

PRODUCTIVITY IN CONSTRUCTIONS WITH ROLE OF SITE EFFECT AND COMPLEXITY VARIABLES

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Abstract- The complexity theory-related research is a crucial part of the Iraqi construction industry. Critical theory looks into how chaos theory can lead to order and patterns as well as how the most basic, simple historical principles can lead to complex patterns and behaviors. Things' complexity helps us better understand how evolution works. The findings of this study, which also provided a definition of the complexity factor, provide a summary of earlier investigations into the concept of complexity. The analysis of building project complexity issues is a component of complexity thinking. By examining this study, it is possible for Iraqi construction management departments to determine the degree of a project's difficulty and develop the most efficient techniques for construction management. Many engineers and other professionals worked on the presentations for the study and the closed questionnaire. The Opponents (Architects and engineers working on building sites and in academic institutions; construction management researchers; and constructing technicians). The study results were used to rank the pertinent elements using frequency analysis (from least powerful to most powerful). This listing reflects the findings of the investigation. You can determine the project's difficulty and create effective management strategies by looking into these characteristics.

Keywords: Project Difficulty, Difficulty in Project, Site Productivity, Complexity Theory, Project Factors Effect.

1. INTRODUCTION

The presence of a formidable network of subcontractors on complex building projects is one of the factors that contributes to the difficulty of these endeavors [1]. To get a feel of what chaos theory is all about, one can look at how effective management and structure theory were combined to explain why everyone in our universe is larger than its constituents. This is possible because complexity theory was developed to explain why everything in the universe is bigger than the sum total of its components. Complex technologies attempt to model and characterize the systems they are trying to understand in order to make sense of phenomena that are beyond the realm of standard scientific

comprehension [2]. Although "complexity program" and "difficult program" sound like they may be interchanged, in reality they are not the same thing. The author makes a distinction between complex and complicated based on the Latin roots of the phrases. The expressions "cum plexus" (which literally translates to "started packing with") and "cum pliare" imply a reductionist approach to the problem (lead to "piled up with") [3]. A number of works on the difficulties of constructing various kinds of buildings will be scrutinized in this study in order to achieve a deeper comprehension of the complicated and complexity theory. There have been a number of studies done in the past that demonstrate that difficulty management can also be utilized to assess how the task's complexity is covered.

There are numerous angles from which one can approach elaborating on the topic at hand. An operating system is comprised of a number of components, the first of which is the definition, which is the most fundamental and elementary of the three. These elements are tightly entwined with one another. The complexity of a problem is a measure of how interwoven and dependent on one another its solutions are. The idea of complexity, which is investigated in this field of study, is expanded upon by the field of study known as complex systems theory. Systems theory can be applied to the study of a wide variety of complicated procedures, including those found in community, psychology, science, and technology. These methods can all be investigated using systems theory. Any action involves some degree of complexity, and the theory of complexity can assist us in gaining a deeper comprehension of the social attitudes held by those carrying out the work as well as the networks of people that surround them. The ideas can be applied to projects of any size, and "complexity" does not denote "difficulty" or "big" in this context.

One of the primary advantages of complexity theory is that it provides researchers with the theoretical groundwork they need to conduct more in-depth study that is founded on dynamic and flexible analysis [4]. This is a significant advantage. Understanding how simple fundamental laws can lead to the creation of complex behavioral and structural patterns and structures is necessary in order to deal effectively with complex

transdisciplinary circumstances [5], [6]. When viewed from a relational angle, a number of ideas become apparent that are essential to comprehending the process of project management. When analyzing complicated projects, it is necessary to take a number of factors into consideration, including those pertaining to the economy, culture, and the environment. This is something else that must be kept in mind. This contains the various aspects that influence the theory of complexity and complicated initiatives. In order to satisfy environmental, profitability, and economic standards, in addition to the rules connected to contracting, it is possible that the procedures for contracting and the procurement of materials will need to be more complex. This is due to the fact that projects of varied degrees of complexity are utilized in an appropriate manner to fulfill the requirements of contracting. As a direct consequence of this, complexity-related influences are reduced to a minimum [7].

2. THE STUDY'S OBJECTIVES

1. Investigate the theoretical approaches in construction projects through literature reviews
2. Determine what influences the application of complexity theory in the construction industry
3. The complexity underlying construction industry is increasing due to a number of causes
4. The results of the closed questionnaire were used to come up with a conclusion judgement
5. Conclusive statements about a certain subject or issue based on research findings.

3. REVIEW OF THE OLD LITERATURE

The following literature analysis of earlier investigations provides a depiction of the significance of complexity as well as the factors that have an effect on it. The complexity hypothesis posits that it is very challenging to successfully manage building projects [8]. In addition, researchers have utilized a range of approaches, such as questionnaires and focus groups, to learn more about the practices that are utilized in project management [9]. Consider compiling a list of the various items that can be linked to the idea. The level of complexity of an organization has a one-to-one correlation with its outputs, as well as its failure and success criteria [10], [11].

Background, education, and one's physical location all play a role in the development of one's personality traits. As a consequence of the researchers in this study utilizing a variety of methodologies to investigate the factors that determine the reasons for enterprise catastrophes and the complexity of projects, the researchers obtained a wide diversity of enterprise managers' judgments of the factors. To get insight into the relative significance of various factors in the success or failure of a project, a survey was conducted among project managers from all over the world. Within the population that was observed, there can be found at least three different types of response styles and a total of five distinctive groupings. Those aspects of a project that have an effect on the project manager and the members of his or her team will have the most influence on the final product.

The method in question seeks to achieve the goal of understanding and successfully managing complexity. What followed is a list of the events that took place:

1. The difficulty framework is helpful in assisting with comprehension because of its structure [12].
2. The most of the difficulties that managers had to deal with could be alleviated if they had even a basic understanding of the several solutions available to them.
3. As a result of the workshops, a taxonomy of responses to the final complexity was developed [13].

The complexity can be reduced, and a method for evaluating answers to residual difficulties, including the potential of assigning managers to projects, can be implemented. The method of project complexity has drawn a lot of attention lately, likely because of the growing level of complexity inherent in construction endeavors. The level of complexity in a construction project has an effect on everything from managing projects to the deliverables. It may be more challenging to create specific goals and objectives, and it may result in changes to the particulars of the project's organization [14].

4. COMPLEXITY THEORY'S ELEMENTS

1. Even in the context of a loose parallel, the term "complexity" should not be used in certain management publications because it is not a legitimate term.
2. It is not appropriate to use the word "complexity" as a metaphor in the management literature, even though this is what appears to be happening in some instances.
3. It is imperative that the term "complexity" be applied in an exact manner rather than only as a metaphor, as is the case in (Furthermore, we suppose the principles are intended to assist people see and interpret situations in a new light).
4. The study of characteristics of the theory that enhance its applicability or boost its capability for creative application will take up a significant portion of the time allotted to this topic.
5. Although the Complexity Theory has a great deal of intellectual appeal, putting it into practice is notoriously challenging.
6. There may be a "two-valued logic" that celebrates "new paradigms" and despises everything associated with "old paradigms" if complexity notions are taken too seriously (frequently referred to as Classical) [15].

5. PROJECT COMPLEXITY AND COMPLEXITY THEORY

In their estimation, management should prepare a crystal-clear vision for the company, provide functional leadership, begin communicating and promoting the organization's goals, and establish a platform for open communication all while making detailed decisions, controlling people, and preparing for an uncertain future [16]. Because of this, construction project managers are expected to have a solid comprehension of complexity theory. The significance of complexity in the overall strategy of project management has been acknowledged for some time now [17]:

1. Because of how complicated the project is, management, planning, as well as control are all much simpler to figure out.
2. Because of the complexity of the project, it can be difficult to determine the project's aims and objectives.
3. Hardness is a significant consideration in determining the most appropriate project organizational structure.
4. The project's complexity influences the project inputs used, such as the administrative personnel's knowledge and competence needs.
5. When choosing the correct project procurement structure, complexity is frequently utilized as a consideration.
6. Project complexity has an impact on schedule, quality, and cost goals. In general, the greater the project difficulty, the longer and more expensive the project will be.

6. THE COMPLEXITY OF CONSTRUCTION PROJECTS

The degree to which a project's various elements are connected with one another and dependent on one another, as well as the degree to which there is ambiguity surrounding those aspects, can be characterized as the complexity of the project. The complexity of a project may primarily be broken down into two categories [18]: how challenging it is, and how risky it is. The amount of effort required to complete the project is directly proportional to the level of expertise possessed by the team as a whole. What may go wrong? What could possibly go wrong? What could possibly go wrong? What could possibly go wrong?

The complexity of project management is an essential part of the process that must be followed in its entirety if one wants to achieve success in managing a challenging endeavor. It is more crucial given that the complexity of the project is both a fiercely discussed topic and a key predictor in the performance of the team [19].

The most challenging aspect of managing the difficulties of a project is for the project manager to not only understand how to eliminate or at the very least lessen the negative consequences of the complexity but also to comprehend the potential that results from the complexity [20].

7. FACTORS THAT INFLUENCE THE DIFFICULTY OF CONSTRUCTION PROJECTS

The impact of a variety of factors on the project's complexity was investigated. Six major elements were identified, which were then subdivided into countless sub-factors. The following are the major components [21], [22]:

1. The inherent difficulty: A form of complicated condition having a big number of different pieces and a huge number of possible interconnections and feedback rings that is ultimately complex.
2. Uncertainty can be applied to any epistemic circumstance in which knowledge is either incomplete or anonymous. It is possible to utilize it to predict what will occur in the future, to examine physical measurements that have already been made, or to explore area that has

not been mapped out. Uncertainty can arise in circumstances in which people are ignorant, apathetic, or both, as well as in circumstances that are only partially observable and/or chaotic. Physicists, statisticians, and insurance are just a few examples; others include sociology, economics, and finance, as well as the information sciences.

3. The number of available technologies include: The term "technology" refers to a collection of methods, abilities, protocols, and processes that are applied in the creation of goods or services or in the attainment of goals such as scientific study. One kind of technology is the understanding of procedures, methods, or other comparable items. Another form of technology is the embedding of technology within machines to allow them to function without requiring extensive knowledge of how they operate. To put it another way, the presence of a significant quantity of technology in an organization will call for an increase in the amount of planning and management that is performed.

4. All of the jobs, operations, and bundles of activities for each phase need to be kept in a sequence that does not shift or is otherwise irregular.

5. The process of beginning a new phase before the previous one has come to a close is referred to as overlapping. Due to the necessity of operating in parallel during periods that overlap one another, there are times when additional resources are required. If the next step is carried forward before the right information from the previous phase has been gathered, there is a risk of additional work having to be done later on.

6. Organization's intrinsic complexity: It's the degree of differentiation among the numerous pieces that make up an organization. This variety of professional specializations is frequently managed within the business.

The following are the five dimensions of complexity [23], [24]:

Expectations, unpredictability, wiggle room, and the cost 1) of construction (e.g., Costs to drivers and correct), Constraints on price and motivations.

2) Plans (Time, Schedule Risk, Authorized Milestones, and Resource Availability).

3) Speculative (what the job entails and how it relates to the rest of the project).

4) Description (Constituents, construction challenges, local problems, environmental considerations, legislative and legal problems, regional concerns, worldwide surprises).

5) Finance (public funding, future revenue stream financing, asset value exploitation, finance-driven project delivery techniques, commodity-based estimation, financial risk mitigation, differential inflation rates).

8. STUDY APPROACH

In Figure 1 depicts a field survey that was conducted to examine the influence of complexity features on Iraqi building projects [25], and this section of the study delves into the specifics of the survey. The flowchart is an outline of the methods that the researcher went through to arrive at practical implications [26].

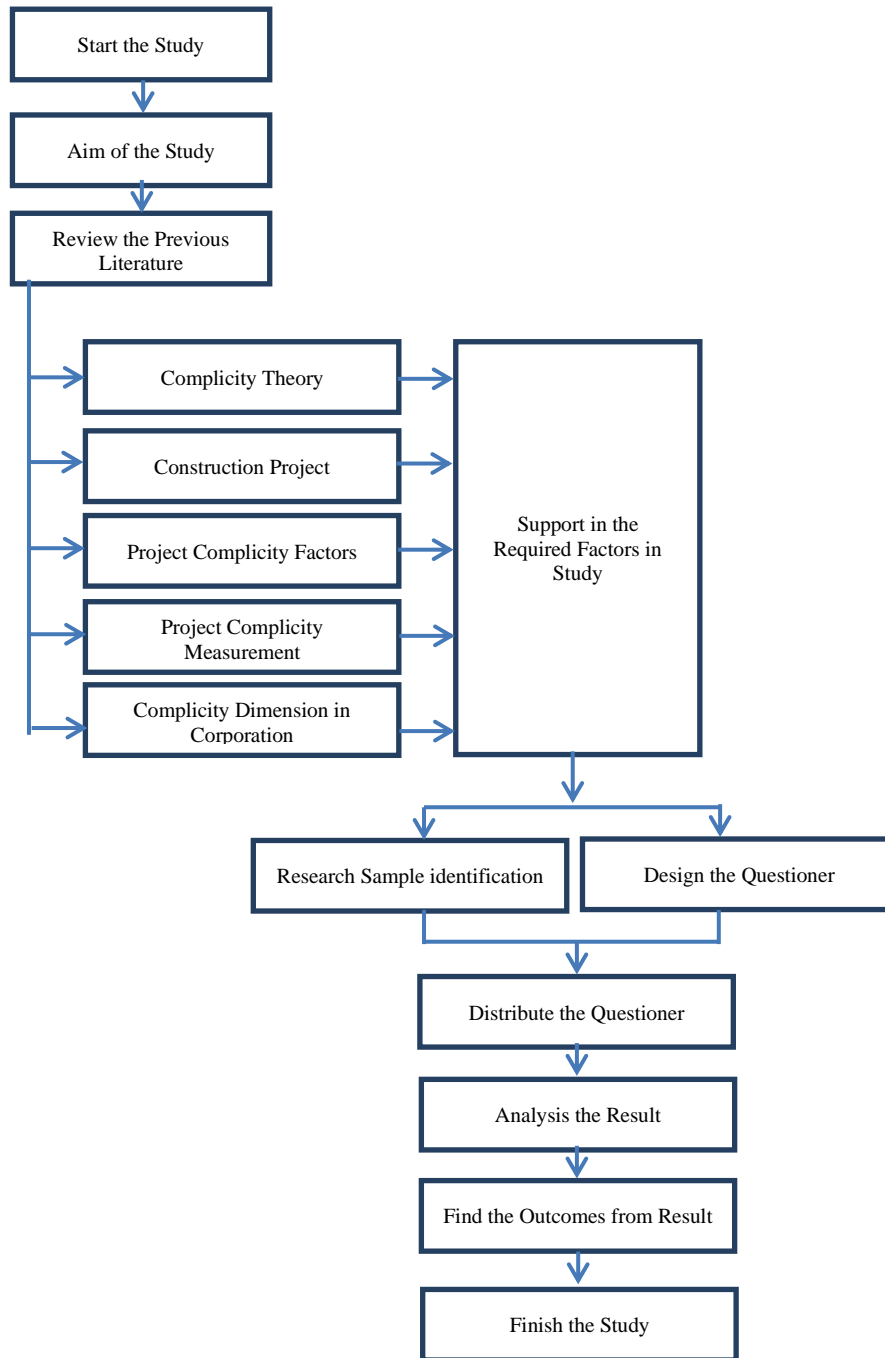


Figure 1. Shows the investigation process [26]

9. THE RESEARCH SAMPLE

The performance of the closed questionnaire approach is highly dependent on the quality of the study sample that it utilizes. The sample for this study consisted of individuals with prior experience working in the following subfields of engineering [27]:

1. As a result, site engineers are needed to deal with a number of difficult issues.
2. Academics, because they possess sufficient knowledge of complexity elements and their impacts.
3. Engineers in management roles, because some of the proceeding to the next phase are organizational in nature.

As the sample size increases, the distribution of the sample means will move closer to normality; this is true for any regular population, regardless of sample size, according to the Central Limit Theorem. Because more than 30 people responded to the questionnaires that were handed out, the data is adequate for statistical analysis. The process of analysis will be carried out based on the responses received (45 in total). In order to cover the two categories described in the previous paragraph, the closed questionnaire method included participants from both the public and private sectors who worked in a variety of building disciplines. The overall number of respondents who participated in the survey and finished it is presented in Table 1.

Table 1. Number of respondents as well as their characteristics

Organization	Number of respondents
For General Trading as well as Contracting Ltd., there is free space	6
Located in the Ministry of Health or Department of Health	8
The Ministry of Architecture and Urban Development (MAUP)	6
The Ministry of Housing and Building	5
The University of Baghdad	8
Transmission project directorate of the Electricity Ministry	6
World Energy General Contractors Ltd.	6
Totals	45

10. ANALYSIS OF SURVEY

The number of participants and the average mass of those responses are used in the discussion of the data. We can use this information to determine what the vast majority of survey participants believe by performing the following steps:

1. The way people respond to various questions is gauged using a Likert scale [28]. There are five options here, and the correct answer is:
 - i. Totally Ineffective
 - ii. Slightly Effective
 - iii. Effective
 - iv. Averagely Effective
 - v. Powerfully Effective
2. The first step in the analysis process is to figure out how often each of the five options is chosen.
3. In order to calculate the average, you will first need to provide a range of values to each answer. Each response option is given the same weight according to the average. Table 2 displays a ranking of response alternatives based on their respective value [29].

Table 2. Weight is the answer [29]

Answers	Period	Average
A complete waste of time	0-2	1
Effectively, but only somewhat	2-4	3
Inadequately powerful	4-6	5
Effectively powerful	6-8	7
A complete waste of time	8-10	9

The median (m) average value was calculated for each survey question, and those calculations served as the basis for the analysis and evaluation that followed. Given that the mean and the median are both located in the middle of a range that goes from one to nine (5). After that, you will need to determine that the average value between 1 and 9, which is 7, and then look at the average values for each question in respect to that value.

- 1) It's meaningless if M is less than 5, because the item's evaluation has been negatively impacted.
- 2) A rating of 5 M 7 indicates that the factor seems useful and thus should be considered.
- 3) In cases where M exceeds 7, the item is given a lower evaluation score (powerful). As a result, the aspect should indeed be taken into consideration.

11. THE QUESTIONNAIRE'S RESULTS

The following table summarizes the findings of a survey conducted on Iraqi construction projects; Respondents were asked to provide their age. The question confirms that the sampling method is properly implemented to ensure that study participants will provide reliable data. The results show the no of respondents who their ages (20 to 30) year old are 62 respondents, for the ages of (30 to 40) years old there are 20 respondents, for the ages of (40 to 50) years old there are 15 respondents and there are (7) respondents their ages are more than 50 years old, Table 3 and Figure 2.

Table 3. The results of the questionnaire

Ages	Responses	Percentage
20 to 30 years	62	59.62%
30 to 40 years	20	19.23%
40 to 50 years	15	14.42%
More than 50 years	7	6.73%

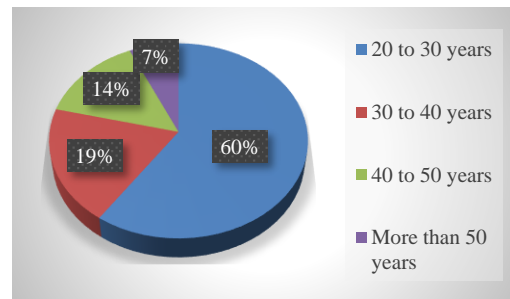


Figure 2. Ages of questionnaires

The researcher conducted a questionnaire about the Educational achievement of the research sample to get an idea of the scientific levels of the research sample, and the results were as follows 59.62% of respondents their Educational achievement is B.Sc., 24.04% of respondents their Educational achievement is M.Sc. and 16.35% of respondents their Educational achievement is Ph.D., Table 4 and Figure 3.

Table 4. Educational achievement

B.Sc.	62	59.62%
M.Sc.	25	24.04%
Ph.D.	17	16.35%

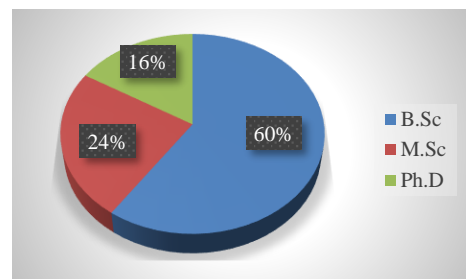


Figure 3. Educational achievement

The researcher asked the respondents about the type of projects implemented by the organization, the outcomes of the question were shown in the figure below, the high percentage 55.77% obtained by the service projects and roads and bridges project obtained the lowest percentage its value = 2.88%, Table 5 and Figure 4.

Table 5. The type of projects implemented by the organization

Service Projects	58	55.77%
Residential and Commercial Towers	20	19.23%
Checking and preparing designs	19	18.27%
Irrigation Projects	4	3.85%
Roads and bridges	3	2.88%

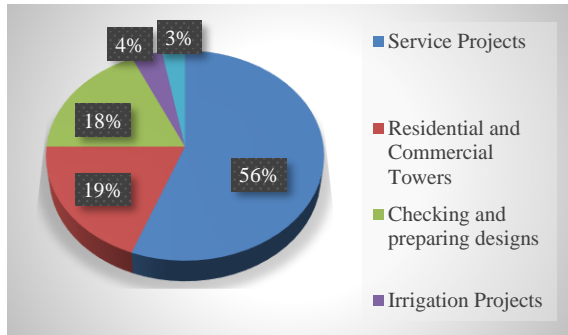


Figure 4. The type of projects implemented by the organization

As seen in, Table 6 and Figure 5, the respondent engineering specialization comes from civil 51, Electricity 6, Architectural 12, Mechanical 12, Communication 6, at the end Computer and Information comes with 15 people.

Table 6. Professional Specialization

Civil	51	58.62%
Electricity	6	6.90%
Architectural	12	13.79%
Mechanical	12	13.79%
Communication	6	6.90%
Computer and Information	15	17.24%

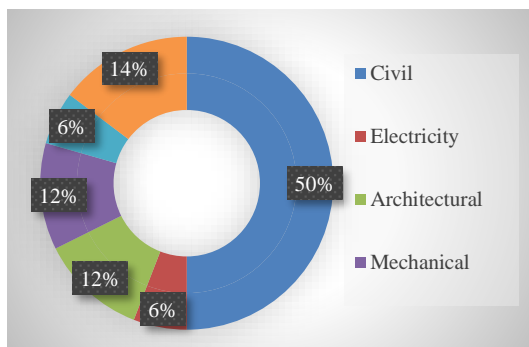


Figure 5. Professional Specialization

12. CONCLUSION

The investigation investigated the various problems that could arise during construction projects in Iraq. The results of this research make it abundantly clear that being familiar with a variety of criteria is required to accurately evaluate the level of difficulty associated with a building project. Because of this, complexity theory may be used to the analysis of building projects as well as the surroundings in which project managers carry out their responsibilities. The construction manager is interested in the interdependencies between the roles that technology plays in a task, as well as aspects such as the information generated, its transmission, utilization, and

feedback, as well as other factors that obtained average assessments in the subject matter of the study.

It is conceivable to apply this concept to Iraqi construction projects throughout the process of reconstructing liberated areas, which require the simultaneous completion of a large number of construction projects due to damage sustained by a range of important facilities (such as infrastructure projects and highways). If complexity theory is applied, all of the work that will be done in the future relating to these topics will be made much easier and more efficient. It is difficult for a single company to achieve financial success without the simultaneous achievement of other businesses. We may also be able to correct our impressions of the organizations that we are researching by utilizing complexity theory. It teaches us how to approach the topic of evolution with a more critical mindset, which is an important skill to have.

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