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A new framework for complexity analysis in international development projects – Results from a Delphi study

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A B S T R A C T

The main objective of this paper is to develop a framework for characterising project complexity in International Development (ID) projects. Contemporary challenges in ID projects have led to their growth in their complexity, which in recent years has driven researches in recent years to publish numerous papers that deal with this topic, demonstrating its importance in current project management research. Nevertheless, existing literature lacks in generally accepted framework that considers specifics of project complexity in ID projects. Thus, new framework was developed, based on a two-round Delphi survey, building upon existing TOE (technology-organisation-environment) framework with new empirical insights given from the experts in the field of ID projects. The main contribution of the paper is the validation of existing TOE complexity factors, in the context of International Development projects. Additionally, eight new complexity factors were proposed by the experts, and it was concluded that Environmental complexity had the biggest impact on International Development projects. From a managerial perspective, proposed complexity framework can be used for making a complexity footprint, which could indicate the critical areas of the project where complexity could be expected. In addition, the model represents a novel theoretical lens for assessing complexity in ID projects.

A R T I C L E I N F O

Keywords:
International development projects (ID);
Project management;
Complexity;
Project complexity;
Technology-organisation-environment (TOE);
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1. Introduction

Over the last ten years, interest in project management has significantly grown. It has been reported that about 24 % of the world GDP ($19 trillion) is spent on projects every year [1]. Project failure seems to be the rule in all types of projects [2], and this seems to be particularly true for International Development (ID) projects that have the ultimate objective to reduce poverty or to improve governance and build institutional capacity [3-5]. Contemporary challenges (dynamic and uncertain environment, increasing number of stakeholders) that influence these projects are closely related to the complexities of these projects [6-10]. It has been acknowledged that there is a correlation between project performance and complexity, and still, there is a huge knowledge gap about how complexity relates to project management practice and no widely accepted framework of project complexity in ID projects [11-14].

Numerous papers have been published in the field of project complexity, with intention to explain the relationship between complexity theory and project management [8, 9, 15, 16]. Management of ID projects requires a novel framework for dealing with project complexity due to their specifics in comparison to conventional projects. The framework in this paper includes some of the elements of TOE (technology-organisation-environment) framework, proposed by Bosch-Rekveldt, as well as the complexity model proposed by Vidal and Marle [9, 17]. This paper investigates complexity factors that contribute to overall complexity of ID projects from the perspective of the experts.

ID projects have specific context that increases their overall complexity. These projects cover almost every sector of activity, since they take place at multiple locations and in a different time zone. These are public-sector projects that show cultural complexity, unique context and institutional challenges. ID projects are specific due to their intangible, unique goals, unique ways of organizing, tool-intensity and the large number of stakeholders.

Delphi method has been used in this study to verify the significance of existing complexity factors proposed in the literature and to further update the list of complexity factors in the context of ID projects. Novel, modified complexity framework was developed based on the insights of the Delphi study. We found that experts take as most important the following complexity factors in ID projects: Clarity of goals, Variety of stakeholders' perspectives, Dependencies between tasks, Interface between different disciplines and Dependencies on other stakeholders. Most of the factors with the highest grade are in the group of Environmental complexity, which makes this type of complexity the most important for this type of projects. This conclusion is a unique contribution, in comparison with the results given from the similar studies done on different type of projects (see for example [17]).

The paper is organized as follows. Section 2 reviews recent works on complexity in the field of ID projects and presents the theoretical background of the proposed model. Section 3 introduces Delphi research, including data collection an analysis processes related to the Delphi questionnaires done by practitioners and experts. Section 4 proposes a refined measuring model for complexity in ID projects and shows the significance of this research. The final section presents conclusions, potential implications and limitations of the proposed model.

2. Literature review

2.1 International development projects

International development (ID) projects are the projects that deal mainly with poverty reduction, and cover sectors of agriculture, transportation, water, energy, health, population, education, reform and governance, etc. [18]. These are public projects, funded by donors from developed countries and are implemented in under-developed countries, which bring numerous political and cultural challenges [4].

ID projects have certain similarities with conventional projects: they deliver goods and services, they are limited, temporary and unique endeavours that go through project life cycle; these projects are constrained by the "iron triangle"- time, cost, and use project management standards, tools and techniques for the implementation [3, 19].

Peculiarities of ID projects are often interconnected with their not-for-profit, social, technical, and political nature; they are funded by external donors and have intangible and even conflicting objectives difficult to measure. In addition, they often have more stakeholders in comparison to conventional projects – at least three most important stakeholders: funding agency, implementing agency and the beneficiaries [3], that often have conflicting expectations. ID projects have specific context in which they occur, with numerous political, cultural, legal, social, technical, economic and environmental challenges. Important characteristics of ID projects are optimism bias, planning fallacy, strategic misrepresentation, and they are prone to media scrutiny, intolerance of failure, rigid procedures etc. [2].

Ika *et al*. [4] claim that due to their evident socio-political complexity, ID projects could "fit at the far right end of the spectrum on a continuum from private sector projects, through public sector projects, to international projects".

2.2 Project complexity

Projects can be observed as complex, self-organising systems, with their specifications (requirements and constraints) that undergo design process that is highly social, consisting of hundreds of designers, customers, and other participants [24]. Complexity has been recognized as one of the most important streams in project management research [20]. One of the first problems in understanding project complexity is lack of consensus regarding the definition of complexity in the project context [4, 6, 7, 13-16]. A review of recent papers had confirmed that definitions of complexity continue to be ambiguous [17, 18]. One of the most cited definitions is Baccarini's one defines complexity as "consisting of many varied interrelated parts and can be operationalised in terms of differentiation and interdependency" [21]. Followed by Baccarini's work, Williams explained that complexity consists of "structural complexity" – the number of varied components, "interdependency" – degree of dependence between these components and "uncertainty in goals and means" [22]. Geraldi *et al*. clarified complexity into structural, dynamical, uncertainty, pace and socio-political complexity. Sommer and Loch [23] define complexity as having "two dimensions": system size (the number of influence variables) and the number of interactions among influence variables.

The term "complex" stems from the Latin words cum (together, linked) and plexus (braided, plaited). The Oxford dictionary defines complexity as "consisting of parts" and "intricate, not easily analysed or disentangled." [15].

When defining complexity, it is important to make a distinction between two terms [8]: "complex" and "complicated". Complex systems contain multiple parts with several connections and interactions between the parts and behaviour that is a result of these emergent properties. Complicated systems emerge as the result of complex systems, without the right tools for analysis and management.

Vidal claims that there are two main scientific approaches to complexity [24]:

1) Descriptive complexity – this approach considers complexity as an intrinsic property of a project system,
2) Perceived complexity – complexity as subjective matter.

Bakhshi *et al*. concluded that there are three main schools of thought within the construct of complex projects: the Project Management Institute (PMI) perspective, the "System-of-systems" (SoS) approach, and the complexity theories perspective [25].

Cicmil and colleagues distinguish two different terms when discussing complexity [5]:

- Complexity in projects (how complexity can be manifested in projects),
- Complexity of projects (what factors make projects complex or difficult to manage).

The first stream is mainly theory-driven, and leans on complexity theories [5, 14, 19]. The second stream is practitioner-driven and aims to identify factors of complex projects and the strategies on how organisations can respond to complexity [20-23]. This paper focuses on the second stream.

Lack of consensus in defining project complexity leads to lack of understanding the concept. In this paper, we will accept Vidal's definition of project complexity as "the property of a project which makes it difficult to understand, foresee, and keep under control its overall behaviour, even when given reasonably complete information about the project system" [24].

2.3. Complexity factors in project management – Gathering elements from the literature

Numerous attempts have been made to measure and model project complexity (Appendix A – Complexity measuring in the literature), and most of them attempted to measure complexity quantitatively by focusing on the most important complexity factors [8, 9, 14, 17, 21, 22, 26-28]. In this paper, the classification of complexity factors proposed by Bosch-Rekveldt has been adopted – the TOE framework (Table 1), that includes Technological, Organizational and Environmental complexity factors [17]. It builds upon Baccarini's and Williams' existing complexity frameworks [21, 29].

Table 1 Included elements of TOE framework

Complexity type	Element name
Organisational complexity	Duration, Compatibility of different project management methods and tools, Size in CAPEX, Size of the project team, Number of locations, Resource and skills, Experience with parties involved, Interfaces between different disciplines in ID projects, Number of different nationalities in ID projects, Number of different languages, Cooperation of JV partners, Trust in project team (JV partner), Organisational risks
Technological complexity	Number of goals, Goal alignment, Clarity of goals, Scope largeness, Uncertainties in scope, Quality requirements, Number of tasks, Variety of tasks, Dependencies between tasks, Uncertainty in technical methods, Conflicting norms and standards, Newness of technology, Experience with technology
Environmental complexity	Number of stakeholders (internal and external), Variety of stakeholders' perspectives, Dependencies on other stakeholders, Political influence, Organisational internal support, required local content, Experience in the country of implementation, Stability of project environment, Risks from environment

De Bruijn already categorized complexity factors in three groups: technical complexity, social complexity and organizational complexity. This categorization has been furtherly developed by Jaafari, and also by Xia and Lee, but they have investigated the significance of TOE factors only in large engineering projects [17]. Technical view included technical content of the project, Organizational view included people and organizational aspects of the project, and Environmental view was mainly focused on the influences in the project environment on the complexity.

3. Methodology

3.1 Delphi method

As already mentioned, there is no clear consensus of the researchers on the complexity measures. Several studies have already been done in the area of project complexity, based on statistical calculations or surveys. ID projects are characterised with dynamic environments, numerous stakeholders, customized projects, and exposure to external conditions that often make traditional, research methods unrealistic for this type of research. The main benefit from conducting a qualitative study is validation of a local expression and ability to understand certain phenomena from the inside out [30]. Delphi method is designed to obtain reliable consensus about the topic from a panel of experts by conducting series of questionnaires combined with controlled opinion feedback, and with results of each round being fed into the next round [31]. In the field of management, a modified approach of Delphi method has been used to shape a group consensus about the relative importance of proposed issues [32]. Lindstone and Turoff [33] proposed the following definition: "Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this "structured communication" there is a need to provide the following: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or view; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses." Delphi method is more objective in its outcomes than individual statements, even though the judgments of experts are based on subjective opinions. One of the main advantages of the approach is the fact that direct confrontation of the experts is avoided [32]. Delphi method was widely used in the field of industrial engineering and project management [34-36]. There are several quantitative methodologies that could be used for investigating the relative importance of issues (e.g., Emerging Issues Analysis, Environmental Scanning, Issues Management, Analytical Hierarchical Process). Most of them are future oriented and outline individual opinions. The major advantage of Delphi in comparison to these methodologies is that it is the most prominent of consensus methodologies [37]. Additionally, Delphi approach was selected in this paper to reconcile different opinions between practitioners and experts about the importance of different complexity factors in ID projects. The validity of results was assured by heterogeneity of the panellists and anonymous response format.

Delphi study does not need to include a representative sample of any population. It consists of qualified experts who have a deeper understanding of the selected research issues, which makes the selection of the participants one of the most critical requirements [38]. Existence of bias was reduced in the study by implementation of a well-structured, academically rigorous process, and by selecting qualified experts for participation in the study in accordance with predefined guidelines - preparing a Knowledge Resource Nomination Worksheet.

In this paper two-round "ranking-type" Delphi was used to develop group consensus about the relative importance of complexity factors in ID projects (Figure 1 Delphi study algorithm). Purpose of the research was to develop a ranked list of most important complexity factors for ID projects. Two panels of participants were selected: the first group were academics, and the second group were practitioners – experienced project coordinators in ID projects.

Three-step strategy was adopted as a research program in the paper. Firstly, list of complexity factors that contribute ID projects was identified, based on the literature review (see Appendix A). Secondly, the identified factors were quantitatively tested, in order to verify if selected factors were truly relevant to the experts. Additional factors were proposed by the panellists. Thirdly, the selected factors were again ranked in the second round of the Delphi, and recommendations weremade. Biases are reduced by strategically constructed questionnaires, controlled feedback, detailed analysis of the group response and by two rounds of the research. Iteration is essential factor of any Delphi study. In this paper, iteration involved redistribution of the Delphi survey accompanied with controlled feedback, given to panellists with simple statistical summaries of the responses from the first round. This step, together with preserved anonymity of the participants, eliminates the dominance bias and minimizes the effects of the von Restorff effect [39].

Recent studies provide some theoretical discussion related to the complexity factors in the field of ID and their relative importance [4]. This paper contributes in obtaining a more comprehensive view from the perspective of the two major stakeholders in international development: practitioners and academics.

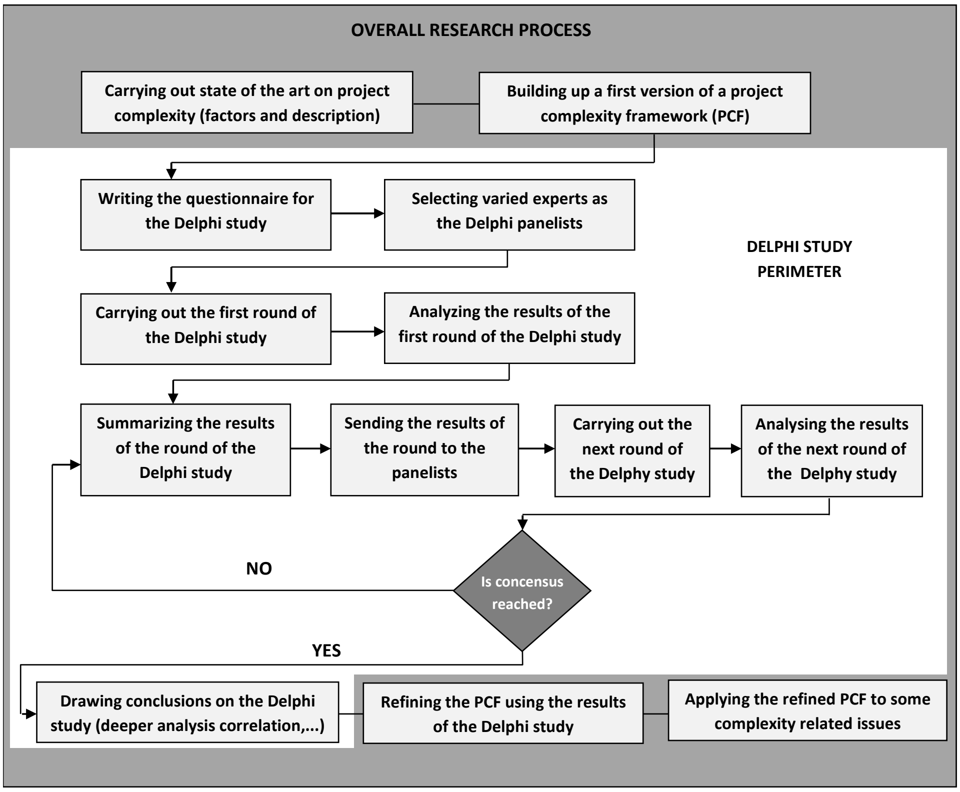

Fig. 1 Delphi study two round algorithm [24]

3.2 Participants selection

In this paper, experts were divided into two panels: academics and practitioners. Heterogenous group of participants allows for a somewhat different perspectives about the selected topic, as well as the comparison of the perspectives of the different stakeholder groups. A panel usually consists of 15 to 30 participants from the same discipline, or five to 10 per category from different professional groupings. Following the recommendations from Delphi literature, there was 11 participants in the first phase of the study, and 7 participants in the second phase of the study.

The following steps were included in selection of the experts for the Delphi study (Table 2) [38]:

Step 1: Preparing a Knowledge Resource Nomination Worksheet (KRNW) – identification of relevant disciplines or skills: academics and practitioners; identifying relevant academic and practitioner literature,
Step 2: Populating KRNW with names,
Step 3: Nominating additional experts by existing contacts,
Step 4: Inviting experts for each panel until the target size of the panel is reached.

The academics were selected based on the literature review of academic and practitioner journals. We have identified experts and asked them to nominate others for inclusion on the list.

They were provided with a brief description of the Delphi study and explanation that we have identified them as the experts on complexity in the field of project management and invited to participate in the study. The practitioners were selected from the base of Erasmus plus project coordinators. Seven academics and four practitioners agreed to participate in the Delphi study. Web was used as the mean for reaching focus organizations. Related literature focused on two most prominent SCI journals in the area of project management (International Journal of Project Management and Project Management Journal) were reviewed in order to identify articles concerning ID projects and complexity. Delphi questionnaire was administrated using e-mail and Survey Monkey software.

Table 2 Knowledge Resource Nomination Worksheet

Disciplines or Skills	Organizations	Related Literature
Academics	European Commission	Academics
Journal List		International Journal of Project management
Practitioners – Erasmus plus coordinators' list		Project Management Journal

4. Results and discussion

4.1 Data collection and analysis method

The Delphi questionnaires were administered using e-mail and the Web. One of the benefits of using these "rapid" media is increasing speed of the turnaround time between questionnaires, which is important factor in the Delphi method [32].

Administration of the questionnaires included the proposed procedure for "ranking-type" Delphi studies by Schmidt [40], that includes the following steps:

- Brainstorming for important factors and validation of the proposed factors,
- Narrowing down the original list to the most important ones,
- Ranking the list of important factors.

4.2 Brainstorming for important complexity factors

In this phase, panellists were asked to rank complexity factors on the five-level Likert scale. These factors belonged to the three main groups of factors: technological, organizational and environmental group. In addition, participants were asked to list additional relevant complexity factors in ID projects with a brief explanation for each factor. Duplicates were removed, new complexity factors were classified, and the terminology of the proposed factors was unified. After this, consolidated lists were sent to participants.

Validation of categorized list of factors - in this phase, panellists were given a list with all the consolidated factors obtained from the first questionnaire, grouped into categories, with brief explanation of each factor, based on the information from the first questionnaire. Furthermore, an exact copy of the responses from the first phase was sent to participants. Panellists were asked to verify that their answers were correctly interpreted and placed them in an appropriate category. According to Schmidt [40], "without this step, there is no basis to claim that a valid, consolidated list has been produced."

New elements were proposed by the experts: (1) Overlap of the project phases, (2) Interdependence of different stakeholders, (3) Diversity of stakeholder expectations, (4) Lack of clarity or consensuses on project benefits among project stakeholders, (5) Variation (1st type of uncertainty), (6) Foreseen uncertainty (2nd type of uncertainty), (7) Unforeseen uncertainty (3rd type of uncertainty), and (8) Chaos (4th type of uncertainty).

TOE factors were rated on a five-level Likert scale by the panellists. Consensus measurement has a pivotal role in Delphi research which could be defined as a gathering around median responses with minimal divergence [41]. Two criteria were selected for consensus measurement: (a) mean > 3 and (b) Interquartile range IQR < 1.

Six elements had the mean less than three, and were excluded from the next phase: (1) Quality requirements, (2) Duration of ID projects, (3) Compatibility of different project management methods and tools, (4) Size in CAPEX, (5) Number of different languages, and (6) Cooperation of Joint Venture partners.

Consensus between two groups of panellists was not reached (IQR>1) for the following elements, and they were rated again in the second phase: (1) Number of goals, (2) Goal alignment, (3) Clarity of goals, (4) Number of tasks, (5) Dependencies between tasks, (6) Conflicting norms and standards, (7) Newness of technology (world-wide), (8) Experience with technology, (9) Resource and skills availability, (10) Interfaces between different disciplines, (11) Trust within the project team (Joint Venture partner), and (12) Experience in the country of implementation.

4.3 Narrowing down the original list to the most important complexity factors

In the second phase, the list of factors was narrowed. Four participants did not proceed with the study; seven panellists remained in the second phase of the study (four academics and three practitioners). The main goal of this phase was to understand the rating of importance of the factors, based on the different perspectives of various stakeholder groups.

All the new factors proposed by the participants had the mean >3, which makes them all significant to complexity of ID projects based on the opinion of the panellists.

In addition, IQR was >1 – consensus was not reached on the following statements:

- Number of different nationalities in ID projects influences project complexity;
- Political influence in ID projects influences project complexity;
- Stability of the project environment (in terms of exchange rates, material pricing etc.) in ID project influences project complexity;
- Interdependence among different stakeholders' influences project complexity;
- Chaos (4th type of uncertainty) influences project complexity.

T-tests measure the difference between two groups of panellists. In the first round, they showed difference on seven answers, and in the second round there is no difference in the answers.

Project coordinators thought that the number of goals, compatibility of different project management methods and tools, as well as the size in CAPEX and required local content in ID projects had more significant effect on project complexity than academics did.

Academics find that variety of stakeholder's perspectives, dependencies on other stakeholders and the political influence had a more significant effect on project complexity than project coordinators did.

Table 3 Wilcoxon test

	Number of goals	Goal alignment	Clarity of goals	Number of tasks	Dependencies between tasks	Conflicting norms and standards	Newness of technology (world-wide)	Experience with technology	Resource and skills availa-bility	Interfaces between different disciplines	Number of different nationalities
Z	-1.300[b]	-1.13[b]	-1.134[c]	-1.633[c]	-1.000[c]	-.816[b]	-0.333[c]	-1.000[c]	-0.577[c]	-1.604[c]	-0.736[c]
Asymp. Sig. (2-tailed)	0.194	0.257	0.257	0.102	0.317	0.414	0.739	0.317	0.564	0.109	0.461

[a]Wilcoxon signed ranks test
[b]Based on positive ranks
[c]Based on negative ranks

Wilcoxon matched-pairs signed-ranks test measures changes in consensus between first and second round of Delphi study. Wilcoxon test has the purpose of measuring stability of the data and helping researchers determine if there was a difference between the data of two Delphi rounds.

All the concepts reached stability (the significance level was set at .05) and thus the Delphi was terminated with two rounds. For 11 questions that were repeated in both rounds, there was no significant statistical difference (Table 3).

4.4 Ranking the list of important factors

The descending order of the top ten weighted measures were found to be Clarity of goals (4.57), Variety of stakeholders' perspectives (4.45), Dependencies between tasks (4.43), Interfaces between different disciplines (4,29), Dependencies on other stakeholders (4.27), Risks from environment in ID project (4.27), Lack of clarity or consensuses on project benefits among project stakeholders (4.14), Unforeseen Uncertainty (4.14), Political influence (4.14), Number of stakeholders (internal and external) (4.09); for all the means see Appendix B.

Most of the factors with the mean higher than three are in the group of Environmental complexity. Based on the research, it is concluded that Environmental complexity has the most significant effect on the composite complexity, in comparison to technical and organizational complexity contribution. It might be concluded that experts think that environmental complexity is the most important of three types of complexity, which is the main contribution of the paper. In addition, it was found that uncertainty significantly influences complexity, based on the new factors proposed by the experts. Four uncertainty types were proposed, based on the classification of Meyer *et al*. – variation, foreseen uncertainty, unforeseen uncertainty and chaos. Particularities of different types of uncertainty require different managerial approach: "Projects in which variation and foreseen uncertainty dominate allow more planning, whereas projects with high levels of unforeseen uncertainty and chaos require a greater emphasis on learning."

Novel, modified complexity framework was developed based on the insights of the Delphi study (Fig. 2).

4.5 Implications of the study results

In the increasingly complex and unpredictable environment of ID projects, understanding complexity is becoming very important for planning, managing and executing strategies. Organizations that are delivering ID projects need to understand and adapt to these changes and include constant feedback from all the stakeholders in all the project phases.

One of the uses of the given complexity framework is creating awareness amongst the different stakeholders about the complexity on the project. Additionally, the framework could be used to access complexity on the project in different project phases and react in accordance to it.

Project managers of ID projects are usually not enough equipped to adequately handle complex projects since they base on their managerial style on traditional project management tools and techniques. Understanding the potential complexities can be a first step to making better strategies to manage ID projects.

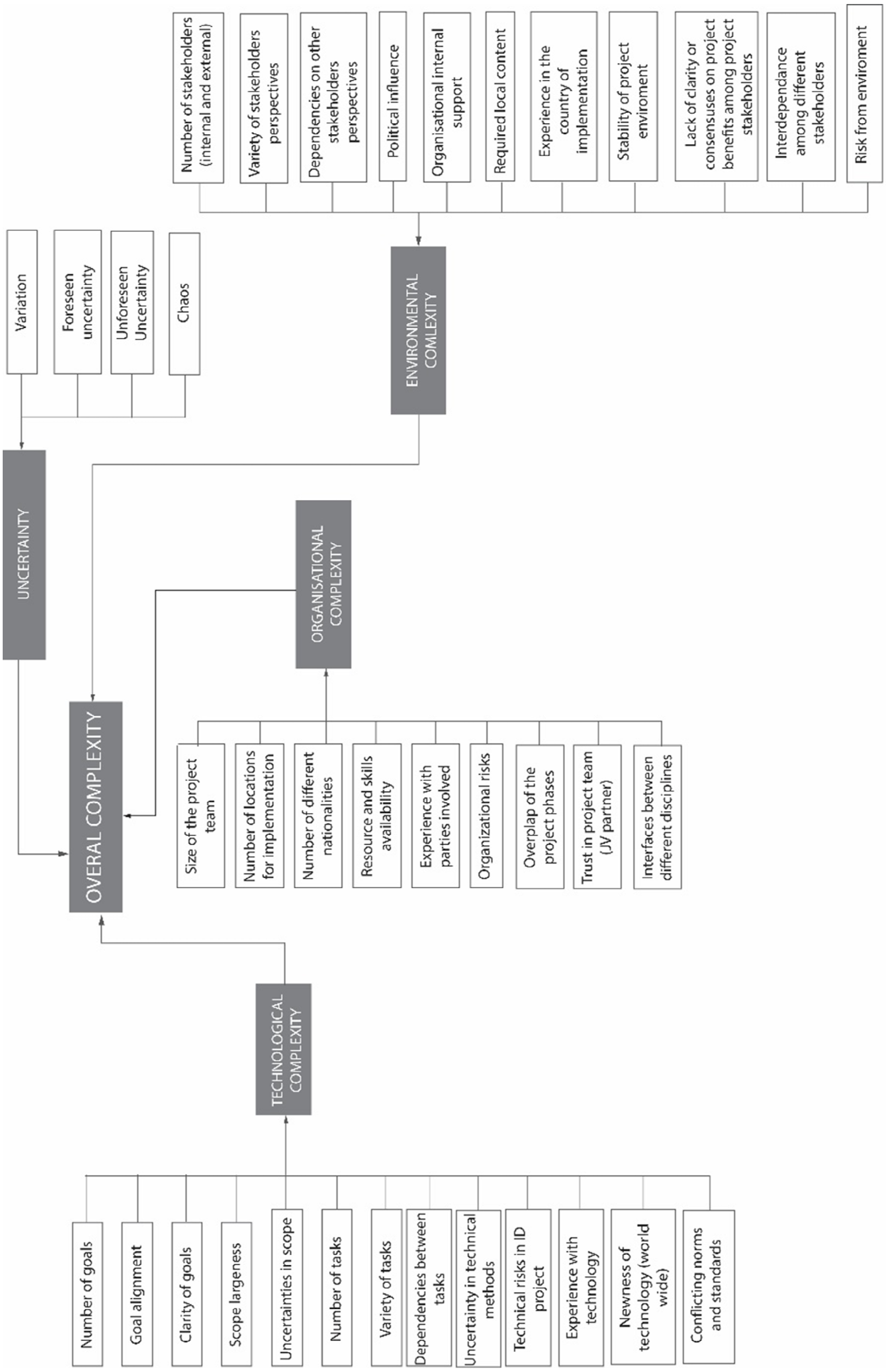

Fig. 2 Modified TOE framework

4.6 Limitations of the study

One of the limitations of the study could be sample size and response rate in the second round of the Delphi study. Future research could widen the results of this study by conducting interviews with non-responders. It would also be useful to investigate opinions from different stakeholders in International Development projects (except from project coordinators) about their perceptions on important complexity factors in ID projects.

The Delphi approach has many drawbacks, including subjective nature of the research, that can sometimes lead to biases. Additionally, method can be considered vulnerable to misrepresentation. The accuracy and reliability of the study are based on subjective judgment of the panellists. In this paper, biases were reduced by strict procedures, iteration, controlled feedback etc. For the validation of the given framework, it would be worthwhile conducting quantitative study that would objectively investigate refined list of complexity factors, in the context of different types of projects.

Additionally, Delphi approach could be supplemented with some other qualitative methodologies like Issues Management or Analytical Hierarchical Process, that would provide greater efficiency of the research.

Lastly, it would be worthwhile investigating how the selected complexity factors influence overall project performance of ID projects, when it comes to quality, time and costs, as well as how to manage the complexity elements in order to increase the chance of project success. In this context, it could be worthwhile investigating what are the competencies of project managers they need to work on complex ID projects.

5. Conclusion

A two-round Delphi survey was conducted to identify which complexity factors have the greatest influence in ID projects. A novel, modified TOE framework was proposed to access complexity in the domain of ID projects. This article is a first step in bridging the knowledge gap toward the development of a theoretically grounded and empirically validated framework of project complexity in ID context.

Inductive approach was used in the combination with literature review. Insights from the two-round Delphi resulted in the modified complexity framework. In total, 37 elements of complexity were identified and grouped in technical, organizational and environmental complexity group (Figure 2). Additional separate group was proposed by the experts – uncertainty category. The major contribution of this paper is investigation of complexity factors in ID sector, which was conducted for the first time. Organizational complexity was usually found to be the most significant type of complexity in previous researches conducted on large infrastructure projects. The Delphi study showed that, from the perspective of experts, Environmental factors were the most important in ID projects. Implications of this for organizations that are implementing ID projects should be to periodically review project objectives and to match project adaptability to the environment. On the other hand, the research methodology proposed in this study can be replicated to the other International Development projects to quantify different kinds of project complexity for improving the decision making and improving their execution performance.

The insights of the study can be used by both the academics and the practitioners. The framework could be used to assess the complexity of the ID project. Existing framework has an objective to contribute to better understanding of project complexity in the context of international development, and identification of complexity areas in specific projects, that could lead to better management of potential risks, as well as improvements in the process of project planning and implementation.

One of the major limitations of the study could be overcome by investigating the framework by employing quantitative approach. In addition, project coordinator's competences that match complexity type could be furtherly investigated in the future.

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Appendix A

Complexity measuring in the literature

No.	FACTOR	SUB-FACTOR	ELEMENTS	SUB-ELEMENTS	SOURCE
1.	STUCTURAL COMPLEXITY	TECHNOLOGICAL	Goals	- Number of goals - Goal alignment - Clarity of goals	Lu *et al.* (2015); Brady and Davies (2014); Senescu, Aranda-Mena, And Haymaker (2013); Geraldi *et al.* (2011); Geraldi (2009); Haas (2009); Whitty and Maylor (2009); Maylor *et al.* (2008); Vidal and Marle (2008); Geraldi and Adlbrecht (2007); Remington and Pollack (2007); Ives (2005); Williams (2005); Xia and Lee (2004); Williams (1999); Baccarini (1996); Shenhar and Dvir (1996)
			Scope	- Scope largeness - Quality requirements	
			Tasks	- Number of tasks - Variety of tasks - Dependencies between tasks - Interrelations between technical processes - Conflicting norms and standards	
			Experience	- Newness of technology - Experience with technology	
			Risk	- Technical risks	
		ORGANISATIONAL COMPLEXITY	Size	- Project duration	
			Resources	- Compatibility of different project management methods and tools - Size in budget - Size in Engineering hours - Size of project team - Number of locations included	
			Resources	- Resources and skills availability - Experience with parties involved - Interfaces between different disciplines - Number of financial resources - Contract types	
			Team	- Number of different nationalities - Number of different languages - Cooperation JV partner - Overlapping office hours	
			Trust	- Trust in project team - Trust in the contractor	
			Risk	- Organizational risks	
		ENVIRONMENTAL COMPLEXITY	Stakeholders	- Number of stakeholders - Variety of stakeholders' perspectives - Dependencies on other stakeholders - Political influence - Company (*implementing body*) internal support	
			Location	- Interference with existing site – N/A - Weather conditions – N/A - Remoteness of location - Experience in the country	
			Market conditions	N/A	
			Risk	- Risks from environment	
2.	DYNAMICAL COMPLEXITY			- Changes in all the elements that consist structural complexity	Kiridena et. al (2016)
3.	SOCIO-POLITICAL COMPLEXITY				Beach (2016); Geraldi *et al.* (2011); Maylor *et al.* (2008); Bresnen *et al.* (2005); Cicmil and Marshall (2005); Ives (2005); Shenhar and Dvir (1996); Jones and Deckro (1993)
4.	UNCERTAINTY	STRUCTURAL	Uncertainties in scope		(Shenhar, 2001; Tatikonda and Rosenthal, 2000, Maylor *et al.*, 2008; Mykytyn and Green, 1992) Geraldi and Adlbrecht, 2007; Hobday, 1998;
		DYNAMICAL	Change in elements	- Changes in scope, deviations	Geraldi and Adlbrecht, 2007; Collyer and Warren, 2009; Petit, 2012; Chapman, 2003; Atkinson *et al.*, 2006; Bosch-Rekveldt *et al.*,2011; Maylor *et al.*, 2013; Saunders *et al.*, 2015
			External uncertainty	- External contexts - Unclear organizational context - External elements - External political influence	
5.	PACE				Geraldi *et al.* 2011; Dvir, *et al.*, 2006; Shenhar and Dvir, 2007; Williams, 2005
6.	PROJECT SUCCESS	SHORT-TERM	Time		Ika, L. A., Diallo, A., & Thuillier, D. (2012)
			Cost		
			Objectives		
		LONG-TERM	Impact		
			Sustainability		
			Relevance		

Appendix B

Complexity factors in international development projects: Mean values

FACTOR	MEAN	Type of complexity
Number of goals in ID projects affects project complexity	3.86	TECH
Goal alignment in ID projects influences project complexity	3.43	TECH
Clarity of goals in ID projects influence project complexity	4.57	TECH
Scope largeness in ID projects influences project complexity	3.27	TECH
Uncertainties in scope in ID projects influence project complexity	4.06	TECH
Quality requirements in ID projects influence project complexity	2.73	TECH
Number of tasks in ID projects influences project complexity	3.86	TECH
Variety of tasks in ID projects influences project complexity	3.45	TECH
Dependencies between tasks in ID projects influence project complexity	4.43	TECH
Uncertainty in technical methods to be applied in ID projects influences project complexity	3.73	TECH
Conflicting norms and standards in ID projects influence project complexity	3.57	TECH
Newness of technology (world-wide) in ID projects influences project complexity	3.86	TECH
Experience with technology in ID projects influences project complexity	3.71	TECH
Technical risks in ID projects influence project complexity	3.27	TECH
Duration of ID projects influences project complexity	2.82	ORG
Compatibility of different project management methods and tools in ID projects influences project complexity	2.73	ORG
Size in CAPEX influences project complexity	2.55	ORG
Size of the project team in ID projects influences project complexity	3.64	ORG
Number of locations for implementation of ID projects influences project complexity	3.91	ORG
Resource and skills availability in ID projects influence project complexity	4.00	ORG
Experience with parties involved in ID projects influences project complexity	3.64	ORG
Interfaces between different disciplines in ID projects influence project complexity	4.29	ORG
Number of different nationalities in ID projects influences project complexity	3.14	ORG
Number of different languages in ID projects influence project complexity	2.73	ORG
Trust in project team (JV partner) in ID projects influences project complexity	4.00	ORG
Organisational risks in ID projects influence project complexity	3.27	ORG
Number of stakeholders (internal and external) in ID projects influences project complexity	4.09	ENV
Variety of stakeholders' perspectives in ID projects influences project complexity	4.45	ENV
Dependencies on other stakeholders in ID projects influence project complexity	4.27	ENV
Political influence in ID projects influences project complexity	4.14	ENV
Organisational internal support in ID projects influences project complexity	3.55	ENV
Required local content in ID projects influences project complexity	3.00	ENV
Experience in the country of implementation of ID project influences project complexity	3.71	ENV
Stability of project environment (exchange rates, material pricing) in ID project influences project complexity	3.71	ENV
Risks from environment in ID project influence project complexity	4.27	ENV
Overlap of the project phases influences project complexity	3.43	ORG
Interdependence among different stakeholders	3.71	ENV
Diversity of stakeholder expectations	3.86	ENV
Lack of clarity or consensuses on project benefits among project stakeholders	4.14	ENV
Variation (1st type of uncertainty)	3.57	UNC
Foreseen uncertainty (2nd type of uncertainty)	3.71	UNC
Unforeseen uncertainty (3rd type of uncertainty)	4.14	UNC
Chaos (4th type of uncertainty)	3.86	UNC