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ScienceDirect

Procedia Technology 16 (2014) 1155 – 1165

Procedia Technology

CENTERIS 2014 - Conference on ENTERprise Information Systems / ProjMAN 2014 - International Conference on Project MANagement / HCIST 2014 - International Conference on Health and Social Care Information Systems and Technologies

Equivocality in IS/IT Project Evaluation: Model Development and Pilot Study

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Abstract

IS/IT projects are perceived as ventures which are prone to failure and may lead to disruptive conditions. Evaluating the continuation of projects is highly important for stakeholders and decision makers. However, this event is hampered by the problem of equivocality. The main objective of this study is to examine the equivocal situations and their causes in inducing the ambiguity toward the projects next course of action. A theoretically grounded research model is constructed that postulates the influence of content, context and process of evaluation on the extent of equivocal situations prevailed when evaluating IS/IT projects. This paper describes development of the model and the measurements. By surveying knowledge professionals experienced in IS/IT project management, the model is tested using Partial Least Squares (PLS). The paper presents a discussion of the initial findings and conclusions.

Peer-review under responsibility of the Organizing Committee of CENTERIS 2014.

Keywords: Equivocality; evaluation; information system/technology projects; exploratory model; pilot test.

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Peer-review under responsibility of the Organizing Committee of CENTERIS 2014.
doi:10.1016/j.protcy.2014.10.130

1. Introduction

Large and expensive IS/IT investments often lead to disruptions in businesses and could spell disaster for organizations. It is reported that failure rates for IS/IT investments remain persistently high as still close to half of organizations' IS/IT spending is devoted to underperforming projects [1-3]. Hence, evaluation of these projects is utmost importance to: (1) provide indication of the projects' progress and likely success; (2) appraise worthiness of continuing the projects, and; (3) allow intervention to projects which deviate from their plan [4-6]. There are several courses of action ranging from continuation to termination. Keil [7] argued that *"one of the most difficult management issues that can arise in connection with IT projects is deciding whether to abandon or continue a project that is in trouble"* (p. 422).

Drawn from Bowen's decision dilemma theory, this paper focuses on equivocality affecting the continuation decision of IS/IT projects. Earlier studies have shown the importance of equivocality in affecting continuation decisions [8]. Yet, the causes of equivocality are not well recognized. Equivocal situations raise potential problems of unwarranted continuation and premature termination in decision-making and hinder organizations to purposefully decide the projects next course of action [9, 10]. Grounded in prior literature review and exploratory studies, this paper endeavors to investigate the equivocal situations by means of constructing the model and the measurement explaining the causes of such situations. It is opted to ascertain causes that are more salient in determining equivocal situations.

This paper presents the results of a pilot study of IS/IT project evaluation. By developing and testing the measurement model, the construction of a valid survey instrument will be used in further studies. The remainder is organized as follows: the next part presents the development of a model of equivocality through prior literature review and exploratory studies. Then, the third part presents the development of the model and the measurements, the questionnaire design as well as the data collection. The fourth part presents testing of the measurement model using Partial Least Squares (PLS). Finally, a discussion of the findings and conclusions are presented.

2. Foundation and related work

While prior studies have mainly focused on psychological factors of the phenomenon positing flawed decisions and errors in decision-making we subscribe to and follow Bowen's conjecture. Bowen [11] introduced the term of equivocal information which refers to information for which multiple (positive or negative) interpretations can be constructed. The theory posits that continuation decisions of troubled IS/IT projects are seen more as dilemmas rather than errors of decision-making. These dilemmas occur when decision-makers have to struggle deciding the projects' next course of action in the face of problematic equivocal situations. When information surrounding the projects is deemed to be ambiguous, equivocal situations might emerge and can lead to escalation caused by commitment of prudent economic belief and curiosity to decipher the problems [12]. Conversely, abandoning the project will necessitate unequivocal negative information suggesting that even additional resources will not bring the project to success [11]. Several causes of equivocal situations are implicitly mentioned in some studies. For instance, lack of clarity about projects' success and failure criteria, vagueness of project charter, or ambiguity of information surrounding the projects execution [4, 13, 14]. These instances are seemed to induce equivocal situations. However, extant studies have not yet explored the concepts of equivocality in IS/IT projects specifically, which makes the phenomenon and the causes are not well understood.

We have conducted a prior study consists of three main steps: literature review, seven expert interviews, and four project case studies. These steps have used qualitative data as part of an exploratory phase to (1) improve our understanding toward the concept of equivocality; (2) to identify typical characteristics of equivocal situations; and (3) to inductively reveal the causes of equivocal situations. Based on our synthesis of the extant studies, equivocal situation in IS/IT project evaluation is defined as the state when decision-makers or evaluators encounter a lack of clarity and confusion in deciding the continuation of a project, in which occurred when lack of knowledge or diverse knowledge exists in regard to information surrounding the project, especially its past performance and future attainment. This situation is typically shown by the existence of multiple interpretations, conveyed meanings or perceptions toward the project. Other indications include the indeterminacy of analyzed data to support decision-

making, the demand of "richer" or different types of information, and the involvement of decision-makers in reaping consensus by exchanging views and judgments through social interaction to settle disagreements.

After developing a framework that map the a-priori causes of equivocal situations within evaluation frame we employed qualitative exploration to corroborate and analyze the emergence of equivocal situations across projects in practice and to derive potential elements to indicate them. By defining the characteristics of equivocal situations to the participants, the main question in the qualitative part was why the characteristics of equivocal situation prevailed. Recorded interviews and supporting documents were analyzed. Throughout these steps the a-priori causes of equivocal situations was continuously improved and the measurement model was developed. Eight categories of the cause of equivocal situations were suggested. The model development will describe in the next section.

3. Research method: model of equivocal situations

We constructed the measurement items by adopting the scales that were relevant within our constructs' definitions and aligned with our qualitative findings. Likewise, development of the new items was also possible following our prior exploratory study. The existing scales were reworded to ensure suitability with the research domain. We utilized two rounds of Q-sorting exercises to assess validity of our constructs by following the procedure set by Moore and Benbasat [15]. WebSort/OptimalSort online card sorting was used to conduct the sorting exercises. By using features of the site we were able to employ the exercises remotely and simultaneously and then download and analyze the raw data promptly. The first round consisted of four master students in Business Administration and the second round consisted of four doctoral students and faculty members in IS field. Both groups did not have specifically prior experiences with the research theme. The participants were briefly introduced to the research; specifically to the objective of the sorting exercises. They were asked to open the website requested and read the instruction via their browsers. After they understood all the instructions, they continued the exercises bearing in mind that they can ask questions related to the sorting during the exercises. The categories as well as their definitions were presented in the site. The participants' task was to group randomized-items that belong together. The "Indecisive" category was also provided whether they were unsure of the item(s) placement. Durations of the exercises were approximately 20-30 minutes.

Following the initial round of exercises, we analyzed (1) our discussion with the participants; (2) the raw data and the output from the sorting website (e.g., result sheets, dendrogram output); and (3) the matrix that calculate the inter-judge agreement levels, computed Kappas and "hit ratios" to further refine the items and the constructs. Several refinements were made, specifically toward the phrasing and wordings of the measurement items. Then, the final modifications were employed in the second round. An average "hit ratios" of 68 per cent, an average raw agreement of 69 per cent, and an average Kappa of 64 per cent were attained for the constructs in the first round. This was further improved in the second round yielding an average "hit ratios" of 86 per cent, an average raw agreement of 85 per cent, and an average Kappa of 83 per cent. The value of 0.65 or higher suggested an acceptable agreement [15]. Results of the sorting exercises suggested the items tap adequately into the intended constructs. This was also ensured substantive validity to continue for the next pilot test. The results from the Q-sorting exercises were used to compose draft of the questionnaire. Table 1 shows summary of the agreement measures for both rounds.

The questionnaire was mainly divided into two parts. The first part contained the questions used to investigate the equivocal situations and their causes as well as the decisions and the actual implementation of the projects. The second part contained the questions eliciting profile of the participants and the chosen projects. The draft questionnaire was examined by the research team then several modifications were made to make sure the content was clear and easy to understand, yet short enough to complete. The questionnaire was operated using the online tool and distributed as a web link. Potential participants were asked by sending and posting the invitation in several relevant LinkedIn groups, and requesting IS/IT professional organizations to partake in the survey. Two replies were received from the organizations giving agreements to publish the survey invitation on website and in newsletters. Around 60 people accessed the survey and 33 participants completely filled in the survey. In the survey, participants were asked to recall a recent review or evaluation of a challenged IS/IT project they involved in and to keep this one project in mind throughout the questionnaire. We employed most of the scales based on 7-point Likert scales that typically ranging from (1) Not at all and (7) Very great extent for each of the measurements.

Table 1. Inter-Judge Agreements.

Agreement Measure	Combination	Round 1	Round 2
Raw agreement	1,2	0,71	0,90
	1,3	0,68	0,81
	1,4	0,66	0,85
	2,3	0,71	0,82
	2,4	0,69	0,91
	3,4	0,66	0,81
Average		0,69	0,85
Cohen's Kappa	1,2	0,67	0,88
	1,3	0,63	0,78
	1,4	0,61	0,82
	2,3	0,67	0,80
	2,4	0,65	0,90
	3,4	0,61	0,78
Average		0,64	0,83
Placement ratios summary			
Complexity in process (CP)		0,44	0,81
Sophistication of technology (ST)		0,50	0,94
Challenges in project management (CPM)		0,65	0,71
Lack of standards (LS)		0,67	0,88
Changes in external state (CES)		0,75	0,85
Different frames of reference (DFR)		0,85	0,85
Failure of evaluation methods (FEM)		0,63	0,88
Lack of evaluation data/information (LED)		0,94	1,00
Average		0,68	0,86

Appendix A. provides illustration on the derivation of constructs from initial literature review, the relation with the qualitative study, and the selected items to operationalize the constructs based on both prior study and further analysis of extant studies. The quotations in the table were by no means exhaustive but intended to provide exemplar of the constructs-items development. The aforementioned process, specifically in our prior study, provides substantial content validity of the constructs and the instrumentation before empirically testing them.

Our framework is based on the CCP framework and the CPME [16, 17]. The framework is described as follows: Firstly, a group of decision-makers or evaluators defines the object of evaluation and uses particular criteria to assess the object. This is termed as the ***content*** of evaluation or the constituents within the "*what*" of evaluation. Secondly, evaluation will be influenced by its ***contextual*** settings; these are the external environment of the projects and the people who handled the evaluation. Thirdly, evaluation will be influenced by the ways of or "*how*" evaluation is conducted, termed as the ***process*** of evaluation. The identified problems related to equivocal situation during project evaluation are mapped into the framework accordingly. Fig. 1 depicts mapping of the causes of equivocal situations into the content, context and process within evaluation frame.

We modeled equivocal situations as a dependent variable which is affected by eight independent variables, i.e., eight different categories of the causes, within the Content, Context and Process (CCP) frame. Through evaluation perspective, the model can be used to differentiate which part of the evaluation constituents that were substantially and generally affected by the causes that would lead to the prevailing equivocal situations. We posit that the causes are positively associated with the occurrence of equivocal situations when evaluating and deciding the projects next course of action. Fig. 2 presents the proposed research model.

Context

Evaluation frame	Identified cause
• Influences from external environment	• Changes in external state
• Involvement of people as evaluators/decision-makers	• Different frames of reference

Content

Evaluation frame	Identified cause
• Object of evaluation	• Complexity in process • Sophistication of technology • Challenges in project management
• Establishment of evaluation criteria	• Lack of standards

Process

Evaluation frame	Identified cause
• Utilization of appraisal techniques and tools	• Failure of evaluation methods
• Making sense of the data	• Lack of evaluation data/ information

Fig. 1. Mapping the causes of equivocal situations within CCP of evaluation frame

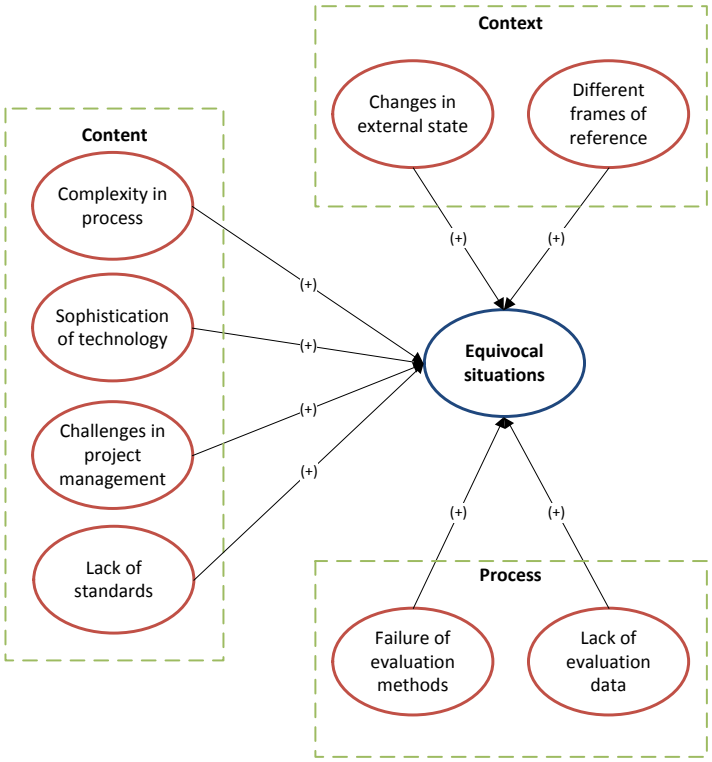

Fig. 2. Research model

4. Analysis and result

Most participants have the role of project manager (33%) followed by senior manager of IS/IT – CIO (15%). They mostly come from IT services industry (21%), Government (15%) and Education (15%). More than half of the participants come from organizations which are considered larger than industry average. Additionally, 15 percent of the projects were suffering substantial abandonment. 36 percent of the projects are categorized as escalated projects and another 36 percent of the projects were continued as planned. 67% of the projects were considered larger and longer than other IS/IT projects undertaken by the organizations.

We utilized PLS using SmartPLS 2.0 (M3) [18]. PLS is well suited for theory building and prediction as well as handling mixed reflective and formative measures [19]. PLS was used to test the measurement model and will be used later to analyze the direction and strength of each relationship in our further study. We modeled the indicators of equivocal situations as reflective measures. For the causes of equivocal situations, we modeled the indicators as formative measures since the causes are grounded by a thematic inductive method of literature review and exploratory qualitative studies [20]. For the reflective construct, the suggested threshold values for indicator loadings, the average variance extracted (AVE), composite reliability, and Cronbach's alpha are 0.70, 0.50, 0.70, and 0.70, respectively [21, 22]. All values for the construct of equivocal situations (ES) are higher than the suggested threshold. The result suggests a good quality of measurements. For formative constructs, we analyzed the measurements by means of examining the threat of multicollinearity. We generated the matrix of latent variable correlations and the values of variance inflation factor (VIF) (Table 2). The latent variable correlations show none of the correlations are above 0.90 and the maximum variance inflation factor (VIF) is 2.718. The result suggests that multicollinearity is not a problem in our study, even for a more restrictive VIF value of 3.3 [21-23]. We included the weights of the constructs in Table 2; however, assessing the significance of the indicator weights is less appropriate in this time due to small sample size. Examining the signs and the magnitudes of the weights, some problems might exist. Cenfetelli & Bassellier [20] suggest examining suppressor effects in the occurrence of negative indicator weights. Suppressor effects, which make the interpretation of formative indicators problematic, may be resulted from heterogeneity of the current data [24]. Further extensive analyses can be performed in follow up studies with larger sample size to tackle these problems and to make decisions concerning the indicators.

Table 2. Variance Inflation Factor (VIF) and weights for formative measures.

Construct	Item	VIF	Weight
Complexity in process (CP)	CP1	1,235	0,592
	CP2	1,281	0,366
	CP3	1,081	0,396
Sophistication of technology (ST)	ST1	1,238	0,668
	ST2	1,097	-0,340
	ST3	1,135	0,603
Challenges in project management (CPM)	CPM1	1,836	-0,033
	CPM2	1,438	-0,059
	CPM3	1,499	0,194
	CPM4	1,154	0,387
	CPM5	1,029	0,717
Lack of standards (LS)	LS1	1,602	-0,274
	LS2	1,515	-0,323
	LS3	1,168	1,293
Changes in external state (CES)	CES1	1,253	-0,338
	CES2	1,336	0,089
	CES3	1,128	-0,081
	CES4	1,398	0,976
Different frames of reference (DFR)	DFR1	1,330	-0,131
	DFR2	1,318	0,683
	DFR3	1,191	1,006
Failure of evaluation methods (FEM)	FEM1	1,358	-1,624
	FEM2	1,358	1,713
Lack of evaluation data/information (LED)	LED1	2,718	-0,256
	LED2	1,563	1,071
	LED3	2,525	0,149

5. Discussion and conclusion

While the importance of equivocality in affecting continuation of IS/IT projects is recognized antecedents of this phenomenon are not well established. To address this gap, this paper focuses on developing a model that can be used to predict the equivocal situations when evaluating and deciding the continuation of IS/IT project and to identify the salient drivers. In light of our qualitative part, a conceptual model and its measurements are proposed in this paper. The measurements underwent a validation procedure. By gathering the pieces, this study analyzes the measurement scales. This study contributes by means of developing and validating the instruments to measure equivocal situations along with their causes. Still, the use of current small sample size entails several limitations.

The use of PLS algorithm is then restricted only to show the indicators weights without including the path coefficients for each of the causes. This means that the salient drivers of equivocal situations cannot yet be determined. Bootstrapping cannot be performed as well due to the size of current sample. These points need to be settled in follow up studies that use larger sample size. Nevertheless, this study highlights the essential part in providing a conceivable explanation of the causes of equivocality and prediction of the equivocal situations during IS/IT project evaluations. For our future research, we have contacted several IS/IT-professional organizations to obtain their willingness to participate in the study. After improving the current samples, the measurement model will be finalized and re-tested to comply with the validity requirements. By using a valid measurement model, substantial predictive power of the model may be obtained. Further examination can also include the possibility to improve the current model by constructing a hierarchical component model (HCM). This is beneficial especially to reduce the number of competing causes that directly connect to equivocal situation construct, and when the constructs included in the model are highly correlated [25].

At present, we received replies from around 40 per cent of the participants who are willing to discuss further the survey and their responses. This also allows us to conduct further post-hoc examinations to gain rich insights into the relationships among the constructs and on how the participants copped with such situations. Eventually, the study will shed some light on underlying mechanisms of equivocal situations and help practitioners to assess and forestall the equivocal situations when evaluating and deciding the continuation of their IS/IT projects.

Appendix A. Summary of constructs and items development

Derivation of constructs from prior studies and items development.

Construct	Item		Reference of extant studies
Complexity in process (CP): *the extent to which the process of developing IS/IT involves substantial intricacy* **Initial references from the literature review:** Brun and Saetre (2008); Chang and Tien (2006); Fazlollahi and Tanniru (1991); Jones and Kydd (1988); Koufteros, Vonderembse and Jayaram (2005); Lim and Benbasat (2000) **Quotation exemplar from the qualitative study:** *"...[the situation] was actually [occurred because] the amount of stakeholders is too big to organize in that certain time limit...".*	CP1	Multiple stakeholders were involved in the development process of the project	Perceived complexity in software development [26]. Information systems development project (ISDP) complexity [27]. Project complexity in new product development [28].
	CP2	The development process of the project involved a lot of integration with other systems	
	CP3	Compared to other IS/IT projects undertaken in your organization, how would you describe this project?* Much less complex to implement – Much more complex to implement	
Sophistication of technology (ST): *the extent to which the design of IS/IT product or solution is considered innovative or advanced* **Initial references from the literature review:** Brun et al. (2008); Fazlollahi et al. (1991); Kydd (1989) **Quotation exemplar from the qualitative study:** *"...there is no other project that comparable with our project in whole [region] based on [the theme]...".*	ST1	The concept of the IS/IT product was very novel	Concept complexity and novelty in the new product development [29]. Project complexity in software project risks [30, 31] Innovation in black swan IS/IT projects [32]
	ST2	The design of the IS/IT product involved the use of immature technology	
	ST3	Compared to other IS/IT projects undertaken in the organization, how innovative/new were the ideas/technologies?* No innovation or new technology involved – Completely innovative in nature; never attempted before	
Challenges in project management (CPM): *the extent to which the IS/IT project encounters substantial management challenges* **Initial references from the literature review:** Mähring and Keil [14], Hantula and DeNicolis Bragger [33], Jones and Kydd [34], Kydd [35], Levander, Engström [36], Pan and Pan [37] **Quotation exemplar from the qualitative study:** *"..I made several attempts toward the [project] to make [the] goals more specific, there're quite some reports about it, but it [did] not [really become] specific, no, it was still a bit [of a] vague project."*	CPM1	The project had NOT adequately set out project milestones	Project planning and project monitoring & control in software projects [38]. Requirement diversity in information systems development project [39-41] Project management in new product development project [42].
	CPM2	Senior management did NOT adequately control the project in order to keep it on track	
	CPM3	Ineffective communication among people in the project management structure	
	CPM4	A lot of effort and time was spent in managing the project due to reconciling the requirements of various users of this IS/IT	
	CPM5	The project charter as the basis for managing the project was vague	
Lack of standards (LS): *the extent to which evaluators/decision-makers utilize evaluation criteria to ascertain the project value* **Initial references from the literature review:** Bowen [11], Hantula and DeNicolis Bragger [33], Jones and Kydd [34], Brun and Saetre [43], Chang and Tien [44], Fazlollahi and Tanniru [45], Koufteros, Vonderembse [46], Lim and Benbasat [47] **Quotation exemplar from the qualitative study:** *"..so there were no plans for uhm go-no-go for the project board.. most of it was in the head of the project manager that time.."*	LS1	Clear and well communicated criteria for go/no-go decisions and significant resource adjustments were set by the decision-makers (reverse)	Decision-making clarity in innovation projects [42] Formal evaluation system in innovation projects [29] Credibility and efficiency in innovation project proposal screening [48]
	LS2	The evaluation criteria were considered credible by the decision-makers (reverse)	
	LS3	A set of criteria to evaluate the project was agreed by the decision-makers (reverse)	
Changes in external state (CES): *the extent to which the project is affected by organizational environmental dynamics* **Initial references from the literature review:** Chang and Tien [44], Fazlollahi and Tanniru [45], Carson, Madhok [49]	CES1	Changes in law, rules or regulations had significant impact on the project	Organizational environment in software projects risks [30, 31, 50]. Environmental volatility in new product development [51].
	CES2	Changes in organizational structure external to the project had significant impact on the project	

Construct	Item		Reference of extant studies
Quotation exemplar from the qualitative study: *"...there're a lot of political pressures as well in the project [which] makes people quite nervous [be]cause of [the] political pressure..."*	CES3	Politics had a negative effect on the project	
	CES4	Resources were shifted away from the project because of changes in organizational priorities	
Different frames of reference (DFR): *the extent to which evaluators/decision-makers have diverse viewpoints when evaluating the project* **Initial references from the literature review:** Jones and Kydd [34], Levander, Engström [36], Fazlollahi and Tanniru [45], Daft, Lengel [52], Frishammar, Floren [53], Zack [54] **Quotation exemplar from the qualitative study:** *"...you have different stakeholders and different user groups.. and they have different [backgrounds].. So their evaluation is different.."*	DFR1	The decision-makers had different backgrounds	Team diversity in software development agility [55]. Senior team heterogeneity [56].
	DFR2	The decision-makers had skills and abilities that complement each other (reverse)	
	DFR3	The decision-makers were diverse in terms of their professional experience	
Failure of evaluation methods (FEM): *the extent to which evaluators/decision-makers apply techniques or tools to evaluate the projects* **Initial references from the literature review:** Tiwana, Keil [9], Bowen [11], Keil and Flatto [57] **Quotation exemplar from the qualitative study:** *"No no nothing.. no no.. there was a zero method here.. Yes [we have certain method], just choose not to use it.."*	FEM1	A predefined procedure was applied to evaluate the project and to decide the next course of action (reverse)	Formal evaluation system in innovation projects [29].
	FEM2	Evaluation techniques or tools were applied to evaluate the project and to decide the next course of action (reverse)	
Lack of evaluation data/information (LED): *the extent to which evaluators/decision-makers use data surrounding the project to support decision-making* **Initial references from the literature review:** Bowen [11], Newman and Sabherwal [58] **Quotation exemplar from the qualitative study:** *"..there was an evaluation moment but there was really like very little materials to make the.. that you could use to make a decision..".*	LED1	The data used were accurate enough to evaluate the project (reverse)	Satisfaction with data of the information systems users [59]. Data quality in ERP implementation [60].
	LED2	It is difficult to evaluate the project effectively because some of the data needed were NOT available	
	LED3	The data were at an appropriate level of detail to evaluate the project (reverse)	
Equivocal situation (ES): *the extent to which evaluation of the project is hampered by equivocality* **Initial references from the literature review:** Daft, Lengel [52]; Watts Sussman and Guinan [26]; Lim and Benbasat [47]	ES1	The project status or condition was hard to ascertain caused by different interpretations among decision-makers toward information surrounding the project	Environmental ambiguity in new product development [51]. Ambiguity in software development [26]. Information equivocality in organizational work units [61]. Perceived equivocality in text-based and multimedia representation [47].
	ES2	Decision-makers lacked clarity and understanding of the condition of the project and thus were confused concerning the next course of action	
	ES3	It was problematic to analyze the condition of the project since insufficient objective data was available to base the decisions on	
	ES4	Decision-makers needed to exchange opinions, share meanings and beliefs toward the project to settle disagreement and reach consensus for the next course of action	

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