The Effects of Requirements Elicitation Issues on Software Project Performance: An Empirical Analysis

Neetu Kumari Sethia and Anitha S. Pillai

Department of Computer Applications, Hindustan University, Tamil Nadu, India
neetu_sethia@yahoo.com,
mca@hindustanuniv.ac.in

Abstract. [Context and motivation] Studies have emphasized the need for effective requirements elicitation owing to its significant impacts on software quality and overall project outcomes to meet system objectives. The empirical studies in literature present the relationships between the specific characteristics that affect elicitation and project performance that focus on process control and product flexibility. There is, however, no substantial research on the empirical relationship between the generalized problems in requirements elicitation and project performance. **[Question/problem]**The issues encountered in requirements elicitation generalized through categories of problems of scope, problems of volatility and problems of understanding. This study aims in establishing an empirical model to study the behavior between the requirements elicitation issues and project performance. This study also validates the model for its consistency with practitioner's views and earlier studies. **[Principal ideas/ results]** Researchers and practitioners have focused on developing tools and techniques that will enhance the requirements elicitation and analysis phases. However, the effectiveness of the tool usage is dependent on skills and behaviors of people and organization using them. The aspects of behavior are best modeled using techniques adopted in social research, viz. confirmatory factor analysis; the technique is adopted for this study. **[Contribution]** This study deduced a causal relationship between the requirements elicitation issues and project performance. This study also attempted to establish a priority-setting and decision-making to address elicitation issues that can control and manage residual performance risks.

Keywords: Requirements elicitation issues, Confirmatory factor analysis, Causal model.

1 Introduction

Studies have determined that requirements engineering activities have an increasing impact on the overall project outcomes. This means that poor requirements engineering activities is one of the major causes for project failure. Requirements elicitation (RE) is an essential and foremost activity of the project. This activity, in itself, has a significant influence on the overall project performance. The importance of RE is also

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driven from the fact that attracts a number of issues, as information systems (IS) development shifts more towards adoption of global software development (GSD) frameworks [18].

Christel & Kang [1] categorize RE problems into three groups, namely, problems of scope, problems of volatility and problems of understanding. In their technical report [1], they describe these categories as follows: *Problems of scope* are those in which the requirements may address too little or too much information. This means that the boundaries of the system to be development may be ill-defined. *Problems of volatility* are related to the changing nature of requirements. This implies that requirements evolve over time. *Problems of understanding* are related to the poor understanding of requirements, within groups as well as between groups such as users and developers. These are related to incomplete or poor understanding of requirements, lack of appropriate verbal and written communication, lack of domain knowledge, conflicting views amongst users amongst other critical pre-requisites for a good RE.

Nidumolu [3] focus on uncertainty regarding user requirements because of its central importance in software development. Adopting the theories of Nidumolu [3], requirements uncertainty encompasses three dimensions such as requirements instability, requirements diversity and requirements analyzability. Requirements instability and requirements diversity are dimensions that reflect elicitation issues. The definitions are adopted from [3]. *Requirements instability* is the extent of changes in user environment over the course of the project; this is derived from the concept of environmental instability in organization theory, which describes the extent of changes in the task environment. *Requirements diversity* is the extent to which the users differ amongst themselves in their requirements; this is derived from the concept of organizational heterogeneity in organization theory, which describes the degree of variety or heterogeneity in the task environment.

The survey conducted for this study shows that RE consumes a relatively small percentage of the overall effort required for IS development (Table 1). The impacts of poor RE are severe, though. Researchers have identified several critical causes of poor RE [19, 21]. Prior studies have also established relationships between project performance and specific causes of poor RE such as change [9, 10], knowledge [11], quality [14], stakeholder [12, 13], human factors [14, 15], etc. There is, however, little or no empirical knowledge on how the summarized (say, summarized view of problems of scope, problems of volatility and problems of understanding) effect of issues in RE actually impact the overall performance of the project. There is a need to address this gap, as knowledge on how this summarized view of issues in RE impacts the project performance, is of practical interest.

This study integrates two theories described above to address the gap. One is related to the three categories of RE challenges by [1]; this theory forms the core framework for the rest of this work. The other is related to the dimensions of requirements uncertainty as described by [2, 3]. Based on explanation of these dimensions in Nidumolu's theory, we captured the contextual equivalence between problems of volatility and requirements instability which enabled us to leverage the requirements instability constructs [3]. We also leveraged the construct for requirements diversity owing to similar contextual equivalence between the problems of scope and requirements diversity. We deduced a construct for problems of understanding to capture a summarized view of the challenges in RE. We use the term *elicitation issues* to describe this summarized view of problems of volatility, problems of scope and problems of understanding, for the rest of the discussion.

To summarize, this study empirically confirms the general understanding of the relationship between elicitation issues and project performance. This is accomplished through the adoption of confirmatory factor analysis and causal models.

2 Background

2.1 Theoritical Model

The primary objective is to comprehend RE issues as categorized by [1] into an empirical model. We attempt to construct the causality between RE issues, viz., problems of scope, problems of volatility and problems of understanding and overall project performance. This is done by defining measures that are attributable to behavior and skills required for RE.

Extensive studies have been done in identifying the causes for poor RE, especially in GSD environments [18, 19]. Literature has evidences that theoretically confirm the inability to elicit requirements, which lead to significant gaps; these gaps adversely affect the project execution and the project success. According to Nidumolu [3], these gaps are called *requirements uncertainty*. Adapting Nidumolu's theory of requirements uncertainty, the constructs that play a critical role in this study are requirements instability and requirements diversity. The construct parameters were carefully examined for this study. We have leveraged constructs for elicitation issues needed for this study from Nidumolu's work. Existing constructs have been modified and new constructs have been developed to ensure that the model captures all the dimensions of elicitation issues and meets the required objectives of this study.

Studies have attempted to maximize project performance through implementation of contingency models. The work of Nidumolu [2] discusses the generalized model (figure 1) that establishes links between the following constructs: requirements uncertainty, uncertainty coping mechanisms, residual performance risks and project performance. The objective of the study is to construct causality between elicitation issues and project performance. Therefore, we re-design the existing requirements uncertainty model from [2] as shown in figure 2.

The elicitation issues in the proposed model is expected to influence the residual performance risk in a manner similar to requirements uncertainty, as proven in prior studies. Horizontal and vertical co-ordination has been retained in the model as we experience similar arrangements in practice. The details of the constructs are discussed further in section 3.2.

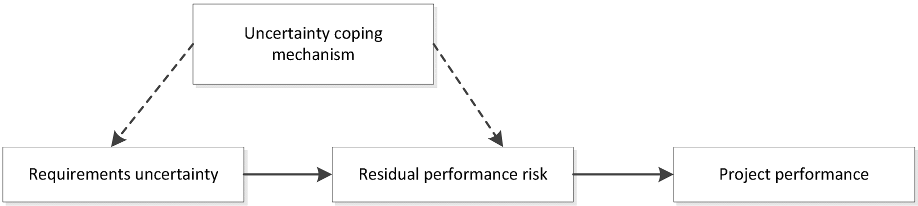

Fig. 1. Generalized uncertainty framework [2]

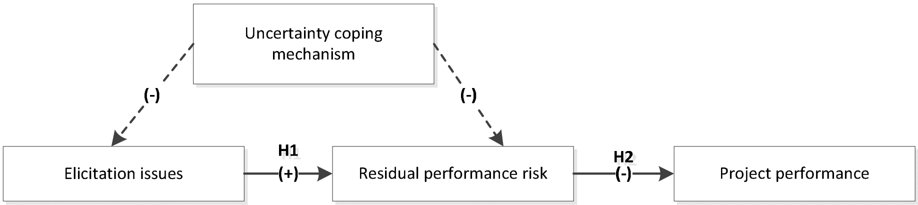

Fig. 2. Proposed requirements elicitation issues model

2.2 Hypotheses

The causal relationship between the constructs is depicted in Figure 2. Based on this, the study proposes two hypotheses that are discussed below. The elicitation issues reported in literature can be broadly characterized as change, communication, human-factors, knowledge, scope, requirements, social and organizational, stakeholder and tools, techniques and methods. Theoretical and empirical studies present the individual impacts of some of these characteristics to the overall project success. There is extensive focus in literature on the adoption of improved processes to enhance the quality of these characteristics so that the overall project quality and outcomes can be improved. Residual performance risk is the amount of risk remaining after the completion of the requirements analysis phases [3]. The characteristics of elicitation issues are critical since they contribute to the residual performance risk, which in turn influences the overall project performance. This means that the degree of successful execution of these characteristics directly or indirectly determines project performance. Based on the above discussion, the study formulates the first hypothesis, as described below:

H1: *Higher levels of elicitation issues will lead to higher levels of residual performance risk. This means that an increase in the effects of elicitation issues will increase the effects of residual performance risks.*

A successful project outcome is characterized by the controlled project cost, adherence to schedules and system benefits, amongst others. The amount of performance risk gradually decreases as performance becomes more evident [3]. Fall-outs due to elicitation issues are carried to the other phases of the project. These in turn contribute to the residual performance risk, impacting the system quality and project outcomes. For example, a common issue is about users not documenting requirements that seem "obvious". This implies the existence of requirements that are overlooked and not documented contributes to the requirements uncertainty. If this issue is not handled or fixed in the project's requirements engineering phase, this issue will increase the risk of the final system not meeting the required objectives. Based on this discussion, the study formulates the second hypothesis, which is described below:

H2: *Higher levels of residual performance risk will lead to lower levels of project performance. This means that a decrease (increase) in the effects of residual performance risk will increase (decrease) the effects of project performance.*

3 Research Method

3.1 Sampling

A total of 203 online survey responses were obtained resulting in a response rate of 92.27%. The sample included individuals extensively involved in RE and have been engaged in that project until closure. This approach was necessary to gather appropriate data for effective analysis. Purposive sampling was adopted for the purpose of this study. Table 1 represents the demographics features of the survey population.

Table 1. Demographic features (*N=203*)

Characteristics	Value	%/ Mean
Project status	Success	90.15%
	Failure	9.85%
Location of Organization	India	84.73%
	U.K.	1.48%
	U.S.A	13.79%
Project domain	Healthcare/ Insurance	52.71%
	Banking, Financial Services & Capital Market/ Communications/ Consure goods & services/ Defence/ Energy & utilities/ Life sciences/ Manufacturing/ Mining/ Retail/ Technology/ Transportation & logistics/ Travel & hospitality	42.86%
	Others	4.43%
Team strength of the project		43.28
*Overall duration of the project*Note: 186 cases*		1.95 years

Table 1. (*continued*)

Characteristics	Value	%/ Mean
Position of respondents in the elicitation process	Management	58.62%
	Technical	29.06%
	Coaching/ Auditing	2.96%
	Business/ Requirements analysts	21.18%
	Others	1.97%
*Number of [requirements/ business] analysts taking part in the elicitation process	*Note : 198 cases*	7.17
*Number of end-users participating in the elicitation process	*Note : 194 cases*	9.79
*% Proposition of overall system developement effort devoted to RE processes	*Note : 182 cases*	25.27%
*% Proposition of overall RE effort devoted to elicitation process	*Note: 171 cases*	29.35%

**Not all cases were considered since either the questions remained un-answered or they were considered outliers.*

3.2 Constructs

Elicitation Issues. Elicitation issues represent the categorization of problems in RE as described by Christel & Kang [1]. Three dimensions describe elicitation issues and are discussed below:

- The *Problems of scope (PoS)* are those in which the requirements may address too little or too much information [1]. This conceptually maps to the *requirements diversity* that describes the extent to which the users differ amongst themselves in the final requirements [3], Three items (PoS1, PoS2, PoS3) adapted from [3] that describe this scale (table 2).
- The *Problems of volatility (PoV)* is the extent of changes that the requirements undergo during the project life cycle [1]. This conceptually maps to the *requirements instability* that describes the extent of changes in user environment over the course if the project [3]. A new item was introduced to capture a complete view based on the description provided by [1]. Five items (PoV1, PoV2, PoV3, PoV4, PoV5) of which top four items adapted from [3] describe this scale (table 2).
- The *Problems of understanding (PoU)* is the degree of requirements understanding absorbed as part of the elicitation process. This describes the extent of ambiguity and communication challenges that can result in poor elicitation. Six items (PoU1, PoU2, PoU3, PoU4, PoU5, PoU6) based on the descriptions provided by [1] describe this scale (table 2).

.***Project Performance.*** Project performance is a multi-dimensional construct that describes the performance outcomes [3]. Two dimensions are selected to describe this construct:

- The *Process control (PC)* is the extent to which the development process is under control [3]. Four items (PC1, PC2, PC3, PC4) of this construct (table 2) adapted from [3].
- The *Product flexibility (PF)* is the degree of scalability exhibited by the final product. This means the extent to which final product can distinctly support new features and functionalities, according to [3]. Four items (PF1, PF2, PF3, PF4) of this construct (table 2) are adapted from [3].

Uncertainty Coping Mechanisms. Multiple groups are involved in a software-development project. A better coordination is always required for the project development activities to be executed effectively. For this reason, there are two constructs identified that provide a comprehensive view of such coordination [3]. These coordination constructs collectively determine the uncertainty coping mechanism.

- The *horizontal co-ordination (HC)* is the extent to which the co-ordination between users and project staff is undertaken through mutual adjustments and communication [3]. Four items (HC1, HC2, HC3, HC4) of this construct (table 2) are adapted from the work of [3].
- The v*ertical coordination (VC)* construct is the extent to which the coordination between the users and project teams is undertaken through decisions by authorized entities such as project managers and steering committees [3]. Three items (VC1, VC2, VC3) of this construct (table 2) are adapted from the work of [3].

Residual Performance Risk. *Residual performance risk (RPR)* is the extent of difficulty in estimating the performance-related outcomes of the project, regardless of a specific estimation technique used. The amount of performance risks present in the later stages of the project after project planning and requirements analysis phases have been completed [2]. Five items (RPR1, RPR2, RPR3, RPR4, RPR5) of this construct adapted from the work of [2] are shown in table 2.

All the above constructs were measured on a 5-point Likert-type scale with 1= strongly agree and 5= strongly disagree.

3.3 Confirmatory Factor Analysis

Confirmatory factor analysis (CFA) is a type of structural equation modeling that deals with measurement models, that is, the relationship between the observed variables and the latent variables [4]; this is used to establish or verify dimensionality of scales [6]. In this study, we have adopted second-order CFA using SPSS AMOS 21 to test the hypotheses. This dimensions described in table 2 are the observed variables whose measures are captured through survey responses. The model is designed (figure 3) based on eight first-order latent construct represented collectively through three second-order latent constructs such as elicitation issues (problems of scope, problems of volatility, problems of understanding), uncertainty coping mechanisms (horizontal coordination, vertical coordination) and project performance (process control, product flexibility).

The estimation technique used to derive factor loadings is maximum likelihood. This technique has shown to be robust [6]. Multiple iterations executed to obtain an

Table 2. Dimension Characteristics

ID**	Dimension charateristics	Factor loading	Mean	S.D
PC1	Significant control over project costs	.913	3.74	1.031
PC2	Significant control over project schedule	.870	3.67	1.114
PC3	Project's adherence to auditability and control standards was high	.519	3.77	.901
PC4	Overall control exercised over the project was high	.783	3.75	.911
PF1	Cost of adapting the software to changes in business was low	.659	3.41	.936
PF2	Speed of adapting software to changes in business was high	.744	3.62	.878
PF3	Cost of maintaining software over its lifetime was low	.746	3.47	.875
PF4	Overall long-term flexibility of software was high	.813	3.66	.878
PoV1	Requirements fluctuated quite a bit in earlier phases*	-		
PoV2	Requirements fluctuated quite a bit in later phases	.850	3.49	1.078
PoV3	Requirements identified at the beginning of the project were quite different from those existing at the end	.561	3.02	1.167
PoV4	Requirements will fluctuate quite a bit in future	.666	3.12	1.008
PoV5	Analyst's interpretation of technical details of requirements significantly low	.409	2.96	1.107
PoS1	Users of this software differed a great deal among themselves in the requirements to be met	.917	3.29	1.085
PoS2	Lot of effort had to be spent in reconciling requirements of various users of this software	.917	3.38	1.108
PoS3	It was difficult to customize software to one set of users without reducing support to other users	.740	3.07	1.103
PoU1	Users not completely sure of what is needed	.707	3.03	1.108
PoU2	Users had low understanding of capabilities and limitations of their computing environment	.655	3.19	1.057
PoU3	Users had low understanding of problem domain	.676	2.83	1.065
PoU4	Users had significant challenges in communicating requirements	.881	2.97	1.087
PoU5	Users omit information that seemed "obvious"	.885	3.33	1.105
PoU6	Users specified requirements which were ambiguous/ un-testable	.826	3.15	1.063
HC1	Oral communication (e.g., face-to-faco, telephone, etc) between users and project teams was high	.880	4.02	.965
HC2	Written communication (e.g., memos, notes, etc) between users and project teams was high	.757	4.04	.892
HC3	Scheduled group meetings between users and project teams were high	.799	3.96	.908
HC4	Unscheduled group meetings between users and project teams were high*	-		
VC1	Individual (e.g., a project manager) influence or authority was high*	-		

**removed from subsequent analysis*

*** PC- Process Control; PF – Product Flexibility; PoV – Problems of Volatility; PoS - Problems of Scope; PoU – Problems of understanding; HC – Horizontal coordination; VC - Vertical co-ordination; RPR – Residual Performance Risk*

appropriate model fit resulted in the removal of three items, HC4, PoV1 and VC1 owing to poor factor loadings.

Validity and Reliability. The Cronbach's coefficient α-value determines the internal consistency (reliability) and a value > .70 is acceptable. All factors (table 3) except for vertical coordination computed the α-value > .70 which is found acceptable [6]. Though the inclusion of vertical coordination might pose a problem, we continue to retain this factor in the model, owing to its importance in practice.

Table 3. Internal consistency: Cronbach's coefficient alpha test

Dimensions	**PoS**	**PoV**	**PoU**	**PC**	**PF**	**HC**	**VC**	**RPR**
α –value	.862	.726	.883	.862	.769	.740	.553	.886
Overall α-value for 34-items = .795								

It is necessary to establish convergent validity, discriminant validity and composite reliability, when doing a CFA [7, 8]. Convergent validity [7] describes the extent to which the latent factors are explained by the observed variables. Discriminant validity [7] explains the degree to which the latent factor is explained by other variables than its own observed variables. The thresholds for the convergent and discriminant validity and reliability are depicted in table 4.

Table 4. Thresholds for model reliability and validity (adapted from [7, 8])

Measures	**Composite Reliability (CR)**	**Convergent Validity**	**Discriminant Validity**
Thresholds	CR > 0.7	CR > AVE* AVE > 0.5	MSV** > AVE ASV*** < AVE

Average Variance Extracted **Maximum Shared Variance*Average Shared Variance*

An excel-based tool, StatsToolPackage.xls [7] aided in the computation of the validation and reliability measures. The results are shown in table 5. The values computed confirm that the model adheres to the validity and reliability measures.

Table 5. CFA model: reliability and validity

					Correlations*			
	CR	AVE	MSV	ASV	PP	RPR	EI	UCM
PP	0.729	0.576	0.404	0.348	**0.759**			
RPR	0.872	0.580	0.514	0.301	-0.554	**0.762**		
EI	0.857	0.669	0.514	0.336	-0.636	0.717	**0.818**	
UCM	0.728	0.604	0.332	0.168	0.576	-0.285	-0.300	**0.777**

**The diagonal in the correlation matrix contains the square-root of the AVE (bold)*

PP – Project Performance; RPR – Residual Performance Risk; EI – Elicitation Issues; UCM – Uncertainty Coping Mechanism; CR – Composite Reliability; AVE – Average Variance Extracted; MSV – Maximum Shared Variance; ASV – Average Shared Variance

The factor loadings and the computed mean and standard deviations are depicted in table 2. The measurement model (figure 3) produced the following fit indices: *N= 203, χ2/d.f.* = 1.424, *GFI=.848, CFI=.945, RMSEA=.046, PCLOSE=.790, NFI=.839, SRMR=.0663.* The fit indices were within the acceptable thresholds [5, 6] of a model fit as depicted in table 6. The fit indices resulted in a good model fit and enabled us to proceed with a causal model.

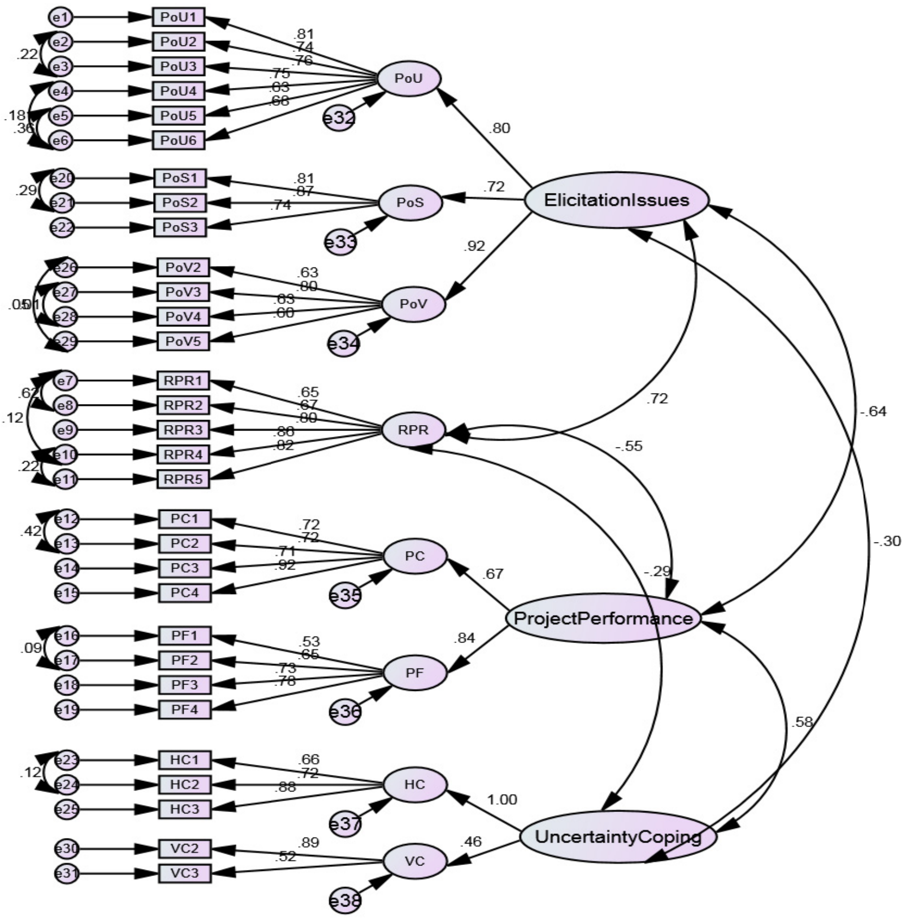

Fig. 3. Measurement model

3.4 "Causal" Model

According to Bagozzi and Yi [6], "SEMs have applicability to testing causal hypotheses yet are relevant to testing functional relationships, generalizations and cross-validations." Figure 4 depicts the final causal model deduced from the measurement

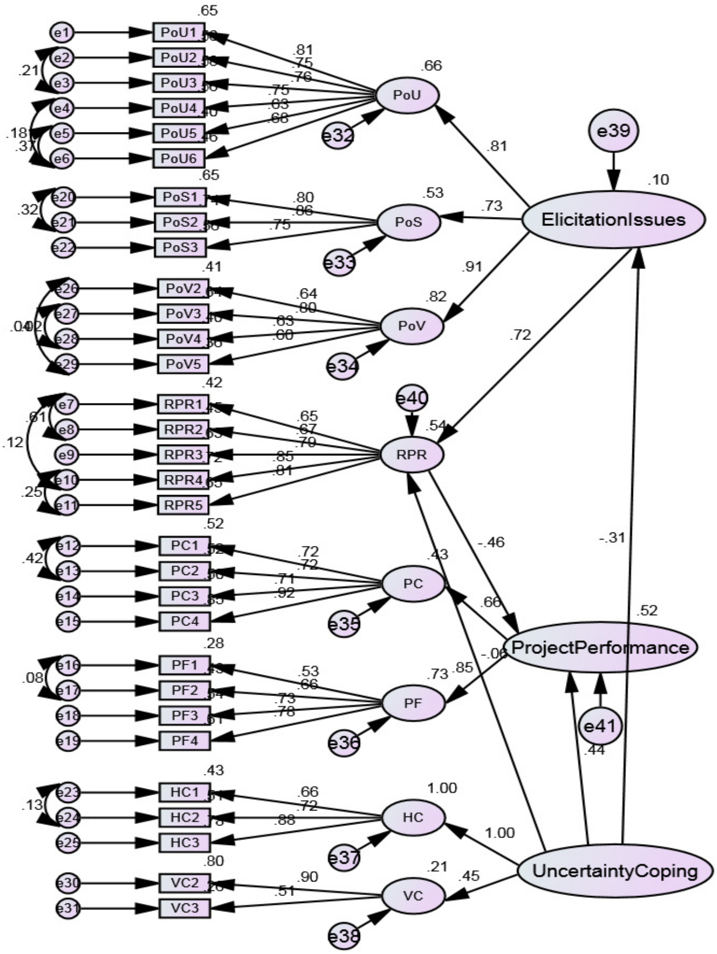

Fig. 4. Causal model results

model. The values in each of the arrow depict the standard coefficients that reflect the degree of the causal relationship.

The causal model produced the following fit indices: *(N=203, χ2/d.f. =1.442, GFI=.846, CFI=.943, RMSEA=.047, PCLOSE=.733, NFI=.837, SRMR=.0700).* The computed fit indices were within the acceptable thresholds (table 6).

Table 6. Goodness-of-Fit : Comparitive measures

GOF measure	Recommended GOF level [5, 6]	CFA measures	Causal model measures
Chi-square/ d.f.	Recommended level between 1 and 3	1.424	1.442
GFI	0 (No fit) to 1(perfect fit)	0.848	0.846
CFI	0 (No fit) to 1(perfect fit)	0.945	0.943
RMSEA	<0.060	0.046	0.047
PCLOSE	>0.050	0.790	0.733
NFI	0 (No fit) to 1(perfect fit)	0.839	0.837
SRMR	<0.090	0.0663	0.0700

3.5 Discussion of Results

H1: Higher levels of elicitation issues will lead to higher levels of residual performance risk. This means that an increase in the effects of elicitation issues will increase the effects of residual performance risks.

The standardized co-efficient between elicitation issues and residual performance risk is 0.72 ($p < .001$), which determines a positive link between the latent factors. This proves that increased levels of elicitation issues will lead to increased levels of performance risk. This empirical finding supports H1. This also validates the theoretical view that elicitation issues impacts project performance; in this case is through the residual performance risk. The impacts of elicitation issues to residual performance risk will determine the strength of its association with project performance.

Which problem contributes most to elicitation issues? This computed coefficients provide an interesting insight into the impacts of elicitation issues on residual performance risk. Problems of volatility (coefficient=.91, $p < .001$) determine a higher impact on elicitation issues, followed by problems of understanding (coefficient=.81, $p < .001$) and problems of scope (coefficient=.73, $p < .001$). This shows that the change in the user environment creates comparatively larger impacts. Change has been proven to be a critical characteristic of elicitation issues in theory impacting project outcomes. Based on this empirical result, we conclude the volatile nature of requirements to be the top contributing factor increasing residual performance risk; thereby impacting project performance. This analysis presents a focus on the prioritization on the category of elicitation issues that need to be addressed.

What contributes most within the problem category? This above conclusion can be further detailed to determine the measurement variables contribute to the increased effects of problems of volatility. For example, in this case, the standard coefficient between problems of volatility and POV3 is .80 ($p < .001$) depicts the strongest factor loading when compared to other parameters. This empirical evidence validates the theory on this observation and confirms that the final requirements drawn are different from those identified during the requirements engineering phases of the project. Similarly degree of impacts of other measures can be drawn.

This discussion can be extended to problems of understanding and problems of scope. The top contributing factor in problems of understanding is POU1 (coefficient=.81, p<.001). POU1 describes that the users are not completely sure of what is needed. The top contributing factor in problems of scope is POS1 (coefficient=.80, p<.001). POS1 describes that the users of this software greatly differed amongst themselves in the requirements to be met. This empirical result validates the related theory that contributes to elicitation issues.

H2: Higher levels of residual performance risk will lead to lower levels of project performance. This means that a decrease (increase) in the effects of residual performance risk will increase (decrease) the effects of project performance.

The standardized coefficient between residual performance risk and project performance is -0.46 (p < .001), which determines a negative link between the factors. This finding supports H2. Similar conclusions have been drawn in past studies [2, 17]. The characteristics of elicitation are discussed in section 2.2. If activities that comprehend these characteristics are not executed according to the project's expectation, the drawback will certainly influence the residual risk, thereby impacting project performance. If the activities in elicitation are executed well, the level of risk that is carried to the other phases of the project is comparatively reduced and performance will improve. Hence, there is a need to execute the requirements phase in a controlled manner so that the residual risks are also controlled and managed effectively through the course of project execution.

Though not explicitly hypothesized, the discussion of uncertainty coping mechanism is important. Horizontal and vertical coordination are important dimensions in any project execution. They influence the overall project performance through their impacts on the residual performance risks. Nidumolu [3] empirically proves this association. His work [3] discusses the negative association of horizontal and vertical coordination with residual performance risk. In this study, we make two critical observations pertaining to uncertainty coping mechanism:

- Firstly, higher levels of uncertainty coping mechanism lead to lower levels of performance risk (coefficient = -.06, p < .001). This means that increased level of interactions between users and project managers, both internally or through the involvement of authorities or steering committee, reduces the residual performance risk and improves project performance.
- Secondly, higher levels of uncertainty coping mechanism leads to lower levels of elicitation issues (coefficient =-.31, p < .001). Given the uncertainty coping mechanism is negatively associated with elicitation issues, increased levels of interactions between users and project staff, either internally or through authorities can reduce elicitation issues and thereby, reduce the related performance risk. These observations support the importance of uncertainty coping mechanism in any project execution for improved project performance.

4 Threats to Validity

This section discusses relevant validity threats based on the categories described under pragmatist view in [20].

Theoretical Validity. The constructs used in this study are generalized categorization of elictation issues, namely the problems of scope, volatility and understanding.

Detailed factors such as scope, human factors, quality, requirements, etc. that contribute to elictation issues are not explictly considered to be part of the causal relationship. This generalized view can cause potential deficit in the considering key factors, thereby posing a threat to theoretical validity.

External Validity. 84.73% of participants are from India and mostly associated with projects in the context of offshoring; 52.71% associated with healthcare/ insurance domain. Given the dynamic nature of the domain as well as challenges associated with global software development, the generalizability of outcomes may be challenged. The factor loadings may potentially represent context-dependent results and possibly vary for other domains and/or projects executed in-house, posing a threat to external validity.

Construct Validity. As described in [3], factor analysis is a powerful technique in assessing construct validity. Table 2 describes the factor loadings across the relevant dimensions. Loading < 0.4 were excluded from the study and the remaining were carefully examined and retained for subsequent analysis. This statistically elevates any threat to this validity in this study.

Internal Generalizability. This is concerned with the degree to which conclusions/ inferences are drawn about relationships between variables [20]. The conclusions are drawn based on 203 survey responses over 34 dimensions [table 2]. Practitioners confirm that the correlations drawn based on the causal model lead to accurate conclusions based on the good sample size. This statistically elevates the threat to this generalizability and confirms the conclusions to be reasonable with respect to the collected data.

5 Implications for Research and Practice

This study demonstrates the influence of the general categories of elicitation issues to project performance. Future research could extend this study to address the influence of detailed elicitation issues such as those identified in [19] to project performance. This will be a critical research area to understand and realize the influence of the core factors that contribute to poor elicitation and their influence on overall project performance. Given the dynamic nature of business requirements and applicable mandates and a good percentage of projects being executed in the global software development framework, this enhanced study will be of importance to conduct elicitation effectively.

For practitioners, this study has important implications. In practice, challenges pertaining to lack of knowledge or experience in conducting effective elicitation have been recorded as leading to failures in capturing relevant requirements and in turn potential project failures. The model provides an empirical perspective on the impacts of elicitation issues along with priority-setting of elicitation issues. These priority-setting of parameters can support business analyst and requirements engineers to be prepared to realize and address relevant risks that may potentially surface during elicitation. These findings will support in the *continuous* refinement of elicitation process guidelines that can draw practitioner's attention to determining action on specific areas of focus during elicitation. This is also expected to aid in the decision making processes during the early planning phases of software development.

6 Limitations

Like any research, this study has certain limitations too. Firstly, the study focuses only on requirements elicitation and not any other activities of the project's requirements engineering phase. Secondly, the constructs reflect elicitation issues categorized as problems of scope, problems of volatility and problems of understanding. While the constructs provide an overall view of the impacts on elicitation, they may not best capture detailed factors of elicitation issues [19, 21] and their impacts to project outcomes. Thirdly, the assumption in this study is that project success is governed largely by effective requirements gathering and hence, any other measure that might have contributed to the overall project success (thought elicitation as an activity may not been effective) is not considered or validated in this context. Lastly, Cronbach co-efficient α-value for internal consistency for vertical coordination is < .70 can be regarded as a limitation in this study.

7 Conclusion

This study deduced the causal relationship and level of influence amongst 13 elicitation issue characteristics categorized as problems of scope, problems of volatility and problems of understanding with 8 characteristics of project performance categorized as product flexibility and process control. While empirical outcomes support the hypotheses, this study also deduced a priority-setting for categories in elicitation issues that can be addressed appropriately to keep residual performance risks in control throughout the project execution. In this case, the study suggests the factor that contributes significantly to residual performance risk to be problems of volatility followed by problems of understanding and problems of scope. The standard coefficient in the model provides in-depth view on the causes for poor elicitation by further studying the parameters within problems of volatility, problems of scope and problems of understanding. These empirical findings can support practitioners and researchers to strengthen their execution of the RE activities. This can aid in decision-making and project planning processes for improved project performance and reduced risks.

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