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To cite this article: Aqeel A Hussein *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **664** 012069

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Analysis of Relationship between Design and Implementation Stages within Construction Projects in Iraq

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Abstract. Within last years, construction projects have quickly accelerated in both number and size. This study deals with some of effects of performance management and its outputs from service and cost viewing. By focusing on the relationship between the two main stages in construction projects, that is the design and implementing stages, the research is going on using method of questionnaire survey including four main factors: the state of design process, the state of implementing process, the state of interaction between the two stages (design and implementation) and the state of problems resulted during and after construction. A questionnaire was distributed into 50 construction projects and the data are collected and analysed through SPSS. The results have shown that there is a weak relationship between design and construction stages in local construction projects. Research showed also that it could not be claimed that this situation (weakness of the interaction of stages) is responsible of defects in the performance of these projects, which in turn results in service and cost problems. Interpreting for this situation was that the results reflected the weakness in the actual management performance in the local construction projects.

1. Introduction

This research deals with the relation between the two main stages in any construction project: design and implementing. Since years Iraq witnessed wide increase in the field of construction. This covered many types of building such as housing, commercial, healthcare and education projects. However, the ways of implementing projects remain the same as before. This study tries to investigate the real state of implementing projects from the viewpoint of the relationship between the stages of these projects, precisely design and implementing stages. It is known that when this relationship is stronger, the performance of project would be more effective in both serviceability and economy. Hence, if this relation can be evaluated in appropriate manner it will be a chance to measure the service and economical influences reflected from the state of the relation. The approach of this study is to survey as much construction projects as possible, then to evaluate the real relationship between design and implementing stages and finally to measure the service and economical influences reflected on these projects from the existing situations. This study used questionnaire for collecting data about the state of construction projects in Iraq covering 50 worksites and selecting one engineer from each site to respond to the prepared questions. The statistical methods were used in analyzing data and extracting the results. This study was carried out in such a way that focuses on the mentioned two stages because of the limitation of the time scope and that the objects of the research need not been complicated. The issue of the research is to see if the construction projects work well. This question in itself carries a list of other questions



such as: are these projects adopting the correct consequence beginning from the design stage both architectural and structural? Is the implementing process carried out according to suitable design documents and drawings? To what extent the stages of such projects are interrelated? It is sure that many topics should be involved but the study selected the most important ones [1].

2. Methodology

2.1. Concurrent Engineering

This study aims to contribute with a practice in dealing with evaluation and measuring overall performance of project management especially in construction field. The basis of such new trends is the effective interrelation between various stages of work. This is one of the most recent concepts in engineering management, adopted under more than one term such as “concurrent engineering “. Adopting this direction shows advantages in improving performance for administration and technical systems being involved in design and implementing construction projects in either service or economic issues [2].

2.2. Research Hypotheses

The research hypotheses to be tested in this study are as follows:

Hypothesis 1: The construction projects in Iraq do not adopt interrelation between the design and implementing stages.

Hypothesis 2: The weakness of interrelation between the design and implementing stages in the construction projects in Iraq leads to negative results in the service and economic affairs of these projects.

These hypotheses will be tested by methods that described in the next sections.

2.3. Relationship between Stages of Construction Projects

All stages of construction need to be incorporated with constraints imposed by the construction process in the design stage. Depending on which construction process is considered, these effects may be encoded into formal rules, or else may be conveyed through individual experience and expertise. Addressing these design concerns early in the development process creates the opportunity to reduce construction costs and improve quality. Often the method of accomplishing the integration of design with other functions in companies is through the use of functional teams. These teams may include people with expertise in constructing, marketing, finance, service or other relevant areas, depending on the type of project. Another important functional barrier is the separation between the engineering designer and the customer. Under the same philosophy of removing the design- construction barrier, the designer must become more responsive to customer desires and thereby create a more successful work. This is known as design-marketing integration.

Design process is existed as long as construction is existed. Early, there was a division where the designer is responsible for producing the design and the labour is responsible for making the actual works. Because of this division there is the opportunity for the designer to work in ignorance of the worker constraints. A design is generally difficult and costly to produce and does not necessarily conform to the desires of the customers. This functional separation and its resulting effect on the resulting design may be repeated with other functions such as maintenance. The remedy for this situation is to have the designer become more aware of other affairs of the organization. The barriers should be removed. There have been several distinct reasons for claiming that the role of construction concerns in the design process should be increased. Among these reasons are the increasing level of competition, the role of new construction process, and the need to reduce development lead time [3][4].

2.4. Current Ways in Implementing Construction Projects

It has been seen from the wide survey to the local construction projects that the ways of processing design of these projects may be as follows:

1- Implementing first the architectural design and then transfer to the structural design. The two steps are made separately and in consequence.

2- Implementing both two steps instantaneously in such a way that interaction can be made between them.

On the other hand, from the view of mechanism of design stage as whole, the ways are as follows:

1- Performing design by formal bureaus.

2- Performing design by informal bureaus (that is by professional designers) and then adopting them for legal requirements by formal bureaus.

3- Performing design by informal way without adopting by any formal bureau.

About the construction process there are the following ways:

1-Construction is implemented by a formal contracting company.

2-Construction is implemented by an informal contractor

3-Construction is implemented by owner himself (being the manager).

All the mentioned categories are presented in order in suitable manner for purpose of analysis and involved in more than one way in the questionnaire [5]

2.5. Service and Economical Influences

Service and economical influences may result from managing the project operations, from situations and conditions the project implemented within and from the limitations of the owners. The topic of management is the interest one here. The problem of the research depends on existing of such influences resulting from a specific state, that is: absence of the interrelation between the stages of the projects. Examples on service influences can be those representing defects in performing of building (or structure). The cracks in walls or in ceilings, errors in levels of the parts of the building, defects in sanitary or electric systems, vibration or noise effects in case of steel structures and so on. In addition, there are the economic effects which do not result only from the defects indicated but also from another more direct reasons. Examples of these are the reworks or damages and then reconstructing, exchange materials with costlier ones, overestimating in design, time consuming, necessity for early maintenance and so on.

Some of influences appears directly after completing the construction stage and others appear after some time. For example, ignoring the insulation layers of roofs, which is very common, may be influence the performance of the building after several months but the errors in the levels of the building will appear directly [6][7].

2.6. Survey Participants and Survey Development

This study was designed to use a survey to gather data about the procedures used in design and implementing construction projects. The survey was targeted for individuals involved with the managing and executing of construction projects. Possible titles of survey respondents were: operations manager, design engineer and site engineer. The survey participants were selected from a number of construction projects being constructed nowadays in Iraq. Survey participants were selected on basis of random selecting from the work environment.

In order to conduct the study on a reasonably manageable scale, the population sample was targeted at 50 participants. Questions were selected and set in this survey after specific attention in developing the hypotheses for the study. Questionnaire has reviewed several times and numerous changes were made to the wording of the questions, the format of the questionnaire and the questions, the alignment and placement of the text, and the sequential order of the individual questions. The final version of the survey takes approximately 10 minutes to be completed. The questionnaire is divided into 5 parts [8].

3. General Results

Fifty completed survey responses were received of the 75 surveys distributed (67%). Collected data were treated and analysed using SPSS Program. Of the 50 survey responses received, 39 were from

engineers working in contracting companies and 11 were from engineers working on their own accounts. Their job functions may be represented in the figure.(1)

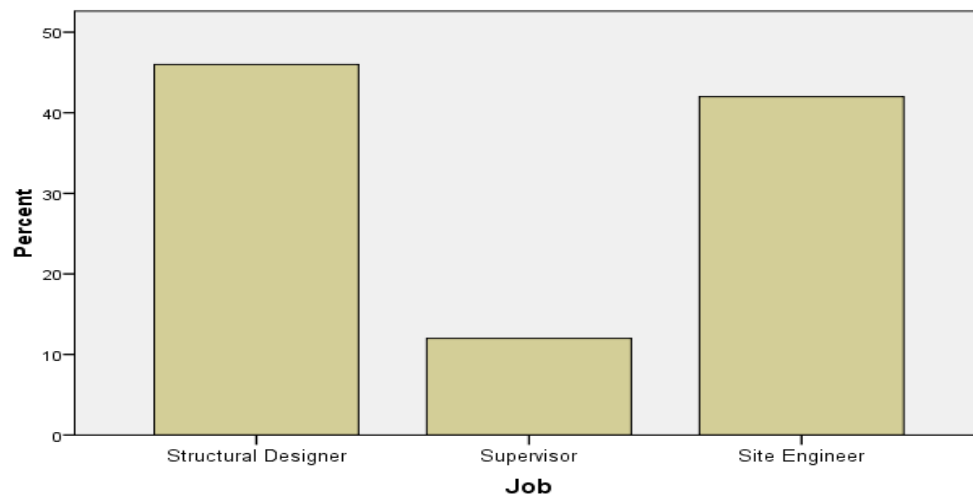


Figure 1. Job functions of the participants

The distribution of the types of construction projects is shown in figure 2.

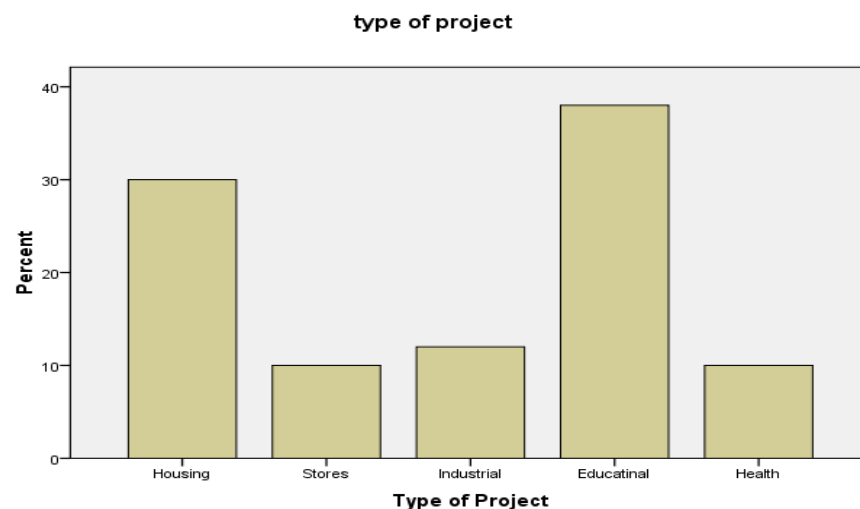


Figure 2. Types of Projects

Because of the importance of training in the various areas, one of the questions in the questionnaire was about the number of times of training each participant had gotten in his field of work. Results show that most engineers have not gotten training but one time (42%) and only (6%) have five times of training or more. This result indicates the need to establish the direction to learn more and train more because this will result in more improvement in the performance of the constructing process including the strengthening of the relation between stages of the projects.

Table (1) gives the state of design process from view of carrying out. The data indicates weakness in the design process for that only 32% are carried out and adopted at formal bureaus. Table (2) gives the state of sequence of the process of design. It is seen that only 26% of cases adopt the instantaneous design both architectural and structural. Although this is an internal factor (within the process of design only),

it reflects, however, the classical pattern of the behavior regarding this critical stage. This means that modification is needed to the design process behavior to make it more effective and this will improve the overall performance including the interrelation between the different stages of projects.

Table 1. State of design process

Percent	Frequency	State
32%		Carried out and adopted at a formal Bureau
32%	16	Carried out informally and adopted at a formal Bureau
36%	18	Carried out informally and not adopted

Table 2. Sequence for the process of design

Percent	Frequency	State
74%	37	Architectural design performed then structural design
26%	13	Instantaneous design both Architectural and structural

4. Statistical Analysis of Hypotheses

In this section the hypotheses are tested using statistical analysis.

The first hypotheses: "The construction projects in Iraq do not adopt interrelation between the design and implementing stages".

Questions 14 and 15 in questionnaire regarding adjustment works and level of feedback are to measure the interrelation between the two stages of design and implementation. The state of adjustment works is shown in Table 3.

Table 3. State of adjustment works

Percent	Frequency	State
20%	10	Much
40%	20	Few
40%	20	None

It is obvious that there is a weak interrelation between the two stages (design and implementation) in that 40% of cases has none adjustment works and only 20% has much adjustment works. Table (4) gives the state of the level of feedback between designers and executors. This level is low for 58% of cases and moderate for 28% of cases which indicates weak interrelation between the two stages of design and implementation.

Table 4. State of feedback

Percent	Frequency	State
14%	7	High
28%	14	Moderate
58%	29	Low

The second Hypothesis: "The weakness of interrelation between the design and implementing stages in the construction projects in Iraq leads to negative results in the service and economic affairs of these projects".

The states that represent the service and economic affairs of projects are represented in the questionnaire by the following:

- Cracking in the walls or ceilings
- Deflection in the beams or slabs
- Damage or collapse in any structural element

- Moisture leakage in the roofs or walls
- Reworks in the tasks of the project
- Early maintenance for any element in the project
- Duration (time) satisfaction
- Budget satisfaction
- Unexpected problems in the mechanical and electrical works

A comparison is made between the effect of the state of interrelation between the stages and the effect of the states of design process and implementing process. Table (5) gives the results. Measuring these effects is made by making chi-squared test to check if there is a statistical significance for variations of recorded states of the three issues design, implementation and concurrency. The significance values are shown in the table 5.

Table 5. Results of Chi-squared Tests

	Cracks	Deflections	Damages	Moisture	Reworks	Early Maintenance	Late Time	Budget	Mechanical & Electrical
Des. adopt	0.25	0.99	0.79	0.55	0.05	0.98	0.35	0.19	0.08
Des seq	0.67	0.14	0.67	0.16	0.03	0.34	0.66	0.94	0.37
Identity	0.89	0.96	0.89	0.44	0.84	0.51	0.38	0.79	0.41
Servey	0.61	0.87	0.92	0.87	0.04	0.88	0.08	0.73	0.01
Soil	0.45	0.95	0.25	0.94	0.17	0.29	0.17	0.20	0.08
Schedule	0.86	0.57	0.86	0.88	0.64	0.46	0.71	0.67	0.38
Adjust.	0.60	0.86	0.92	0.87	0.04	0.88	0.07	0.73	0.01
Feedback	0.45	0.95	0.25	0.94	0.17	0.29	0.16	0.20	0.08

From results shown in table (5) it can be shown that there are only six cases of problems that have statistical significance which equals or less than 5% with the states of design, implementation and concurrency. However, there are five other cases near 5%. In other words, cases show that there is no impact for the three states on the level of problems.

Many interpretations can be made for this result. There may be lack in the process of response to the questionnaire. However, the most likely reasoning is that the result reflects the weakness in the actual management performance in the local construction projects. There is no difference in the performance whether the design and implementation processes made in low or high quality levels.

Table (6) shows the mean values and standard deviations of each state after translating the string choices of checklist in the questionnaire into numeric values as follows:

- a = 3
- b = 2
- c = 1

Table 6. Mean values and standard deviations of the three states

State	Design	Implementation	Concurrency
Mean Value	2.05	2.17	2.17
Standard Deviation	0.43	0.22	0.30

From these values, there is no indication in that the more concurrency having more impact on the performance of the projects. Its effect seems like the effect of design and implementing processes. In other words, the research gives no sign for the second hypothesis. This means that it is can't be claimed that the concurrency plays a distinguish role in local construction projects.

5. The Questionnaire

5.1. Part I: Characteristics of individuals, companies and type of project

1. Please specify the area you are working in.

(a) Contracting company

(b) On own account

2. Please specify your job function

(a) Architectural Designer

(b) Structural Designer

(c) Supervisor

(d) Site Engineer

3. Please specify type of the project

(a) Housing Buildings

(b) Stores

(c) Industrial Buildings

(d) Supermarket Buildings

(e) Healthcare Buildings

4. Please indicate number of trainings you have gotten in your field of work

5.2. Part II : Process of design by individual/company

5. Please specify process of carrying out and adopting the design drawings and documents:

(a) Carried out and adopted at a formal bureau

(b) Carried out informally and adopted at a formal bureau

(c) Carried out informally and not adopted

6. Please specify the sequence of design process:

(a) Architectural design performed then structural design

(b) Instantaneous design both architectural and structural

(c) No design at all

5.3. Part III : The implementing stage of the construction project

7. Please specify the state of the executing of the project:

(a) Recorded contracted company

(b) Unrecorded contractor

(c) Owners by their selves

8. Please specify the method of surveying works?

(a) With electronic instruments

(b) With classical theodolite and level

(c) With manual methods

9. Please specify the method of investigation soil bearing capacity?

(a) By a laboratory

(b) By field inspection

(c) None

10. Do you follow a certain time scheduling of works? Please select:

(a) Detailed schedule

(b) Bar chart

(c) None

5.4. Part IV: Relation between the design and implementing stages

11. Are there adjustment works which are not involved in the architectural documents? Please select:

(a) Much

(b) Few

(c) None

12. Please specify the level of back feeding between executors and designers during implementing of the project.

(a) High

(b) Moderate

(c) Low

5.5. Part V: Service and economic effects

13. Is there any case of cracking in the walls or ceilings of the buildings in the project?

(a) None

(b) Few

(c) Much

14. Is there any case of deflection in the beams or ceilings of the buildings in the project?

(a) None

(b) Few

(c) Much

15. Is there any case of damage or collapse in any structural element in the buildings of the project?

(a) None

(b) Few

(c) Much

16. Is there any case of moisture leakage in the roofs or walls of the buildings in the project?

(a) None

(b) Few

(c) Much

17. Is there any case of reworks in the tasks of the project?

(a) None

(b) Few

(c) Much

18. Are you directed to make any early maintenance for a structure in the project?

(a) None

(b) Few

(c) Much

19. Is the timing of the tasks meeting your previous time expectations?

(a) Exact

(b) Near

(c) Far

20. Is the budget of the owners equal that needed enough to undertake all tasks required in the project?

(a) Exact

(b) Near

(c) Far

21. Is there any unexpected problem in the mechanical and electrical works ?

(a) Yes

(b) No

6. Conclusions and Recommendations

Two essential conclusions can be extracted from this study:

- 1- There is a weak interrelation between the two stages (design and implementation) so that 40% of construction projects has none adjustment works and only 20% has much adjustment works. The level of feedback between designers and executors is low for 58% of projects and moderate for 28% of projects.
- 2- Results showed no impact of concurrency of project stages on the service and economy affairs of projects like cracking, deflection, damage, rework etc.

This study recommends that it is important to make improvement for the performance of the management of local construction projects by using modern trends such as concurrent engineering. Researchers may contribute in this improvement by making larger surveys, putting more accurate criteria and making biter design for their surveys. One of most common problems facing researchers in the case of using questionnaires is the probable lack of accuracy in participant response, so another recommendation is to put a more effective strategy in preparing questionnaires depending on the state of the community culture and awareness.

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