

Evaluation of Documentation System in Iraqi Construction Projects

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ABSTRACT

In Iraq, the construction industry is considered one of the main sectors that contribute strongly to the Iraqi economy. Documentation is a process of collecting documents from past and current works of corporations, then archiving and classification of information to become easy and useful for reuse in the future. The aim of this study is to investigate the reality of documentation in the Iraqi construction industry and how to improve archiving and classification of documents and how documentation can be useful used in contractor and consultant corporations. This research has been conducted through literature reviews followed by a field survey. 80 questionnaires were distributed to contractors and engineering offices. 70 useful questionnaires were received from respondents with an 87% response rate. The findings indicated that the construction projects in the Diyala governorate are applying documentation. The study found that foundations classified and updating the documents as printed and written files and computer files, but foundations lack computer programs and web models for easy archiving and discovery of documents, documentation system currently used doesn't prevent Confusing, conflict in schemas because they still used Auto CAD and paper documentation. The large number and accumulation of paper documents are also considered the most often problem in the documentation system currently used, and construction projects don't have a database for all information related to projects where, it is limited to cabinets full of paper documents, which causes a waste of time and effort when searching for any document or information related to the projects. The study recommended that companies and foundations have to increase cost and effort consumed in the documentation process, improve the owner and staff abilities in computer and web applications, assign a key person for collection and archiving project documents, establishing an internet website for companies, or using cloud applications for storage of documents and sharing information.

1. Introduction

Construction projects are unique and dynamic in nature, having their own demands of quality, time, and resources. Construction documentation plays a vital role from planning until the demolition.

One component at the heart of a successful project is effective comprehensive project documentation. The nature of a construction project involves the generation of a large amount of information. This information must

be collected and saved not only to describe the unique nature of a construction project but also to preserve memory and serve as a reference or evidential material. The huge volume of items makes control challenging and reliance on filing cabinets full of paperwork and plans that can delay progress. Even electronic communication and storage systems can rarely be efficiently searched. This can make review and approval processes difficult to manage, particularly as working on outdated and poorly coordinated

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information is a major cause of errors, duplication, and rework.

While construction documents haven't changed much since the mid-twentieth century and look much the same as they did decades ago, the technologies for producing, managing, duplicating, and distributing them have evolved greatly since the introduction of photocopying in the 1960s, through fax and the generation of documents facilitated by word-processing and spreadsheet software with personal computers and the introduction of CAD in the late 80s.

However, the transmission of information is still done as hard copies in the mail or using couriers although diskettes can reuse the information in digital form. However, the main change occurred with the Internet in the 1990s, which radically enhanced the possibilities of data transmission and the use of document management systems for project documentation in the construction industry [1]. According to construction industry sources, 70% of project documentation is paper-based, and 50% of all construction projects involve litigation. As a result, the project team becomes preoccupied with creating a plethora of documents in order to effectively communicate and document construction progress [2]. Zhu and Issa, [3] define Construction documents as things that are actually shared among project participants and serve as portals to shared and non-shared project information sources. That it is essential that the construction process demands timely project documentation that can be easily assimilated, as failure to effectively locate and manage documents during a project may result in delay and incorrect decisions. Haddad [4] defines documentation as one of the main ways by which cultural heritage values can be given meaning, understood, defined, and recognized.

Gangane et al., [5], conducted a global survey to assess the impact of construction documents and records on project management. 103 responses were recorded from Qatar, the United Arab Emirates, the United States, Kenya, and a number of Indian cities. It can be summarized that the process of documentation and record-keeping is an integral part of the company concerned in order to avoid overruns of both time and cost. Efficient recordkeeping

and documentation aid for the management of risk relating to process, legal, material, and quality. Abdul Kareem, [6] suggested that problems related to the processes of documentation, updating information, and following up construction projects in Iraq that observed by the parties involved in a number of construction companies exist but are not so big because most companies and projects are not big enough, also this study concludes that there is a need to using and apply information technology to overcome these problems .Rajab,[7] distributed a questionnaire for collecting information from contractors and engineering offices to investigate the use of documentation in the Gaza Strip construction industry. This study found out that the unstructured graphic files and unstructured text data files such as Bill of quantity, contracts with the owner, inspection forms, material, and soil testing reports, subcontractor and supplier agreements, meeting minutes, and letters received and sent were the most important documents collected by companies. Unstructured multimedia files such as video files and sound records and safety, environment reports were the less important documents collected. The Companies classify documents as printed and written files, as well as computer files, but they lack computer programs and web models for easy document archiving and discovery. Furthermore, the procurement and construction phases were found to be the most beneficial from archived documents. The pre-planning phase was less phase exploited of archived documents. Finally, the study discovered that the company owner, project manager, and office engineer are most users of documentation, with a small number of site engineers.

According to a survey Edwards [8], documents are used to process up to 80% of corporate information. The total number of documents related to a single building structure has also been estimated to be on the order of 10,000 [9]. As a result, the construction process necessitates timely project documentation that can be easily assimilated. Failure to locate and manage documents effectively during a project can cause delays and incorrect decisions [10]. According to Abd and Khamees [11], lack of

appropriate documents, change orders and as a built-drawing for existing buildings is very common. Because current documentation methods do not lend themselves to managing the continuous changes to buildings, therefore researchers aim to detect conflicts between schemes and reality in order to configure a document based on reality using BIM [11].

Existing buildings and facilities contain relatively static data. The traditional data storage method is 2D system, which is paper documents, CAD drawings, or PDF files. The storage method system is fragmented and inefficient when it comes to retrieving and updating the parameters of a piece of the facility or equipment. Traditional documentation method sometimes fails to serve in managing the development, rehabilitation and renovation of existing buildings. The lack of appropriate documents, change orders. To address the challenges of life-cycle management of buildings because current documentation methods do not lend themselves toward managing the continuous changes to buildings [12]. In addition to that, Iraqi Construction projects suffer from the loss of many construction documents. There is a dearth of research on the documentation of construction projects in Iraq although this would have significant benefits in addressing the problems related to project documentation, clarity, conflicts, and claims. Accordingly, this paper examines the reality of documentation systems in the constructions project.

This research aims to evaluate of documentation system in Iraqi construction projects. And some of objectives:

- To identify methods of archiving documents in construction projects.
- To identify documents collection, archiving methods of documents.
- To know the quality of the documentation system used in construction projects.

The paper is structured as follows: Firstly, a literature review has been provided about documentation in the construction industry. Secondly, the research methodology adopted has been discussed, and, thirdly, the findings that emerged from the questionnaire were presented, discussed, and analyzed revealing the reality of documentation in construction projects in Iraq. Finally, the conclusions are drawn.

2. Methodology

In this study, the researcher used the questionnaire method as it includes questions within two parts that are distributed to know the opinions of the selected sample of experienced engineers in the field of construction projects.

Eighty Questionnaire forms were distributed to engineering specialists and engineering experts in construction project implementation and management in Iraq. However, seventy questionnaire forms were adopted in the analysis and assessed because some of the receipt forms were marginal and imperfect responses or not filled. Table1 shows the distribution of the questionnaire forms.

Table 1: Distribution of forms for the questionnaire

Foundation Name	Distributed	Received
Ministry of Health and Environment	20	17
Diyala Investment Commission	13	13
Ministry of Education - School Buildings Directorate	10	7
Ministry Municipalities and Public Works	17	14
Private sector	20	19
Total	80	70

The researcher used the interview method with the questionnaire distribution where

personal visits and meetings were conducted with each engineer during which they studied

and discussed the contents of the questionnaire form in order to clear up any misunderstandings if the questions were unclear. Second, all responses were thoroughly scrutinized to ensure that the questionnaire form was correctly completed. Finally, to validate the questionnaires' reliability, statistical analysis was performed using the statistical package social science (SPSS) program V.25. In comparison to other methods, such as the online questionnaire, the interview method has a reasonably high response rate and reduces the likelihood of inadequate or inaccurate responses [13].

2.1 Design of questionnaire

Using the descriptive approach, the researcher designed the questionnaire as follows:

- Gathering general information associated with the respondents (respondent name, ministry name, qualification, specialization, years of experience, and age)
- Direct questions about the nature of projects run by institutions, the nature of the documentation system used in projects, and which programs are used in engineering work.
- Open-ended questions with (11) questions about the documentation system currently used in construction projects and the availability of software used for documentation and to provide a central database that can be referenced. A five Likert scale has been used (always, often, sometimes, rarely, never (no)).
- Open-ended questions with (18) questions about the development of the documentation system currently used in construction projects. A five Likert scale was used (completely agree, agree, neutral, disagree, and completely disagree).

First part:

The first axis included (11) questions about the documentation system in construction projects,

Table 3. Shows the analysis of the items of the first axis, the arithmetic mean, and standard deviation for each paragraph from the axis:

Questions about the first part:

- 1- Documentation software for a construction project are available from the planning stage to the operation stage
- 2- The documentation system used in your organization meets the actual need for documenting construction project documents.
- 3- There is a special department or division responsible for document authentication
- 4- Documents are documented for all construction projects and according to their size.
- 5- Feedback is available from the documentation departments or divisions to the projects implemented at the present time.
- 6- A database is available that can be consulted if required
- 7- The documentation system used has a high retrieval speed.
- 8- Ease of exchange and transfer of information between project parties.
- 9- The current documentation system has a high level of security and ensures that documents are not damaged.
- 10- Providing documentation requirements (devices and people with experience) is related to the management and development of the construction project.
- 11- The current documentation system is prone to accidents such as fire, moisture, and electrical fault.

Second part:

The second axis included (18) questions about the quality of the documentation system used in construction projects currently, the questions will explain below. Table 4 shows the analysis of the items of the second axis, the arithmetic mean, and standard deviation for each paragraph from the axis:

Questions about the second part:

- 1- The engineering documentation system currently used reduces errors and conflicts in schemas

- 2- The large number and accumulation of documents in the construction projects currently leads to an increase in time, effort, and costs.
- 3- Having a current engineering documentation system in place helps achieve the desired quality
- 4- Existing engineering documentation contributes to the clarity of information regarding the actual completion of the engineering project.
- 5- The existence of engineering documentation currently reduces cases of arbitrariness and abuse of power or influence.
- 6- The existence of the currently in place documentation system obviates the search or application of new and developed engineering documentation software.
- 7- The decision-making process in the ministries or institutions related to documentation is carried out on a scientific and objective bases.
- 8- The senior management of engineering projects is interested in the opinions and suggestions of employees regarding documentation problems
- 9- Documentation decisions are made in a timely manner without delay.
- 10- The existing documentation system in place helps to achieve constructive accountability.
- 11- The senior management of engineering projects is currently keen on the participation of workers in making decisions related to documentation, as well as the commitment of the aforementioned senior management to support and encourage it.
- 12- The presence of engineering documentation currently applied contributes to reducing cases of illegal profit.
- 13- Personnel working in engineering projects have the necessary authority to make decisions related to documentation.
- 14- The existence of new and advanced engineering software obviates the need to resort to previous engineering applications.
- 15- Non-mandatory engineering documentation in terms of non-obligation to perform it and non-compliance with its observance and application in work is inversely proportional to the quality and effectiveness of the aforementioned documentation.
- 16- The efficiency of the senior management of the company or the engineering project, as well as the provision of the technical staff, its efficiency, and incentives, which is charged with engineering documentation and its follow-up, is directly proportional with the quality and effectiveness of the mentioned documentation.
- 17- The documentation system currently used reduces rework in engineering projects and prevents what weakens it from chaos, improvisation, and lack of coordination between project staff and different administrations.
- 18- The absence of statistics on the results of engineering documentation for previous projects is inversely proportional to the quality and effectiveness of the documentation referred to.

2.2 Sample description

The following figures show the characteristics of the questionnaire sample:

Figure 1 show the percentage of respondents according to work sector where the percentage of public sector equal 72%, private sector equal 28%.

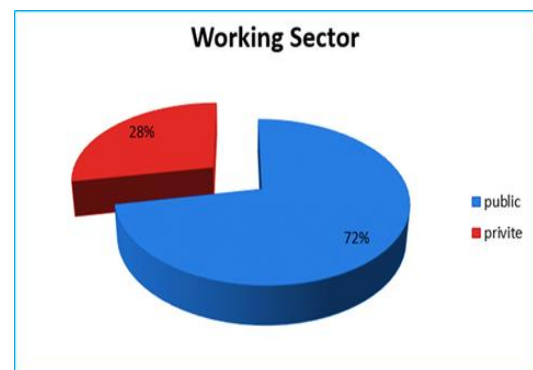


Figure 1. Work sector

Figure 2 shows the academic qualification of respondents where the percentage of Bachelor (79%), Master (15%), Ph.D. (6%).

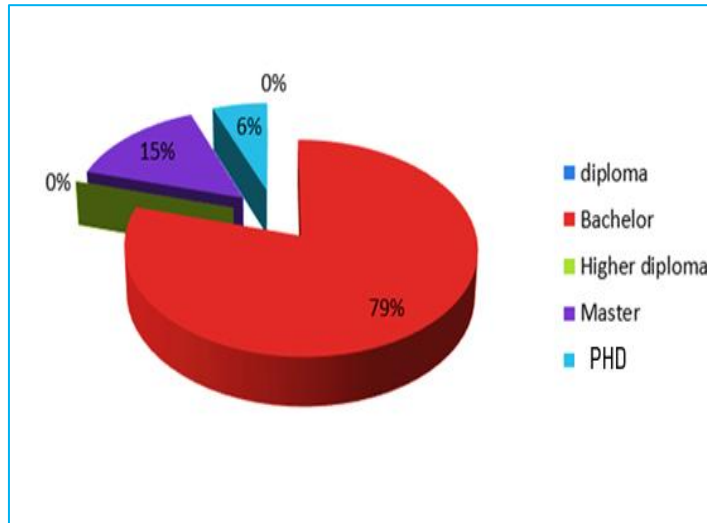


Figure 2. Respondents' educational levels

Figure 3 Illustrates the specialization of respondents where the percentage of Civil Engineer (62%), Architect (4%), Mechanical

Engineer (15%), Electrical Engineer (15%), (12%), and other (4%).

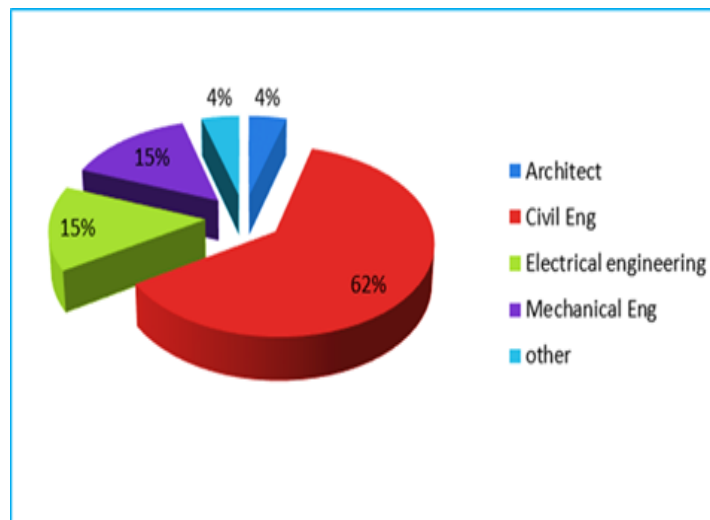


Figure 3. Respondents' specialization

Figure 4 depicts the respondents' group, where the percentages of consultants (13%), designers (9%), project managers (5%), site engineers (63%), contractors (4%), and resident engineer (6%).

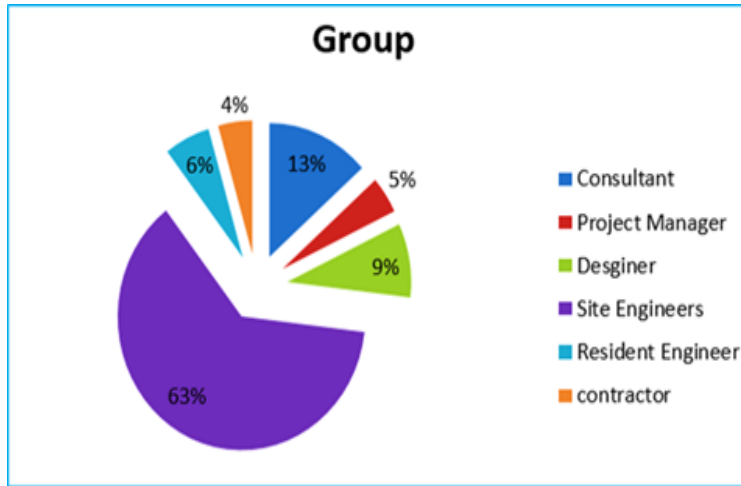


Figure 4. The respondents' group

Figure 5 Illustrates the respondents' practical experience. The percentages are as follows: less than 5 years (15%), 5-10 years (35%), 11-15 years (28%), 16-20 years (6%), more than 20 years (16%).

(35%), 11-15 years (28%), 16-20 years (6%), more than 20 years (16%).

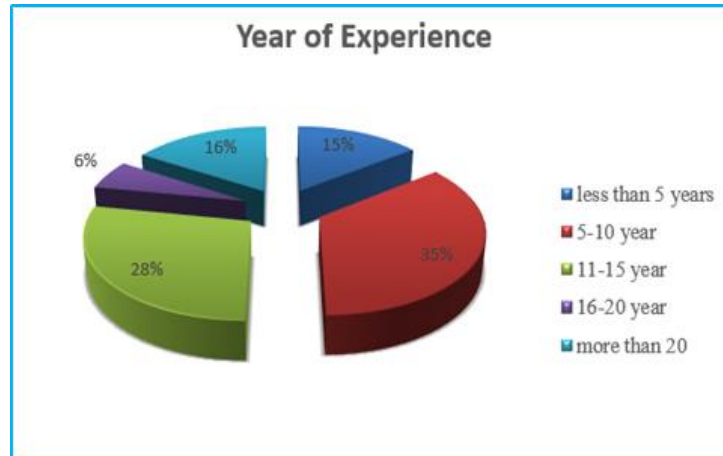


Figure 5. The respondents' practical experience

Figure 6 shows the percentage of documentation types used in construction projects, where the percentage of paper documentation equals 55%, the percentage of electronic documentation equals 4%, and the percentage for both of them equal 41%.

the percentage of electronic documentation equals 4%, and the percentage for both of them equal 41%.

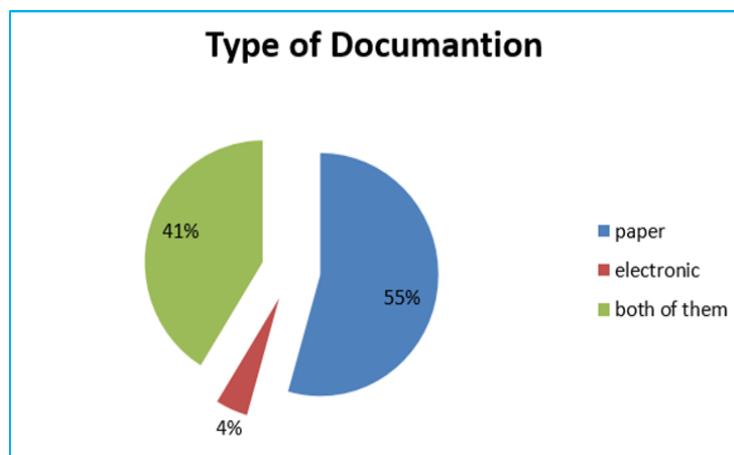


Figure 6. The percentage of documentation types

Figure 7 shows the percentage of project types in which the respondents work, where the percentage of building projects equals 68%, the

percentage of infrastructure projects equals 26%, and the percentage for other equal 6%.

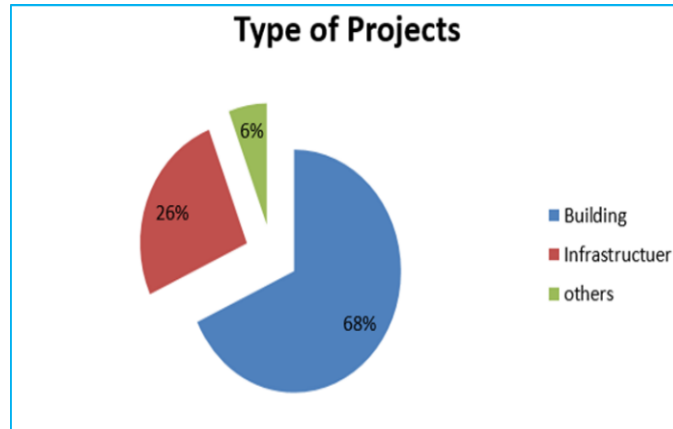


Figure 7. The percentage of project types

2.3 Reliability of questionnaire

One of the most popular methods of calculating reliability is to use the Alpha Cronbach constant, which ranges from 0 to 1 if

the result is close to a value of 1 it indicates a high degree of reliability [14]. The reliability rating based on the Alpha-Cronbach coefficient value is shown in Table 2 below.

Table 2. Reliability Cutoff Values (Yockey, 2016)

Cronbach's alpha	Degree of Reliability
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Un acceptable

The reliability of the questionnaire was measured using Cronbach's alpha coefficient at the axes level, and the results were as follows:

- First Axis: reliability coefficient = 0.764
- The second axis: reliability coefficient = 0.831

From the previous results, it is clear that the questionnaire is stable and valid for measuring the objectives of the study.

3. Results and discussion

From the results in table 3: the results showed that the current documentation system is prone to accidents such as fire, moisture, and electrical fault is the highest percentage of response level according to the point of view of specialists with (mean =4.142, SD=1.011). This high percentage

is attributed to the construction projects' dependence in general on paper documentation, which makes it vulnerable to these accidents, as well as the lack of fire sensors, alarm bells, surveillance cameras, with the absence of large halls dedicated to documentation that enjoyed to international specifications represented in the engineering organization of buildings, where documentation halls lacking adequate lighting and ventilation.

The result about the question the current documentation system has a high level of security and ensures that documents are not damaged according to the point of view of specialists with (mean=1.971, SD= 1.102). This result is consistent with the Iraqi construction projects suffer from Loss of documents due to their manual circulation or failure to return to

their original place, which leads to their loss. This result is in line with (khamees,[12]and Nsaif et al.,[15].

The result about the question a database is available that can be consulted if required is (always = 7.1 %, mean=1.9, SD= 1.229) construction projects suffer from lack of a centralized database due to lack of application of information technology, and on the other hand, this result agrees with what Abdul Kareem, [6] who recommended by the need to exist and apply information technology IT in the field of documentation in Iraqi construction projects to overcome these problems.

The result about the question “documentation software for a construction project is available from the planning stage to the operation stage” is (always = 5.1 %, mean=1.642, SD= 1.179). where construction projects lack the use of sophisticated software to document and archive construction documents and non-use of cloud applications it may be because of the high cost of some programs or the strong resistance to change and engineers stuck to the familiar documentation system, this result agrees with researchers from other countries Rajab [7].

The results showed that “The documentation system used has a high retrieval speed.” is the lowest result according to the point of view of specialists with (mean=1.6, SD=1.068).This result is consistent with the Iraqi construction projects suffer from problems of retrieving documents and information due to Total reliance on the capabilities of individuals in storage and retrieval operations, which lead to wasting time and effort and not reaching data, and documents in a timely manner to take action or a decision.

According to table 4:

The results showed that “The large number and accumulation of documents in the

construction projects currently leads to an increase in time, effort, and costs” is the highest percentage of response level according to the point of view of specialists with (completely agree = 67.1%, mean =4.457, SD=1.031). Where construction projects suffer from document accumulation, which makes it difficult to control and access documents because of the huge number of papers that could reach thousands, this causes waste of time and effort when searching for any document or information as well as the cost due to consumption a large number of papers. This result also agrees with researchers from other countries (Turk, et al., [9], (Finch et al., [10] and (Zhu& Issa,[3].

The result about the question “The engineering documentation system currently used reduce errors and conflicts in schemas ” is (mean=2.071, SD= 1.2.07) this result can be considered weak, where the documentation method in construction projects is a 2D system, which is paper documents, CAD drawings, or PDF files. This method does not give a full visualization of the building, and doesn't discover the conflicts between the different disciplines, and using modern software for this purpose will reduce these conflicts and errors., and using modern software for this purpose will reduce these conflicts and errors. This result is in line with Abd & Khamees [11

The lowest result is “The existence of the currently in place documentation system obviates the search or application of new and developed engineering documentation software” with (mean = 1.485 and SD= 0.775) according to the point of view of specialists, and this result is consistent with the findings of other researchers (Rajab, [7] and Khamees [12].

Table 3: Statistical analysis of items for the first part

Item	Percentages of response levels%					Mean	S.D
	always	often	Some times	Rarely	Never (NO)		
Q1	5.7	4.3	10	8.6	71.4	1.642	1.179
Q2	5.7	4.3	15.7	15.7	58.6	1.828	1.191
Q3	11.4	5.7	14.3	2.9	65.7	1.942	1.443
Q4	14.3	52.9	15.7	12.9	4.3	3.600	1.027
Q5	7.1	8.6	15.7	22.9	45.7	2.085	1.271
Q6	7.1	4.3	14.3	20.0	54.3	1.900	1.229
Q7	2.9	7.1	5.7	15.7	68.6	1.600	1.068
Q8	5.7	20.0	38.6	17.1	18.6	2.771	1.144
Q9	2.9	7.1	20.0	24.3	45.7	1.971	1.102
Q10	40.0	25.7	25.7	7.1	1.4	3.957	1.041
Q11	48.6	25.7	18.6	5.7	1.4	4.142	1.011

Table 4: Statistical analysis of items for the second part

Item	Percentages of response levels%					Mean	S.D
	Completely agree	agree	Neutral	disagree	Completely disagree		
Q1	8.6	5.7	7.1	41.4	37.1	2.071	1.207
Q2	67.1	24.3	1.4	1.4	5.7	4.457	1.031
Q3	7.1	11.4	2.9	37.1	41.4	2.057	1.249
Q4	5.7	20.0	15.7	35.7	22.9	2.500	1.212
Q5	4.3	8.6	18.6	42.9	25.7	2.942	6.392
Q6	1.4	2.9	0	34.3	61.4	1.485	0.775
Q7	1.4	5.7	14.3	22.9	55.7	1.742	1.002
Q8	2.9	11.4	12.9	24.3	48.6	1.957	1.160
Q9	4.3	14.3	5.7	35.7	40.0	2.071	1.195
Q10	1.4	18.6	12.9	50.0	17.1	2.371	1.023
Q11	4.3	11.4	15.7	51.4	17.1	2.342	1.034
Q12	11.4	5.7	11.4	32.9	38.6	2.185	1.321
Q13	5.7	34.3	14.3	32.9	12.9	2.871	1.190
Q14	14.3	15.7	10.0	24.3	35.7	2.485	1.471
Q15	55.7	25.7	11.4	4.3	2.9	4.271	1.020
Q16	67.1	17.1	8.6	5.7	1.4	4.428	0.971
Q17	7.1	12.9	7.1	40.0	32.9	2.214	1.238
Q18	52.9	34.3	7.1	4.3	1.4	4.328	0.893

4. Conclusion

After investigation of the reality of documentation in construction projects and analysis of responses, the researcher concluded that:

- 1- There is a weakness in the documentation system in construction projects, especially in the public sector, where foundations still use paper documentation only and folders of stacked paper documents, most of projects do not have a central database, do not use advanced engineering programs for documentation, and there are no special departments and divisions for documentation.
- 2- The paper documentation system currently used in projects is exposed to accidents such as fires, moisture, and electrical faults.
- 3- The methods used to store and document building data are a two-dimensional system, which is paper documents, AutoCAD drawings, and PDF files, as it is a fragmented and ineffective system when it comes to retrieving and updating information about an element of the facility and does not give a complete visualization of the building.
- 4- It was found that the sheer volume of documents in construction projects makes control challenging and reliance on filing cabinets full of paperwork and plans can delay progress.
- 5- Low interest of engineering staff and senior management of engineering projects in documenting and archiving construction project documents.

Recommendations

- The need to pay attention to documenting construction projects by institutions working in the construction sector in Iraq and to follow advanced methods and programs in documenting construction project documents, and improve the owner and staff abilities in computer and web applications, assign a key person for collection and archiving project

documents, establishing an internet website for companies, or using cloud applications for storage of documents and sharing information.

- Providing special departments or divisions for documentation and archiving of construction projects.
- Developing the traditional archive and not abandoning it or neglecting it, and considering the electronic form as a support rather than a substitute, and keeping the paper copy of the archive for reference when needed, due to its legal argument.

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