

The Impact of Terrorism on Construction Industry in Iraq

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Abstract

Suicide attacks, bombings, explosions became the part of daily life in Iraq. Consequently, the threat of terrorism put the Iraqi construction sector in the face of unique and unusual challenges that not seen on other countries. These challenges can have extensive impact on construction projects. This paper seeks to examine the impact of the terrorist attacks on construction industry and determine the extent to which the impact of terrorism on construction projects in terms of cost, schedule, and quality. This study adapted quantitative and qualitative approaches to collect data using questionnaire survey and interviews, as well as historical data. The study focused on projects that have been the target of terrorist strikes in Diyala governorate. A variety of statistical procedures were employed in data analysis. The results revealed the extent to which terrorist attacks impact construction projects in terms of cost, time, and quality. The results of this study will enhance the awareness of all construction parties to the impact of the terrorist attacks against construction projects. Eventually, this can develop a risk management assessment and assist contractors to properly protect projects and buildings to minimize injuries and fatalities in the event of terrorism.

Keywords: Construction, Terrorism, Terrorist attacks, Risk, Cost, Schedule, Quality

تأثير الهجمات الارهابية على الصناعات الانشائية في العراق

المستخلص:

أصبحت الهجمات الانتحارية، وتفجير القنابل، والانفجارات جزء من الحياة اليومية في العراق. وتبعاً لذلك ان خطر الارهاب وضع قطاع الانشاءات العراقية في مواجهة تحديات فريدة وغير عادية لا توجد في بلدان اخرى. هذه التحديات يمكن ان تؤثر تأثيراً بالغاً في مشاريع البناء. تسعى هذه الورقة إلى دراسة تأثير الهجمات الإرهابية على قطاع الانشاءات وتحدد المدى الذي يؤثر فيه الارهاب على المشاريع الانشائية من حيث التكلفة والجدول الزمني، والجودة. هذه الدراسة تبنت الأساليب الكمية والنوعية لجمع البيانات باستخدام الاستبيان والمقابلات، إضافة الى البيانات التاريخية. وركزت الدراسة على المشاريع التي كانت هدفاً للضربات الإرهابية في محافظة ديالى. تم توظيف مجموعة متنوعة من الإجراءات الإحصائية في تحليل البيانات. أظهرت النتائج مدى تأثير الهجمات الإرهابية مشاريع البناء من حيث التكلفة والوقت والجودة. ومن المتوقع ان نتائج هذه الدراسة ستعزز الوعي لكل اطراف المشروع تجاه تأثير الهجمات الإرهابية لمشاريع البناء. وبالنسبة، هذا يمكن تطوير تقييم إدارة المخاطر ويساعد المقاولين في حماية المشاريع والمباني بشكل صحيح للحد من الإصابات والوفيات في حال حدوث الإرهاب.

الكلمات الرئيسية: الانشاءات، الارهاب، الهجمات الارهابية، ادارة المخاطر، الكلفة، الجدولة، الجودة.



1. Introduction

The construction industry significantly contributed to the prosperity of the economy of nations and improved the level of people's life. The construction industry has also significance interaction with other economics sector as multiplier effects through its backward and forward linkages [1]. It is well known that construction projects are characterized as wide scope and complex. The complex nature of construction project creates a substantial potential risks. In fact, it is impossible to get rid of all the risks in the construction project [2]. Therefore, effectively manage risks throughout the construction process has become a central element preventing unwanted consequences [3].

Risk expresses the fear that economic activities cause losses or devalue of an important asset or a decrease in the performance of the business [4]. Project risk management is one of the important aspects in construction projects. It seeks to recognize the potential risks related to construction project and respond to those risks. Project risk management employs approaches that are likely to mitigate or prevent the effects of incidents [5]. Risk management was defined as the process of identifying, analyzing and responding to risk controlling the consequences of risk [6]. PMBOK [7] described risk management as the specific process of identifying, analyzing, and responding to project risk. For effective risk allocation, risk management provides a systematic and consistent approach to risk identification, assessment and control [8].

According to Smith et al. [9], project risks can be divided into three main groups: known risks, known unknowns and unknown unknowns. The difference between these categories is the ability to predict or foresee the risks. In construction projects, the sources of risk may be divided into external risks (e.g. financial, economic, political, legal and environmental), internal risks (e.g. design, construction, management and relationships) and force majeure risks [2]. Terrorism is considered one of the important and serious external sources, especially in some countries such as Iraq that suffering from clashes and wars. It's is therefore critical for the construction industry to effectively allocate resources and work jointly to help in securing the nation against future attacks [10].

However, terrorist events (suicide attacks, bombings, explosions) became the part of daily life in Iraq, there is no research dealt with this threat. The terrorist attacks affect all sectors and particularly construction industry. Therefore, it is vital to realize the importance of this risk and consider it early in the design to minimize its consequences. The reason for this shortage might be related to the security situation in Iraq and the difficulty in collecting data due to high level terrorist attacks. This paper attempts to fill this gap. Specifically, this paper aims at investigating the impact of terrorist attacks on construction projects in terms of cost, schedule and quality. This research is confined to study some projects that had been afflicted by terrorist attacks in Diyala governorate. The data was collected using questionnaire survey and interviews, as well as collecting historical data.



This study provides empirical evidence of the impact of the terrorist attacks on the construction projects. This would alert construction parties to seriously consider the threat of terrorism in initial project decision and properly protect projects and buildings. This is important, not only for contractor benefits, but to minimize injuries and fatalities in the event of a terrorist attack.

2. Background

The literature submits different definitions of terrorism events. It was defined as the intentional use or threat to use violence by persons or subnational groups to gain a political or social objective through the intimidation of a large audience beyond that of the immediate victims [11]. Similarly, terrorism was defined as an unlawful act of force and violence against people or property to intimidate or compel a government, the civilian population, or any segment thereof, in furtherance of political or social objectives [12]. In the same context, Kosnick [10] implied that the terrorism unlawfully uses the force or violence by individual or an organized group against people or property with the intention of intimidating or coercing societies or governments, often for ideological or political reasons. Terrorism was also defined as an action of violence when its psychological effects are out of proportion to its purely physical result [13].

Terrorism has become fundamental issue for world politics and threatens construction, as well as other industries. Thus, responding to the threat of terrorism presents important challenges to the construction industry [14]. With the wide range of terrorist attacks against government infrastructure, private and commercial structures, the anxieties raised about terrorist threats versus civilian and military infrastructure [15]. Therefore, political economy scholarship has started to make efforts to address the issue of terrorism and counterterrorism for last two decades [16]. Particularly, since the attacks of September 11, 2001; inevitable effects on tourism events seriously became the object of concern [14].

Enders and Sandler [11] argued that terrorism generates a substitution effect. The terrorists can switch tactics when observing an increase in a particular government counterterrorism program, pursuing attacks less affected by the government's efforts. Moreover, the terrorists attempt to hit vulnerable locations that lack defending measures. Therefore, protective actions against terrorism that was taken by developed countries would transfer some attacks against these countries' interests to poorer countries; for example, the post 9/11 attacks in Indonesia, Morocco, Kenya, Saudi Arabia, Turkey, and elsewhere [11].

Huge expenditure was spent for both the damages and the threat of terrorism events. Consequently, businesses require extra security and more time. Therefore, growth is declined in countries where the threat of terrorism extends. Abadie and Gardeazabal [17] investigated terrorism impacts on economic growth in the Basque Country of Spain. They found that terrorism has decreased per capita GDP by 10 percentage points since 1960s.



Masood [18] attempted to investigate impact of terrorism on construction industry in Pakistan. The results of his study showed that terrorist activities badly impacted the construction projects.

Abadie and Gardeazabal [17] found that as terrorism risk increased in a country, foreign direct investment substantially decreases in that country. Kosnick [10] examined the impact the terrorism on each phase of construction project life cycle (Initiation, Design, and execution) in Kenyan. He found that force protection was exponentially increased (initiation phase), cost design modifications were included (design phase), and urgent action was performed to secure all facilities (execution phase). Subsequently, the cost of secured construction was sharply increased.

Likewise, Chen and Siems [19] mentioned that terrorism has overall a negative effect on different industries; despite, the attack did not have the same impact across all of the industrial zones. Masood [18] stated that all the items of construction industry projects have negative correlation with increase in terrorist attacks caused weak performance of construction industry on economic scale. The impact of terrorism has generated an enormous workload for the construction industry. In addition, projects might be being cancelled because the owner prefers to invest elsewhere that more secure.

1. Research Methodology

This research aims to study the impact of terrorism factor on Iraqi construction projects performance, in terms of cost, quality time for various projects in different fields which are witnessed terrorism attacks during their life cycle and rebuilt again. The quantitative and qualitative approaches were adopted for this research. Data was collected using interviews and collecting historical data, as well as questionnaire survey. Therefore, the methodology used in this research divided into two parts.

The first part was conducting interviews and reviewing historical data. For this purpose, projects were randomly selected from three ministries in Diyala governorate; Ministry of Education, Ministry of Construction and Housing, and Ministry of Communications. Table (1) illustrates the projects from each Ministry.

Table (1) Construction projects studied in this research

Number	Ministry	Project Name
1	Ministry of Education	Nablus Primary School
		Al-Nasser Primary school
		Al-Moahib Primary school
		Al-Thera Primary school
2	Ministry of Construction and Housing	Alharonih bridge
		Imam wase Bridge
		Kanan-Baghdad Bridge
		Gazzanah bridge
		Narain -Rever Bridge
3	Ministry of Communications	Baquba Communications Building
		Jalawla Communications Building
		Bahrez Communications Tower



Historical data was collecting from the projects that include cost of project, project time execution, rebuild/repair cost, and the number of staff/users for each project. The data collection process was not easy because of the strict instructions not to provide information without the approval of the higher authorities for security reasons.

The goal of the interview is to quantify the impact of terrorist attacks on selected construction projects that have been terrorist attacks. This study invited five experts in construction building who are involved in construction projects. Prior to interview, the researchers developed a script to share critical details about the topic and researchers. This script guides the interviewing process and it is helpful to alleviate any concerns the interviewees might have about confidentiality [20]. The questions were posed as an open-ended question to allow the respondents to offer any additional information. The questions start with basic background data about the participants (name, title, etc.) to warm up and build confidence with them. The other questions focused on assessing the consequences of terrorist attacks on projects.

Part two, included short and simple questionnaire survey. The questionnaire consisted of close-ended questions and divided into two parts. The first part was designed to gather general demographic characteristics of the respondents (e.g., educational level, age, experience, and occupation). The second part aimed to investigate the respondents' viewpoint on the effect of terrorism risk on construction projects in Iraq; in terms of cost, time, and quality. The questionnaire distributed for many people specialized in the construction industry. The questionnaire was analyzed carefully, participants were invited to rate item on a five-point Likert scale [21] that required a ranking of 1–5; where 1 represented Probably, 2 Rarely, 3 Sometimes, 4 Often, and 5 Always. The data were analyzed qualitatively using the Statistical Packaging for Social Science (SPSS) software, Version 17. A variety of statistical procedures were employed in data analyses, including descriptive statistics (frequency distributions, measures of central tendency, and measures of dispersion), Chi-Square, Relative importance, and ANOVA.

4. Results and Discussion

This work in this paper is chiefly concentrated on finding the magnitude the impact of terrorism works on construction industry in Iraq which is appeared ignored during construct the projects in different areas in Iraq in spite of this country endure of many problems which related with terrorism threats. The results divided in two parts. Part1 discusses the data collected from the records and interviews for three types of construction projects. Part 2, consists of full analysis for the questionnaire by Statistical Packaging for Social Science (SPSS) to give indication about importance of terrorism factor on construction projects in term cost, time and quality.

4.1 Part 1 Analysis

This section deals with data that collected from the projects records and interviews. Table (2) displays the basic demographic information of the interviewees. It can be seen from this table that the respondents were aged (42-55) years. Moreover, four of them hold Bachelor degree and one of them hold Master degree. All interviewees employed in jobs directly related to the implementation of design and construction of buildings.

Table (2) General respondent demographic of interviewees

Interviewee	Age	Educational	Occupation	Ministry
1	55	Bachelor	President of the Education Committee in Diyala council governorate	Education
2	40	Master	Manger of the Department of School Buildings	Education
3	40	Bachelor	Director of the Designs Department	Communications
4	42	Bachelor	Manager of the Technical Department	Construction and Housing
5	44	Bachelor	Manager of the Designs Department	Construction and Housing

4.1.1 Schools Projects

School buildings were extremely influenced by violence and terrorism. Fig.(1) shows an example of the extent of the damage of the school buildings as a result of terrorism events. Table (3) presents the summary of information concerns four schools of 72 schools that have been attacked by terrorists.



Fig.(1) Damaged schools buildings by terrorism events

It can be seen from this table that there is a long time of disruption in schools and education as a result of buildings damage. Also, Table (3) shows the original schools construction costs, rebuild costs, and the total number of students and staff of each school. Based on these data, the percentage increment of buildings construction costs were determined, as shown in Table (3).

Table 3 Schools buildings that affected by terrorism attacks

Project Name	School construction costs (\$)	Number of Staff and Students	Disruption time	Rebuild Cost (\$)	Percentage Increment of Construction Cost
Nablus Primary School	300,000	500	3	650,000	216.7
Al-Nasser Primary school	250,000	450	2	400,000	160.0
Al-Moahib Primary school	200,000	650	2	375,000	187.5
Al-Thera Primary school	250,000	800	5	510,000	204.0
Total	1,000,000	2400		1,935,000	

Fig.(2) illustrates the cost of rebuilding of the four schools. Obviously, the costs for four schools almost have doubled to \$650,000, \$400,000, \$375,000, and \$510,000. The reason for this, as respondents declared, the cost for delivery material and equipment to the job site is very high due to threats of terrorist attacks. Moreover, the rebuilding cost includes demolishing, cleanup and debris removal costs. With the wide range of terrorist threats, most contractors and skilled labours denied to work in such areas. Therefore, there is lack of effective project monitoring and skilled labours. Subsequently, the quality level of construction expected to be low [22].

Due to long time of disruption in schools and education, students and staff had to move to another schools. The average distance for the closest school was at least 10 kilos; each student and staff had to pay minimum (2\$) daily. In other word, the transportation cost is around (320\$) yearly. This makes the total transportation cost (2,304,000\$) for (2400) students and staff in 3 years as average. This amount is considered as waste, which can be used to build new schools or renovate and improve current schools. In addition, there is serious risk that these students and staff to be victims of terrorism attacks and other threats.

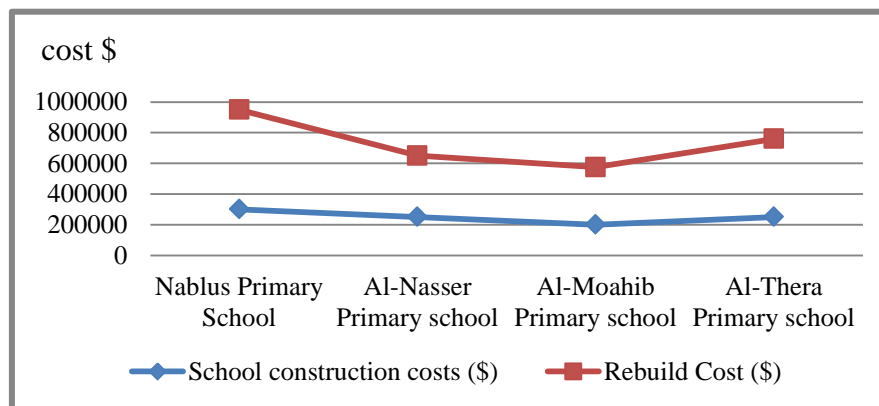


Fig.(2) The effects of terrorism on cost

It was clear also the bad distribution for these schools in some of the areas that are exposed to terrorist acts in sometimes make them goals for these groups. The political decisions were of the main reason by this bad distribution in Diyala governorate, since some of the council 'members bias for their regions and insisted to make these projects build there in spite of there is a real risk of exposure to these projects to terrorist attacks [23].

On other hand there is problem in the design of these projects and especially in redesign when the decision has been taken to rebuild the schools. The designer did not consider any protection from terrorist attacks in his mind and did not take in his account any antiterrorism which became vital in these types of building and for country such as Iraq. Counter-Terrorism defined by [24], those physical, technological and operational measures proposed to diminish, prevent, deny and defend against acts of terrorism". Lazell [25] mentioned that antiterrorism measures are being increasingly integrated into the design, construction and operation of the built environment.

4.1.2 Communications Projects

Communications projects were also subjected to terrorist attacks. Fig.(3) shows an example of the projects that were affected by the terrorist attacks. Table (4) provided a lot of information about the project construction costs, number of users for these projects, disruption time, and rebuild costs for three projects of eighteen buildings that were affected by terrorist attacks

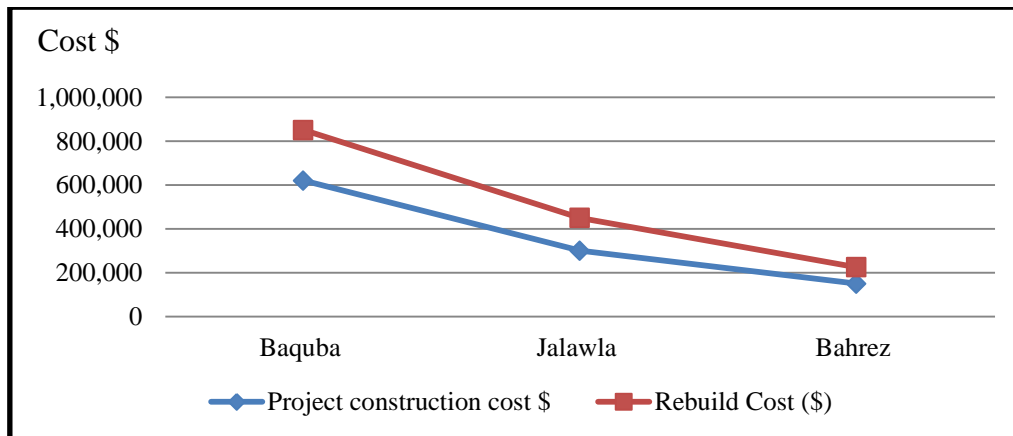


Fig.(3) Damaged projects by terrorism events

Table (4) Communications buildings affected by terrorism events

Project	Project construction cost \$	Users	Disruption time	Rebuild Cost (\$)	Percentage Increment of Construction Cost
Baquba Communications Building	620,000	100,000	1	850,000	137.1
Jalawla Communications Building	300,000	75,000	2	450,000	150
Bahrez Communications Tower	150,000	15,000	2	225,000	150
Total	1,070,000			1,525,000	Total

The Fig.(4) displays the project construction costs and rebuilds costs for each project. It can be seen that the percentage increment of construction costs virtually equal for three projects. The rebuild cost increased by one and half times the original construction costs.

**Fig.(4) The effects of terrorism on communications buildings costs**

However, the percentage increment of construction costs of project in Baquba is slightly less than other projects. The reason for this can be related to the location of project. Baquba is the center of Diyala governorate, which possesses better security situation relatively. Therefore, the resources and transportation can be provided at a lower price. The political decision was also from the major reason to this loss because they build in clash area and it was possible to build a small project in low price and was sufficient and satisfies the purpose [26].

4.1.3 Bridges Projects

This section aimed to expose the extent to which terrorist attacks affect bridges which belong to ministry of construction and housing. The study focused on five bridges of eleven bridges that were affected by terrorist attacks as shown in Fig.(5). Table (5) reveals the details regarding these projects. Based on this information, the percentage increment of construction costs are determined. It can be seen from Table (5) that the disruption time could be reached up to 6 years. In other words, around 4,000,000 publics were deprived of the services. The bridges provide fundamental service that cannot be postponed. Therefore, these publics had to find another alternative, which might cause them extra paid, or even their life [27].



Fig.(5) Damaged bridges by terrorism events

Consequently, the local politicians have to promptly offer temporary bridges. On the contrary, the political decision was made to build permanent bridges, naturally require a long time to finish them [28]. This led to a long time of disruption; in addition to the possibility of being exposing to other terrorist attacks [27].

Table (5) Some bridges impacted by terrorist attacks

Project	Bridge cost (\$)	Disruption time	Rebuild/ Repair Cost (\$)	Percentage Increment of Construction Cost
Alharonia bridge	6,800,000	2	2,600,000	38.2
Imam wayse Bridge	3,000,000	2	4,000,000	133.3
Kanaan-Baghdad Bridge	2,200,000	2	2,800,000	127.2
Gazzanah Bridge	2,000,000	6	4,600,000	230.0
Nareen -Rever Bridge	8,000,000	2	5,200,000	65.0
Total	22,000,000		19,200,000	Total

Looking to the Fig.(6), we can remark that the percentages widely vary. The reason for this variation is imputed to two reasons. The first is the level of damage of each bridge. In fact, some of bridges were completely destroyed, while others were moderately affected. The other reason is some of bridges were built long time ago, where the construction cost was extremely low [27].

To sum up, the terrorist attacks incredibly affect construction industry. These attacks caused overrun cost, delay services and construction, and poor quality. Realizing this threat, designers should consider it in structural design and features necessary for mitigating the loss from attacks. In fact, the effects of a terrorist attacks on construction can be architecturally mitigated [29]. If the plan was put and implemented early in the design process, it often cost nothing or very little [29]. For example the shape of building; large and gradual re-entrant corners is less affected than small or sharp corners [30].

Likewise, the choice of exterior material is important as it is the portion of the building closest to the blast. It is suggested to use lightweight materials such as timber or plastic for decoration, which are less likely to become lethal projectiles comparing to brick, stone, or metal [29].

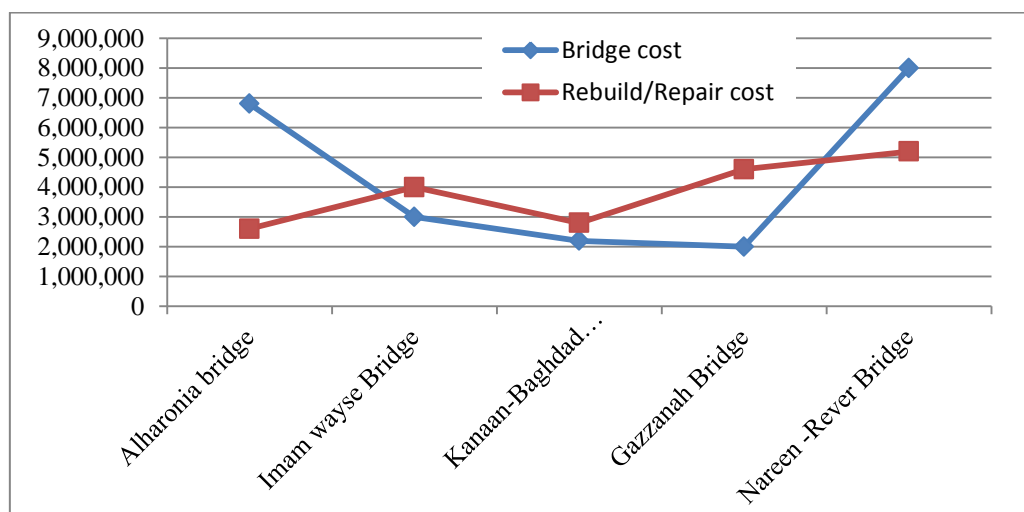


Fig.(6) The effects of terrorism on bridges projects costs

4.2 Part 2 Statistical Analysis of Questionnaire Survey

The questions were designed to capture the respondents' perspectives about the frequency of effecting terrorist attacks on construction project in terms of cost, time, and quality. A total of 112 questionnaires were satisfactorily completed, making the total response rate at 89.6%. The demographic background of respondents is shown in Table (6). The table indicated that the majority (%78.5) were hold Bachelor degree.

**Table (6) Descriptive statistics of general respondent demographic (GRD)**

GRD	Groups	Frequency	Percent
Educational	Diploma	21	18.8
	Bachelor	88	78.5
	Master	2	1.8
	PhD	1	0.9
Age	20-29 yrs	22	19.6
	30-39 yrs	31	27.7
	40-49 yrs	42	37.5
	50-59 yrs	15	13.4
	60 + yrs	2	1.8
Occupation	Quantity Survey	21	18.8
	Contractor	29	25.9
	Designer	5	4.4
	Site Engineer	34	30.4
	Manager	21	18.7
	Director	2	1.8
Experience	5 - 9 yrs	14	12.5
	10 - 14 yrs	25	22.3
	15 - 19 yrs	32	28.6
	20 - 24 yrs	39	34.8
	25 + yrs	2	1.8

Regarding the age of the respondents, 37.5% were aged between 40-49 years and 27.7% were aged between 30-39 years. The majority of the respondents (30.4%) were involved in "Site Engineer". Third respondents (34.8%) were had experience between 20 - 24 years.

Table (7) displayed the results of the second part of the questionnaire that concerns the frequency of terrorism events effects on construction project. Noticeably, the cost of project is extremely affected by terrorist attacks ($R_{II} = 0.92$). More than half respondents (59.82%) admitted that their organization always faced this problem. The remaining respondents (40.18%) indicated that project cost was often affected. The random assumption was proved, as the statistical hypothesis recorded significant difference at $P < 0.05$ between the observed and expected distribution of frequencies.

Project time was ranked second with R_{II} of 0.84. More than third respondents (%35.71) denoted that always project time was disturbed. Slightly less than half respondents (%49.11) confessed that the project time was often influenced by terrorism events. The rest of respondents indicated that this problem was occurred sometimes (%11.61) and rarely (%3.57). Table (7) shows a highly significant difference at $P < 0.01$ between observed and expected frequency distribution according to the randomness status of outcome assumption.



Quality obtained third ranking with RII of 0.75. Less than third (%30.36) respondents stated that quality was always affected by terrorism events. Similar percentage (%32.14) of respondents asserted that quality was often influenced. The remaining of the respondents revealed different views, where %21.43 sometimes tackled this problem, 12.50 rarely faced this problem, and %3.57 never experienced this problem. The statistical hypothesis result indicated a highly significant difference at $P < 0.01$ between observed and expected frequency distribution according to the randomness status of outcome assumption.

Table (7): The frequency of effecting terrorist attacks on construction project

Item	Choices	Frequency	Percent	RII	CS P-value
Cost	Never	0	0		$\chi^2 = 4.321$ $P=0.038$
	Rarely	0	0		
	Sometimes	0	0	0.92	
	Often	45	40.18		
	Always	67	59.82		
Time	Never	0	0		$\chi^2 = 59.786$ $P= 0.00$
	Rarely	4	3.57		
	Sometimes	13	11.61	0.84	
	Often	55	49.11		
	Always	40	35.71		
Quality	Never	4	3.57		$\chi^2 = 32.643$ $P=0.000$
	Rarely	14	12.50		
	Sometimes	24	21.43	0.75	
	Often	36	32.14		
	Always	34	30.36		

5. Conclusions and Recommendations

Terrorism in Iraq increased dramatically against everything; schools, public building, bridges ...etc. This study focused on the impact of terrorism attacks on construction of schools buildings, communications projects, and bridges in terms of cost, time, and quality. In term of cost, the results showed that the amount of losses hit \$1,935,000 for four schools, \$1,525,000 for three communications projects, and \$19,200,000 for five bridges. By grouping those expenditures together, loss reaches 22660000. Regarding to the disruption time, the results revealed that the schools disrupted for 5-10 years; communications services suspended for 1-2 years; and the bridges took 2-6 years to be repaired or rebuild. In light of the difficult and dangerous circumstances, quality level will certainly be affected as the skilled labour and effective supplier avoid working in such areas. In addition, the results show that the cost of the project is the most likely to be affected by terrorism strikes, followed by time, then quality.



Two limitations of this research of this study should be declared. First, this study is confined to school, communications project, and bridges in Diyala Governorate. Therefore, the results might be different in other Governorates. Second, it focused on construction; however, there are other significant losses. For example furniture, equipment, employee property, vehicles, computer systems, inventory in stores.etc. As well as human life and pain, which are impossible to really evaluate.

Based on the findings of the research, a number of recommendations are proposed. The terrorism events are beyond control of construction party; however, designers and contractors had to improve safety in design and structure that can withstand or resist terrorist attacks. Prior to make any political decision to build new project, the potential terrorist threats should be examined and evaluated. As long as terrorism is a threat, it is crucial to provide practical alternatives for any destroyed project, rather than build new one. The new project required long time and might expose to terrorism attacks again.

The outcomes of this study empirically provide evidence of the impact of the terrorist attacks on construction projects. This would increase the awareness of the contractors towards the importance of choosing the suitable material and giving the highest priority when considering structural design approaches for mitigating the effects of attacks.

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