.5.3. Credit History

The client doesn't give all the project's budget to the contractor in one go. In public sector projects payments get stuck due to lack of efficient systems. All this makes it difficult for the contractor to run the project from his resources (Anagnostopoulos & Vavatsikos, 2006). What contractors can do is they may take a loan from the market (banks) and may return when they get their payments for the project. A contractor who owns a good history in returning loans has better chances to receive loans in future and continue his work.

2.5.4. Cash Flow Forecast

Cash flow forecasting involves the process of foreseeing the inflow and out flow of cash. Moreover, it is an important dimension to measure the financial strength of the firm as it tells you when and how much the firm may have to borrow and then how to repay the debt. An effective cash flow forecasting is important for a contractor to survive (Alzahrani & Emsley, 2013)

2.5.5. Bonding Capacity

This attribute of the contractor is based upon the level to which a contractor has a relationship in the market based on finances acquisition from the market.

Authors relate the cost overruns with the dimensions of complexity as one dimension or two at a time. As in the above section the example of some mega projects was discussed; those mega projects failed due to complexity in one dimension or the other. All dimensions should be studied simultaneously and the impact of each and the collaborative effect should be a check that will be done by this study.

Moreover, the role of contractors in construction projects has been worked upon but each feature of the contractor has not been studied individually. This study considers the financial features of the contractor and tests the moderating effect on the relationship between complexity and cost overrun of a construction project.

Research Model

Cost overrun is the dependent variable of the study. The variables including information complexity, task complexity, goal complexity, environmental complexity, technological complexity, and operational complexity are assumed to be the antecedents of the cost overruns. Financial attributes of the contractor moderate the relationship between independent and dependent variables.

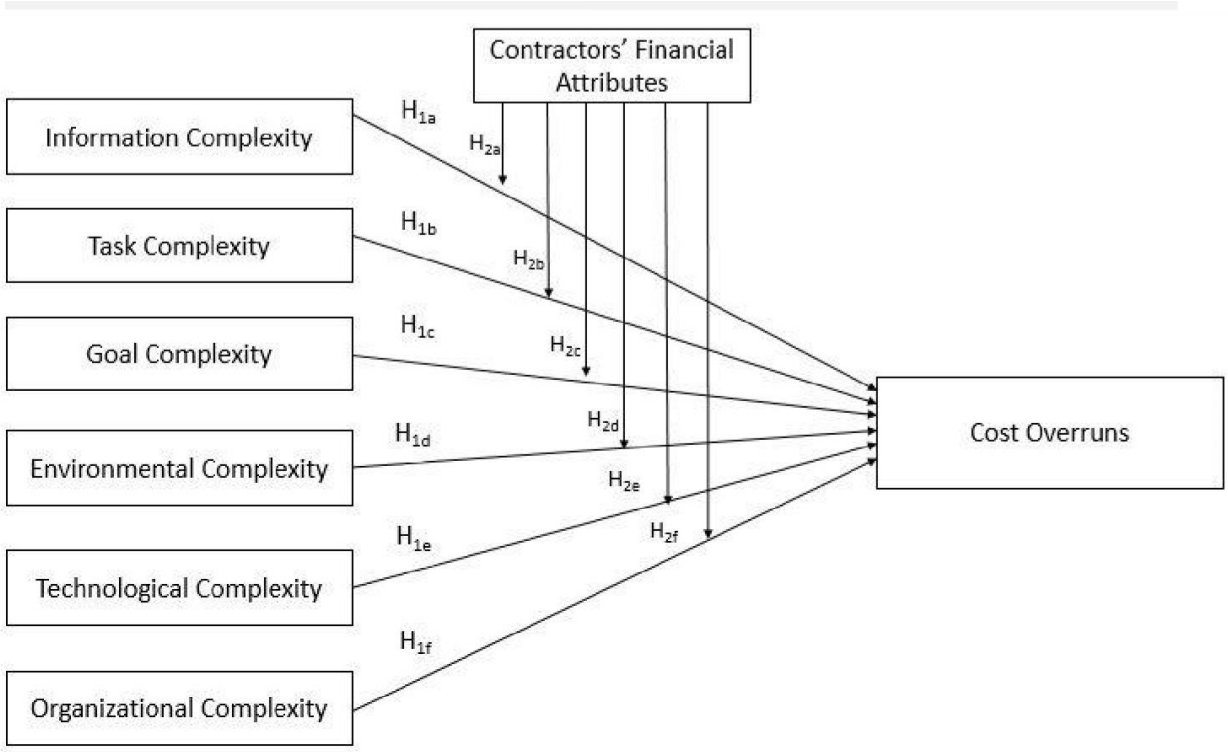

Figure 1 Comprehensive Research Model

The following hypothesis are suggested in the research model:

H_{1a} = Information complexity has a positive impact on the cost overrun of the project

H_{1b} = Task complexity has a positive impact on the cost overrun of the project

H_{1c} = Technological complexity has a positive impact on the cost overrun of the project

H_{1d} = Organisational complexity has a positive impact on the cost overrun of the project

H_{1e} = Environmental complexity has a positive impact on the cost overrun of the project

H_{1f} = Goal Complexity has a positive impact on the cost overrun of the project

H_{2a} = Contractors' financial attributes have a negative impact on the strength of the relationship of information complexity and cost overrun of a project.

H_{2a} = Contractors' financial attributes have a negative impact on the strength of the relationship of information complexity and cost overrun of a project.

H_{2b} = Contractors' financial attributes have a negative impact on the strength of the relationship of task complexity and cost overrun of a project.

H_{2c} = Contractors' financial attributes have a negative impact on the strength of the relationship of technological complexity and cost overrun of a project.

H_{2d} = Contractors' financial attributes have a negative impact on the strength of the relationship of organisational complexity and cost overrun of a project.

H_{2e} = Contractors' financial attributes have a negative impact on the strength of the relationship of environmental complexity and cost overrun of a project.

H_{2f} = Contractors' financial attributes have a negative impact on the strength of the relationship of goal complexity and cost overrun of a project.

Research Methodology

The research was conducted with the help of a survey based on a questionnaire and statistical analysis is done by using Statistical Package for Social Sciences version 22. SPSS is a handy tool that has helped researchers analyse their findings easily (Arkkelin, 2014). Nested research methodology was employed in this study.

4.1. Questionnaire

The questionnaire comprised of four sections; in the first section general bio data of the respondents was asked; in the second section various dimensions of complexity were adapted from the study performed by Luo. et. al. (2017) and the magnitude of a dimension of complexity encountered in the last project the respondent completed will be asked for on a continuous scale ranging from 'Extremely High (5)' to 'Extremely Low (1)'. In the third section a question will be asked about the estimated cost and final cost (in PKR) of a recent project that the respondents have completed. Finally, the last section of the questionnaire will involve the financial attributes of the contractors and the respondent will be asked for the financial attributes on a Likert scale of High=5 to Low=1 answering the question about the density of the attribute owned by the contractor employed on the project (Yusoff & Janor, 2014). Self-administered questionnaire filling was done for the survey.

4.2. Unity of Analysis and Data Collection

Project managers, senior engineers, project owners and contractors were employed on infrastructure projects. A pilot study was conducted to test the questionnaire gathering 33 responses and data was entered in SPSS. Cronbach's Alpha were computed and the variables in the questionnaire were found reliable. Pilot studies are helpful to get rid of any extra variable that may not explain any significance in the study (Alzahrani & Emsley, 2013). After these questionnaires were collected from 230 respondents, they were valid for analysis. The greater the number of entries in the data, the better is the statistical result (Arkkelin, 2014). After that data collected from the survey was entered in SPSS and MS Excel. Reliability and validity of all data sets was done, and only reliable data measuring complexity was accepted. Reliability was tested by Cronbach Alpha, variables with $\alpha > 0.70$ were kept. The data was checked for out-liars and normality using SPSS. As complexity had six dimensions; factor loading for each dimension had to be calculated for that using SPSS AMOS for Confirmatory Factor analysis which was done for the complexity of projects.

The data obtained from 3rd section i.e. cost overruns section, was in ratio scale. The respondents answered budgeted and actual cost for the last project they completed. Cost

overrun was calculated from the difference of the two reported costs. Data received from this section was converted into a continuous scale of 5 to 1 from High=5 to low=1. The third section was about contractors' financial attributes and the responses High (5) to Low (1) for the magnitude of these attributes about the contractor which was employed on the said project.

4.3. Operationalisation of Variables

4.3.1. Project Complexity (Independent Variable):

A total of 27 indicators are made the part of the study of measuring 6 types of complexity. After conducting a confirmatory factor analysis, only 25 factors were made a part of the study.

4.3.2. Cost Overruns (Dependent Variable):

Cost overruns are calculated on a ratio scale where budgeted and estimated costs are to be reported for the last project the respondent completed. Later for analysis the scale was converted to continuous scale.

4.3.3. Financial Attributes of Contractors (Moderator):

Financial attributes of the contractors involved in the project the respondent gives the response. Financial attributes are being measured using the following indicators on the scale of Extremely High (5) to Extremely Low (1).

Complexity has 6 types to be considered; we will see the individual effect of all the types of project complexity on cost overrun using multiple linear regression. Regression analysis is the most common technique to forecast one variable with the effect of other (Gliner et al., 2002). The analysis of moderation is offered by the contractors' financial attributes on the relationship of project complexity and cost overruns by the Hayes Model of Moderated regression.

4.4. Population and Sampling

The sampling technique used for the study is convenience sampling. This sampling is a type of non-probability sampling where a researcher selects a sample based on the convenience, that is who is easy to approach in a population (Bryman, 2016). In this sampling the researcher may draw a sample from one representative city. This sampling involves picking up individuals from a population based on the convenience to the researcher (Perla & Provost, 2012). A very low cost is incurred, and the survey is done in a comparatively less time. Various construction companies were visited, and questionnaires were distributed

according to the sample size drawn by the formula $n = \frac{N}{1+N(e)^2}$, where N= Population Size, n= Sample Size. e= Level of precision at 95%.

Table 1 Questionnaire Distribution and Response Rate

Firm	Population (Project PM)	Sample Size	Questionnaire Administered	Responses Received
PMO NUST	35	33	35	33
NESpak	24	23	26	24
Nescom	27	22	27	24
Habib Rafiq Pvt. Ltd	24	32	25	24
FWO	23	22	24	21
NLC	32	33	32	31
Matracon Pakistan	32	33	32	30
ZKB Pvt. Ltd	22	22	23	22
MIDJAC	23	22	23	21
Total	242	226	247	230

Table 1 explains the distribution of questionnaires in different firms.

Results

The impact of the six types of project complexity on the cost overruns in a project was done using multiple linear regression in SPSS and the moderation offered by financial attributes of the contractor to the relationship between project complexity types and cost overruns was studies by the Hayes model of moderated regression. The result of the statistical analysis was significant for both linear multiple regression and moderated regression.

All the 12 hypotheses of the study are found to be significant using statistical tests. The impact of six types of project complexity was positive on the cost overruns in the construction projects and the impact of moderator on the relationship between six types of complexity and cost overruns was negative.

The impact of project complexity on cost overruns was significant and project complexity predicts a significant proportion of cost overrun in the construction projects in Pakistan i.e., 82%. Financial attributes of the contractors play a vital role in the construction projects when it comes to the relationship between project complexity and the cost overrun.

5.1. Computation of Types of Project Complexity

From the pilot study, 41 variables were made a part of the study from which 27 were found reliable reporting Cronbach Alpha's > 0.70. After the pilot study CFA was used where only 25 variables were left computing 6 types of project complexity. All the six types of

complexity namely information complexity, task complexity, technological complexity, organisational complexity, environmental complexity, and goal complexity were recorded on a scale of high to low and computed on the average of all the indicators.

5.2. Computation of Cost Overruns

Cost overruns were recorded in construction projects calculating the difference between actual and budgeted cost and then converted to a scale of High to Low, as 0 – 20 % as Low = 1, 21- 40 % as Moderately Low =2, 41 -60 % as Average = 3, 61 – 80 % as Moderately High, and 80 % and above as high=5.

5.3. Computation of Financial Attributes of the Contractors

The financial attributes of the contractor were recorded using 4 indicators all confirmed as reliable using Cronbach Alpha's value > 0.7 and then taking the average effect between 5 = high and 1 = low.

5.4. Standardised Coefficients of Types of Project Complexity

The table shows the standardised coefficients for the types of complexity when studied against cost overruns in multiple linear regression.

Table 2 Standardised Coefficients for Types of Complexity

Complexity Type	Standardised Coefficient
Environmental Complexity	.311
Organisational Complexity	.238
Task Complexity	.201
Technological Complexity	.255
Goals Complexity	.209
Information Complexity	.086

Environmental complexity shows the highest coefficient which means that in the context of the infrastructure projects in Pakistan, environmental complexity has the most vital effect on cost overruns, then organisational complexity and at the last information complexity has the least impact on cost overruns as compared to others.

5.5. Interaction of Financial Attributes

Financial attributes of the contractors offer a moderation in the relation between all six types of project complexity and cost overruns. The following table shows the interaction effect of the moderator variable with the relationship of the predictor variable and the predicted variable in the study.

Table 3 Interaction Impact for Types of Complexity

Type of Complexity	Impact of Interaction
Information Complexity	-0.0989
Task Complexity	-0.1567
Technological Complexity	-0.2083
Organisational Complexity	-0.1227
Environmental Complexity	-0.1038
Goal Complexity	-0.1901

The impact of moderator on the relationship between technological complexity and cost overrun is the maximum as shown by the interaction value 0.2083 and the negative sign shows the negative impact of the moderator on the strength of relationship between technological complexity and cost overruns. For higher magnitudes of financial attributes of the contractor the strength of relationship between project complexity and cost overrun decreases.

Discussions

Project complexity is defined in six dimensions of information, task, technological, environmental, organisational & goal complexity. Out of these six dimensions goal complexity has the highest impact of cost overruns in a project and information complexity has the lowest of all types of complexity. Goal complexity was defined by four indicators including the number of stake holders requiring changes, change of project organisations, uncertainty of goals and complexity of contractual relationships. It can be said that these four are the major causes of cost overruns in a project. Moreover, the selection of a sound contractor for the project is mandatory. As the results indicate, the contractors with sound financial attributes can minimise the effect of complexity in a project on the cost overruns and vice versa.

An important contribution of this study to knowledge is to identify complexity types and dimensions associated to each type that impact cost overruns in a project with the moderation offered by financial attributes of the contractor, hence putting light to the role of contractors who may play on the relationships between various elements in a project. The impact of a contractor's financial attributes on cost overruns and project complexity has been statistically proven significant which provides a literature evidence to further studies and researchers can explore the impact of more attributes of the contractors on different elements inter-related to each other in a construction project.

Conclusions

The first is the contribution to the theory by working on the dimensions of complexity which have an impact on the cost overrun on the construction projects and second, the role of financial attributes of the contractor on the strength of the relationship between project complexity and cost overrun. This concludes that when some elements in a project interact with each other, there are certain elements which have a significant impact on the relationship elements in a project have. The relationships between various elements of a project and the elements which may impact these relationships should be taken care of during all phases of the project life cycle.

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