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"The role of modern technology for safety and security management in construction sites in Kuwait"

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----------*ABSTRACT*----------
The research aimed to investigate the significance of modern safety techniques in the construction industry of Kuwait. It found a lack of awareness among workers and organizations, hindering their implementation. The study highlighted the benefits of using modern safety technologies to address safety issues and recommended training workers, government support, and the involvement of professional institutions to raise awareness.

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I. Introduction

The construction industry is a major contributor to the economy, although it poses high safety risks for workers. In the USA, construction workers have a higher rate of injuries and fatalities compared to other industries. Similarly, in the UK, construction workers are at a higher risk of being killed or injured than other industries. Construction hazards extend beyond to include work delays, increased costs, low productivity, and a negative reputation for construction stakeholders. The need for modern safety management is critical to the planning, design, execution, and operations stages, to effectively reduce these hazards. Implementing modern technology in construction safety and planning can improve the work environment and minimize hazards, with planning serving as the foundation for safety management [2].

Safe construction requires planning from design to maintenance to reduce hazards and improve the work environment. Limited experience among safety engineers and lack of technical training for construction crews can lead to safety failures. Safety planning involves assessing hazards and aligning safety measures with construction plans. Modern safety technologies such as artificial intelligence, virtual or augmented reality, and Building Information Modeling (BIM) are needed to enhance safety planning in construction.

II. Aim of research

This research aims to identify the importance and benefits of implementing modern safety technologies in Kuwait and overcoming barriers to improve safety and eliminate occupational hazards in the construction industry.

III. Purposes of research

- Identification of the importance and benefits of implementing modern technologies in safety management.
- Assessment of the awareness level of using modern technologies in safety management in Kuwait.
- Investigation of barriers to using modern technologies in safety management in Kuwait.
- The role of modern technologies in safety management in solving safety problems in Kuwait.
- Providing recommendations for implementing modern technologies in safety management.

IV. Methodology

The research aimed to enhance existing hypotheses regarding the significance of modern technologies in safety management and to explore their awareness, importance, and barriers to adoption in Kuwait's construction industry. This was achieved through a questionnaire designed to measure the research objectives.

V. Research hypotheses

The research hypotheses are:

1. Inverse relationship between the importance of modern technologies and barriers to implementation in safety management.
2. Positive relationship between modern technologies and their popularity in safety management.

3. Positive relationship between implementation of modern technologies and increased safety on site.

VI. Research questions

RQ 1: what is the importance and return of applying modern technologies in safety management?

RQ 2: what is the awareness level of modern technologies in safety management in Kuwait?

RQ 3: What is the relationship between awareness level of modern technologies in safety management and adoption of technologies in Kuwait?

RQ 4: What are the barriers to applying modern technologies in safety management in Kuwait?

RQ 5: What is the effect of awareness level of modern technologies in safety management on implementation barriers in Kuwait?

RQ 6: What is the effect of importance and benefits of modern technologies in safety management on implementation barriers in Kuwait?

RQ 7: What are the recommendations to implement modern technologies in safety management in Kuwait?

VII. Delimitations of the research

7.1 Knowledge

the research aimed to develop a clear knowledge of modern technologies in safety management and their importance and barriers which help to adopt these technologies in construction projects in Kuwait.

7.2 Approach and Instrument

Research objectives were measured by a questionnaire to answer the main questions of the study. The questionnaire was created based on the findings of previous studies, and as a result, it includes conclusions and recommendations.

7.3 Geographical

Research covers construction industry in Kuwait.

7.4 Population and Sample

The study population includes engineers in different disciplines of the construction industry, civil engineering trainers, contractors, and real estate owners

VIII. Research design

The research problem has been identified, objectives, research questions, and hypotheses have been established, and the research technique has been selected. Previous studies on the same topic were reviewed to prepare the questionnaire. Face validity was conducted by construction safety professionals. A pilot study was conducted to measure the questionnaire's validity and reliability. The collected data were analyzed using the SPSS program, and conclusions and recommendations were drawn.

IX. Contribution to knowledge

The research aims to increase awareness and understanding of modern safety technologies in Kuwait. It will analyze the importance of these technologies, their benefits, and the barriers to their application. Additionally, it will provide a comparative guide for the development of current conventional safety technologies.

X. Literature review

10.1 Mixed reality technique

In construction, augmented reality is used for virtual planning, allowing contractors to learn from mistakes without using real resources or compromising safety. It combines computer-generated images with the real world, presenting a spectrum between reality and digital virtuality. This technology helps prevent workplace incidents and economic losses by assisting in site arrangement before construction begins. Figure (2) illustrates MR-VR examples for construction safety applications along the reality–virtuality spectrum.

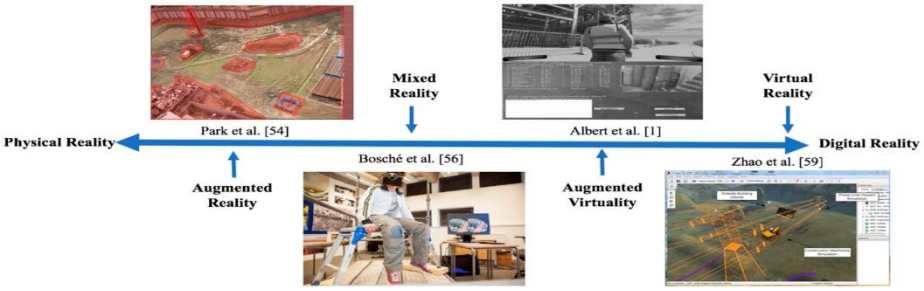

Figure (1) MR-VR examples for construction safety applications

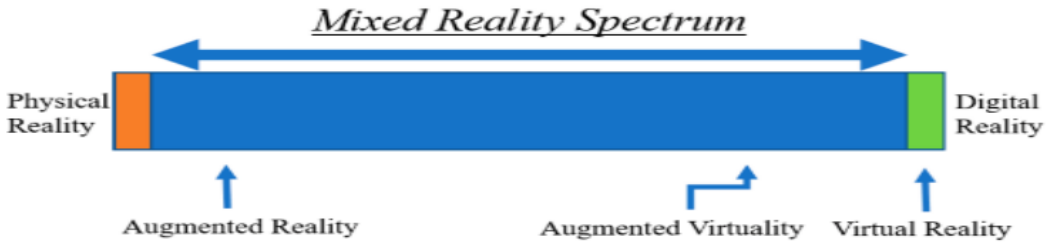

Figure (2) the Mixed-Reality Spectrum

10.2 CAD 3-D models

3D CAD creates models and logistic plans that improve workplace safety, including site preparations, equipment placement, and hazard identification. Virtual reality training in site-specific digital replicas is the most effective way to train, allowing for emergency response and hazard identification training and contractor onboarding.

10.3 BIM technology

BIM technology enhances site training, layout planning, and safety inspections. It automates safety-rule checking to identify and address potential risks before work begins, improving worker understanding and safety.

10.4 Laser scanning

A 3D laser scanner allows staff to locate the blind spots of heavy equipment at the site using the photogrammetry process [12], Where it performs accurate calculations based on the work environment and equipment measurements to ensure the safety of equipment maneuver at the site; hence hazard recognition, physical workplace conditions and identification can be enhanced.

10.5 Quick response (QR) codes

The QR codes are used to easily access the safety instructions and all the information related to the site equipment and tools. In addition, for the safety operational precautions can be easily accessed for all site crews; hence hazard recognition, safety planning, and identification can be improved.

10.6 Radio frequency identification (RFID)

RFID tags in personal safety equipment such as a safety helmet is used to locate workers and warn them when they approach dangers. Also, RFID tags are attached to safety gear to check safety on site. it improves safety compliance on site, enhances safety planning, and physical workplace conditions [13].

10.7 Robotics and Automation

Robots can perform many tasks on site such as welding in risk situations. constructing walls in bad climate conditions, and laying concrete pipes in trenches [14]. It can mitigate problems concerning workers' health and safety, prevent hazards, and enhance safety planning.

10.8 Unmanned aerial vehicles (UAVs)

Unmanned aerial vehicles can be used to perform inspections in high elevations, take captures for specified parts of construction, and take measurements in risky or hard locations [15]. it can be used to improve safety inspections and hazard recognition and identification.

10.9 Wearable sensing devices (WSDs)
Examination of workers' vital signs, such as body temperature and movement, with immediate data transmission to site safety supervisors for necessary action.
10.10 Sensors
Temperature and oxygen sensors are used to raise the efficiency of monitoring and to recognize and identify dangers on the site by sending warning signals in the event of an emergency, so the site security specialist can deal with the risks [16].

XI. Warning systems

Various warning systems, such as those used in highway construction, are employed to alert workers of potential hazards. Different technologies can be used based on project risks. For example, laser scanners or drones can be used to survey the site for creating a BIM model. Additionally, BIM technology and virtual reality can simulate the construction process to identify safety hazards. Safe structural design, like scaffolding and shoring systems, is essential for on-site safety.

XII. Safety Management Problems in Kuwait

There are many problems related to security and safety management in the construction sector in Kuwait, and it is a joint responsibility between contractors, consultants, and government authorities. It has been observed that problems arise due to the following reasons [17]:

- Unorganized work.
- Weak record-keeping and incident reporting system.
- Extensive use of foreign labor.
- Extensive use of subcontractors.
- Lack of safety regulations and legislation.
- give low priority to safety.
- The small size of most construction companies.
- Competitive Bidding.
- Extreme weather conditions during the summer.
- Contracting companies are not responsible for paying accident compensation to workers, as insurance companies that are not interested in adopting safety procedures on-site pay it.

The safety issues in Kuwait highlight inadequate safety management at construction sites due to heavy reliance on subcontractors, small companies, and foreign labor. Large companies also overlook safety costs when applying for tenders, and there is a lack of realistic records monitoring site accidents, resulting in low on-site safety management priority.

XIII. Benefiting from previous studies and what the current study adds

The research framework, methodology selection, and research tool were guided by previous studies and modern technologies in safety management. The study focuses on the impact of applying modern technologies in defining risks and improving safety management plans in construction sites, particularly in Kuwait.

XIV. Target population and sampling of the questionnaire

Research population includes engineering professionals in the construction industry in Kuwait. Research sample includes specialist in many engineering branches and safety management.

XV. Questionnaire design

According to the results of previous studies that were presented on the modern technologies in safety management, a two-part questionnaire was prepared, where the first part includes respondent's demographic data, while the second part is includes (**16**) questions to investigate awareness level of the modern technologies in safety management, benefits of applying these technologies, and barriers against its application in Kuwait. The questions were initially defined, and then the final questionnaire was formulated and prepared. The research contains various questions to achieve its objectives and obtain all the required data to extract the results and list the necessary recommendations to address the research problem questionnaire questions were formatted using the five-point Likert scale with some common sets of response categories called quantifiers to facilitate understanding as shown in table (1)

Table (1) The used quantifiers for the rating scale (the five-point Likert scale)

Field	**Level of response**				
Awareness level of modern safety technologies in Kuwait	Never	Little	Somewhat	Much	Very much
The importance and advantages of applying modern safety technologies	Unimportant	Of little importance	Moderately important	Important	Very important
Barriers of modern safety technologies application	Very weak	Weak	Average strength	Strong	Very strong
Scale	1	2	3	4	5

XVI. Questionnaire revision

The questionnaire was revised and refined through the following stages:

16.1 Face validity

Face validity was used to ensure the initial validity of questionnaire. Therefore, it has been assessed by safety management experts in the construction industry. The required modifications were made to the questionnaire.

16.2 Pre-testing the questionnaire

The survey question has been reviewed by professionals in the construction industry to ensure that the questions are clear and easy to understand and that the wording of the questions is not ambiguous.

16.3 Pilot study

pilot study was carried out to test all survey steps. It was done by distributing and collecting 30 copies of the questionnaire. The results were analyzed using (SPSS) program to estimate the following:

- Statistical validity of the questionnaire.
- Reliability of the questionnaire by Cronbach's Coefficient Alpha method.

16.3.1 Statistical validity of the questionnaire

Two statistical tests were applied to ensure the statistical validity of the questionnaire as follows:

Internal validity test

Internal validity test was carried out by measuring the Pearson correlation coefficients between each item in one field and the whole filed. Tables (2 , 3 & 4) show the correlation coefficient for each item in each field to the whole field.

Table (2) correlation coefficient for each item in the first field

Number	**Item**	**Pearson coefficient**	**P-value**
A1	I have a good idea about modern technologies of project safety management	0.748	0.01
A2	Construction workers in Kuwait have an idea about modern technologies of project safety management	0.753	0.01
A3	My organization applies modern technologies of safety management in the construction field	0.761	0.01
A4	I use 3D models to develop a project safety management plan	0.782	0.01
A5	I use software like Revit to simulate project safety	0.754	0.01

Table (3) correlation coefficient for each item in the second field

Number	**Item**	**Pearson coefficient**	**P-value**
B1	Improving hazard recognition and identification	0.816	0.01
B2	Reducing on-site hazards	0.772	0.01
B3	Improving the site safety management plan	0.82	0.01
B4	Enhancing awareness of risks on-site	0.789	0.01
B5	Enhancing communication between employees to avoid risks	0.832	0.01
B6	improving the working environment and adhering to safety instructions	0.879	0.01
B7	improving the efficiency of inspection of safety procedures	0.806	0.01
B8	Helping solve safety problems in the construction sector	0.718	0.01

Table (4) correlation coefficient for each item in the third field

Number	Item	Pearson coefficient	P-value
C1	High cost of applying modern safety technologies	0.721	0.01
C2	Lack of awareness of construction workers about the importance of applying modern safety techniques	0.764	0.01
C3	weak specifications and requirements related to safety in the construction sector in Kuwait	0.782	0.01
C4	Lack of trained workers to use modern technologies in construction	0.705	0.01
C5	Refusal of construction companies to adopt new technologies related to safety	0.719	0.01
C6	Small size of most construction companies in Kuwait	0.759	0.01
C7	Relying on unqualified subcontractors in the construction sector in Kuwait	0.741	0.01
C8	Lack of accident records at the sites, which reduces the importance of updating safety management techniques	0.752	0.01
C9	Weak safety management in construction projects mostly in Kuwait	0.741	0.01
C10	Low priority of safety management in the construction sector in Kuwait	0.763	0.01

It can be concluded from tables that the correlation coefficient of each item to its field are significant at p-value = 0.01; so the questionnaire is internally consistent, and valid to measure all questionnaire items.

Structure validity test

Structure validity test ensure the validity of each field and whole structure. it was done by measuring the correlation coefficient between one field and whole questionnaire. Tables (5) show the correlation coefficient for each field to whole questionnaire.

Table (5) correlation coefficient for each field to whole questionnaire

Number	Field	Pearson coefficient	P-value
F1	Awareness level of modern safety technologies in Kuwait	0.681	0.01
F2	The importance and advantages of applying modern safety technologies	0.708	0.01
F3	Barriers of modern safety technologies application	0.701	0.01

It can be concluded from table that the correlation coefficient of each field is significant at p-value = 0.01. Thus, the fields are valid to measure questionnaire purposes.

16.3.2 Reliability test

Reliability of questionnaire was measured by Cronbach's alpha coefficient test through the SPSS software.
The Cronbach's alpha coefficients were calculated for each field and whole questionnaire. Table (6) shows Cronbach's alpha coefficients for all fields and whole questionnaire.

Table (6) Cronbach's alpha coefficients for all fields and whole questionnaire

Number	Field	Cronbach's Alpha (Cα)
F1	Awareness level of modern safety technologies in Kuwait	0.730
F2	The importance and advantages of applying modern safety technologies	0.917
F3	Barriers of modern safety technologies application in Kuwait	0.824
All fields		0.78

The results shows that Cronbach's alpha coefficients of fields range from 0.73 and 0.917, while reliability of all fields equals 0.78, which ensures the reliability of the questionnaire.

XVII. Respondents' profiles

(60) specialists in the construction industry in Kuwait have filled out the questionnaire. Figure (3) shows the distribution of questionnaire respondents according to their field of work.

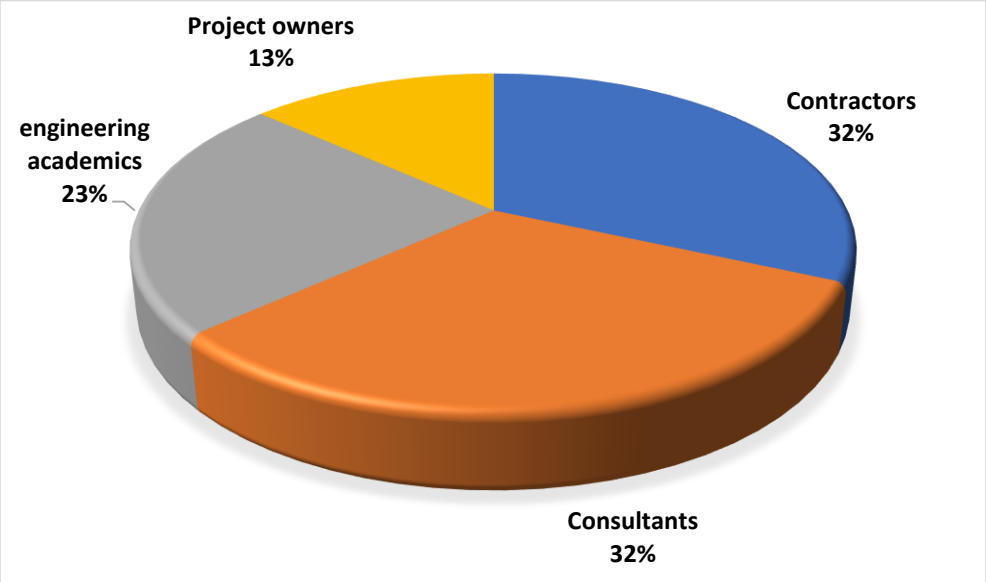

Figure (3) the distribution of questionnaire respondents according to their field of work

XVIII. Study Analysis

18.1 First field (Awareness level of modern safety technologies in Kuwait)

The initial section consists of 5 items measuring the awareness level of modern safety technologies in Kuwait. SPSS software was used for analysis. Mean, standard deviation, and agreement level were calculated for each item to determine the overall trend. Table 7 displays the statistical analysis for this section.

Table (7) statistical analysis of the first field

Number	Item	Mean	SD	Agreement level	P-value
A1	I have a good idea about modern technologies of project safety management	2.85	0.97	Moderate	0.01
A2	Construction workers in Kuwait have an idea about modern technologies of project safety management	2.43	0.778	Low	0.01
A3	My organization applies modern technologies of safety management in the construction field	2.51	0.91	Low	0.01
A4	I use 3D models to develop a project safety management plan	2.03	0.98	Low	0.01
A5	I use software like Revit to simulate project safety	2.00	0.99	Low	0.01
All statements		2.36		Low	

From the statistical analysis of the first field shown in the table, the following results can be concluded:

- The respondents have a good idea of the modern techniques of project safety management which ensure the reliability of the questionnaire.
- Low awareness level of modern safety technologies among workers in the construction industry in Kuwait.
- Low implementation of technologies related to the safety management in the contracting companies in Kuwait.
- The low level of application of modern safety techniques at the level of consultants, as the results showed the lack of use of 3D and simulation programs software such as (Revit) despite their availability.
- In general, there is low awareness level of modern safety technologies in Kuwait among workers, contractors, consultants, and related organization.

Figure (4) shows distribution of first field items according to the mean.

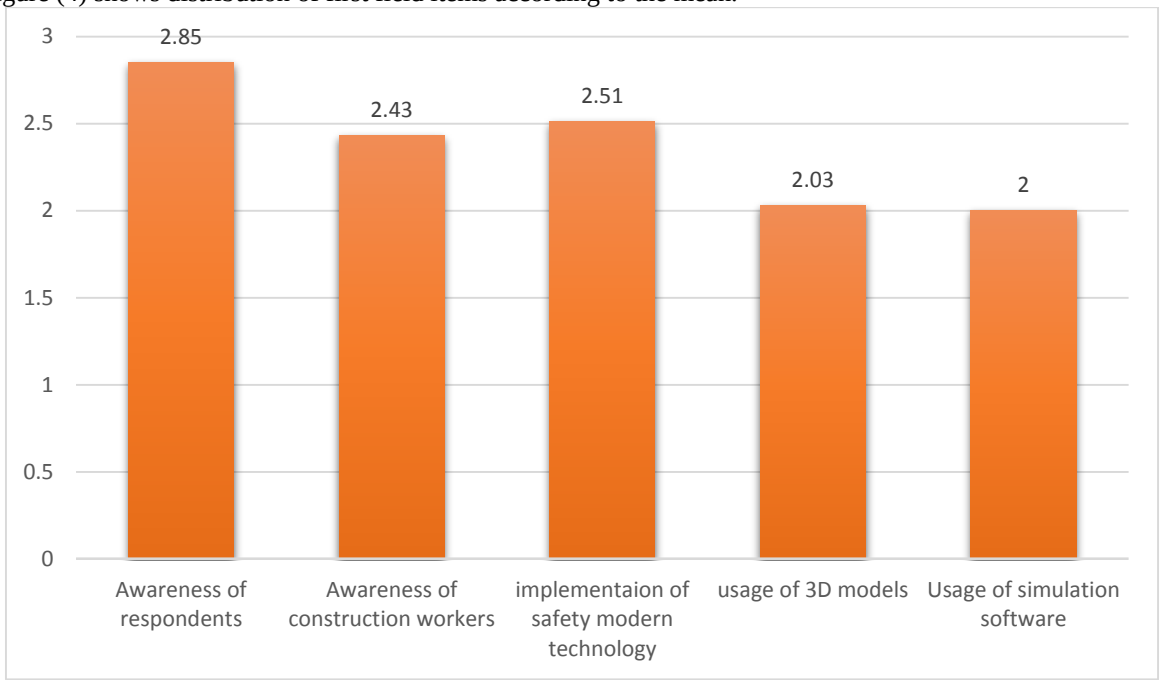

Figure (4) distribution of first field items according to the mean

18.2 Second field (The importance and advantages of applying modern safety technologies)

The second field contains (8) items to measure the importance of applying modern safety technologies in Kuwait. The analysis was done using (SPSS) software. Mean, standard deviation, relative importance index, importance level, and rank were calculated for each item to arrange the importance items and estimate the general importance level of all statements. Table (8) shows statistical analysis of the second field (The importance and advantages of applying modern safety technologies).

Table (8) statistical analysis of the second field

Number	Item	Mean	SD	RII %	Importance level	Rank	P-value
B1	Improving hazard recognition and identification	4.30	0.85	86	High	5	0.01
B2	Reducing on-site hazards	4.38	0.71	87.6	High	2	0.01
B3	Improving the site safety management plan	4.25	0.85	85	High	8	0.01
B4	Enhancing awareness of risks on-site	4.27	0.82	85.4	High	7	0.01
B5	Enhancing communication between employees to avoid risks	4.28	0.80	85.6	High	6	0.01
B6	improving the working environment and adhering to safety instructions	4.31	0.81	86.2	High	4	0.01
B7	improving the efficiency of inspection of safety procedures	4.32	0.85	86.4	High	3	0.01
B8	Helping solve safety problems in the construction sector	4.85	0.76	97	High	1	0.01
All statements		4.37		87.4	High		

From the statistical analysis of the second field shown in the table, it can be concluded the high importance of implementation of applying modern safety technologies in construction industry. The order of importance is as follows:

1. Helping solves safety problems in the construction sector.
2. Reducing on-site hazards.
3. Improving the efficiency of inspection of safety procedures.
4. Improving the working environment and adhering to safety instructions.
5. Improving hazard recognition and identification.
6. Enhancing communication between employees to avoid risks.
7. Enhancing awareness of risks on-site.

8. Improving the site safety management plan.

The results indicate the difficulty of solving problems related to safety in construction and reducing on-site hazards by current traditional methods which ensure the high importance of applying safety modern technology in solving safety problems and reducing hazards.

The importance of improving the efficiency of inspection, improving the working environment, and improving hazard recognition is almost at the same level, where there is a necessary need to identify and classify risks to develop a safety plan to avoid them. Modern technology in safety management facilitates safety inspections in construction and makes the work environment safe and more productive as it reduces the effects of on-site accidents on the project's implementation.

The importance of enhancing communication between employees and enhancing awareness of risks on-site are high but the level of importance is lower compared to other items, as it is a natural result of improving the working environment and improving hazard recognition and identification (items 4 & 5).

Figure (5) shows importance of modern safety technology according to RII.

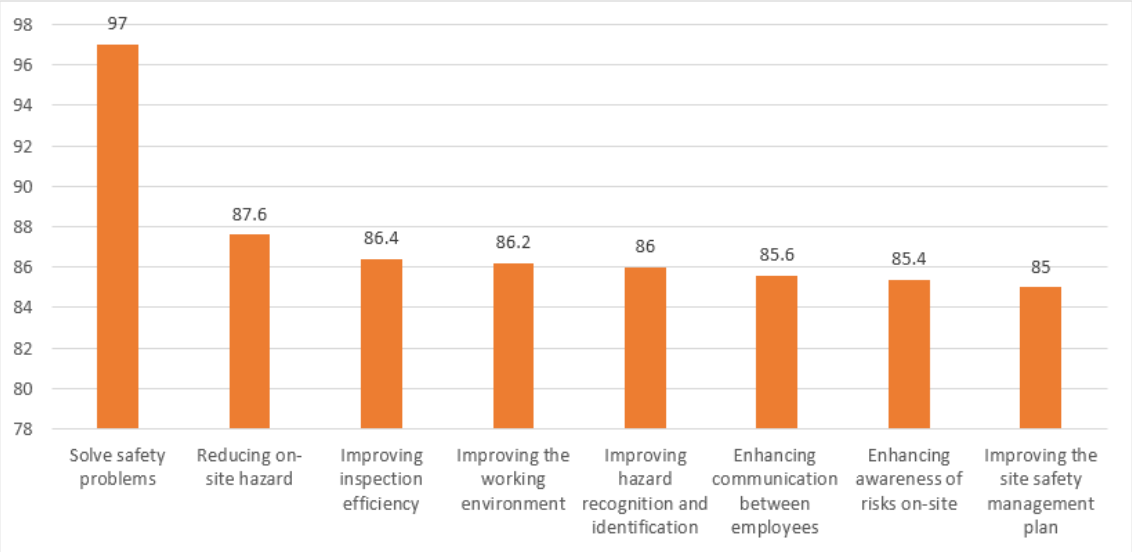

Figure (5) Importance of modern safety technologies according to RII

18.3 Third field (Barriers of modern safety technologies application in Kuwait)

The third field contains (10) items to measure the strength of barrier items that prevent the application of modern safety technologies in Kuwait. The analysis was done using (SPSS) software. Mean, standard deviation, relative importance index, severity level, and rank were calculated for each item to arrange the items according to their impact and estimate the general impact level of all statements. Table (9) shows statistical analysis of the third field (Barriers of modern safety technologies application in Kuwait).

Table (9) statistical analysis of the third field

Number	Item	Mean	SD	RII %	Impact level	Rank	P-value
C1	High cost of applying modern safety technologies	3.5	0.95	70	Strong	10	0.01
C2	Lack of awareness of construction workers about the importance of applying modern safety techniques	3.72	0.98	74.4	Strong	6	0.01
C3	Poor specifications and requirements related to safety in the construction sector in Kuwait	3.51	0.99	70.2	Strong	9	0.01
C4	Untrained foreign labor in the use of safety modern technologies	4.15	0.97	83	V. Strong	1	0.01
C5	Refusal of construction companies to adopt new technologies related to safety	3.57	0.93	71.4	Strong	8	0.01
C6	Low classification of most construction companies in Kuwait	3.67	0.98	73.4	Strong	7	0.01
C7	Relying on unqualified subcontractors in the construction sector in Kuwait	4	0.99	80	V. Strong	2	0.01

C8	Lack of accident records at the sites, which reduces the importance of updating safety management techniques	3.80	0.99	76	Strong	5	0.01
C9	Poor safety management in construction projects mostly in Kuwait	3.84	0.89	76.8	Strong	3	0.01
C10	Low priority of safety management in the construction sector in Kuwait	3.82	0.95	76.4	Strong	4	0.01
All statements		3.76		75.2	Strong		

From the statistical analysis of the third field shown in the table, it can be deduced the strong impact of barriers to the application of modern safety technologies in the construction industry in Kuwait. The barriers are arranged according to RII as follows:

1. Untrained foreign labor in the use of safety modern technologies.
2. Relying on unqualified subcontractors in the construction sector in Kuwait.
3. Poor safety management in construction projects mostly in Kuwait.
4. Low priority of safety management in the construction sector in Kuwait.
5. Lack of accident records at the sites, which reduces the importance of updating safety management techniques.
6. Lack of awareness of construction workers about the importance of applying modern safety techniques.
7. Low classification of most construction companies in Kuwait.
8. Refusal of construction companies to adopt new technologies related to safety.
9. Poor specifications and requirements related to safety in the construction sector in Kuwait.
10. High cost of applying modern safety technologies.

The results indicate that the most impactful barriers were the lack of training of foreign labor in the construction industry and the reliance on unqualified subcontractors which led to poor application of safety management in construction projects. Whereas poor safety specification and the high cost of implementing modern safety technologies had the least impact on application. It may indicate the greater importance of the impact of human resources on the application compared to financial resources and specifications as most companies involved in construction in Kuwait are rated low, in addition to the reliance on unqualified subcontractors and untrained foreign labor.

The low priority of safety management and the lack of accident records at the sites had almost the same effect on implementation as a result of poor safety management on construction projects that ranked higher.

It is worth noting that one of the reasons for the low priority of safety management in projects is that insurance companies cover site accidents without conducting a good examination and inspection of safety requirements, as they are not qualified to do so.

Lack of awareness of construction workers about the importance of applying modern safety techniques had strong impact on modern safety technology implementation; so there is a direct relationship between awareness and adoption of modern safety technology.

Most companies are satisfied with the current procedures and refuse to adopt any development that requires an increase in costs in addition to the training and development time required, especially in the absence of an urgent need for development.

Figure (6) shows barriers of modern safety technologies according to RII.

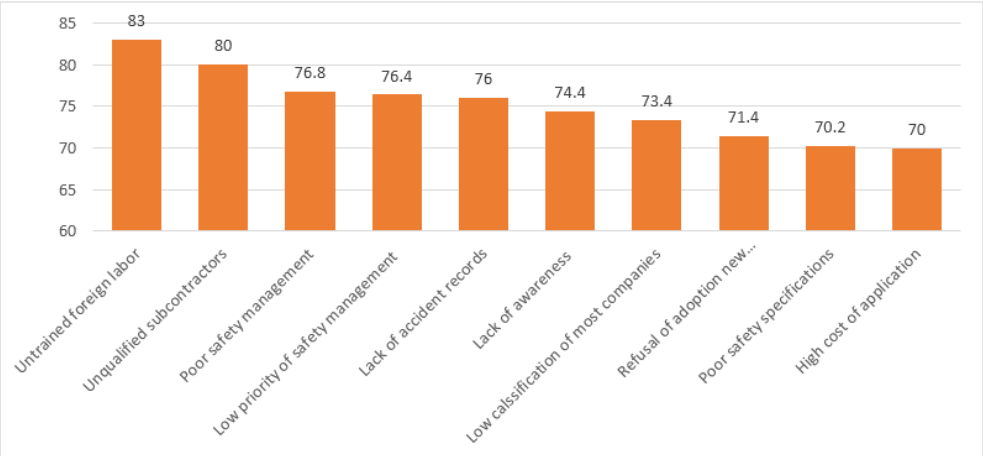

Figure (6) Barriers of modern safety technologies according to RII

XIX. Conclusions of the research

According to analysis of collected questionnaires, the following conclusions were reached:

Low awareness of modern safety technologies among construction workers in Kuwait has led to limited implementation in contracting companies. The study found low application of modern safety techniques among consultants, with little use of 3D and simulation software like Revit. Overall, there is a low priority for safety management technology, leading to reduced interest in modern safety technology.

The results showed the high importance of the implementation of modern safety technologies in the construction industry due its benefits and advantages. The importance of modern safety technologies according to questionnaire results are arranged to

- *Help solve safety problems and reduce on-site hazards*
- *Improving the efficiency of inspection of safety procedures.*
- *Improving the working environment and adhering to safety instructions.*
- *Improving hazard recognition and identification.*
- *Enhancing communication between employees to avoid risks.*
- *Enhancing awareness of risks on-site.*
- *Improving the site safety management plan.*

1. The results indicate the difficulty of solving complicated problems related to safety in construction and reducing on-site hazards by current traditional methods which ensure the high importance of applying modern safety technology in solving safety problems and reducing hazards.
2. The importance of improving the efficiency of inspection, improving the working environment, and improving hazard recognition is almost at the same level, where there is a necessary need to identify and classify risks to develop a safety plan to avoid them.
3. Modern technology in safety management facilitates safety inspections in construction and makes the work environment safe and more productive as it reduces the effects of on-site accidents on the project's implementation.
4. The importance of enhancing communication between employees and enhancing awareness of risks on-site are high but the level of importance is lower compared to other items, as it is a natural result of improving the working environment and improving hazard recognition and identification.
5. Strong impact of barriers to the application of modern safety technologies in the construction industry in Kuwait generally.
6. The barriers to the application of modern safety technologies are arranged as follows:

- Untrained foreign labor in the use of safety modern technologies.
- Relying on unqualified subcontractors in the construction sector in Kuwait.
- Poor safety management in construction projects mostly in Kuwait.
- Low priority of safety management in the construction sector in Kuwait.
- Lack of accident records at the sites, which reduces the importance of updating safety management techniques.
- Lack of awareness of construction workers about the importance of applying modern safety techniques.
- Low classification of most construction companies in Kuwait.
- Refusal of construction companies to adopt new technologies related to safety.
- Poor specifications and requirements related to safety in the construction sector in Kuwait.
- High cost of applying modern safety technologies.

7. Most impactful barriers to modern safety application were the lack of training of foreign labor in the construction industry and the reliance on unqualified subcontractors which led to poor application of safety management in construction projects.
8. Poor safety specification and the high cost of implementing modern safety technologies had the least impact on application. It may indicate the greater importance of the impact of human resources on the application compared to financial resources and specifications as most companies involved in construction in Kuwait are rated low, in addition to the reliance on unqualified subcontractors and untrained foreign labor.
9. The low priority of safety management and the lack of accident records at the sites had almost the same effect as modern technologies application barriers.
10. Insurance companies cover site accidents without conducting a good examination and inspection of safety requirements as they are not qualified to do so.
11. Lack of awareness of construction workers about the importance of applying modern safety techniques had strong impact on modern safety technology implementation. So, there is a direct relationship between awareness and adoption of modern safety technology.

12. Most companies are satisfied with the current safety procedures and refuse to adopt any development that requires an increase in costs in addition to the training and development time required, especially in the absence of an urgent need for development.
13. Contracting companies neglect to allocate an adequate budget for safety management in construction tenders, which leads to a low level of safety management in projects.

XX. Recommendations

Based on the research results, the recommendations are as follows:
1. Training and qualifying construction workers on modern safety technologies through the following methods:

- Integrating modern safety technologies into training curricula in engineering institutes and colleges and specialized academic institutions.
- Cooperating with relevant companies qualified to provide the necessary technical support.
- Providing specialized and accredited training courses in this field.

2. The society of engineers and specialized civil institutions should spread awareness about modern safety technologies by holding workshops, training courses and events.
3. Providing governmental support for modern safety technologies by issuing mandatory rules stipulating their use in large and special projects to obtain approvals and licenses from municipalities and relevant government agencies, then gradually application to the rest of the projects.
4. Taking the safety management plan into account when comparing the bids of contracting companies in government tenders.
5. Encouraging companies and institutions in the construction sector to apply modern safety technologies after completing the necessary preparations for the application, such as training, technical support, programs, and rehabilitation for workers.
6. Activating the role of regulatory authorities, such as the municipality, in inspecting safety management in construction sites.
7. Site insurance companies should contract with construction safety management consultants to check site safety plans and conduct a good on-site inspection.
8. Provide the necessary financial resources to start the application of modern safety technologies, technical support for institutions, and choose appropriate technologies for application.
9. Adopting a safety management plan before starting work on the site, with the need to have a record of accidents and periodic safety reports.
10. Supporting more studies related to modern safety technologies to choose the most suitable for application according to the nature of the construction sector in the State of Kuwait.

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