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Identification and Management of Major Risk Factors in Construction of Healthcare Centers Projects

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K E Y W O R D S

Healthcare center, risk analysis, risk identification, risk matrix.

A B S T R A C T

More attention is needed for healthcare centers projects and its development to change and improve the health situation in Iraq. The study of risk in this type of projects is essential to avoid the problems encountered during the project life cycle. This paper aimed to identify risk factors facing the construction of an advanced healthcare centers and to enhance the possible solutions based on the opinion of experts. For data collection, fifty-five risk factors were presented in a questionnaire form. The result showed that the major risk factor was government corruption, which has a direct influence on the economy and a negative impact on the infrastructure in the country and its development. The analysis showed that financial problems represent the highest risk during the years in all construction projects. Other considerable risk factors were time overrun, labor safety, as well as environmental risks, which are related to waste treatment. Other important risk factors were related to the ventilation system and air conditioning, also risk in providing continuous electrical power during the day. In term of risk groups, the five most effective ones were political, Economic, Safety, Operation & Maintenance and Construction risks.

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1. Introduction

One of the most important development indicators of nations is the availability of advanced healthcare systems. This clearly appears in all the ancient civilizations like Mesopotamia, Egypt, China, and Rome. Nowadays, healthcare is very different due to advanced technology and modern lifestyles. It is now not just depending on having skilled doctors, experts or just advanced technology, they cannot be that useful together without having a well-planned healthcare system and a well-designed healthcare centers including the buildings.

In general, construction business has a very poor reputation for managing risk. Risk analysis is either neglected or done subjectively by merely adding a contingency plan. As a result, several major projects fail to fulfill schedule deadlines and cost targets with an attendant loss to each contractor and owners [1]. Planning for a brand-new structure or major rehabilitation needs early consultations and cooperation among the project managers, architects, style engineers, risk and safety specialists, construction project managers, infection management professionals, and building managers. In addition, it could be argued that one of the most effective factors that have a great impact on keeping Iraq's healthcare system in that primitive state is not making a risk plan assessment for such type of projects [2].

The phrase ''Risk'' is used in many various ways and with many different words, like ''hazard'' or ''insecurity.'' These risk events may possibly have a positive or negative result on the objectives of the project, the riskier the activity is, the more expensive the consequences if the wrong decision is made [3]. Risk Management (RM) is now an essential part of business and project planning and a recognized and valued skill globally. It is one of the key project management procedures. Risk Management practices are extensively used in both public and private sectors, covering a wide range of activities and operations including government, insurance, public institutions, military, construction projects, healthcare, finance, and investments, etc. [4]. In the context of construction project management, RM is a comprehensive and organized way of identifying, analyzing and responding to risks that we deal with to achieve the project aims and objectives [5, 6]. Moreover, it takes part in educational institutions through a formal study course and awarding degrees in risk management [7.[

Despite the fact that the cost of risk is one of the largest expense items, construction companies have never thought about seriously [8]. According to the project management body of knowledge PMBOK [9], the identification of the risks is the most important step in the risk management process. Risk identification helps the key project participants, client, consultant, contractor, designer, and supplier to meet their specifications and minimize negative influences on the performance of construction project in relation to cost, time and quality objectives. There are many reasons that make risk identification a very important act like decreases the likelihood of major disturbances to business's plans and raises the chances of the business achieving its goals; helps to recognize the risks in early phases and incorporate into plans which increase the chance of project success; it can provide a logical foundation for better decision making regarding all risks. Assessing and managing risks can be a great weapon against project catastrophes. By evaluating the plan for possible difficulties and developing strategies to address these problems, it improves the chances of making a successful project [10].

The aim of this paper is to identify the risk factors that are facing the construction of an advanced healthcare centers and the possible solutions based on the opinions of engineers, consultants, contractors, doctors, experts, and owners. To achieve that, a five-point Likert scale questionnaire form will be adopted as the major source of data. The creation of the questionnaire depends on many direct interviews with a specialist in the field of construction, renovation, and maintenance of healthcare centers and head manager of general hospitals in Baghdad and Erbil to get the needed information to form this questionnaire and to support the field of this study.

2. Literature Review

With the increasing amount of construction projects in the Arabian Gulf Region (AGR) and many more international businesses and companies moving into the new global markets, there are limited studies to identify and evaluate the effect of risks on projects in this region. Sabah, et al. [11] presented an overview of the risks related to international construction projects in the Arabian Gulf Region. Seventy-four risk factors met in the AGR were recognized and their influence on cost and schedule performance metrics was evaluated. These risk factors were spotted and grouped into ten categorize. The projects that are impacted by both schedule and cost were identified and a comparison has been made between them and a statistical test has been made to check if there was any statistical indication between the impact of each factor on cost and schedule. It has been found in this paper that some of the risk factors have a significantly higher impact on cost or schedule like insufficient scope definition and inadequate schedule. Moreover, an international risk assessment tool (IRAT) has been developed to help international organizations improve their visual ability to identify, report, and mitigate risks. On the other hand, Vidivelli and Jayasudha [12] from India aimed to find the essential risk factors facing construction projects in order to reach the project goals in cost,

quality, time, safety and environmental perspectives. Their results concluded that the main risk factors in the building and construction industry are the time and financial risks, and the financial represent the highest risk that can face the projects with the regression value equals 1.00, also indicated that the chosen factors influenced the risk directly. Zavadskas, et al. [13] from Lithuania presented a risk assessment of construction projects. This assessment was based on different methods of decision-making. The evaluation of risk takes the goals and the interests of the stakeholders into consideration as well as the factors that have an impact on the construction progression efficiency and property value. They concluded that when using different calculation methods, Different results obtained and for decision-making, it is sensible to use several methods and select the best one according to collected results. While in Pakistan, Ehsan, et al. [14] aimed to evaluate and identify risks and uncertainties in the construction industry, also aimed to create foundations for the development of a risk management planning of the future studies so designers, contractors and potential investors in Pakistan can adopt it. Moreover, discussed that the risk faced in the construction industry in Pakistan is mostly based on the experience and intuition of both the consultants and contractors. Risk transfer and risk elimination were the most utilized risk and these practices were the origin behind the problems of low quality, low productivity, and delay in projects. Petersen [15] from Philadelphia, USA concluded that the risk increases during the renovation and construction of healthcare centers because these activities release dust and disease-inducing germs and microbes into the surrounding environment. Hospitals must consider the possible impact on health in the construction and renovation projects they do, because more than one in five work-sites, infections occur in a hospital setting industry. Hospitals can avoid possible risky situations and decrease the hazards to staff and patients thru focusing on infection control. To overcome risks, he suggested to improve the environmental monitoring, Communication, and training, as well as devotion to strict infection control procedures, they are all necessary steps to manage the risks and make an effective construction schedule.

Streifel and Hendrickson [16] discussed that all buildings under construction or under renovation are not immune to risky environments, counting construction induced air pollution and this is a very important reason why risk management is important for all projects. Also mentioned the production of fungi from water-damaged materials, and how it can result in the rejection of the building by the owner. Moreover، created steps to identify issues related to specific sites and other potential hazards with the potential solutions to each risky point that can face the project during the construction or renovation.

3. Research Methodology

The questionnaire will be adopted as the major source of data using risk matrix assessment to define the level of potential risk in terms of its probability and impact to overall project stages. The data for this paper was gained by means of a questionnaire. The questionnaire consisted of two key sections, each one containing several brief questions to be answered on a 1-5 scale for both the impact and the probability. The data gained from this survey will be analyzed using Microsoft Excel, creating the risk matrix (likelihood and severity matrix) according to PMBOK [9].

Previous studies like Mahamid [17] presented a risk scale for both impact and probability to determine the three zones (green, yellow and red) of risk effectiveness in road construction. In the aim of getting more accurate and realistic results, the researcher chooses to take specialists recommendation who lives and deal with such risks in their work instead of depending on previous studies which may not match reality in term of selecting the risk scale.

A pilot study was conducted in order to select the scale of risk effect. According to the suggestion of the experts in the field of construction and the field of managing healthcare centers in Iraq, especially the experts working in Baghdad Medical City, the effect of risk factors will be defined in three categories high, moderate as shown in Table 1.

To calculate the data, According to Assaf and Al-Hejji [18], the formula shown below will be used for calculations based on the severity index which is called the impact.

$$Impact\ (\%) = (n/N)/5 * 100 \quad (1)$$

$$Probability\ (\%) = (n/N)/5 * 100 \quad (2)$$

Where:

(a) represent the constant weighting that is given to each response ranges from 1 for never up to 5 for very high occurrence while (n) represent the frequency of the responses, and (N) represent the total number of responses.

The Importance Index as a function of both severity index (Impact) and frequency (probability), which is called the effectiveness, as shown below:

$$\text{Effect (\%)} = \text{Probability (\%)} \times \text{Impact\%100} \quad (3)$$

Table 1: Scale of Risk Effect

Effect	Scale
0 – 35	Low
36 – 70	Moderate
>70	High

4. Data Analysis

Figure 1 illustrates the respondent profile of this paper as a percentage of the total number of valid questioners received classified into three categories. The first one shows the degree of education of each participant while the second one shows the percentage of civil engineers to other engineers participated in this survey and the third category shows the respondent's position.

5. Research Findings and Discussions

Table 2 shows the analysis results of the probability, impact and the effect of risk. It illustrates that there is only one high risk among all fifty-five risk factors, which is R50 that stand for corrupt government. This shows that the corruption in the government has reached high levels in which effects reached all corners of the country and the life in it even the construction field. It has a high negative effect on the infrastructure and its development in the country. This factor (i.e., corrupt government) is related directly to the financial issues in any project. For that, difficulties in covering the project financially come with 62.22% risk effect. This explains why there are many construction projects delayed or canceled in Iraq. In their study, Vidivelli and Jayasudha [12] from Lithuania found that among the various risk factors, financial risk is the highest risk factor in construction. In addition, Abbasi et al. [19] found that the most effective risk factor that occurs in the construction industry in Jordanian companies are based on financial issues and Akintoye and MacLeod [20], also mentioned that the most effective risk factors were the financial risks. From all the above, it can be said that the financial problems remain in its position as the highest risk during the years in most construction projects around the globe.

The analysis shows that 22 out of 55 risk factors were scaled low with a risk effect below 35%. Factors related to poor design, undocumented change orders and poor contract documents, are very important factors for its direct influence on the project success. These factors where scaled low and ranked 33.17%, 26.80%, and 29.52% respectively. These results reflect the good practices regarding these factors in the construction field in Iraq. In his study, Zavadskas, et al. [13] found that risks related to documents and information have a great influence on the projects in Lithuania with a high-risk scale. The effect of near projects is very low with only 21.04%, this closely goes with Wang, et al. [21] for such factor found to be the lowest among all factors. This is due to the fact that most of the existing health centers were constructed fare enough from other infrastructure. On the other hand, cleaning and sterilizing procedures during the operation phase have a 34.43% of risk effect. The analysis shows that factors related to safety have a moderate risk effect with 62.35% and 62.40% for both labor safety and protective clothing respectively. Similarly, Vidivelli and Jayasudha [12] reported that safety risk has a moderate risk effect and less than the financial ones in a construction project. Factors related to the design of the ventilation system, air-conditioning system, providing electricity 24/7, waste treatment, budgeting, quality control and delay in completing the building in time need more attention and more control and their risk should be reduced because if neglected, they could pose a significant risk in such projects.

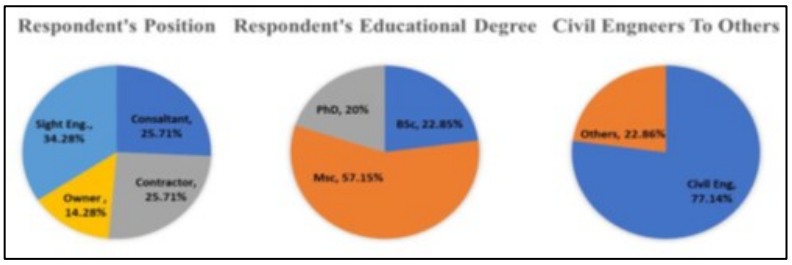

Figure 1: Respondent Profile

Table 2: Probability, Impact and Risk Effect Scale

R	Risk	Probability	Impact	Effect	Risk Scale
R1	Poor/incomplete design	52.12	63.64	33.17	Low
R2	Undocumented change orders	46.06	58.18	26.80	Low
R3	Improper verification of contract documents	49.70	59.39	29.52	Low
R4	Not considering sunlight in rooms and corridors	56.36	63.03	35.53	Moderate
R5	Not considering emergency exit in case of fire for patient's safety	58.18	73.94	43.02	Moderate
R6	Poor ventilation system design	60.00	70.91	42.55	Moderate
R7	Not using large elevators to transport patients	54.55	64.85	35.37	Moderate
R8	Not considering wide doors.	51.52	56.36	29.04	Low
R9	Not providing emergency system to evacuate patients and staff during fires	60.61	75.76	45.91	Moderate
R10	Not considering future expansion and development to the health centre to absorb more patients and provide advanced services	64.85	75.15	48.73	Moderate
R11	Not considering the standard colours for interior painting	47.88	55.15	26.41	Low
R12	Not using high-quality materials	67.27	76.36	51.37	Moderate
R13	Not using special tiles to avoid slipping	43.03	56.36	24.25	Low
R14	Delay in completing the project in time	72.12	80.00	57.70	Moderate
R15	Lack of supervision and regulation in project	61.82	75.76	46.83	Moderate
R16	Lack of quality assurance and control	63.03	69.09	43.55	Moderate
R17	Delay due to accidents during construction	47.88	58.79	28.15	Low
R18	Necessary technical skills are not available	56.97	69.09	39.36	Moderate
R19	Increase of labour costs	47.88	50.91	24.37	Low
R20	Low workers' productivity	55.15	64.85	35.76	Moderate
R21	Theft of materials at site	58.18	70.30	40.90	Moderate
R22	Damage and wastage of materials by workers	58.18	66.67	38.79	Moderate
R23	Increase/change of material price	50.30	57.58	28.96	Low
R24	Losses due to bad storage of material	58.18	67.27	39.14	Moderate
R25	Will there be a traffic control around the building to provide easy access to the healthcare centre?	61.21	68.48	41.92	Moderate
R26	Labour safety is not considered	74.55	83.64	62.35	Moderate
R27	Not using protective clothing	75.15	83.03	62.40	Moderate
R28	suffocation due to flying dust inside the construction site	51.52	64.85	33.41	Low
R29	Workers smoking in work site and during work	75.15	67.27	50.56	Moderate
R30	Accidents due hazardous materials used in construction site	51.52	59.39	30.60	Low
R31	Not providing fire extinguisher in site	75.15	77.58	58.30	Moderate
R32	No secure the electric power 24/7	58.18	66.06	38.44	Moderate
R33	Not providing good air conditioning system and suitable temperature	58.18	69.09	40.20	Moderate
R34	Not considering waste treatment	70.91	80.00	56.73	Moderate
R35	Not considering continuous maintenance of equipment, electricals and other services	56.36	66.06	37.23	Moderate
R36	Not considering Maintenance of furniture and disposal of broken furniture.	51.52	60.00	30.91	Low
R37	Not providing sound insulation between rooms	63.64	67.88	43.20	Moderate
R38	Providing a fire detection and dedicated fire extinguisher system	55.15	75.76	41.78	Moderate
R39	Having a cleaning and sterilizing procedures	55.15	62.42	34.43	Low
R40	Unusual climate change	51.52	63.03	32.47	Low
R41	High temperature days	68.48	62.42	42.75	Moderate
R42	Compliance with pollution and safety rules	64.85	75.76	49.13	Moderate
R43	Difficulty accessing the site	49.09	56.97	27.97	Low
R44	Problems from near project	41.82	50.30	21.04	Low
R45	Local people do not support the project	46.06	55.15	25.40	Low
R46	Labour disputes	46.67	53.94	25.17	Low

R47	Religious conflicts	46.06	54.55	25.12	Low
R48	Tribal customs	56.97	65.45	37.29	Moderate
R49	Changes in laws and regulations	56.00	68.48	38.35	Moderate
R50	Corrupt government	83.03	88.48	73.47	High
R51	International sanctions	55.15	69.70	38.44	Moderate
R52	Tax rate increase	49.70	64.24	31.93	Low
R53	Decrease/change in the state budget	67.88	80.61	54.71	Moderate
R54	Variation of government policies	59.39	69.09	41.04	Moderate
R55	Difficulties in covering the project financially causing delay in completing the building in time	73.33	84.85	62.22	Moderate

All the results showed in Table 2 were applied on probability and impact "Risk" matrix. these risk matrixes; Figure 2 and Figure 3, as shown below, were drown on a scale using Microsoft Excel, the green zone represents the low risk while the red zone stands for the high-risk factors and the area between them, colored in yellow, represent the moderate risk. The first matrix, Figure 2, shows each risk factor considering its probability and impact, while the second one, Figure 2, show risk groups (categories) considering its probability and impact. It is clear to notice in Figure 2 that R50 is the highest risk factor and it is the only one in the red zone. Most of the risk factors were in the yellow zone representing a moderate effect. Risk factors related to stakeholders and environment appeared in the low-risk area.

From Figure 4, it is obvious that safety during the construction phase has the highest risk effect with 49.6%. directly followed by the operation &maintenance phase with a risk effect rate up to 40.36% then comes the construction phase with 38.79% and the design phase with 36.28% of risk effect. It can be said that safety during the construction phase of health care centres represents a serious issue that needs to be dealt with as well as the operation and maintenance phase. These results reveal the real problem with health care centres are majorly related to the operation and maintenance phase.

In their study, Vidivelli and Jayasudha [12], found that risk during the construction phase is the highest risk group followed by risks related to design groups then the safety comes after that. Likewise, Banaitiene and Banaitis [6] found that design phase and construction phase risks were the highest among the other factors. This difference is because, in Iraqi construction sites, there is a lack of safety practices due to the absence of low and requirements for safety. Additionally, according to interviews with consultant engineers in Baghdad, most of the construction projects in Iraq including healthcare building projects have a simple design, familiar and ordinary building procedures, for that, they came with the lowest risk comparing to the safety and operation and maintenance risk groups.

It can be also recognised that political risks have the highest risk effect with around 50%, directly followed by the economic risks with 47.47%. These results are close in value, and this obviously reflects the political conflicts in the country, which is directly influencing the economy. Risks related to environmental factors with 34.67 % while stakeholders' conflicts intents have the least risk effect with 28.25 %. Vidivelli and Jayasudha [12] as well as Zavadskas, et al. [13], reported that political issues represent the most effective risk followed by economic factors, while stakeholders and environmental risks have the least risks. Banaitiene and Banaitis [6] also reported that the economic and political risks were the highest risk factors. In their paper, Akintoye and MacLeod [20] also mentioned that the most effective risk factors with respect to the external risk were the economic and the political risks while the environmental risks have the lowest influence in construction projects. From all the above, it can be said that the economic and political problems are related to each other in general and have almost the same rate of effectiveness in most of construction projects.

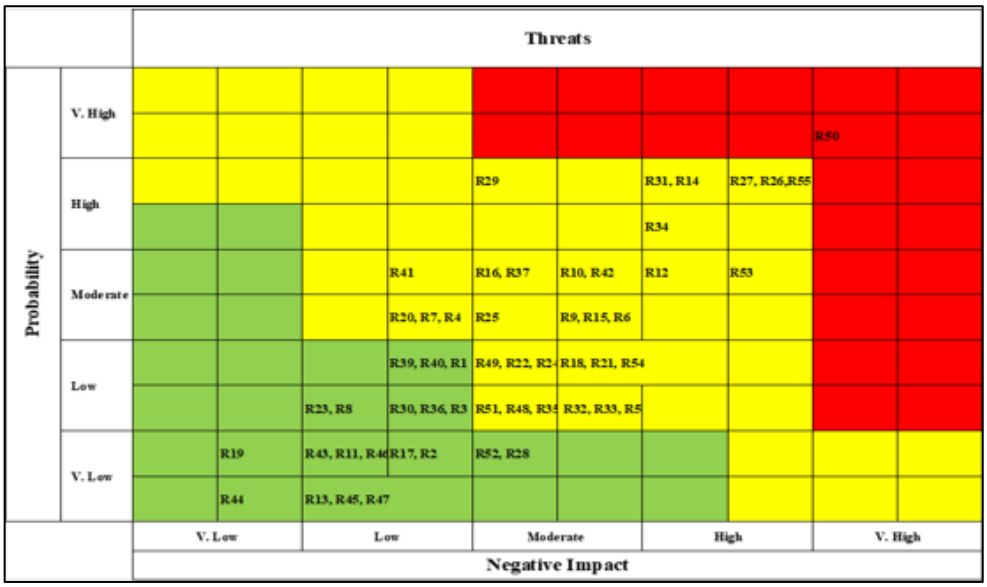

Figure 2: Impact, Probability Matrix for All Risk Factors

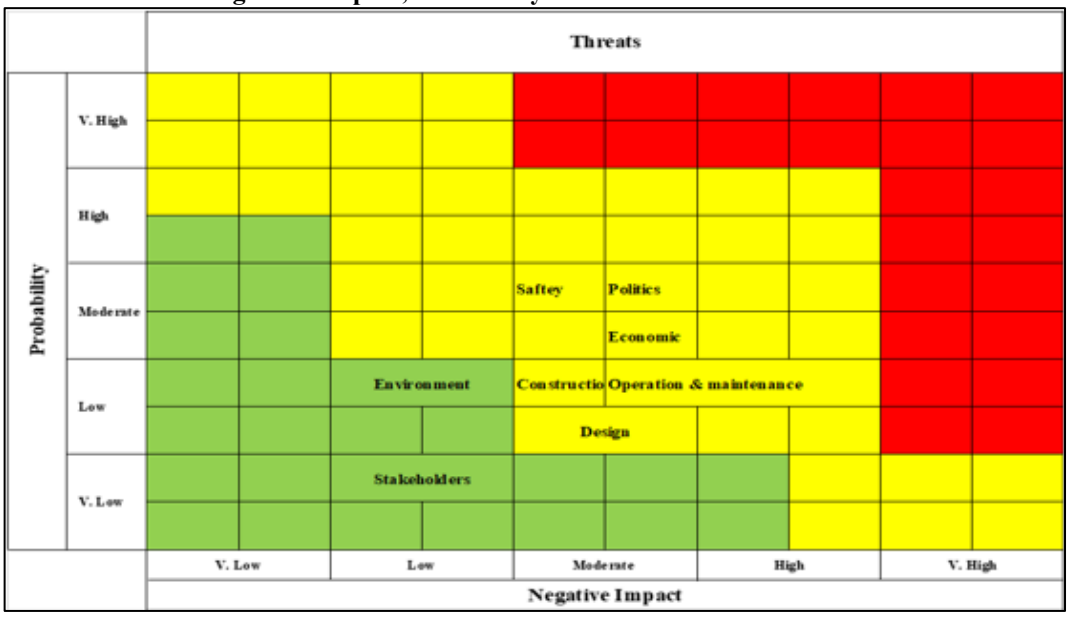

Figure 3: Impact, Probability Matrix for Risk Groups

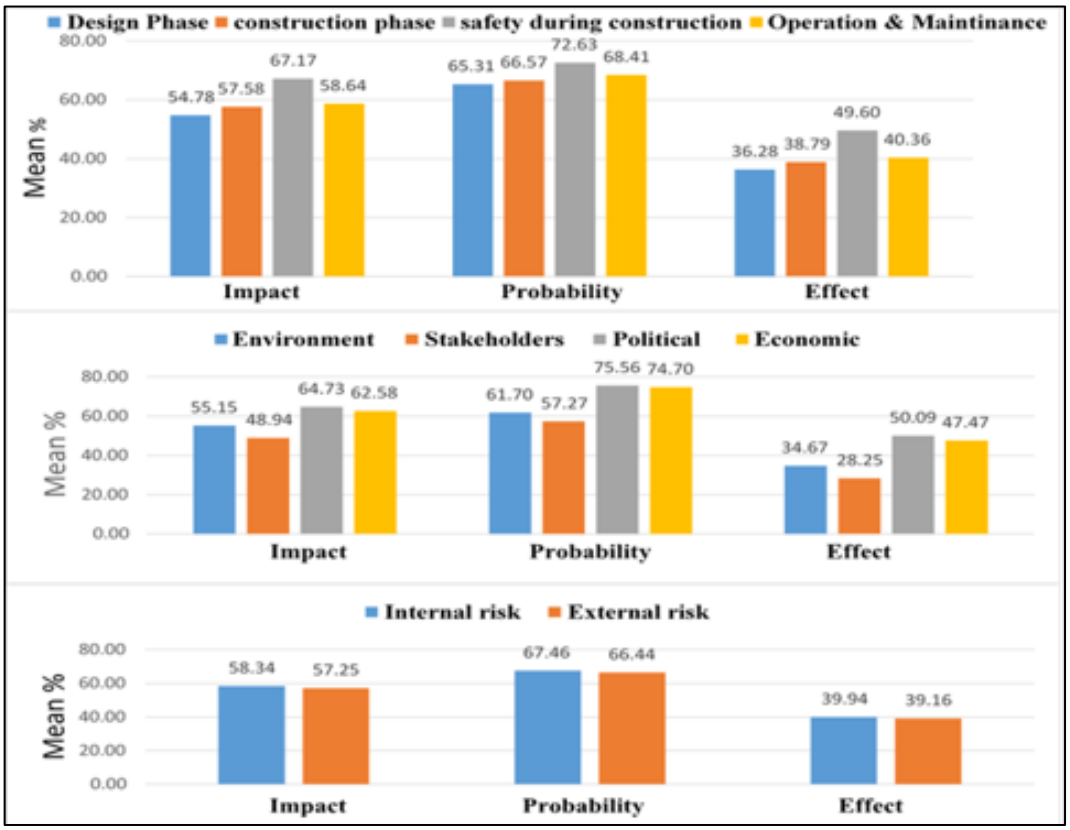

Figure 4: Mean values of the probability, impact and effect of different risk groups

6. Conclusions

The construction industry is well known for its risk and uncertainty, which can possibly have negative outcomes for the construction projects. In this study, the analysis shows that health care centres in Iraq are facing many influential risks throughout its lifecycle (i.e. design, construction and operation and maintenance phase). These risks have a significant impact on the development and progress of all the health system in the country. Many risk factors should be taken seriously and not underestimate them for it could be a great threat. It has been found that the most influencing risk factor is the government corruption. This factor has a direct and indirect effect on all the other risk factors. Government corruption has a negative impact on the progression cycle of any country and on all life aspects including the healthcare system. It represents the major cause of the significant decline in the field of construction and for sure the health system too. Government corruption influences the economy directly which cause major fanatical problems and difficulties in covering the project financially causing a delay in completing the project on time. Moreover, future expansion and development must be given more attention so that health centers can absorb more patients and provide more advance services. Safety during construction shows high-risk value in this survey, this is because in Iraqi construction sites, labours do not use protective clothing during work and there is no law enforcement for labour safety.

Providing electricity 24/7 must be taken seriously as well as providing a dedicated fire protection system for the taken efforts are not enough to reduce risks and prevent accidents. Another important factor within the operation and maintenance phase is waste treatment. This represents a major threat to the ecosystem in Iraq, and the risk of epidemics and disease is high because all healthcare center's wastes are disposed onto the river without treatment .

In addition, the five most effective risk factors where corrupt government, not using protective clothing, not considering labour safety, financially difficulties and delay in completing the projects. In term of risk groups, the five most effective groups were political, economic, safety, operation & maintenance and then construction risks. Overall, reducing risk factors and its influence is very important, it is not an impossible task to do, but still, government corruption is the main and the most effective and difficult factor to deal with.

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