Identification Of Risk Factors Affecting Infrastructure Projects In Complex Geopolitical Context: Application To Palestine

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Abstract. Infrastructure projects in countries with high geopolitical risk (CHGR) face unique and significant challenges. This study addresses the need for a comprehensive risk identification framework by developing a Risk Breakdown Structure (RBS) tailored for these contexts. Through a mixed-method approach that integrates an extensive literature review with a detailed analysis of historical project data, this study systematically identifies and classifies critical risk factors. The research categorizes risks into 13 areas, with the most significant being geopolitical and logistical, such as outbreaks of hostilities, border closures, and restrictions on movement and material entry. The findings provide a practical tool for project managers and donors to proactively identify and manage risks, thereby improving project outcomes in politically complex environments.

I. INTRODUCTION

The implementation of infrastructure projects in a complex geopolitical context such as conflict areas, areas under occupation, or areas with economic or political instability experience unique challenges related to government instability [1], immature and changeable policies, regulations and laws, external and internal conflicts, expropriation of foreign assets, and corruption, along with weaker institutions [2]. These characteristics lead to high uncertainty and risk in the construction of infrastructure projects [3]. The negative consequences of these risks include financial loss, delays, cost overruns, poor project-level performance, a negative impact on enterprises' competitiveness, reputation, financial stability, and development [4].

Risks are inherent in every construction project and, if not managed effectively, can negatively affect the achievement of project goals. Construction projects typically define goals in terms of cost, time, and performance [5]. The risk management process consists of three main stages: risk identification, risk assessment, and risk mitigation plan. Risk identification is considered the most important stage of the risk management process because it allows the Project responsible to anticipate the identified risks' potential impact and develop a mitigation plan to eliminate or reduce their consequences on project objectives. Moreover, a detailed, comprehensive, and well-defined structure of potential risks provides a basis for later stages and ensures risk management effectiveness [6].

While there exists a large body of research on risk identification in construction projects [6,7], the literature about risk identification in CHGR is relatively limited and unmapped [2], [8]. Nevertheless, risks resulting from the political situation are recognized as the most significant risks for foreign investment in infrastructure, especially in developing countries [9]. Recently, a growing body of research has been dedicated to analyzing these risks due to the willingness of many international construction enterprises to expand their businesses in new, emerging, and large markets for construction in Asia, Africa, and Latin America [4].

Current research has mainly focused on identifying critical variables contributing to political risks associated with international construction projects [10, 11, 12, 13], assessing their impact [1, 14, 15], or identifying management strategies [4]. In addition, some literature is concerned with examining political risks associated with foreign direct in vestment in the infrastructure (FDII) of developing countries [2, 9]. However, little attention has been devoted to identifying risk factors affecting the construction of infrastructure projects in CHGR.

Recent research indicated that some international construction companies tend to venture into CHGR due to limited competition and significant infrastructure investment[8]. However, implementing projects in these countries is characterized by high uncertainty and

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risks. Limited studies have been conducted to identify risk factors affecting construction projects within these countries. For example, Kadry et al. (2017) investigated the causes of delays in CHGR using a triangulation approach that merges quantitative and qualitative assessments. This research focused on one negative consequence of risks related to time overrun and did not account for other aspects related to cost overrun and performance.

Implementing projects CHGR, such as Syria, Iraq, Yemen, Afghanistan, Lebanon, and Palestine [16], is generally characterized by distinctive circumstances that translate into unique reasons for project delays [8] and cost overruns. However, the literature review revealed that few studies have focused on the adverse impact of risks within these countries; none of these studies has provided a holistic, detailed, and comprehensive approach to identify and categorize these risks [2]. For instance, A Kassem et al. (2021) have theoretically identified risk factors in oil and gas construction projects in Yemen, Bayat et al. (2019) have analyzed the major public-private partnership (PPP) risks in infrastructure projects in Afghanistan, Mahamid (2011) has identified the risk matrix for factors causing time delay in road projects in Palestine. Most existing literature is limited to a specific type or delivery method of infrastructure projects. More importantly, most studies have followed a similar approach to identify risk factors based on literature review and data collection through a survey [2]. However, such single-source data is subject to significant bias [11], a standard limitation of research using subjective data collected through questionnaire surveys.

This research aims to provide a comprehensive list of risk factors affecting infrastructure projects in CHGR using a combined approach. The main contribution of this research concerns the identification of risks affecting infrastructure projects in CHGR, and using a mixed approach to identify and classify risk factors.

II. Research Methodology

Researchers have outlined several tools and techniques for risk identification including checklist analyses, strengths, weaknesses, opportunities, and threats (SWOT) analysis, interviews; questionnaire survey, examination of historical data, literature review, brainstorming, Delphi technique, diagramming techniques, and knowledge-based systems [6, 20, 21, 22, 23]. However, one tool cannot identify all potential risks. Combining techniques is the best alternative for effective risk identification [20,24]. Furthermore, this combination needs to be tailored to account for project complexity, people involved in the identification process, and the risks that need to be identified [6, 20, 21, 22, 23].

A mixed-method approach is used to identify and classify risks. First, a literature review was conducted to identify the general risk factors affecting construction projects in CHGR. Then, an analysis was carried out using a large set of data about projects conducted in a country with high geopolitical risk to identify risk factors that affect performance and cause delay and cost overrun for infrastructure projects.

Finally, the results from the abovementioned analysis were compared and merged to create a comprehensive list of risks, which was used to establish a risk classification system. Figure 1 summarizes the proposed methodology. The following sections describe the methodology in detail.

A. Stage I: Identification of primary risk factors that affect construction projects CHGR

A comprehensive literature review was conducted to determine relevant articles about political factors that affect construction projects. Scopus and Web of Science (WoS) were used. Scopus was the leading search engine because it compresses various databases across disciplines [7, 25].

The literature search used the “article title, abstract, keywords” field for articles published in the last two decades (2001-2021). The main keywords used to search the articles are illustrated in Table I.

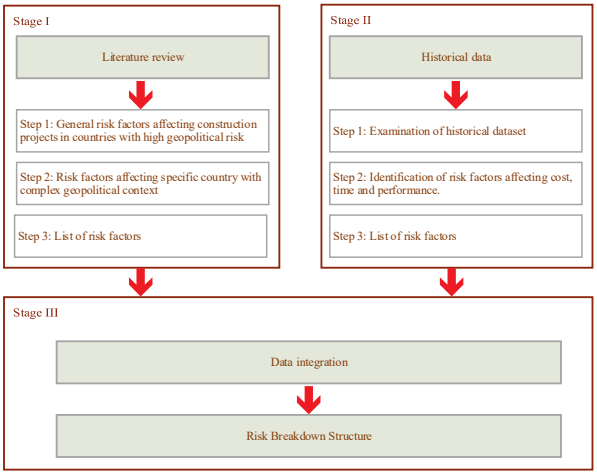

Figure 1. RESEARCH METHODOLOGY

TABLE I. STEPS FOR THE LITERATURE REVIEW PROCESS

(TITLE-ABS-KEY (political AND risk) AND TITLE-ABS-KEY (construction))	1236 document results
Limited to Articles published in journals in English	688 document results
Subject area = engineering	145 document results
Content analysis for the abstract	47 Articles
Detailed content analysis - Identify relevant articles by reading their full texts	10 Articles

As a result, 10 articles were selected to identify general political risk factors and analyze the proposed risk classification system.

Many researchers revealed that risk factors are contextual, as risks affecting different regions or contexts are different [25]. In addition, risk probability, impact, and severity are Project- and context-specific [8]. To identify risks in a specific context, a detailed analysis is required to capture relevant risks. A comprehensive and more detailed literature review has been conducted to identify risk factors in a country with a complex geopolitical context. Data were extracted from the Scopus search engine. The list of keywords was broader than the research conducted earlier to include, in addition to the specific name of the country, the following keywords: "Risk factor", "Cost overrun", "Delay", "Change order", "Variation order", "Dispute", and "Contingency". After selecting articles, a detailed content analysis was conducted to identify the risk factors and the classification system.

B. Stage II: Analysis of data related to infrastructure projects in a country with a high geopolitical risk

A detailed examination of historical data for infrastructure projects implemented in a country with a complex geopolitical situation has been conducted to identify the leading causes of risks. The analysis includes examining the available documents such as contract documents, monthly progress reports, variation order requests, variation orders, baseline schedules and updates, time impact analysis, risk register, and final report.

C. Stage III: Establishing a risk classification system

The previous analysis results constitute an unstructured list of potential risks, which can be hard to understand or manage [26]. However, effective risk management needs a well-defined structure of risks to facilitate interpretation, management, and manipulation of the large amount of risk data produced during the project life cycle [25, 26]. This can be achieved by a risk classification or categorization system that forms a Risk Breakdown Structure (RBS). The RBS provides a consistent language for risk reporting, removes redundancy and ambiguity [26], adds to the effectiveness of the risk management process, and creates a better understanding of risk [27].

The selection of risk classification methods depends on the project's characteristics, the type of project delivery system, and the project party conducting the risk identification and assessment [6]. This research proposes a new risk classification system based on system theory concepts and the nature and source of risks.

III. RESULTS AND DISCUSSION

A. Stage I: Literature review

- *Part 1: General political risk factors affecting construction projects.*

Although intensive research has been devoted to studying political risks in construction projects [10], there is still no consensus on defining the political risk that affects these projects [2]. Xiaopeng and Pheng (2013) indicated that the political risks in international construction projects include: (1) risks related to political events or government intervention; and (2) risks of change or discontinuity in the business because of political change.

Some researchers included risks related to social events (i.e. protests) [11, 28] and the actions of some powerful social organizations [29] as a part of political risks.

Based on the abovementioned definition, at the first stage of the research methodology, a comprehensive literature review including [2, 8, 9, 10, 11, 12, 13, 14, 15, 30, 31] was conducted to set up an initial list of potential political risk factors of construction projects. The analysis indicated that research focused on variables contributing to political risk in international construction projects (7 articles) or to political risk factors of infrastructure projects in developing countries (2 articles). One study focused on the causes of construction projects in CHGR.

An initial list of 69 variables was identified. However, this list includes exogenous driver variables and endogenous vulnerability variables contributing to political risk [14]. Vulnerability variables of a project system are related to project and construction firm characteristics. Therefore, these variables were excluded from the initial list, as the objective at this stage is to identify exogenous variables that affect construction projects regardless of project characteristics or contractor capacity. As indicated in Table II, 33 political risk factors have been identified.

According to Chang, Deng, Hwang, et al. (2018); Chang, Deng, and Hwang (2019); Deng et al. (2018); and Xiaopeng and Pheng (2013), the most significant political factors affecting international construction projects are government instability, project desirability to the host country, changes in law/regulations or policy uncertainty, racism and xenophobia, hostility to foreigners, public opposition, currency instability, misconduct of contractors, and contract repudiation.

Moreover, Kadry et al. (2017) concluded that some unique delays cause significant impacts on construction projects in CHGR. They include corruption, issues with clearing customs, security threats, and theft of equipment or materials.

Most construction projects in CHGR are related to core infrastructures [8], as they provide basic services, poverty reduction, and economic growth [9]. Some research examined political risk factors associated with infrastructure projects in developing countries [2, 9]. However, the risk factors included in these studies were general and were devised from the literature review without considering other tools and techniques for risk identification. These studies highlight the lack of knowledge in identifying risk factors in a specific context or infrastructure sector. Therefore, the following section will select a region with a complex geopolitical context to identify risk factors affecting infrastructure projects.

- *Part 2: Risk factors affecting construction projects in a country with a complex geopolitical context.*

Political risks have been classified into three categories or levels: 1) geopolitical risk (macro-level), country risk (meso level), and project risk (micro-level) [11, 32]. Geopolitical risk refers to measurable conflicts, tensions between countries, wars, or events that disrupt regular international peace and security and affect foreign enterprises in a general sense [3, 32], such as continued conflicts in the Middle East.

Many countries and regions in Africa, the Middle East, Asia, and South America are unstable and suffering from protracted conflicts and/or prolonged occupations, such as Afghanistan, Yemen, Iraq, Syria, Lebanon, Palestine, Libya, Sudan/South Sudan, and the Western Sahara [16, 33]. This research selected the occupied Palestinian territory to identify the specific risk factors associated with infrastructure projects.

As indicated previously, a more detailed literature review was conducted to identify risk factors. A total of 11 articles were selected, including (i) three factors causing claims and change orders, (ii) five articles related to time and cost overrun, (iii) two articles related to performance, and (iv) one article dedicated to the determination of contingency amount in construction projects. Most of these studies (8 out of 11) had analyzed the construction projects without specifying the construction sector; the remaining were dedicated to road projects.

Previous studies were based on a literature review followed by a questionnaire to elicit the opinion of experts regarding the importance of each risk factor. The Relative Importance Index (RII) was the leading indicator used to measure the significance of each factor. A three-zone risk matrix (red, yellow, and green) was used in two studies to determine the severity of each risk. The relative importance evaluation was conducted from different perspectives, including owners, consultants, and contractors.

Palestine's unique and complicated geopolitical situation is characterized as protracted conflict and prolonged occupation [33]. Currently, the Palestinian territories are comprised of two distinct territories: the West Bank and the Gaza Strip. Most studies focused on Gaza (8 out of 11), while the remaining focused on West Bank Road projects.

Table III summarizes the results of the literature review on risk factors affecting construction projects in Palestine. It reveals that:

- Risk factors related to the geopolitical situation such as siege and border closure at Gaza, segmentation and restrictions on movement in West Bank, the outbreak of hostilities (military action, wars, strikes, riots, etc.), in addition to internal conflict, are ranked as the most significant factors that affecting cost, time and performance of construction projects.
- Restrictions on the movement of goods and people and the prolonged closures of territory resulted in a severe shortage of resources, including construction material, equipment, and experts, which led to an unexpected increase in material prices and a considerable amount of construction delay.
- Factors related to the quality of contract documents, including design drawings, specifications, and bill of quantities, are significant sources of changes during the construction phase, leading to cost and time overruns.
- The primary sources of project delay are the project delivery awarding criteria, financial instability, and public opposition factors.

The literature review provides valuable information about risk factors affecting construction projects in a country with a complex geopolitical context. However, the list of factors is not related to a specific construction sector. It is subject to bias because all research studies are based on a single technique to identify potential risks. Such a mono-method could not identify all potential risks for a specific sector. Therefore, a detailed analysis of risk factors affecting water infrastructure projects implemented in Palestine is presented in the following section.

TABLE II. LIST OF POLITICAL RISK FACTORS AFFECTING CONSTRUCTION PROJECTS

		(Sachs et al., 2008)	(Xiaopeng & Pheng, 2013) and (Deng & Low, 2014)	(Deng et al., 2018)	(Chang, Deng, Hwang, et al., 2018)	(Chang, Deng, & Hwang, 2019)	(Chang, Deng, Hwang, et al., 2019)	(Kadry et al., 2017)	(Jiang, Martek, Hosseini, Tamošaitienė, et al., 2019)	(Jiang, Martek, Hosseini, & Chen, 2019)
1.	The relation between the host and the home country		X	X		X	X			
2.	Government instability		X		X		X		X	X
3.	Lack of political/government support		X			X	X			X
4.	Forthcoming Elections		X			X				X
5.	Factional Conflict		X		X	X	X			
6.	Inconsistency / Changes in law or regulation)	X	X		X	X				X
7.	Bureaucracy		X				X		X	X
8.	Weak or poor regulatory/institutional/or policy frameworks and enforcement	X	X		X					X
9.	Vague or complex Laws and Regulations		X				X		X	X
10.	Religious and Ethnic Tensions	X	X		X		X		X	X
11.	Racism and Xenophobia		X							X
12.	Hostility to foreigners		X		X					
13.	Currency Instability (Exchange Rate Volatility)		X		X	X		X		X
14.	Inflation		X		X	X				
15.	Project Desirability to the Host Country		X	X		X	X			
16.	Public Opposition to the Project		X	X		X	X			X
17.	Insufficient External Funding for Project		X	X		X				
18.	Government or Power Groups' intervention/Political interference		X	X		X	X			X
19.	Misconduct of Contractors		X	X		X	X			
20.	Currency Inconvertibility and Transfer Restrictions	X								X
21.	Breach of Contract	X								**X**
22.	Expropriation and nationalization	X			X					X
23.	Outbreak of hostilities (wars, external conflict)	X			X			X	X	X
24.	Civil War (Internal Conflict)	X			X				X	X
25.	Terrorism	X			X		X			X
26.	Riots (Violent demonstrations)	X			X					X
27.	Corruption	X						X	X	X
28.	External interferences or pressure				X	X	X			
29.	Contract repudiation					X				
30.	Issues clearing imported material and equipment							X		
31.	Theft of equipment or materials							X		
32.	Security threats to the construction site							X		

TABLE III. RISK FACTORS AFFECTING CONSTRUCTION PROJECTS IN PALESTINE AS PER LITERATURE REVIEW.

	Factors related to	**Claims and Variation Orders**			**Time and Cost Overruns**					**Performance**		**Contingency**
	References	**(Enshassi, Choudhry, et al., 2009)**	**(Enshassi et al., 2008)**	**(Enshassi et al., 2008)**	**(Enshassi, Al-Najjar, et al., 2009)**	**(Enshassi, Kumaraswamy, et al., 2010)**	**(Mahamid, 2011)**	**(Mahamid et al., 2012)**	**(Mahamid, 2013)**	**(Tayeh et al., 2020)**	**(Enshassi, Mohamed, et al., 2009)**	**(Enshassi, Mohamed, et al., 2009)**
	Methodology for Risk Identification	LR	LR	LR	LR	LR	LR	LR	LR	LR	LR	LR
	Evaluation perspective	CO	O	CO, O, E	CO, O, E	CO	O	CO, E	CO	O, E	CO, O, E	CO
	Type of Project	C	C	C	C	C	R	R	R	C	C	C
	Region	G	G	G	G	G	WB	WB	WB	G	G	G
	Risk Evaluation	(RII)	(RII)	(RII)	(RII)	(RII)	RM	(RII)	RM	(RII)	(RII)	(RII)
	List of the most significant factors											
1.	Public interference and opposition	(66)	(56.9)		(68.55)	(68.55)						
2.	Land acquisition and site possession obstructions	(60.2)	(50.7)	(70.3)	(47.58)	(47.58)						
3.	Discrepancies between contract documents (Design Drawings, Specifications, and Bill of Quantities)	(62.3)	(45.3)	(81.4)	(73.39)	(73.39)						
4.	Errors and omissions in design	(60.2)	(50.5)	(82.4)	(62.1)	(62.1)						(82.78)
5.	Inaccurate Bill of Quantity	(59.9)	(51.7)		(75)	(75)						
6.	Change in projects' requirements (Design, Specifications, Scope of Work)		(85.6)	(77.9)	(75.81)	(75.81)						
7.	Inappropriate award criteria (the lowest price)	(74.4)	(65.8)		(40.32)	(40.32)		(75)		(71.67)		(77.22)
8.	High competition in bids								Red	(67.33)		(75.56)
9.	Owner's/donor's financial problems			(81.1)	(73.39	(73.39)				(67.33)		
10.	Payment delay	(61.7)	(49.3)		(33.06	(33.06)	Red	(69.38)	Red			(79.44)
11.	Fluctuation of currency exchange rate				(77.42	(77.42)				(70)		
12.	Siege and Border closure	(69.0)	(69.8)	(88.4)	(96.77)	(96.77)				(79.67)	(94.1)	(89.44)
13.	Outbreak of hostilities (military action, wars, strikes, riots, etc.)				(96.77)	(96.77)		(84.69)	Red	(72)		(75.56)
14.	Internal political conflict			(78.6)	(96.77)	(96.77)						
15.	Movement restrictions due to road blockage and land segmentation	(64.5)	(61.4)				Red	(83.75)	Red			
16.	Construction site close to security or dangerous areas									(72.88)		(77.78)
17.	Material Price Escalation (due to continuous border closures)	64.2)	(54.0)		(91.13)	(91.13)				(70)	(84.7)	
18.	Lack of resources (material, equipment, and human resources)			(88.4)	(91.13)	(91.13)	Red	(69.06)	Red	(77.33)	(87.1)	(76.67)
19.	Suspension of work				(77.42)	(77.42)						
20.	Poor communication between project stakeholders			(80.5)	(59.68)	(59.68)	Red	(66.88)	Red			
21.	Delays in decision-making by the owner							(68.44)				
22.	Low productivity of labourers							(67.81)				
23.	Accidents and poor safety measures.									(73.67)		
24.	Site constraints (access, storage, electricity, etc.)											(76.11)

	Factors related to	Claims and Variation Orders			Time and Cost Overruns					Performance		Contingency
	References	(Enshassi, Choudhry, et al., 2009)	(Enshassi et al., 2008)	(Enshassi et al., 2008)	(Enshassi, Al-Najjar, et al., 2009)	(Enshassi, Kumaraswamy, et al., 2010)	(Mahamid, 2011)	(Mahamid et al., 2012)	(Mahamid, 2013)	(Tayeh et al., 2020)	(Enshassi, Mohamed, et al., 2009)	(Enshassi, Mohamed, et al., 2009)
25.	Poor quality of work or material	(60.8)	(49.8)		(78.23)	(78.23)	Red	(67.19)			(83.5)	
26.	Continuous verbal instructions to the contractor	(60.5)	(46.8)									
27.	Lack of the consultant's knowledge of available materials and equipment			(82.9)								
28.	The poor site and resource management				(80.65)	(80.65)	Red			(73.67)		
29.	Some suppliers monopolize project materials.				(81.45)	(81.45)						
30.	Contractor's Cash problem during construction				(83.06)	(83.06)			Red			
31.	Delay in construction, supply of raw materials, and equipment by contractors				(83.87)	(83.87)	Red			(69)		

LR: Literature Review, (RII): Relative Importance Index, RM: Risk Matrix, CO: Contractor, O: Owner, E: Engineering consultant, C: Construction Projects, R: Road Projects, G: Gaza Strip, WB: West Bank.

B. Stage II: Analysis of data related to water infrastructure projects in a country with a high geopolitical risk

A sample of completed water infrastructure projects was selected to analyze contract documents, including monthly progress reports, variation order requests, variation orders, baseline schedules and updates, time impact analysis, risk register, and final reports, to identify risk factors causing delay and cost overrun. Table IV shows the general characteristics of each project /sub-project included in the analysis.

TABLE IV. GENERAL CHARACTERISTICS OF PROJECTS.

	Water Infrastructure Projects									
Project	***Project P1***	***Project P2***		***Project P3***		***Project P4***	***Project P5***		***Project P6***	
Sub-project		P2-1	P2-2	P3-1	P3-2		P5-1	P5-2	P6-1	P6-2
Location	West Bank	West Bank	West Bank	West Bank	West Bank	Gaza	Gaza	Gaza	Gaza	Gaza
Budget (million US dollars)	>$10	$5 - $10	<$5	$5 - $10	<$5	>$10	<$5	<$5	<$5	<$5
Original duration (Year)	1-2	1-2	1-2	1-2	<1	>2	1-2	1-2	1-2	1-2

An international cooperation agency financed and implemented all projects from 2010 through 2020, and in cooperation with local sub-consultants and subcontractors, international consultants and contractors carried out the design and execution of these projects. The outcome of the historical data analysis is presented in Table V.

TABLE V. CAUSES OF DELAYS AND COST OVERRUN FOR A SAMPLE OF WATER INFRASTRUCTURE PROJECTS IMPLEMENTED IN PALESTINE.

	Location	**West Bank**						**Gaza**				
	Project no.	***P1***	***P2***		***P3***		***P7***	***P4***	***P5***		***P 6***	
	Sub-project		P2-1	P2-2	P3-1	P3-2			P5-1	P5-2	P6-1	P6-2
	Cost overrun factors											
	Factors related to site conditions											
1.	Unforeseen conditions of existing utilities, poor, and deteriorated existing infrastructure.			X								
2.	Unforeseen geological conditions.	X		X	X							
3.	Changes in site conditions due to the long period between design and construction.											X
4.	Differing site conditions	X		X	X						X	X
	Factors related to contract documents (design drawings, specifications, Bill of Quantities, etc.)											
5.	Errors and omissions in design documents	X				X		X	X	X	X	X
6.	Contradictions between design drawings							X				
7.	Changes in quantities according to approved shop drawings	X	X	X	X	X		X	X	X	X	X
	Factors related to the geopolitical situation						X					
8.	Lack of construction material in the local market.			X	X	X	X	X	X	X	X	X
9.	Restrictions on importing specific construction material imposed by Israeli authorities						X		X	X	X	X
10.	The delay in material acquisition resulted from the Israeli restriction on importing.						X		X	X	X	X
11.	Cost compensation due to the rejection of material entry to Gaza by the Israeli occupying forces.							X	X	X	X	X
12.	Security conditions of site work. Implementing additional safety measures to protect the site from settler attacks				X		X					
13.	Partial termination of the Project.		X				X	X				
	Factors related to the sustainability, operation, and maintenance of infrastructure											
14.	Additional work to improve infrastructure sustainability. Improving system performance and enhancing the future expansion of the system.			X	X	X	X	X				
15.	Improve system quality and efficiency.	X		X	X		X		X	X	X	X
16.	Improve system safety.			X	X	X	X	X	X	X	X	X
17.	Enhance infrastructure operation and maintenance.	X		X	X	X	X	X	X	X	X	X
18.	The acquisition of material for future operation and maintenance work resulted from the local authority's weak financial capacity or a lack of material in the local market.	X					X		X	X	X	X
19.	Constructability and minimizing public disruptions during construction.	X		X	X	X			X	X	X	X
20.	Maintain the operation of the existing system while implementing the new system.							X				X
	Factors related to project stakeholders											
21.	Regulations and requirements of the financing (donation) agency			X			X					
22.	Request of the public administration or promoter	X		X	X				X	X	X	X
23.	Recommendations from the manufacturer or infrastructure service provider.	X								X		
	Delay factors											
	Factors related to contract documents (design drawings, specifications, Bill of Quantities, etc.)											
1	Additional work resulted from changes in the scope of work.			X	X	X	X					X

	Location	West Bank						Gaza				
	Project no.	*P1*	*P2*		*P3*		*P7*	*P4*	*P5*		*P 6*	
	Sub-project		P2-1	P2-2	P3-1	P3-2			P5-1	P5-2	P6-1	P6-2
2	Additional work resulted from changes in design drawings.											X
3	Acquisition of additional materials.									X		
4	Acquisition of additional materials due to a contradiction between the design drawings							X				
	Factors related to weather conditions											
5	Severe weather conditions.					X	X					
	Factors related to safety measures											
6	Work stoppage due to a severe safety accident.					X	X					
	Factors related to geopolitical conditions											
7	Interruption of work by the Israeli authorities						X	X				
8	Restrictions on the movement of construction materials and equipment imposed by the Israeli occupation				X		X	X	X	X	X	X
9	Border closure and checkpoints						X	X				
10	Refusal of material entry without fault or negligence of the Contractor							X	X	X	X	X
11	A delay in getting approval from Israeli authorities for the material						X	X				
12	Strikes and armed confrontations.						X	X				
13	Changes in regulations and procedures for obtaining material entry approval.						X		X	X	X	X
14	Delay during the permit approval process for telecommunication and chemical materials								X	X	X	X
15	Expiration of the material entry permit.						X	X	X	X	X	X

The analysis of Table V reveals the following:

- *Factors related to contract documents*

Factors related to changes in contract documents, including design drawings, specifications, and bill of quantities, such as errors and omissions in design drawings, were common risk factors affecting the cost and time of water infrastructure projects in the West Bank and Gaza. The poor quality of design documents, including contradictions between drawings and the long period between the design and execution phases, were indicated as the primary sources of changes in design.

These factors were also indicated in the literature review among the most significant factors that cause variation orders [34, 35, 36], resulting in time and cost overruns [37, 38], and affecting the amount of contingency [39].

- *Factors related to site conditions*

Unforeseen conditions related to existing infrastructure utilities and geotechnical conditions were reported as cost overrun factors in some projects implemented in the West Bank. This is due to the lack of as-built drawings and information about the existing site conditions and/or utilities. These factors were not specified in the previous stage of the literature review.

"Differing site conditions" is a common risk factor affecting any construction project. Therefore, it was indicated while examining historical data and literature as a reason for the order variation.

- *Factors related to the sustainability of infrastructure, operation, and maintenance*

Enhancement of infrastructure operation and maintenance, sustainability, and constructability are common factors that lead to cost overruns during the execution of projects. This is due to the unavailability of resources during the operation phase, which encouraged project stakeholders to find an alternative design solution to minimize operation costs or use locally available materials. This highlights the importance of considering local market conditions and operation and maintenance aspects during the design phase to minimize changes during the execution phase, especially when an international consultant carries out the design.

These factors were not identified in the literature review stage as all identified researches are dedicated to general construction or road projects. However, risk factors related to the water infrastructure's operation and maintenance phase are important and should be considered early in the project life cycle.

- *Factors related to geopolitical conditions*

Risk factors resulting from the complex geopolitical situation are the most frequent and significant factors causing delay and cost overrun for water infrastructure projects. Political agreements related to infrastructure projects, land segmentation, security situation, outbreak of hostilities, internal conflict, siege and border closure, and restriction on movement of goods and people are examples of such factors identified through literature review and the analysis of historical data.

The geopolitical context of the infrastructure project location determines the magnitude of each risk factor. For example, the aforementioned analysis showed that the magnitude of geopolitical risk factors in water projects in Gaza is higher than that in the West Bank. This is due to a prolonged blockade that severely limits or prevents the entry of construction materials and equipment altogether.

Moreover, land segmentation in the West Bank resulted from an interim political agreement between Israel and the Palestinian Liberation Organization (PLO), which divided the West Bank into three administrative enclaves: Areas A, B, and C. This agreement allowed the Palestinian Authority (PA) jurisdiction over all Areas A and B. However, Area Restricted PA control over "territory-related" issues, including infrastructure planning and water resource

management, represents nearly 60% of the West Bank [33]. As a result, implementing water projects in Area C is challenging and riskier than in other areas due to the required approvals and coordination during the project life cycle and the restriction on movement.

The development of the water infrastructure sector in Palestine is hindered by the political agreement, which requires the approval of Israeli authorities for any infrastructure project. This agreement gives Israeli authorities control of water resources [33]. As a result, Israeli authorities have rejected or long delayed a high proportion of proposed water infrastructure projects [40]. This geopolitical risk factor should be considered at the early stages of any project.

The impact of the geopolitical context is extended beyond the early stage of project approvals and affects the execution, operation, and maintenance phases. For example, one of the significant risk factors related to the geopolitical conditions is the unavailability of resources due to restrictions on the movement of goods.

All water infrastructure projects in Gaza suffered from severe time and cost overruns due to restrictions on construction material. A material entry permit mechanism called GRAMMS (Gaza Reconstruction and Material Monitoring System) was established to facilitate the entry of construction materials and a range of items classified as 'dual use' by Israel, including cement, rebar, and aggregate [33]. Israel converted this mechanism into an obstacle for material entry due to the complicated and protracted procedures and changing regulations. In some projects, a considerable amount of time (120 days) was spent on Israeli approval.

The limitation on the movement of resources in the West Bank seems to be less frequent for construction materials such as cement and rebar. However, specific attention should be drawn to long-lead items such as water pumps and electrical equipment, as the only way to import this equipment is through Israeli ports.

Furthermore, in both the literature review and historical data examination, we found that geopolitical risk factors related to the outbreak of hostilities such as wars, riots, strikes, internal conflicts, siege, and border closure have a severe impact on project completion date and budget for many water projects in West Bank and Gaza Strip. These factors were among the most significant causes of variation, orders, delay, and cost overrun.

In some cases, the deterioration of the political relationship between a donor country and a recipient country, in this case, the PA, leads to the termination of the ongoing project contract. Therefore, this risk factor was also identified as an important contributing factor to project delay [37, 38].

C. Stage III: Establishing a risk classification system

The data analysis results were combined to establish a risk classification system that forms an RBS for infrastructure projects implemented in a complex geopolitical context.

The literature review revealed no consensus on a classification system for risks in the construction sector due to the complex nature of risk [23, 41]. Several approaches have been proposed to classify risks [42]. However, most of them concentrate on the source of risks as the most important criterion [21]. This research proposes a new risk classification system based on system theory concepts and the nature and source of risks.

A typical project can be described as a complex and temporary system of many interrelated and interconnected elements, various organizational units, and a wide variety of people to achieve specific objectives [28]. Therefore, the first level of categorization aims to determine whether the risk factor is generated within the system boundary or its environment, which is referred to as endogenous and exogenous factors, respectively. The second classification system level is based on the source of risks. Finally, the third level is dedicated to risk factors, as indicated in Table VL.

TABLE VI. RBS FOR INFRASTRUCTURE PROJECTS IMPLEMENTED IN A COMPLEX GEOPOLITICAL CONTEXT.

Endogenous risks
Promoter-related risks
Delays in decision-making
Lack of communication between the promoter and other project stakeholders
Promoter interference and additional work requests
Financial risk
Insufficient External Funding for Project
Owner's/donor's financial problems - Unavailability of financing
Payment delay
Regulations and requirements of the financing (donation) agency
Contractual risk
Breach of Contract
Termination of Project.
Misconduct of Contractors
Inappropriate award criteria (the lowest price)
Non-transparent procurement system
Conflicting or imperfect contract
Insufficient project duration
Inaccurate Bill of Quantity

Design risk
Discrepancies between contract documents (Design Drawings, Specifications, and Bill of Quantities)
Errors and omissions in design
Contradictions between design drawings
Changes in projects' requirements (Design, Specifications, Scope of Work)
Incompatibility of technical specifications with the local market
Construction risk
Constructability and minimization of public disruptions during construction.
Accidents and poor safety measures
Site constraints (access, storage, electricity, etc.)
Maintenance and Operational Risk
Lack of integration between infrastructure systems
Not sustainable infrastructure within existing constraints
Not considering future expansion.
High operational cost with limited financial capacity
Improve infrastructure system performance, safety, or operational efficiency.
Exogenous risks
Political risk
Lack of political/government support
Forthcoming Elections
Factional Conflict
Civil War (Internal Conflict)
Power Groups intervention / Political interference
The political relationship between donor countries and the recipient country
Geopolitical risk
Expropriation and destruction of infrastructure by others
Outbreak of hostilities (external conflict, wars, riots, strikes, military action, etc.)
Security threats to the construction site
External interferences or pressure
Failure/delay in obtaining project approval and permits from others, according to geopolitical agreements.
Siege and Border closure
Movement restrictions due to road blockage, land segmentation, and checkpoints
Interruption of work by external forces
Governmental and Legal Risk
Vague or complex Laws and Regulations
Weak or poor regulatory/institutional/or policy frameworks and enforcement
Corruption
Inconsistency/ Changes in law/regulation/policy)
Bureaucracy
Government instability
Delay in Project approvals and permits
Adverse changes in tax regulations
Acquisition and the logistic risk
Issues clearing imported material and equipment
Lack of resources in the local market (material, equipment, and workforce)
Restrictions on the movement of construction materials and equipment
Rejection of material entry for specific items such as chemical material and telecommunication equipment
Failure/delay in obtaining approval for material entry
Changes in the regulation procedures related to material entry permission.
Expiration of the material entry permit.
Economic risk
Currency Inconvertibility and Transfer Restrictions
Currency Instability (Exchange Rate Volatility)
Fluctuation in the inflation rate
Material Price Escalation (due to continuous border closures)
Some suppliers monopolize project materials.
Social risk
Theft of equipment or materials
Public interference and opposition to the Project
Religious and Ethnic Tensions
Racism and Xenophobia
Land acquisition and site possession obstructions

Environmental and site location risk
Severe weather conditions.
Unforeseen geological conditions.
Changes in site conditions due to the long period between design and construction.
Differing site conditions
Unforeseen conditions of existing utilities, poor, and deteriorated existing infrastructure.

IV. Conclusions

This research aimed to identify risk factors affecting CHGR's infrastructure projects. A mixed research methodology combining a comprehensive literature review with an analysis of real projects was used to establish a risk classification system.

The risk factors were classified, based on the concepts of system theory and the source of risks, to create a three-level RBS. The first level was divided into endogenous and exogenous risk groups. The second level was categorized into 13 categories: promoter, financial, contractual, design, construction, maintenance and operational, political, geopolitical, governmental and legal, acquisition and logistics, economic, social, environmental, and site location. The third level was dedicated to risk factors.

The findings of this study indicate that the most frequent and significant risk factors were related to geopolitical situation and logistics. They include an outbreak of hostilities, siege and border closure, movement restrictions due to road blockage and land segmentation, lack of resources in the local market (material, equipment, and manpower), restrictions on the movement of construction materials and equipment, failure/delay in obtaining approval for material entry, and failure/delay in obtaining project approval and permit.

The examination of historical data highlighted the importance of operation and maintenance risk factors for water infrastructure projects, such as the lack of integration between infrastructure systems, system sustainability, operational cost, and limited financial capacity of local entities, and the need to improve system performance, safety, or operational efficiency. Furthermore, the results showed the difference in the magnitude and frequency of risk according to the Project's location. This confirms that risks are contextual.

Other risks were frequently indicated, such as project design and specifications changes, the contradiction between design drawings, differing site conditions, etc.

This study could help international construction enterprises, promoters, financing agencies, and donors involved in infrastructure projects in CHGR. The proposed list of risk factors can be used to anticipate, analyze, and assess risks in future projects.

Future research is required to develop a conceptual model that integrates the risk management process within the lifecycle management of infrastructures, considering operation and maintenance aspects. The system theory concepts could be used to identify the main interacting variables and the influence of exogenous parameters on the implementation process. The general model should contain proactive risk mitigation mechanisms to minimize the adverse impact of risks.

V. Recommendation and Practical Implications

The practical application of a robust Risk Breakdown Structure (RBS) is crucial for improving project outcomes in politically complex environments. For project managers, this framework serves as an essential checklist during the foundational stages of planning, ensuring that all potential risks, from logistical hurdles to geopolitical volatility, are systematically identified and considered. By categorizing these risks, project teams can move beyond general assumptions to develop targeted and resilient mitigation strategies and contingency plans.

Beyond project-level management, this RBS holds significant value for donor organizations. These agencies can leverage the framework to more effectively assess the viability and risk exposure of proposed projects. By incorporating these specific findings into their evaluation criteria, donors gain a deeper understanding of the unique challenges inherent to high-risk regions. This, in turn, allows for a more informed and strategic allocation of resources, ultimately leading to a higher probability of successful project delivery. The research specifically highlights the importance of addressing factors such as donor-related financial issues and regulatory requirements, which can be proactively managed during the evaluation phase.

Finally, the findings offer a critical recommendation for the project's design phase. International consultants and design teams are encouraged to move away from a one-size-fits-all approach and instead give careful consideration to local market conditions and operational and maintenance requirements. By integrating these local insights from the very beginning, a project's design can be more adaptable and robust, significantly reducing the likelihood of costly and time-consuming changes during the execution phase.

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VII. NOTATIONS

C – Construction Projects.
CHGR – Countries with High Geopolitical Risk.
CO – Contractor.
E – Engineering consultant.
FDII – Foreign Direct Investment in the Infrastructure.
G – Gaza Strip.
GRAMMS – Gaza Reconstruction and Material Monitoring System.
LR – Literature Review.
O – Owner.
PA – Palestinian Authority.
PPP – Public-Private Partnership.
R – Road Projects.
RBS – Risk Breakdown Structure.
RII – Relative Importance Index.
RM – Risk Matrix.
SWOT – Strengths, Weaknesses, Opportunities, and Threats analysis.
WB – West Bank.
WoS – Web of Science.