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Factors Causing Reworking on Construction Projects and How to Manage

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***Abstract* - In light of the growing need to improve quality in construction projects, it is vital to limit and eliminate reworks, which can be accomplished by understanding their origins and identifying their causes. So, in terms of causes and categories, this study investigates reworking local projects. Data was gathered through a questionnaire that identified several variables that contributed to the reworking. Human, coordination and communication, technical and engineering, owner, project management, contract, and design was the seven major headings for these variables. To group the variables into core factors, the responses were further condensed using factor analysis. According to the findings of this study, the causes of reworks were inexperienced staff, project execution after a long period of study, a short term provided by the owner, poor whole project management, and insufficient study or project before bidding, as well as separation of design and execution Finally, this study concluded that a thorough commitment to quality management policy implementation will result in fewer reworks on building projects.**

Keywords: Rework, Construction Projects, Factor Analysis, Project Management.

I. INTRODUCTION

The building and construction sector is one of the important sectors that can effectively contribute to national development, and it contributes to total fixed capital, GDP and national employment. However, this sector is sensitive to changes and financial turmoil, and the construction environment is constantly changing, in addition to the continuous flow of new conditions and circulars from relevant government agencies, and the intensity of competition between companies to win projects, which increase the importance of the need for improvement and development in this sector.

Achieving quality in the construction industry has important economic repercussions that lead to a reduction in construction costs by eliminating the costs of correcting defects and errors and the costs of re-executing some non-conforming works, achieving customer satisfaction (the owner), and reducing maintenance costs, which contributes to increasing the economic life of the facilities and earns the entity Implementing trust in its work and increases its share in the labor market and allows it the possibility of competition and continuity [1].

Previous studies have shown that the cost of re-work represents the largest percentage of the cost of non-conformity that leads to re-design or re-implementation of construction in violation of specifications, as:

- 30% of the building after Currency.
- The voltage used is 40-40% of the known voltage.
- The lost items were recorded at a rate of no less than 10% [2].

1.1 The importance of the research and its objectives:

The importance of the research comes from its contribution to understanding the nature of rework, its sources, and causes, and giving the participants in the construction work sufficient information about the impact of rework on the performance of their projects to improve the performance and progress of the projects.

Based on the previous study, this research aims to:

- Defining and evaluating the variables that affect the occurrence of rework in construction projects.
- Pooling the variables within certain groups and deducing the most important factors (factors) that cause re-work.

1.2 Previous literature and reviews on rework

1.2.1 The concept of quality cost:

Quality can be defined following the main requirements of the project, and any deviation from these requirements affects the options of the project, either by accepting in case of conformity or taking corrective actions in case of non-

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conformity [3]. The cost of quality is given by the following relationship [4]:

Quality Cost - Conformity Cost + Non-conformity Cost where the conformity cost is known as the minimum agreement that you need to meet the basic requirements of the owner in the project, while the non-conformity cost includes the total additional amount resulting from the process of re-design or re-design execution of completed and executed works in violation of specifications. Non-conformities need corrective actions, which are actions to remove the causes of the discovered non-conformities or other undesirable situations [4], and most studies now call for improving the quality of operations throughout the building and thus obtaining a high-quality project characterized by: ease of understanding plans - few conflicts between plans and specifications - economical in construction - ease of operation - ease of maintenance [5].

1.2.2 Definition of rework:

Rework represents a new term in the construction dictionary, and it appears when Construction work fails to meet the owner's requirements or when the work performed does not comply with the contract documents and may occur at the design or construction stage and can be in the form of a difference, design error, or omission of elements from the project [6].

It was accepted by researchers and organizations in the field of construction, including The Institute of Construction Works in America defined rework: as field activities that must be completed more than once or activities that remove previously executed work as part of the project [7].From a scientific point of view: it can be known as re-work. Working with unnecessary effort to re-execute the wrongly executed operation the first time [8]. From the point of view of the systems: reworking in a wasteful and active manner with a cost added to the direct and indirect costs of the project [9].

1.2.3 The cost of re-work:

The cost of the defect (defect) is defined as the value of resource consumption as a result of re-executing the defective work, the time of work, materials and equipment consumed to correct it [10]. As for the cost of rework, it is the cost consumed from the point at which the rework incident is known to the time when rework ends, and the activity returns to the original activity, as shown in Figure 1.

Table 1 summarizes the effect of rework on the costs of construction projects according to several studies.

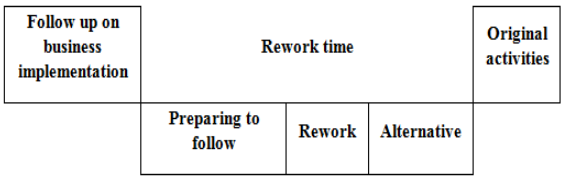

Figure 1: Components of Rework (11)

Table 1: Some summaries of the effect of rework on project costs

Impact	Resource
An American study showed that the average re-work was 4.4% of the cost of the construction phase (structure) only.	[7]
A Malaysian study showed that the cost of rework in building projects may affect an increase of up to 30% of the total project cost.	[2]
An Australian study found that the contribution of rework may reach up to (52%) of the high cost of abuses in projects, and (26%) of them can be attributed to the changes caused by direct rework, and the average direct costs were (6.4%) and the average indirect costs (5.6%) of the value of the original contract.	[12]
This study stated that the cost of re-work may rise to (25%) of the value of the implementation contract, and (10%) of the total project cost.	[8]
A study in Hong Kong showed that the direct rework costs were (16.1%) of the contract value, compared to (4.8%) for the indirect costs. It was also found in a second study in Hong Kong that the direct cost of re-work was (3.5%) of the value of the original contract compared to (1.7%) for the indirect costs.	[10]
An Australian study found that the total cost of re-work was 12% of the value of the original project contract.	[13]

1.2.4 A Glimpse of the Reasons for Rework:

Some research points to many reasons for rework: the main reason can be confusion and confusion, and this is generated from bad information, which is often contradictory, wrong, undocumented, and missing [14].In general, when design defects are discovered at the stage of project implementation, this leads to rework, and this means that most problems are related to the design, such as lack of design quality - lack of design standards - constructability [15].

A group of researchers found that re-engineering work was caused by the owner, changing specifications, design errors, and contracting errors and that reconstructive work is the result of Inappropriate construction techniques or construction management policies [16]. Usually, the increase

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in the extent of the contract will increase the risk of the high cost of projects and increase the possibility of introducing modifications and changes to the executed works [1].

Other factors contributing to rework were also known, including poor design consultancy fees, poor contract documentation, ineffective project planning [8], In addition to poor management practices that may cause rework [4] and the absence of the preparatory phase for work (The strategic stage + management and control) leads to rework due to the lack of specific criteria for the required work, and this was clearly shown in the episode that occurs after the design and the repetition of design modification more than once, which leads to an increase in the time and rework [5]. In the implementation phase, other reasons emerged to re-work, which have an important impact on the cost of the project, which are poor supervision insufficient supervision, bad implementation, selection of an inappropriate subcontractor, acceptance of incorrect work and incorrect work sequence (lack of coordination) [17].This has shown that the changes of the owner after the end of operations and activities were one of the most important reasons for re-work. Change requests due to incorrect planning contribute to an increase in the cost of projects up to 34% and due to wrong information 15% and bad planning methods 15% [14], in addition to Documentation errors (omissions of materials while documenting the contract, errors made during contract documentation), Ineffective use of quality management practices, no time pressure, no poor coordination between design members, - poor planning and coordination of on-site resources [5].

Other research indicated that Rework in construction projects may result from several factors such as quality deviations, poor communication & coordination, changes, errors and omissions [10]. Also, among the factors that cause rework is the lack of commitment to specifications or unclear work specifications [14].The reasons for the responsibility of the customer and the design team to contribute to the rework were incomplete funding during the provision of site investigations, incomplete time and funding attributable to project summaries, low wages for preparing contract documents, Ineffective use of information technology, and bad coordination between members of the design team [2, 13].The reference studies showed that the number of variables that affect re-work can reach a large number exceeding (100) variables, and this constitutes a large area that creates administrative difficulties in controlling and following up. Therefore, it is preferable to manage these variables through careful study and analysis of factors in terms of correlation and overlap, and the mutual influence among them, to shorten them and compile them into specific factors, and this is what you will see in the factor analysis followed in this study.

II. RESEARCH METHODS AND MATERIALS

2.1 Study population and sample

The study population consists of workers in the engineering field in construction and service companies (the General Company for Technical Studies and Consultations in Lattakia, the Directorate of Technical Services in Lattakia, the Military Housing Corporation, the Directorate of Engineering Affairs at Tishreen University, the General Company for Building and construction, a number of private offices) including designers, supervisors, rescuers, project managers, technical monitors, and people who have great experience in projects were directed as much as possible, and the study sample ended with 62 acceptable responses from the questionnaire.

2.2 The search tool

The design of a questionnaire from the reference studies consisted of a large number of variables (100 variables), where they were classified under main axes that express them as shown in Figure 2:

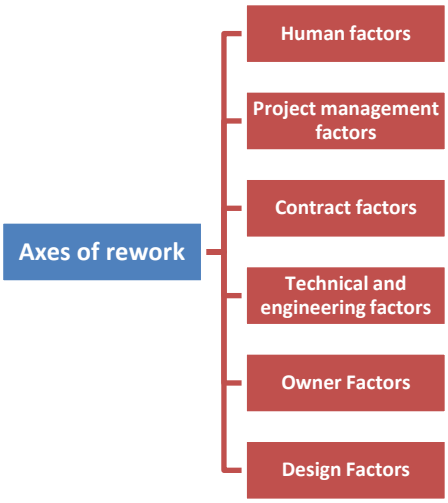

Figure 2: The classification of rework proposed in the research

The respondents were left to select the variables that affect rework and indicate their frequency, using the five-point Likert scale: 5,4,3,2,1, which means: none, rarely, sometimes, often, always, respectively

2.3 Stability of the questionnaire and the validity

Specific numbers of questionnaires were distributed at the beginning to calculate the degrees of validity and reliability, then the reliability test was conducted using Cronbach's Alpha coefficient. Data and stability mean the scale's stability and do not contradict itself. The validity coefficient was calculated by calculating the root of the reliability coefficient, which means that the scale measures what was set for its prey, and

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both stability and honesty are not related to the number of tested variables, but rather to the answers from the questionnaires.

The reliability and validity of all tested variables were studied (the axes combined), and the result was as in Table (2), then for each axis alone. Table (3) summarizes the results of the reliability and validity of the variables according to each axis:

Table 2: Reliability and validity of all tested variables in the research

Number of variables	Reliability	Validity
100	0.964	0.973

Table 3: Summary of reliability and validity of the samples tested in the research

Axis	Number of variables	Stability	Validity
Human factors	13	0.851	0.922
Coordination and communication	11	0.768	0.876
Technical and engineering factors	17	0.871	0.933
Owner	4	0.635	0.797
Project management	26	0.87	0.935
Contract	15	0.851	0.922
Design	14	0.798	0.893

We note from Table (3) the high values of stability and validity for all axes, and depending on it, the questionnaire was distributed extensively to the concerned engineering institutions.

2.4 Data analysis method (practical study)

To arrange the rework variables defined in the questionnaire, the severity index was used, according to the iterations that we obtained from the shy people while preserving the full number of reasons after that factor analysis was applied to the responses to reduce the number of variables to the number less and classify them under specific factors that express them, and by treating the most influential factor (variance) a large percentage of re-work can be reduced.

2.5 Severity Index

Each of the factors has a relative importance index that is used to arrange the variables according to their degree of importance, after it was noted that the most important reasons for rework are based on repetitions, the severity index was implemented using the following equation (2):

$$S.I = \left(\sum_{i=1}^{i=n} \frac{(wifi \times 100)}{n} \right)$$

Where: S.I: Severity index. fi: The frequency of the answer, n: The total number of answers (the number of correct respondents), wi: The weight of each estimate (the assessment on the scale / the number of points on the scale).

2.6 Factor Analysis

Factor analysis is a statistical method aimed at interpreting the wave-correlation coefficients (which It has a statistical significance) between the various variables, which is a mathematical process that aims to simplify the correlations between the various variables included in the analysis, down to the common factors that describe the relationship between these variables and their interpretation.

In other words, factor analysis is a statistical method that works on summarizing a large number of variables into a smaller number known as factors, where each group of variables is associated with only one factor, where the variables in the factor are highly correlated with each other and weakly with the other, provided that the factors explain the largest percentage Possible variation of the original variables or reducing the number of variables in several factors, and these factors can be considered variables in the end and are called indirect variables [18].

Thus, the importance of factor analysis appears as follows:

- To reduce and summarize the variables in a smaller number of the main factors that can explain this phenomenon.
- To highlight the group of latent elements that are difficult to detect, and which can have a role in explaining the relationships between a large numbers of variables.
- Obtaining a new group of variables with a smaller number to partially or completely replace the original group of variables.
- To identify the variables that have significant statistical significance and that require further analysis [19].

To perform the factor analysis, it is usually necessary to go through three basic stages:

1. The R-Matrix correlation matrix is formed to contain the correlation coefficients for all pairs of variables that will be included in the analysis.
2. From the correlation matrix, the factors are calculated, and the most used method is the Principal Components method.

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3. These factors are rotated to make the relationships between the variables and some of these factors as strong as possible. A variation known as varimax, which is a rotation method characterized by maintaining the property of independence between factors, means geometrically that the axes remain orthogonal during the rotation process, and this method aims to rotate the axes in such a way that the variance of the degrees of saturation of each factor is as large as possible.

The meaning of the factors stems from a set of relationships between variables. When explaining the resulting factors, it is extracted from the characteristics of the group of relationships between variables. The function between the original variables and their constituent factors is as in the following equations, and these coefficients are written in the form of a matrix known as the correlation matrix.

$F1 = \alpha 11X1 + \alpha 12X2 + \alpha 13X3 + ... + \alpha 1nXn$
$F2 = \alpha 21X1 + \alpha 22X2 + \alpha 23X3 + ... + \alpha 2nXn$
$F3 = \alpha 31X1 + \alpha 32X2 + \alpha 33X3 + ... + \alpha 2nXn$
....
$Fn = \alpha m1X1 + \alpha m2X2 + \alpha m3X3 + ... + \alpha mn\ Xn,\ m > n$

Where: a: saturation coefficient (correlation), x: variables, amn: saturation of the last variable with the last factor [19].

2.7 Rotation of Axes

If a variable is saturated with two factors, its saturation with the first factor is considered its coordinates on the bad axis, and its saturation with the second factor its coordinates on the samples axis, meaning the first factor is represented by the bad axis and the second factor represented by the samples axis and the emerging point in the coordinate plane (fixed point), then rotating the axes while the point is fixed produces a change in the dimensions.

The point on the two axes is any change in its relation to the two factors, as shown in Figure 3. This is that the correlation represented by the two axes (sense and samples) orthogonal is zero, that is, there is no correlation between the first and second factors, no matter how the position of the two axes changes as long as they remain perpendicular, but the rotation of the axes changes the position of the variable as the exit of its saturation from one factor and its entry into another factor or vice versa, which leads us to the goal of rotation It is the redistribution of saturations of the variables to the factors. This rotation is carried out in several ways, the most famous of which is the Varimax method of orthogonal rotation (the rotation takes place in the positive conventional direction, i.e., counterclockwise).

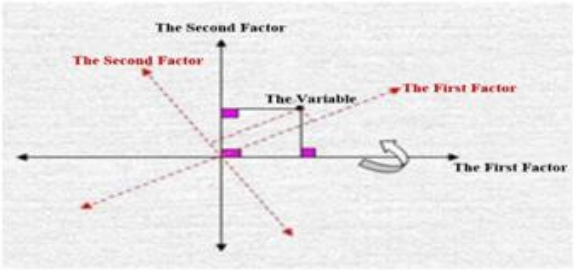

Figure 3: An illustration of the mechanism of rotation of the axes [19]

III. RESULTS

3.1 Graphics for the nominal variables

Statistical graphics were made for the number of years of experience for the respondents, and the percentage of the answers was placed on the chart, Figure 4 shows the respondents' years of experience ranged between (24–31 years), and they constituted 64.81% of the total respondents, and this is what we addressed when distributing the questionnaire (going to people with great experience in projects).

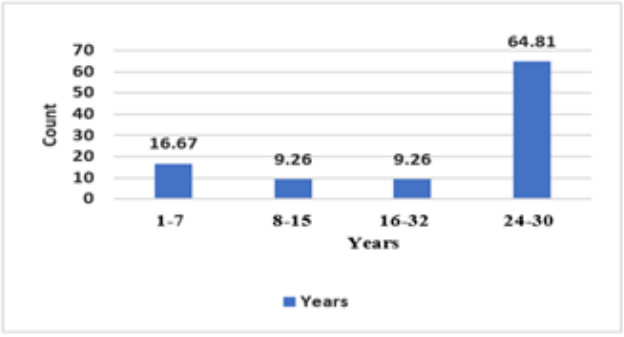

Figure 4: Number of recent years for respondents in the research

As we can see in Figure 5 that most of the respondents were civil engineers and architects, and we note from Figure 6that the field of work for most of the respondents was the implementation of projects, followed by the supervision workers.

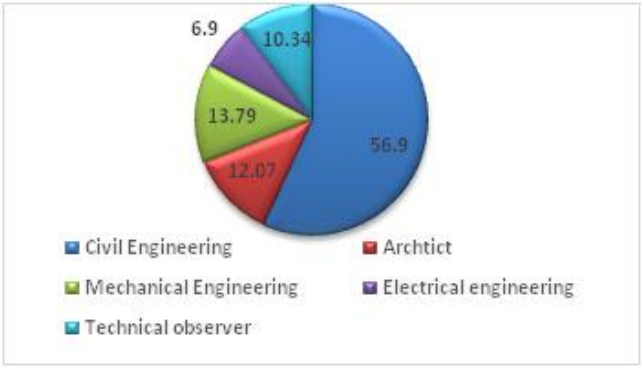

Figure 5: The competencies of the respondents in the research

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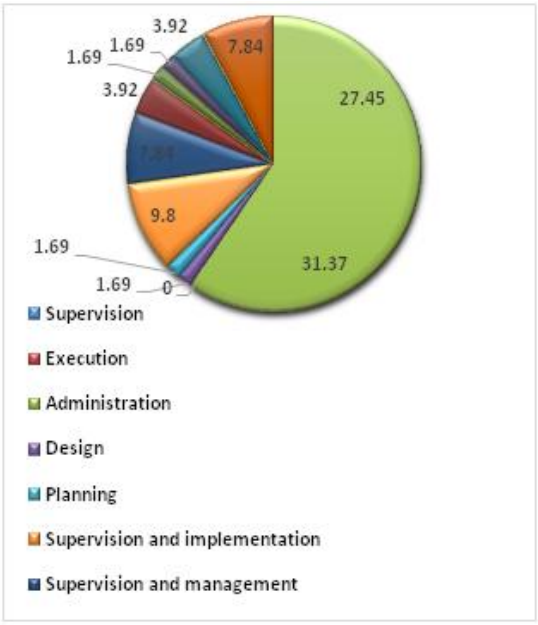

Figure 6: The scope of work of the respondents in the research

3.2 The analysis of the Severity Index

The data were collected from a questionnaire in which the Likart five-scale was used, and the use of tests Parametric statistics (mean, standard deviations ....) to analyze such data do not give meaningful results and therefore non-parametric procedures were used, namely, frequency analysis and severity index, then first a frequency analysis was performed to obtain estimates of the percentage of variables and this It was done using spss20 program, then the percentage estimates were substituted into equation (1) to calculate the severity index, and the tables (4, 5, 6, 7, 8, 9, 10) in the appendix show the order of the variables according to the severity index referral. Based on the results extracted from tables (4, 5, 6, 7, 8, 9, 10) in the appendix, it was found that the order of the first three variables that affect the occurrence of rework are:

Table 4: Summary of the first three variables that lead to rework according to the severity index for each axis in the questionnaire

	1	2	3
Human factors	Inexperienced workers	Lack of planning and supervision of workers	Weak wages
Coordination and Communication	Lack of coordination between the various participants	Quick follow-up without studying	Lack of use of information technology
Technical and Engineering Factors	Implementation of projects after a long period of study	Incorrect action sequence	Non-compliance with specifications and reliance on experience in implementation
Owner	The short duration set by the owner	Lack of knowledge and experience of the owner in the project	The late intervention of the owner in changing the specifications and design
Project management	Mismanagement of the project	The weak site management team	Lack of knowledge of quality management systems and failure to study modifications in a way that includes all relevant parties
Contract	Inadequate study of the project before applying for the offer	Acquisition method (contractor selection method)	Cost pressure
Design	The separation between the design and implementation process	The executor is not involved in the design process	Design errors

3.3 Rework factors according to factor analysis

The main method in this research was implemented using the spss20 program. Tables show the number of factors extracted from the analysis of Principal Components, where the number extracted appears extracted number of the factors according to their contribution to the occurrence of rework, and the criterion for grouping the factors was based on the principle that the variable that has a loading greater than 0.7) in one factor belongs to that factor, and the variable that has a loading less than 0.7 reduces, and the number extracted from Factors, which only shows (27) factors shows the true correlation with the set of observed variables.

Table 5: The number of factors extracted from the factor analysis

Axes	Basic Variables	Short Variables	Factors
Human factors	13	9	3
Coordination and Communication	11	7	3
Technical and Engineering Factors	17	13	6
Owner	4	4	2
Project management	26	14	6
Contract	15	10	3
Design	14	10	4
Total	100	67	27

Thus, we have, for example, in the human factor's axis, three factors from (13) variables that can be considered as new variables, and each A factor that includes a group of

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interrelated variables that can be placed under a title expressed as in Table 6.

Table 6: Factors extracted from the factor analysis of the human factor's axis

	The first factor	The second factor	The third factor
Human factors	Weak planning and supervision of workers	Inexperienced workers	Lack of resources
	Lack of awareness of all the workers about the changes taking place	Inconsistent implementation	Stressed schedule of workers
	Lack of meetings with workers	Neglecting to carry out work	Lack of workers
	Failure to make descriptions of people's work	-	-
	Inappropriate training of workers in the workshop	-	-
	- Lack of planning and supervision of workers	-	-

3.4 Rotation factor

The varimax method was used with the orthogonal rotation method. Also, the criterion for aggregating factors was based on the principle that the variable that has a loading greater than 0.7) in one factor is due to that factor. for all axes. Figure 7 summarizes the (27) factors deduced from the factor analysis for all axes.

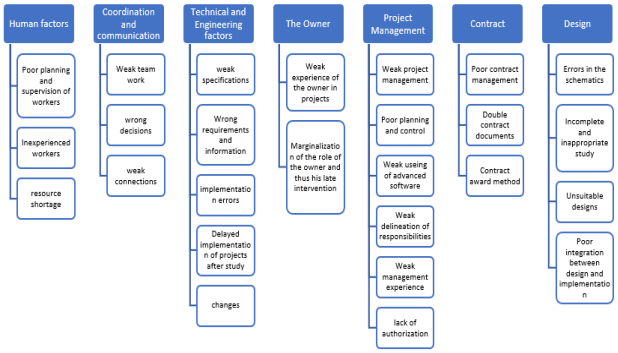
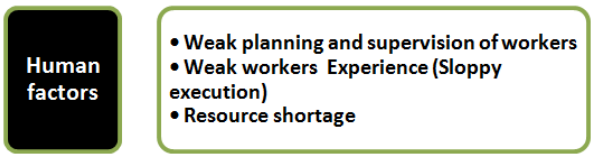


Figure 7: Factors extracted from the factor analysis for all axes

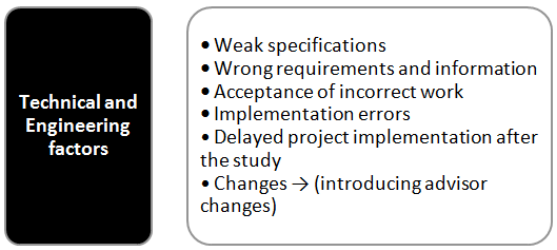
IV. DISCUSSIONS

We will discuss these factors deduced from the factor analysis and present an explanation for them, which are in order:



Among the human factors, there was a variable (sloppy execution, which has the highest managed load of 81.5% under the second factor. As bad implementation is one of the characteristics of the outputs of untrained or inexperienced workers that leads to defective work and may lead to Neglecting the implementation of parts of the work when using these the result will be rework, and if the supervision of the workers is insufficient the work may not be carried out properly. Also, ineffective supervision with poor supervisory experience can misunderstand the work of implementation and thus the supervisor follows the foreman or workers who are under his supervision and this will lead to re-executed work. The lack of resources also increases pressure on the workers available to carry out the work at the appropriate time allocated to it, and this causes fatigue for the workers, and consequently, the implementation of the work with poor quality may require it to be returned.

There is a variable (application of weak communication techniques), which has the highest managed load of 86.5% under the third factor, where the activities in construction projects are divided into functional areas implemented in several fields and include (designers, engineers, contractors) and each field is implemented in a manner Independent of the other and therefore the decisions that are taken do not take into account their effects on the areas of others, and the quick follow-up to correct an error without referring to the concerned authorities and careful study of it and knowing the impact of this correction on other subsequent works can create invisible implementation problems that may cause re-work with Implementation progress.



There was a variable (introducing advisor changes) that had the highest managed load of 91.3% under the sixth factor. As changes to designs and scope of work may cause rework.

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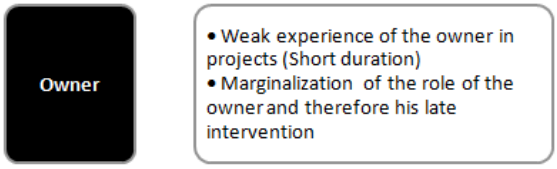
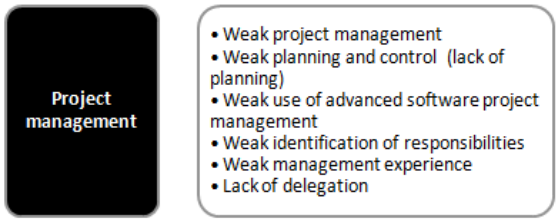
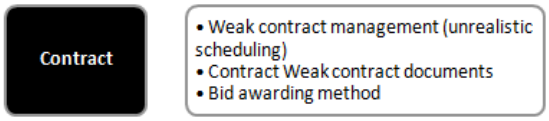
The problem of changing the design is due to the weakness of the design management process, which includes weak summaries related to the functional and technical requirements of projects by customers. Also, non-compliance with specifications during work or the application of weak specifications causes deviation in quality and thus requires re-work. This is in addition to the fact that the increase in the duration of the contract and the failure to implement projects at the time of their study will expose them to the risk of high costs and increase the possibility of introducing changes to the executed and unimplemented works. Receipt of wrong works also leads to other effects on future works in the project that become difficult to remedy and maintenance work may begin before or while investing.



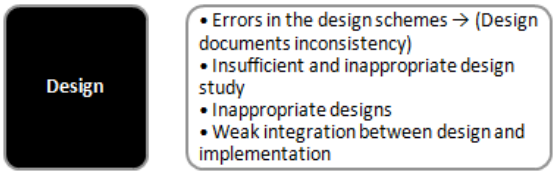
The variable (short duration set by the owner) which has the highest managed load of 88.1% is found under the first factor. Where the increasing demands of the customer to complete the project early contributed significantly to the increase in the number of errors during implementation and neglect of the implementation of the work as required, and this calls for correction and return. Also, the negative role of the owner (customer) in the late intervention in the project and his desire to make changes leads to a rework in the designs and the accompanying rework in the implementation, and this is because the role of customers in the design and construction processes is not clear, and it is difficult to fully define their requirements at first.



A variable (lack of planning) was found that has the highest managed load with 85.6% under the second factor. The incorrect planning is due to the contractor who does not have a clear conception of the project needs, as the success of the project depends on the effectiveness of the main contractor (with his subcontractors) in the construction planning efforts (in other words: planning and coordination within the project). For the development of projects (their need for administrative policies that go beyond the old way of working) to poor work planning that leads to errors during implementation, and which ultimately leads to re-work. Incompetent supervisors bear responsibility for incorrect work as a result of their poor supervisory skills and their inability to keep pace with the implementation of the work for which they are responsible. This impedes the ineffective management of the project team from carrying out the work assigned to them as required and integrated, a factor that contributes to the increase in operational errors that lead to rework, in addition, the project team must work effectively with subcontractors to plan work and control cost in the project to reduce errors and avoid it.



A variable (unrealistic scheduling) was found that has the highest managed load of 87.7% under the first factor as in Table (26). Contract management is as important as the contract itself and includes planning, control, and coordination. In the absence of integration between these components, we will have a weak contract that is often ambiguous, and this leads to a bad contractual relationship between the concerned parties, which is reflected on the ground during implementation and produces errors that need to be corrected. In addition, there is not enough time at the beginning of the project to understand the contract, and therefore the contract documents and its details are weak, which later creates problems during implementation. The bad contract is attributed to the bidding method, as most projects return to placing work on the lowest bidders, who may lack management skills and have a weak interest in contract plans, cost control, and site management, and this subsequently leads to operational errors that lead to rework.



A variable (Design documents inconsistency) was found that has the highest managed load with 87.0% under the first factor as in Table (7). Where bad coordination within the design process, especially among members of the design team, contributes to a conflict in the plans, and these contradictions may not be discovered except during implementation on the ground, and this calls for repeating some of the executed works, and the main reason is the presence of errors, shortages or ambiguities in Drawings and documents, due to the short time allocated to designing tasks, the lack of funding during the provision of site investigations and low fees for preparing contract documents, and consequently problems arise during implementation that were not taken into account in the project study phase. The build ability problems were due to the

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isolation of some designers from the construction process and the absence of the designer on the site to facilitate the implementation of changes to the design and help the implementer to understand and interpret plans. The lack of a linking formula between the design and implementation processes also contributes to a wrong or incomplete understanding of the plans, as the design company sets its conception of the project independently, which can differ in its standards during implementation. Thus, we see that the results that appeared in the research, some of which are similar to those in the reference studies, and that the sources of rework that have significant effects are not very different, and this may be due to the common characteristics of engineering projects and the challenges they face in order to deliver the correct and satisfactory image for all parties. As for the new and different factors, they result from the characteristic of local projects and their negligible development. This is shown, for example, in Table (7).

Table 7: Some of the reasons for rework are similar and different from the various similar reference studies

Similar	Different
Weak specifications and commitment to them	Inadequate study of the project before applying for the offer
Lack of coordination between the various participants in the project	Implementation of projects after a long period of study
Weak project management	Short execution period set by the owner
Errors in design plans	Lack of knowledge of quality management systems
Introducing changes to project work	The separation between design and implementation

V. CONCLUSION AND RECOMMENDATIONS

After analyzing the questionnaire, the most important sources that lead to re-work were revealed:

1. In the human factors: • The item of workers and employees with little experience has increased dramatically. Pleha lacksthe planning and supervision of staff. • Then double the wages.
2. Under the axis of coordination and communication: • The item of lack of coordination between the various participants appeared as the most variable that leads to re-work. • Followed by a quick follow-up without studying. • Then the lack of use of information technology.
3. As for the technical and engineering factors axis: • There was a high impact on the project implementation variable after a large period of study. • Followed by an incorrect sequence of work. • Then not abide by the specifications set and rely on experience in implementation at the same level.
4. Under the axis of the owner: there is an elevation for the short-term item set by the owner. • Followed by the lack of knowledge and experience of the owner in the projects. • Then the late owner intervened to change the specifications or design.
5. In the axis of project management: • The mismanagement of the project item appeared. • Followed by a weak site management team. Then the lack of knowledge of quality management systems and the failure to study the amendments in a way that includes all relevant parties.
6. And under the axis of the contract: You notice the emergence of an insufficient study clause for the project before submitting the offer. • Followed by the acquisition method (contractor selection method). • Then cost pressure.
7. Finally, under the design axis: "The separation between the design and implementation process was found as the most variables that affect re-work. • Followed by the lack of experience of the executor in the design process, then an error in the design. The analysis showed only (27) factors that show the true correlation pattern with the group of observed variables, meaning that only (27) variables out of (100) variables effectively contributed to the occurrence of rework in construction projects. It is considered that obtaining the identification of the main factors causing re-work according to the viewpoint of workers in the projects is of great scientific importance because it helps and allows the development of appropriate solutions to reduce or eliminate these factors, and researchers in this field can now rely on these factors in order to propose appropriate solutions to remove the causes and sources of re-work.

Based on what we have found in the research, it is suggested that effective and thoughtful measures should be taken into consideration to reduce re-work, such as:

1. Improving training and supervising workers and improving project management.
2. Improving the methods and techniques of communication between the project parties.
3. Commitment to specifications, developing procedures, and working to reduce changes to a minimum.
4. Working on educating the customer and increasing his experience of what he needs from his project.
5. Developing contracting methods and contractor selection methods.
6. Integration of work between the designer and the implementer and improving coordination within the design process to prevent conflicts.

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To achieve the previous proposals, it is necessary to adhere to the application of quality management systems and policies, which help greatly in reducing errors in construction and thus not having to carry out corrective actions that raise the cost of construction and increase its time.

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