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# Reality Analysis of Materials Management Practices for the Construction Projects in Iraq

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**Abstract:** ***The aim of this paper is to provide a clear understanding about the extent of the application and the weaknesses of the most important practices in the materials management that observed in Iraqi construction sector. The field survey included, sample selection, questionnaire preparation, data collecting, presentation, analysis, and results evaluation. The questionnaire included eight processes represent construction materials management processes, and each process in turn includes several axes. The research has diagnosed a general weakness in all construction materials management processes, especially in the waste treatment, feedback and handling processes where the degree of application (Conformance Ratio Cr) was 46%, 51%, and 55% respectively. While the degree of application of the remaining processes was: planning 0.64, purchasing 0.7, transferring 0.62, receiving 0.71, storage0.67 respectively. Finally the degree of application of construction materials management was 0.63 which refers to (Middle) degree of evaluation.***

**Keywords:** Materials Management, Construction Projects, Most Important Practices

## 1. Introduction

Construction Material management is determining as the approach to provide, right material at the right place at right time in the right quantity, in order to reduce the cost of project. Materials management is deals with the planning, identification, procuring, storage, receiving and distribution of material [1]- [2]. Construction material represents a high expense in the projects, so minimizing procurement costs promote opportunities for reducing the final project cost [1]. The control of materials is so important for every project and should be handled effectively for the successful completion of a project. An effective material management can bring many benefits for a company. But in spite of their weight in projects, not enough attention is given to materials management. [3]

The management of construction materials in big projects required appropriate consideration due to the various elements involved and importance of the project [4]. Dey, 2001 indicates that about 60% of the total working capital of projects consists of materials costs. Therefore, there is a need for materials management in order to control productivity and cost in any construction projects [5]. Poor material management is related to an inaccurate or surplus ordering of construction materials, damage of materials, inadequate storage condition, and rework due to inaccuracy, bad workmanship, imperfect in site processes and inactive use of materials. Ordering materials that are not used on the project due to loss, damage or being surplus to the project requirements has a cost which is often passed as built into the overall project price and paid by the client. This includes the cost of purchase and delivery, storage and handling, disposal, treatment or return to supplier, and labor to manage the unused materials. [6]

## 2. Supply Chain of Construction Materials Management

The discussion of construction supply chain management (SCM) is usually informed by a broad range of definitions, this diversity of definitions and understanding representing the importance of this topic and discovered a wide range of conceptual issues that help us to understand the nature of SCM in construction. Supply Chain Management (SCM) is an increasingly utilized operations model for enhancing comprehensive organizational competitiveness [7]. Supply chain management (SCM) is defined as business processes merging across the supply chain for the intent of creating value to the customers and stakeholders. It involves the flow of materials, services and provides value to customers by optimizing the use of resources. [8]

The construction supply chain was an operational and strategical cycle that contains labor, materials, equipment, contracting and a finished project. Nowadays Technology, safety, and communications are the three elements that connect all of the components of the chain. [9]

## 3. Objectives of Construction Material Management

The role of the materials management is strictly economical within the construction project; thus the objectives of construction material management must include lowest total cost, optimum quality, assurance of quantity supply, and minimum administrative costs. Materials management should obtain the materials that needed at the lowest supply cost. In addition, proper handling and storage of materials can reduce the final cost of materials; so the construction materials

management ensures that materials are handled properly and stored in an adequate place. When specifications demand a high quality product, quality become the most important objective. These will properly increase the total cost of the project, and cause delaying in the completion of the final product. Construction materials acquisition from the procurement until it is received to the project can have an impact on the schedule of the project. It is clear that an effective management of materials can reduce the impact of materials lack, conversely, and improper management of materials could have impede the final schedule and cost of the project. [2]

## 4. The Field Survey

The field investigation passed in two stages, as follows:
1) Open questionnaire stage: by personal interviews.
2) Closed questionnaire stage: by using questionnaire form.

### 4.1 Open questionnaire stage

Researchers conducted a number of personal interviews with senior engineers who have an experience in managing construction projects and some specialists in the import, testing, storage and distribution of construction materials. The aim of the interviews was to know the reality of the construction materials management and to identify the factors that most affecting on it and find out the mechanism that used in materials receiving, storage and handling of construction materials and to learn the mechanism of entry and way out of construction materials into and out of the stores and the inventory method of materials that used in Iraqi construction sector also to know modern techniques and software that used for estimating and limitation the amounts of construction materials were used.

### 4.2 Closed Questionnaire Stage

The tool of this survey is using the form of closed questionnaire distributed to the engineers working in both of public and privet sectors of various domains to find out the most important practices that should be applied in construction materials management.

Researchers adopted in the preparation of questionnaire paragraphs on the literature reviews, Central organization for standardization and quality control (COSQC), the International Standardization for Organization (ISO) for construction materials 10845[10] and 17025[11] and expert interviews, to prepare the form.

### 4.3 The Questionnaire's Structure

The questionnaire was developed using, as much as possible, an understandable terms to the engineers. The questionnaire's structure Includes eight keys points represented the management of construction materials processes, and each process includes several axes, These axes in turn, includes the most important practices to achieve an effective materials management in Iraqi construction sector.

### 4.4 Statistical Analysis

To determine the degree of application, which statistically means the Conformance Ratio (Cr) that was used in the evaluation of each axis of the questionnaire axes which represents the conformance in each axis of the ideal case application, and it is calculated from the equation below [12]:

$$Cr = M / X \max \quad (1)$$

Where:
Cr: Conformance Ratio for axis
M= Arithmetic Mean (Weighted average of the items)
X max: The highest degree of values

1) If (Cr > 0.55), the evaluation of the axis was (poor), and It (must) be developed.
2) If (0.55>Cr>0.77) the evaluation of the axis was (middle) and development was (Wanted).
3) If (Cr<0.77) the evaluation of the axis was (good) and development was (Desired).

## 5. Processes Evaluation of the Construction Materials Management

### 5.1 Planning process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the planning process and the results were as follows in table 1:

**Table 1:** The analysis and responses evaluation of each axis in the planning process

| No. | Axis of planning process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | Strategy and policy | 55.5 | 0.61 | Middle | Wanted |
| 2 | Technical requirements and specifications | 67.4 | 0.75 | Middle | Wanted |
| 3 | Experiences and qualification | 51.2 | 0.57 | Middle | Wanted |
| 4 | Documentation | 68.3 | 0.76 | Middle | Wanted |

The table above includes the axes of planning process, which involved the most important practices that should be applied to achieve an effective management during planning process. The researcher divided planning process to four axes: Strategy and policy; Technical requirements and specifications; Experiences and qualification and finally the Documentation, and from the analysis and responses evaluation of each axis in the planning process can observed a drop in evaluation of the axes, where the conformance ratio (Cr) of the planning process axes was 0.61, 0.75, 0.57, 0.76 (In the same above order of the axes), Which reflects the negligence of the practices application in the management of construction materials which will reflect negatively on the project as a whole. These findings refer to (Wanted) degree of development required, as shown in figure

1. And as a result, the (Cr) of analysis and evaluation of planning process in the construction materials management was 0.64, which refers to (Middle) degree of evaluation.


**Figure 1:** Conformance Ratio of planning process axis

### 5.2 Purchasing process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the purchasing process and the results were as follows in table 2 which represents the analysis and responses evaluation of each axis in the purchasing process.

**Table 2:** The analysis and responses evaluation of each axis in the purchasing process

| No. | Axis of purchasing process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | Quality standards | 72.3 | 0.80 | Good | Desire |
| 2 | Risks and opportunities analysis | 58.0 | 0.64 | Middle | Wanted |
| 3 | Bidders prequalification | 49.8 | 0.54 | Poor | Must |
| 4 | Choice of suppliers | 58.2 | 0.64 | Middle | Wanted |
| 5 | Contracting | 72.0 | 0.80 | Good | Desire |
| 6 | Documentation | 68.9 | 0.76 | Middle | Wanted |

Researchers enable to locate six axes: Quality standards; Risks and opportunities analysis; Bidders prequalification; Choice of suppliers; Contracting; and Documentation, where the conformance ratio (Cr) of the purchasing process axes was 0.80, 0.64, 0.54, 0.64, 0.80, and 0.76 respectively. The results show different level of evaluation degree of the axes. Half of these axes were their evaluation degree were (Middle), so the degree of develop required was (Wanted). Two of these axes were their evaluation degree were (Good), so the degree of develop required was (Desire). Only one of these axes was their evaluation degree was (Poor), so the degree of develop required was (Must). the (Cr) of analysis and evaluation of purchasing process in the construction materials management was 0.70, which refers to (Middle) degree of evaluation, as shown in figure 2.

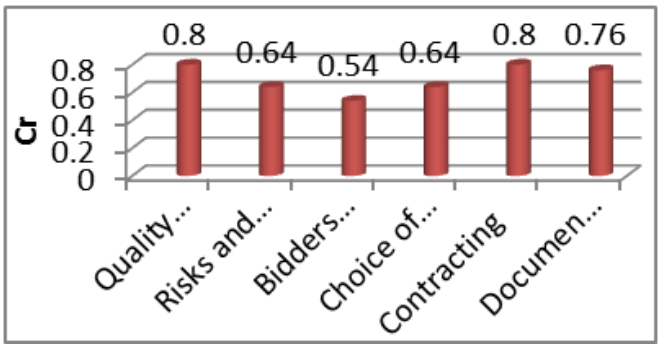


**Figure 2:** Conformance Ratio of purchasing process axis

### 5.3 Transferring process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the transferring process and the results were as follows in table 3 which represents the analysis and responses evaluation of each axis in the transferring process.

**Table 3:** The analysis and responses evaluation of each axis in the transferring process

| No. | Axis of transferring process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | External factors | 64.0 | 0.71 | Middle | Wanted |
| 2 | Risks and opportunities analysis | 54.2 | 0.60 | Middle | Wanted |
| 3 | Selecting the method of transport and transporters | 67.6 | 0.64 | Middle | Wanted |
| 4 | Documentation | 64.8 | 0.72 | Middle | Wanted |

Researchers enable to locate four axes: External factors; Risks and opportunities analysis; Selecting the method of transport and transporters; and Documentation, where the conformance ratio (Cr) of the transferring process axes was: 0.71, 0.60, 0.64, and 0.72 respectively. These findings refer to (Wanted) degree of development required, And as a result, the (Cr) of analysis and evaluation of transferring process in the construction materials management was 0.62, which refers to (Middle) degree of evaluation. This drop was reflected negatively on the management of construction materials and therefore to the whole project.

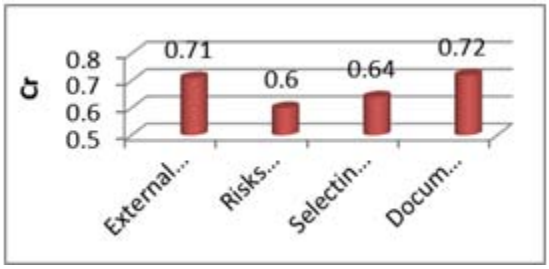


**Figure 3:** Conformance Ratio of transferring process axis

### 5.4 Receiving processes

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the receiving process and the results were as follows in table 4 which represents the analysis and responses evaluation of each axis in the receiving process.

**Table 4:** The analysis and responses evaluation of each axis in the receiving process

| No. | Axis of receiving process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | External conditions | 52.7 | 0.59 | Middle | Wanted |
| 2 | Technical requirements | 60.8 | 0.68 | Middle | Wanted |
| 3 | Test and inspection | 68.5 | 0.76 | Middle | Wanted |
| 4 | Documentation | 68.1 | 0.76 | Middle | Wanted |

Researchers enable to locate four axes: External conditions; Technical requirements; Test and inspection; Documentation, where the conformance ratio (Cr) of the receiving process axes was: 0.59, 0.68, 0.76, and 0.76respectively. These findings refer to (Wanted) degree of development required, And as a result, the (Cr) of analysis and evaluation of receiving process in the construction materials management was 0.71, which refers to (Middle) degree of evaluation. This drop was reflected negatively on the management of construction materials and therefore to the project as a whole.

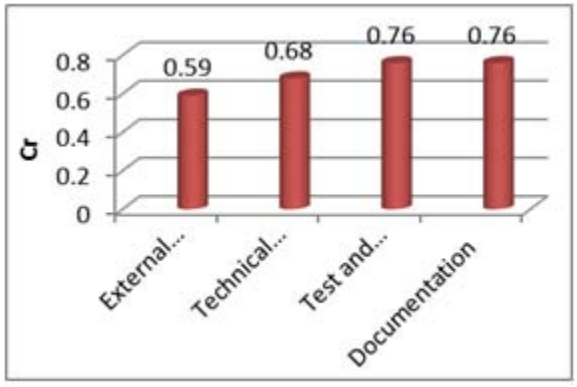


**Figure 4:** Conformance Ratio of receiving process axis

Figure 4 includes the most important practices that should be applied to achieve an effective management during receiving process and observe a decrease in the degree of application of certain practices.

### 5.5 Storage process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the storage process and the results were as follows in table 5 which represents the analysis and responses evaluation of each axis in the storage process.

**Table 5:** The analysis and responses evaluation of each axis in the storage process

| No. | Axis of storage process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | Storage conditions | 57.8 | 0.64 | Middle | Wanted |
| 2 | Technical Specifications | 56.1 | 0.62 | Middle | Wanted |
| 3 | Follow-up inspections and Storage | 65.4 | 0.72 | Middle | Wanted |
| 4 | Documentation | 62.7 | 0.70 | Middle | Wanted |

Researchers enable to locate four axes: Storage conditions; Technical Specifications; Follow-up inspections and Storage; and Documentation, where the conformance ratio (Cr) of the storage process axes were: 0.64, 0.62, 0.72, and 0.70respectively. These findings refer to (Wanted) degree of development required, And as a result, the (Cr) of analysis and evaluation of Storage process in the construction materials management was 0.68, which refers to (Middle) degree of evaluation. This drop was reflected negatively on the management of construction materials and therefore to the project as a whole.

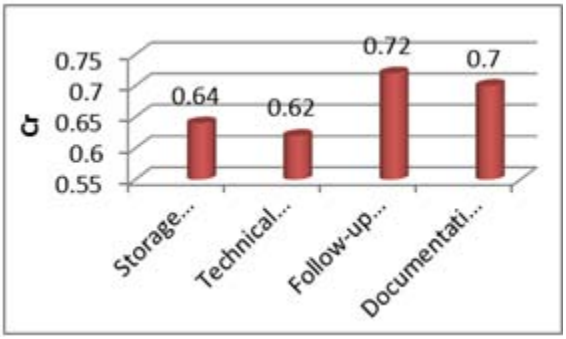


**Figure 5:** Conformance Ratio of storage process axis

### 5.6 Handling process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the handling process and the results were as follows in table 6 which represents the analysis and responses evaluation of each axis in the handling process.

**Table 6:** The analysis and responses evaluation of each axis in the handling process

| No. | Axis of handling process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | Site management | 61.1 | 0.68 | Middle | Wanted |
| 2 | Site supervision | 54.6 | 0.6 | Middle | Wanted |
| 3 | Examination and inspection | 52.2 | 0.58 | Middle | Wanted |
| 4 | Experience and training | 53.0 | 0.59 | Middle | Wanted |
| 5 | External factors | 52.3 | 0.58 | Middle | Wanted |
| 6 | Documentation | 54.3 | 0.60 | Middle | Wanted |

Researchers enable to locate six axes: Site management; Site supervision; Examination and inspection; Experience and

training; External factors; and Documentation where the conformance ratio (Cr) of the handling process axes was 0.68, 0.6, 0.58, 0.59, 0.58, and 0.60 respectively. The results show different degree of evaluation of the axes, but the degree still ranging from (0.55-0.77), so the (Cr) of analysis and evaluation of handling process in the construction materials management was refers to (Middle) degree of evaluation, These findings refer to (Wanted) degree of development required with (Cr)= 0.70.

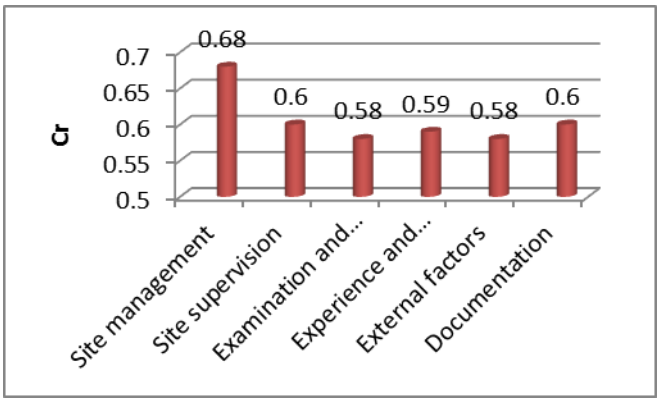


**Figure 6:** Conformance Ratio of handling process axis

### 5.7 Waste treatment process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the waste treatment process and the results were as follows in table 7 which represents the analysis and responses evaluation of each axis in the waste treatment process.

**Table 7**: The analysis and responses evaluation of each axis in the waste treatment process

| No. | Axis of waste treatment process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | Strategy and policy of the company | 37.3 | 0.42 | Poor | Must |
| 2 | Requirements and specifications | 50.5 | 0.56 | Middle | Wanted |
| 3 | Documentation | 45.1 | 0.50 | Poor | Must |

Researchers enable to locate three axes: Strategy and policy of the company; Requirements and specifications; and Documentation, where the conformance ratio (Cr) of the waste treatment process axes was 0.42, 0.56, and 0.50 respectively. The results show significant decrease of evaluation degree of the axes. One of these axes were their evaluation degree was (Middle), so the degree of develop required was (Wanted). Two of these axes were their evaluation degree were (poor), so the degree of develop required was (must). The (Cr) of analysis and evaluation of waste treatment process in the construction materials management was 0.51, which refers to (poor) degree of evaluation.

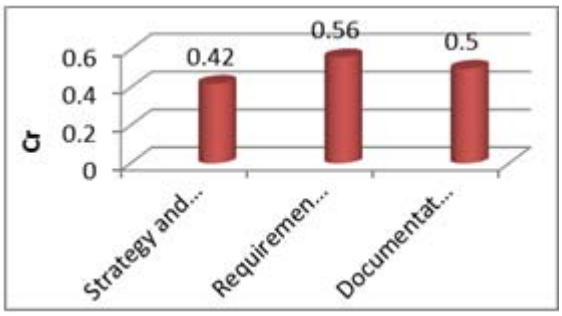


**Figure 7**: Conformance Ratio of waste treatment process axis

### 5.8 Feedback process

Researchers investigate the reality of the application of the most important practices for the management of construction materials during the feedback process and the results were as follows in table 8 which represents the analysis and responses evaluation of each axis in the feedback process.

**Table 8:** The analysis and responses evaluation of each axis in the feedback process

| No | Axis of feedback process | M% | Cr | evaluation of the axis | Degree of development |
|---|---|---|---|---|---|
| 1 | Performance measurement indicators | 53.5 | 0.60 | Middle | Wanted |
| 2 | Performance evaluation | 49.0 | 0.54 | Middle | Wanted |
| 3 | continuous improvement | 46.7 | 0.51 | Poor | Must |
| 4 | documentation | 57.1 | 0.63 | Middle | Wanted |

Researchers enable to locate four axes: Performance measurement indicators; Performance evaluation; continuous improvement; documentation, where the conformance ratio (Cr) of the feedback process axes was 0.60, 0.54, 0.51, and 0.63respectively. The results show significant decrease of evaluation degrees of the axes. The evaluation degree of (continuous improvement) axis was (poor), so the degree of develop required was (must). While the other axes were their evaluation degree were (middle), so the degree of develop required was (wanted). The (Cr) of analysis and evaluation of feedback process in the construction materials management was 0.54, which refers to (poor) degree of evaluation

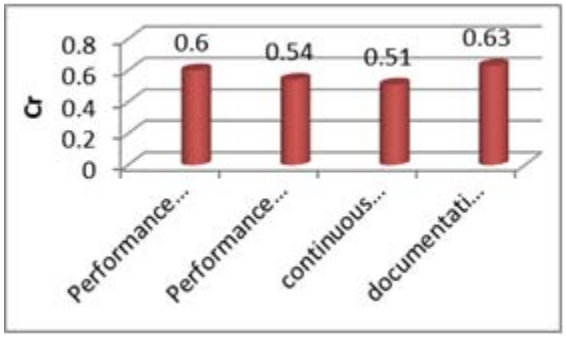


**Figure 8:** Conformance Ratio of feedback process axis

## 6. Results

The researcher enables to know the degree of application of the most important practices during the construction materials management processes, as shown in the table below:

**Table 9:** Degree of application of the most important practices during each process in the construction materials management

| Construction Materials Management Processes | % M | Cr |
|---|---|---|
| Planning Process | 58% | 0.64 |
| Purchasing Process | 63% | 0.7 |
| Transferring Process | 56% | 0.62 |
| Receiving Process | 64% | 0.71 |
| Storage Process | 61% | 0.67 |
| Handling Process | 55% | 0.61 |
| Waste Treatment Process | 46% | 0.51 |
| Feedback Process | 49% | 0.54 |

From the table above researchers observed a general weakness in all construction materials management processes, especially in the waste treatment, feedback and handling processes Where the degree of application 46%, 51% and 55% respectively, as shown in figure 9, Where this result emphasizes the importance of creation of construction materials management system provides ease and speed of transmission of information between the parties to the construction project and minimize materials waste.

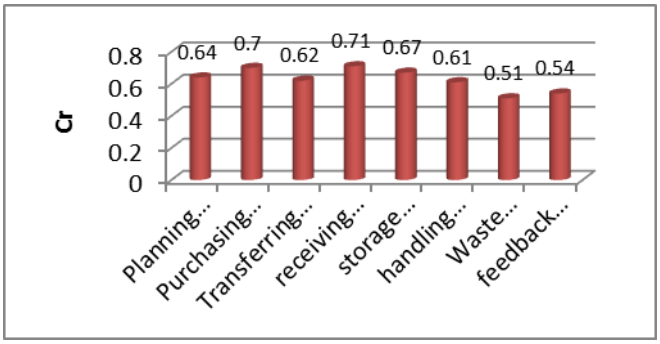


**Figure 9:** Conformance Ratio of construction materials processes

## 7. Conclusion

The research leads to the following conclusions:

1) Weakness in the important practices of construction materials management in Iraqi construction sector.
2) Significant weakness in the aspects of preservation of the environment where the results of the questionnaire showed great negligence of the practices of waste treatment process with low degree of application which was equal to 0.46.
3) The failure to give sufficient importance to the feedback process leads to considerable disruption in the management of construction materials process with low degree of application which was equal to 0.54.
4) The negligence of construction materials-handling operation at the site, leading to many problems like increasing the amounts of construction waste, delayed work at the site that causing a delay in the completion of activities and finally increasing the total cost of the project.

## 8. Future Scope

1) Disseminate the results of the questionnaire on working at Iraq's construction sector companies to take advantage of the results in construction materials management development.
2) Studying the causes of the low degree of application of the important practices and trying to find appropriate solutions at construction companies.
3) Determine the priority of processes that require a higher degree of development in Iraq's construction sector.

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