` International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

# Optimal Responsibility in Causing of Delay for Construction Projects in Iraq by Using ANP Technique

**Dr. Meervat R. Al-taie**

Baghdad University/College of Engineering, Civil Department - Construction Management

**Abstract:** ***The construction projects suffer from the problem of delay in completion due to many factors that lead to slow implementation of time and quality required, in addition to the multiplicity parties involved and their effect in this delay, regardless to the type and nature of the construction project .The problem of delay is very large in Iraq because there are many different circumstances which have had negative effects on the economic situation of the country and on the deterioration of the services level required in time. The research sought to investigate the role of the parties involved in the implementation of the project to determine their responsibility in delaying the completion of the construction projects in Iraq and to know the roles and proportion of their responsibilities depending on the type and nature of the work provided by them in the implementation of the project through setting their priorities by using network analysis technique. The final results show that the contractor, consultant and owner play an important role in the delay of the project with priority (38.52%), (36.41%) and (16.36%) respectively. there are additional factors share with them in causing delay with priority equal to (8.71%).***

**Keywords:** Delay, Construction, Contractor, Cause, Consultant, Owner, ANP

## 1. Introduction

In general, Delay is one of manyproblems have arising during the construction industry, but in Iraq the rate of delay is increasing in implementation of construction project Due to various factors affecting the completion of projects .it is the main causes of disputes in construction industry .

Delay can be defined as "the slowing down of work without stopping construction entirely and that can lead to time overrun beyond the date that the parties have agreed upon for the delivery of the project. Delays occur in every construction project and varies considerably from project to project.(Adekunle, 2015).

Delay is incidents that impact on a projects progress and postpone project activities, may include weather delays, unavailability of resources, design delays….etc.in general, project delays occur as a result of project activities that have external and internal cause and real effect on project (Vidalis,2002).

Construction industry involves the impact of many participants in all construction projects. Therefore, any event that impacts on the construction industry have the potential to affect the whole economy .The construction process is subjecting to many variables factors from many sources, including: available of resources, the party's performance, conditions of environmental, and the contractual relation of the parties' involvement. The completion of construction projects on the agreed time indicates the efficiency of the major parties involved in the implementation of the construction work.

## 2. Research Objectives

Following are the main objectives of the study:

- Identify the causes of delay in construction projects in Iraq.
- Identify the responsibilities for major parties in construction projects according to the implementation works
- Rank the responsibilities for major parties in construction projects which are causing the delay of project
- Find the appropriate solution for the final results

## 3. Literature Review

Globally, over the last decade, many searchers studied the causes and effects of time delays in construction projects especially in building section.Most of them approved that effect of delay for the owner causes many problems like, losing revenue of the construction project, inflation, increase of workers' remuneration, and price of materials and raw materials for completion of the project etc.While for contractors, the delays refer to top prices, high work length, high labor costs, materials and redoubled instrumentation refers to prices (Multashi2016).But another studies focused on the real reasons that cause delay according to the nature of work provided by different parties' involvement in the project delivery including internal and external factors like(project, design, owner, contractor, consultant, work force, material…etc.)

The reality of this research is investigating the fact of causes of delay in construction projects in Iraq, so the research focused on local studies and literatures during the last ten years. This determined the reality for the reasons and causes of delays for many projects in Iraq.

The most important previous local studies and literature are:

1) Mahmmed extracted the effective factors on the project schedule when preparing the project schedule, and in all the stages of the project, and concluded that present a serious and comprehensive approach to all the activities


Licensed Under Creative Commons Attribution CC BY

and tasks surrounding the project and their effect on the time schedule, in order to avoid any claims resulting from changes that occur in the project time schedule. through which the project is successfully performed, and claims due to schedule change are avoided,( Mahmmed,2012 ).

2) Husseinconcluded that the most important reasons for delays of projects in Iraq ,are: Delay the necessary laboratory tests for the materials , Assignment of less tender work ,inefficient financial contractor Sharp rise in prices of construction materials and Failure of contractor in estimate the length of time(Hussein,2013).
3) Jahangerdefined the 58 causes factors ,categorized into 10 groups and ranked. the main results showed that all parties agreed together that the designerwas the most influential causes group .so the contractor group considered as the second most important in causing delay followed by owner as a reason in delay causes.(Jahanger ,2013)
4) Enasinvestigated the causes of construction schedule delays beside the methods of schedule delay analyses by selecting the Time Impact Analysis (TIA) ,which can display the progress of construction works step by step with the help of PRIMAVERA software. and she observed from the delay analysis that, the total of 58 parameters were identified and analyzed.(Enas,2013)
5) Multashi analyzed the influence and success factors in construction taking Alkut Olympic Sports Stadium as a case study. The researcher defined the weakness in the integration of the design stage of the project, which were impacted on the technical integration and specification of architectural. He mentioned to some of main activities in order to decrease the cost of the projects.(Multashi, 2016)
6) Bekr pointed up the most important delay factors affecting the time overrun in Iraq projects are: changing the regulations and bureaucracy in Iraq, facts for security measures,, number of official and non-official holidays, low performance of lowest bidder contractors in the tender, changing the design by owner, changing the design by consultant, payments progress delay by the owner, problems with local community, poor experience construction and economic conditions for the owner (Bekr ,2015).
7) Hazharapproved there are commonalities in thedelays causes of project, he mentioned that the global construction sector including the fragmented nature of project delivery, changes to the scope of works with errors during the construction stage. He defined measures to reduce delays in project including risk and value management, collaborative working and effective management(Hazhar,2015).
8) Al-Ageleconcluded the most important reasons leading to the cost deviation in the construction project of Iraq some of them are: Inability to meet project requirements, planning is Inadequate, estimation of the cost is Inaccurate, cash flows delayedby owners, executive manager of project is Inefficient, poor control to the time of the project or predict the date of its , the population in the project area is a negative impact, the decision and the overlap of powers are multiple sources, and lack performance of the contractor.(Al-Agele.2016).
9) RasheedConcluded the most of the construction projects in Iraq having a delay in the executive projects but its ratio vary from project to another and suggested using the modern method and principles in projects management to reduce and control the delay in projects.(Rasheed, 2017)

## 4. Research Methodology

Most of local existing literatures for previous projects in Iraq identified major parties affect the delay of project delivery with various causes. our study depended on this causes delay and identified a new causes from visiting meeting .the research identified The 126 causesof delay , categorized in four major parties namely owner, contractor, consultant and additional parties including (labour, manager, tool, external). A Field survey adopted to collect data from construction projects in Baghdad .the form of questionnaireorganized in an importance scale according to their respondents were asked to indicate their opinions.

## 5. Questionnaires Structure

There are two types of questionnaires in our study depending on the main objective of the statistical analysis.

**Questionnaire I**: Consist from the list of 126 factors that influencing delay in construction project. thisform of this questionnaire categorized in fourcomponents according to impact of parties in the delay of project. Using five scale importance index (likert scale) from Extremely=5, Great=4, Medium=3, Little =2 and Very little=1.

The questionnaire sample is (82) response including the owners, contractors , consultants ,engineers and managers who are associated with the project activities with sufficient experience and distributed in different projects from different companies

The analysis of this questionnaire data was done by using the Relative Importance Index method, because it best fits the purpose of our study.RII aids in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables. The formula below was used to calculate (RII) the Relative Importance Index (altaie,2015):

$$RII\ \% = (\sum W / AN)\% \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:
W= weighting given to each statement by the respondents, ranges from 1 to 5;
A= Higher response integer (5);
N= total number of respondents.

**Questionnaire II**: The form Consist from 40 causes factors distributed over four components ,which are the most higher importance according to RII from questionnaire (I) .the main target is assessment the priorities for the components and causes specified to selecting the optimal responsibility in causing delay for construction projects according to the conditions and requirement of Iraq .Selected sample respondents are asked to assess the importance of four components and (40) elements to get the optimal according to a scale ranging from 9 to 1.Thomas Saaty developed this scale as shown in Table (1) to strength


Licensed Under Creative Commons Attribution CC BY

the judgments(Saaty , 2008).

**Table 1:** Saaty's fundamental scale

| Intensity of importance | Definition |
|---|---|
| 1 | Equal importance |
| 3 | Moderate importance |
| 5 | Strong importance |
| 7 | Very strong importance |
| 9 | Extreme importance |
| 2,4,6,8 | Intermediate values |

## 6. The Process of ANP

ANP was defined by Saatyas a general theory of relative measurement used to derive composite priority ratio from individual ratio scale reflectingrelative measurement of interconnected elements within control criteria (Saaty, 2001). Three related basic principles of ANP, which are,

1) Decomposition: it is mean the structureof complex problem into a hierarchy or network consist from of clusters and sub clusters in the framework of ANP process.
2) Comparative judgments: it is the pairwise comparisons from responses to derive local prioritiesfor all elements in the cluster with respect to their parent. Basing on the ratio measurement that measures proportion and judgments of each pair of elements in the network in order to derive ratio scale of measures.
3) Synthesis:it is using to multiply the local priorities of the elements in a cluster by the global' priority of the parent element. Construction of Synthesis involves of:
   a) Un weighted supermatrix;
   b) Weighted supermatrix; and
   c) Limited supermatrix

## 7. The process of ANP

ANP comprises in four major steps(PiFang,2011):

*Step1*: Model construction and problem structuring
The problem should be clearly stated and decomposed into a rational system basing on decision maker opinion via brainstorming or other appropriate methods. The steps needed for the construction of the network are:

a) Elements determination;
b) Clusters determination;
c) Influence network determination.

Influences of elements are considered from top to bottom and it can also consider among other elements in the same cluster or other clusters in the model with respect to several properties for each of them.

***Step2***: Pair-wise comparisons matrices and priority vectors. Pair-wise comparisons consist from:

a) Comparisons of Clusters: it is mean clusters that influence a given cluster with respect to a control criterion.
b) Comparisons of Elements: it is mean paired comparisons on the elements within the clusters. All elements are compared to their influence on an element in their own cluster or in another cluster. The influence of each element can be represented by an eigenvector.

Pair-wisecomparison in ANP is made as framework of a matrix,and a local priority vector can be obtained for estimating the relative importance associated with the elements (or components) being compared by solving the following formulae(Nurgül,2014):

$$A \cdot w = \lambda \max \cdot w \quad \ldots\ldots\ldots\ldots \quad (2)$$

Where:
A= denotes the matrix of pair-wise comparison,
W= represents the eigenvector, and
$\lambda$ max = is the largest eigenvalue of A.
If A denotes a consistency matrix, then eigenvector X can be determined using

$$(A - \lambda \max) X = 0 \quad \ldots\ldots\ldots\ldots (3)$$

The consistency index(CI) verifies the consistency of the comparison matrix proposed BySaatydefined as follows(saaty,1980):

$$CI = (\lambda \max - n)/(n-1) \quad \ldots\ldots\ldots (4)$$

Where:
CI = denotes consistency index
RI = denotes the average consistency index

***Step 3***: Supermatrix formation
A supermatrix is actually a partitioned matrix, where each matrix segment representsrelationship between two nodes (components) in a system (Meade and Sarkis,1999).The obtain global priorities in a system involving interdependent influences, the local priority vectors are entered into the appropriate columns of a matrix, known as a supermatrix. The reason to multiply the weighted supermatrix is to capture the indirect influence of an element by any other element.

***Step 4***: the priority weights
The priority weights can be found in the column of the clusters in the normalizedsupermatrix. On the other hand, calculations must be performed to obtaining the overall priorities of the alternatives.
Decision makers or experts who make judgments must be checked by consistency tests, which are conducted based on consistency ratios (CR) of the comparison matrixes (Saaty, 2001).The consistency ratio (CR) is defined as:

$$CR = CI / RI \quad \ldots\ldots\ldots\ldots\ldots (5)$$

Where:
CI = consistency index
RI = the average consistency index for numerous random entries of same- order reciprocal matrices.
If CR >0.1, then the estimate is unaccepted so a new comparison matrix is solicited until CR $\leq$ 0.1.

## 8. ANP research model

To alleviate the statistical analysis ,the following criteria were implemented through the software superdecision to apply the analytical network process(ANP) .The proposed


Licensed Under Creative Commons Attribution CC BY

model study involves five steps;these steps are detailed as follows:

**Step 1**: construct the net work
- Identify the interdependence relations among criteria
- Establish a hierarchical structure and the ANP network

The mainmodel of the study consists from four clusters according to the practical study.all clusters have five criteria define the interactions between them as shown in fig.(1).

**Step 2:** The Experts Survey
- Establish the pairwise comparison matrices judgment.

Comparing the relative importance between paired clusters and elements is required to collect the precise information from experts According to the questionnaire survey.Pair-wise comparison a part of which can be seen in Fig.(2) is adopted using subjective judgments made in regarding to the fundamental scale of pair-wise judgments(Saaty2005).

**Step 3:**ApplyANPtechnique usingsuperdecision software**.**
Test the pairwise comparisons' consistency and obtain the weights.Authors computed geometric means of all paired comparison judgments for each question in order to reveal the aggregated group judgments as given by:

$$\left(\prod_{i=1}^{n} ai\right)^{1/n} = \sqrt[n]{a1\ a2\ a3\ \ldots\ an} \quad \ldots\ldots(6)$$

And then, utilizing the assess/compare module of the SuperDecisions software, the authors arranged these group judgments in pairwise comparison matrices.

**Step 4:** Compare the results obtained
Obtain an understanding about the components and the criteria weights.Automaticallythe SuperDecisionssoftware calculated the eigenvector of priorities and the C.R for all pairwise comparison matrices. allthe consistency ratio was less than 0.1, that are acceptable.

**Step 5:** Formulate the conclusions
Describe the contribution of the ANP model to the accreditation process. The four clusters are combined into a single overall ranking by rating the best higher component, and obtain the priorities for all elements in the model

## 9. RII results

After conducting the first field survey on the (82) research sample, associated with the project activities with sufficient experience and distributed in different projects from different companies, asked them about their roles in causing of delay according to their duties and works classified it in four groups as mentioned above. The researcher used RII to find the best fits to the answers and to predicate a criterion variable with itself or combination with other predictor factors.

Tablesfrom (2) to (5) showed the RII relative important index for 125 factors distributed in four groups with different importance. The aim of this process is to select the most five important for each group and use them in superdecision softwareto get the optimal responsibilities by using ANP technique.

Tables from (6) to (9) explained the high five important factors used in superdecision software

## 10. ANP (Priorities and Synthesized) Results

After completion of all pair wise comparison matrices then the unweightedsupermatrixis built,as shown in table(10).

The weighted supermatix, table (11), raised to limiting powers until the weights converge and remain stable so the limit supermatrix can be achieved. Until all columns of the last matrix are the same.

An interpretation of the priorities in the first right column in Fig(2),show previously the contractor was responsible on causing delay about (38.52%) ,Consultant responsibility is (36.4%) , Owner responsibility is (16.36%) and Additional has the lost responsibility about(8.71%). the weights are more close to the real world situation. The significant differences can also be found in our problem study.

Table(12) showed the corresponding and analyzing the prioritiesfor all factors with respect tothat components and nodes obtained and used to weight the matrix.

## 11. Results Discussion

The weight of pairwise comparison matrices used to obtain the corresponding the priorities of the clusters .The abstracted results are illustrated according to higher priority; they are obtained from running super decision pair wise model.

### 11.1 Contractor Responsibilities
This component is the highest (38.52%). In fact the contract component plays a crucial role for causingdelay in projects.it means that the contracts consideration must be at the top of attention. Poor experience on the part of the contractor staff in managerial and supervisory personnel (12.95%).another factors Have a major effect in causing delay like Lack communication and miss understanding with the parties involved in the project(7.6%), Lack experience in supervision and site management by the contractor(6.5%),Equipment availability and tool shortage on site (6.27%) and Lack controlling to select the subcontractors by the contractor is about (5.1%).

### 11.2 Consultant Responsibilities
Second part is consultant, that impact on the delay of the project by priority equal to (36.41%). The factors priorities that related to consultant responsibility are: Delay in approval of drawings (10.6%), Bad past reputation and history (corruption) of the consultant(7..89%), Errors in design due to unfamiliarity with local specification and conditions of environment (6.5%),Consultant site staff is absence in construction site(6.03%)and Deficiency in drawings details(5.37%)

### 11.3 Owner Responsibilities
The owner plays a different role in the delay of the project. The results indicate that the owner has a responsibility equal to (16.36%). The factors priorities that related to owner responsibility are: Low performance according to the lowest


Licensed Under Creative Commons Attribution CC BY

bidder contractors in the tender system (5.99%), Poor planning of the project(2.96%) , lack qualification of supervision owner's engineers(2.79%), Contract duration is very short for the project of construction(2.56%) and Changing Design by the owner (2.05%).

**11.4 Additional Responsibilities**

The general framework of the project environment can affect the delay of the project, its priority equal to (8.61%). The factors priorities that related to Additional parties responsibility are: The provision of information is poor to parties involved in project(2.92%), Public agencies in roads, utilities and public services needing external work (1.64%), Official and non-official holidays (1.47%), Poor Government relations in Building regulations (1.38%)and Conflict between contractor, consultant and owner(1.28%).

## 12. Conclusion

The final results showed the consultant also has the same responsibility not less than the role of the contractor. It also showed clearly the role of the owner and external factors but not as much as the responsibilities of the two parties.This study ranking the main causes of delay in construction of Iraq by using ANP technic .So the high 11 causes with higher priorities are: Lack of experience on the part of the contractor staff as managerial and supervisory personnel(12.94%), Delay in approval of drawings(10.60%), Bad past reputation and history (corruption) of the consultant(7.892%), Poor communication and miss understanding with the parties involved in the project (7.63%), Poor site management and supervision by the contractor and Equipment availability(6.524%) , Design errors made due to unfamiliarity with local conditions and environment (6.50%), Equipment availability and tool shortage on site (6.27%), Absence of consultant's site staff (6.00%), Low performance of the lowest bidder contractors in the Iraqi government tendering system (5.99%) ,Deficiency in drawings details(5.37%) and Poor controlling of subcontractors by contractor (relationships, payments (5.14%).the last 9 causes ranking from(2.96%0) to(1.29%).

## References

[1] Adekunle and K.W. Ajibola, "Factorial Causative Assesments and Effects of Building Construction Project Delays in Osun State, Nigeria", Architectural Engineering Technology, vol. 4, issue 3, 2015.
[2] Al-Agele H. K., *A. J. Al-Hassan," the reasons of costs deviation in the Iraqi construction projects", field assessment department of civil engineering/college of engineering /university of Baghdad,Iraq,2016.
[3] Altaie,meervat,"optimal solution of investment and traditional contracts for infrastructure projects in Iraq", A Thesis Submitted to the Faculty of Engineering at baghdad University In the Partial Fulfillment of the Requirements for the Degree of phd of science in construction management,2015.
[4] Buroog Basher Mahmood," causes of claims due to changes in time schedules of construction projects in iraq",A Thesis Submitted to the Faculty of Engineering at Cairo University In the Partial Fulfillment of the Requirements for the Degree of MASTER OF SCIENCE in Structural Engineering, 2012.
[5] EnasFathiTahier&R.K.Pandey ,"schedule delay in construction projects using time impact analysis", International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ,2013.
[6] Faris, Hazhar Mohammed Ameen ,"Causes of delays in construction projects in Kurdistan region of Iraq", MSc dissertation, University of Portsmouth,2015.
[7] Hussein Ali AwadGhafelKarim Al Hindawi,,"Causes of Delay in Public Construction Projects in Iraq", International Conference on Innovations in Engineering and Technology (ICIET'2013) Bangkok (Thailand),2013.
[8] GhanimBekr ,"Causes of delay in public construction projects in Iraq ", 2015.
[9] Multashi and R.R. Salgude, "Delay Analysis in Construction Project a Case Study-Alkut Olympic Stadium", International Journal of Science and Research (IJSR), vol. 5, Issue 6, June 2016.
[10] QaisKadhimjahanger ,"Important causes of delay in construction projects in baghdad city",2013.
[11] Rasheed,sawsan ,"Study and Analysis of the Delay Problems in Iraqi Construction Projects ", department of civil engineering/college of engineering /university of Baghdad,Iraq 2017
[12] vidalis, M.S &Naja,T.F, ,"cost and time overrun in highway construction", 4th transport on specially conference of the Canadian society for civil engineering, Montreal, Quebec, Canada,June,2002


Licensed Under Creative Commons Attribution CC BY

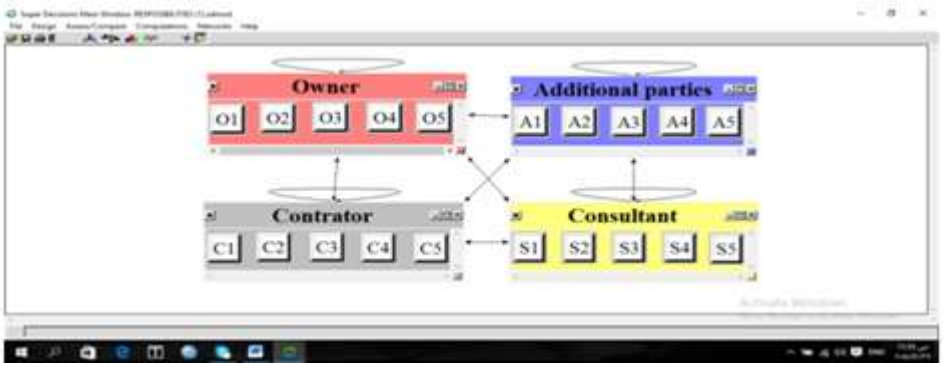


**Figure 1:** Snapshot of ANP model(main window)


**Figure 2:** Pairwise comparison questionnaire

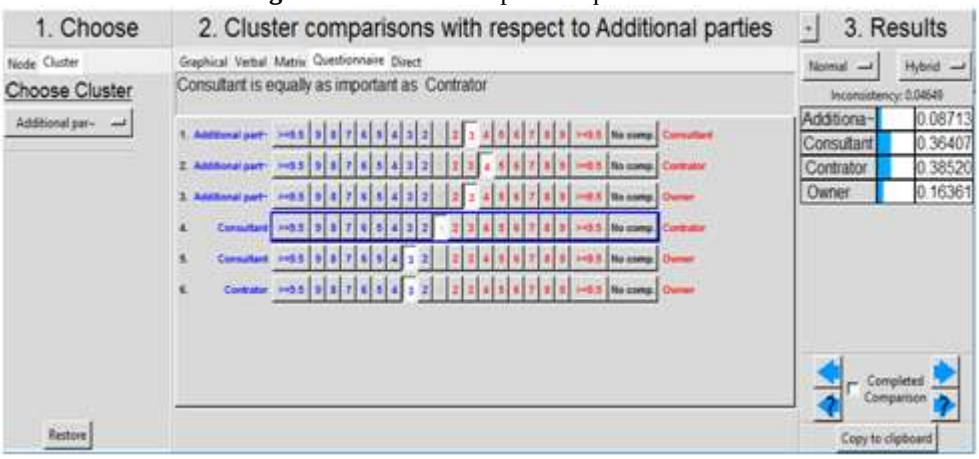


**Figure 3:** Resulting priorities for top level of the model

**Table 2:** RII results - causes delay by the owner

| | Hypothesized factors | 5 | 4 | 3 | 2 | 1 | RII% |
|---|---|---|---|---|---|---|---|
| 1 | low performance of lowest bidder contractors in the tender | 39 | 32 | 7 | 4 | 0 | 85.85 |
| 2 | changing Design by the owner | 32 | 37 | 6 | 5 | 2 | 82.44 |
| 3 | Delay of payments by the owner | 29 | 32 | 8 | 6 | 7 | 77.07 |
| 4 | poor experience of owner in construction | 18 | 21 | 20 | 14 | 9 | 66.10 |
| 5 | lack qualification of supervision owner's engineers | 32 | 34 | 9 | 7 | 0 | 82.20 |
| 6 | the owner is uncooperative with the contractor or consultant | 24 | 44 | 8 | 5 | 1 | 80.73 |
| 7 | poor coordination with contractors or consultant | 32 | 28 | 15 | 6 | 1 | 80.49 |
| 8 | many modifications or change in Contract (replacement or addition a new activity or change in specifications) | 34 | 29 | 12 | 7 | 0 | 81.95 |
| 9 | change the contract by the owner | 21 | 42 | 17 | 2 | 0 | 80.00 |
| 10 | approval Delay of the contractor submits to the owner | 14 | 37 | 21 | 8 | 2 | 72.93 |
| 11 | available utilities on site are Insufficient | 22 | 18 | 34 | 7 | 1 | 72.93 |


Licensed Under Creative Commons Attribution CC BY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | Contract duration is very short for the project of construction . | 32 | 36 | 10 | 4 | 0 | 83.41 |
| 13 | decision making of the owner is slow process | 21 | 22 | 16 | 14 | 9 | 67.80 |
| 14 | Changing variable in the scope of the project | 19 | 24 | 21 | 15 | 3 | 70.00 |
| 15 | delivering Delay the site to the contractor | 14 | 31 | 29 | 7 | 1 | 72.20 |
| 16 | obtaining the work permits are Difficult | 21 | 28 | 18 | 14 | 1 | 73.17 |
| 17 | Lack of unified system for contracts | 18 | 31 | 24 | 9 | 0 | 74.15 |
| 18 | there is no priority from owner to complete the project in High quality | 22 | 34 | 18 | 8 | 0 | 77.07 |
| 19 | Owner interference management and approval in project is very bad | 24 | 20 | 27 | 10 | 1 | 73.66 |
| 20 | owners initial requirements are Unrealistic | 19 | 28 | 26 | 7 | 2 | 73.41 |
| 21 | poor planning of the project | 21 | 16 | 27 | 18 | 0 | 69.76 |
| 22 | High quality of work by owner for the project | 24 | 21 | 13 | 21 | 3 | 70.24 |
| 23 | contract durations imposed by owner is Unrealistic | 16 | 23 | 18 | 16 | 9 | 65.12 |
| 24 | Suspension of work by owner | 18 | 27 | 22 | 12 | 3 | 70.98 |
| 25 | Poor communication and coordination by owner | 23 | 18 | 23 | 14 | 4 | 70.24 |
| | | | | | | | 74.96 |

**Table 3:** RII results - causes delay by the contractors

| | **Hypothesized factors** | **5** | **4** | **3** | **2** | **1** | **RII%** |
|---|---|---|---|---|---|---|---|
| 1 | lack controlling to select the subcontractors by the contractor | 39 | 28 | 10 | 4 | 1 | 84.39 |
| 2 | Lack of experience on the part of the contractor staff in managerial and supervisory personnel. | 37 | 34 | 8 | 4 | 2 | 86.59 |
| 3 | Cash problem during construction faced by the contractor | 31 | 30 | 16 | 5 | 0 | 81.22 |
| 4 | change order requests is Slow preparation of by the contractor | 32 | 28 | 15 | 5 | 2 | 80.24 |
| 5 | Poor planning and scheduling of the project by the contractor | 32 | 31 | 12 | 7 | 0 | 81.46 |
| 6 | Lack experience in supervision and site management by the contractor | 34 | 33 | 9 | 5 | 1 | 82.93 |
| 7 | Inappropriate construction methods that are implemented by the contractor | 32 | 29 | 14 | 6 | 1 | 80.73 |
| 8 | Material quality problems | 32 | 31 | 16 | 3 | 0 | 82.44 |
| 9 | Poor communication and miss understanding with the parties involved in the project | 35 | 33 | 12 | 2 | 0 | 84.63 |
| 10 | Delay in site mobilization | 24 | 27 | 20 | 8 | 3 | 74.88 |
| 11 | Shortage of construction material | 34 | 22 | 18 | 8 | 0 | 80.00 |
| 12 | Equipment availability and tool shortage on site | 32 | 36 | 10 | 4 | 0 | 83.41 |
| 13 | Lack of maintenance and allocation problems for the equipment | 21 | 22 | 16 | 14 | 9 | 67.80 |
| 14 | Delay in preparation of shop drawings | 24 | 24 | 21 | 10 | 3 | 73.66 |
| 15 | Delay of material supply | 24 | 31 | 19 | 6 | 2 | 76.83 |
| 16 | Difficulties from the authorities concerned in obtaining work permits | 28 | 24 | 18 | 11 | 1 | 76.34 |
| 17 | lack of manpower productivity | 24 | 31 | 21 | 5 | 1 | 77.56 |
| 18 | Shortage of qualified engineers | 22 | 34 | 18 | 8 | 0 | 77.07 |
| 19 | Work Delay due to subcontractor | 24 | 20 | 27 | 10 | 1 | 73.66 |
| 20 | High number of subcontractor | 26 | 28 | 18 | 8 | 2 | 76.59 |
| 21 | Poor site management | 21 | 27 | 18 | 16 | 0 | 72.93 |
| 22 | Preparation delay in the submissions of the contractor documents | 24 | 21 | 13 | 21 | 3 | 70.24 |
| 23 | errors during construction by the contractor | 16 | 23 | 18 | 15 | 10 | 64.88 |
| 24 | Termination or breach the contract by the contractor | 28 | 27 | 22 | 5 | 0 | 79.02 |
| 25 | test samples delay of the construction material | 23 | 18 | 23 | 16 | 2 | 70.73 |
| 26 | Shortage in equipment availability | 21 | 24 | 18 | 15 | 4 | 70.49 |
| 27 | Technical mistakes in project site | 26 | 23 | 18 | 10 | 5 | 73.41 |
| 28 | contractors use Unethical behaviors to achieve the highest level of profit | 20 | 22 | 19 | 16 | 5 | 68.78 |
| 29 | Slow permits by government agencies | 23 | 26 | 16 | 10 | 7 | 71.71 |
| 30 | Dependence on a newly-graduated engineer to bear the whole responsibilities in the site | 24 | 29 | 19 | 10 | 0 | 76.34 |
| 31 | Often changing sub-contractor company | 27 | 28 | 16 | 10 | 1 | 77.07 |
| 32 | Insufficient contractor competition | 28 | 35 | 14 | 4 | 1 | 80.73 |
| 33 | Failure in testing material | 29 | 30 | 17 | 6 | 0 | 80.00 |
| 34 | Use of unemployment in projects without qualification | 26 | 24 | 27 | 2 | 2 | 76.34 |
| 35 | Low productivity of labour | 27 | 24 | 21 | 8 | 2 | 76.10 |
| 36 | Major disputes and negotiations of contract | 26 | 26 | 15 | 12 | 3 | 74.63 |
| 37 | controversy and bad harmony between technician team of contractor and consultant | 19 | 23 | 28 | 8 | 4 | 70.98 |
| 38 | contractor competition is Insufficient | 29 | 26 | 17 | 7 | 3 | 77.32 |
| 39 | Poor site conditions (location, ground, etc.) | 24 | 21 | 23 | 11 | 3 | 72.68 |
| 40 | number of staff (contractor) is Insufficient | 28 | 21 | 20 | 12 | 1 | 75.37 |
| 41 | Spending time to find sub-contractors company appropriate for each activity | 28 | 22 | 16 | 12 | 4 | 74.15 |
| 42 | Poor distribution of labour | 30 | 19 | 22 | 9 | 2 | 76.10 |
| 43 | Lack of subcontractor's skills | 34 | 20 | 18 | 8 | 2 | 78.54 |
| 44 | attitude between parties is Uncompromising | 24 | 23 | 24 | 10 | 1 | 74.39 |
| 45 | errors and discrepancies in contract documents | 28 | 26 | 19 | 6 | 3 | 77.07 |
| 46 | contractor experience is Inadequate | 27 | 28 | 22 | 5 | 0 | 78.78 |
| 47 | overall organizational structure linking all parties to the project is Inappropriate | 27 | 24 | 21 | 7 | 3 | 75.85 |
| 48 | Contractor uncommitment to consultant instructions | 23 | 26 | 18 | 13 | 2 | 73.41 |
| 49 | Inappropriate type of contract used (traditional, design-and-build, etc.) | 27 | 25 | 18 | 8 | 4 | 75.37 |


Licensed Under Creative Commons Attribution CC BY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 50 | poor protection of complete work | 19 | 23 | 24 | 12 | 4 | 70.00 |
| | | | | | | | 76.32 |

Table ( 4) :RII results - causes delay by the consultant

| | Hypothesized factors | 5 | 4 | 3 | 2 | 1 | RII% |
|---|---|---|---|---|---|---|---|
| 1 | lack of design information and Delays in design work | 24 | 21 | 23 | 13 | 1 | 73.17 |
| 2 | Poor and inadequate qualification for the team of consultant | 18 | 23 | 26 | 5 | 10 | 68.29 |
| 3 | Deficiency in drawings details | 34 | 20 | 18 | 8 | 2 | 78.54 |
| 4 | inadequate qualification for the supervision engineers of the consultant | 21 | 19 | 23 | 12 | 7 | 68.54 |
| 5 | inadequate consultant's site team | 24 | 22 | 19 | 17 | 0 | 72.93 |
| 6 | Delay in giving instructions | 24 | 19 | 28 | 10 | 1 | 73.41 |
| 7 | Delay in approval of drawings | 28 | 32 | 14 | 7 | 1 | 79.27 |
| 8 | Errors in design due to unfamiliarity with local specification and conditions of environment | 27 | 30 | 17 | 8 | 0 | 78.54 |
| 9 | lack of coordination or communication by the consultant engineer | 26 | 21 | 27 | 6 | 2 | 75.37 |
| 10 | Documents not issued on required time | 27 | 24 | 21 | 8 | 2 | 76.10 |
| 11 | Design errors and discrepancies in contract documents | 21 | 26 | 20 | 12 | 3 | 72.20 |
| 12 | Previous dispute between contractor and consultant | 19 | 23 | 28 | 9 | 3 | 71.22 |
| 13 | Lack of quality assurance or control | 21 | 21 | 17 | 15 | 8 | 67.80 |
| 14 | Low quality of materials | 24 | 21 | 23 | 11 | 3 | 72.68 |
| 15 | Delay of materials approval by consultant | 28 | 21 | 20 | 12 | 1 | 75.37 |
| 16 | Little periodical sessions to address work problems | 20 | 16 | 28 | 14 | 4 | 68.29 |
| 17 | giving instructions is very slowly | 30 | 19 | 22 | 9 | 2 | 76.10 |
| 18 | Consultant site staff is absence in construction site | 34 | 20 | 18 | 8 | 2 | 78.54 |
| 19 | Lack of job security for the consultancy team | 20 | 24 | 23 | 14 | 1 | 71.71 |
| 20 | Waiting time for approval of tests and Poor inspection | 28 | 26 | 19 | 7 | 2 | 77.32 |
| 21 | Bad past reputation and history (corruption) of the consultant | 27 | 28 | 22 | 5 | 0 | 78.78 |
| 22 | Lack of technical and managerial skills of staff | 21 | 24 | 21 | 13 | 3 | 71.46 |
| 23 | decision making process from consultant is Centralization | 23 | 26 | 18 | 13 | 2 | 73.41 |
| 24 | Delays of payments Consultants responsibilities | 27 | 24 | 18 | 10 | 3 | 75.12 |
| 25 | Bad contract management by consultant | 24 | 23 | 19 | 12 | 4 | 72.44 |
| | | | | | | | 73.86 |

**Table 5:** RII results – causes ofdelay by the additional factors

| | **Hypothesized factors** | **5** | **4** | **3** | **2** | **1** | **RII%** |
|---|---|---|---|---|---|---|---|
| 1 | Poor economic (local or global ) conditions (currency, inflation rate, etc.) | 20 | 22 | 19 | 16 | 5 | 68.78 |
| 2 | Problems with neighbors | 19 | 23 | 28 | 9 | 3 | 71.22 |
| 3 | Official and non-official holidays | 28 | 26 | 19 | 7 | 2 | 77.32 |
| 4 | Changes in laws and regulations | 21 | 23 | 19 | 17 | 2 | 70.73 |
| 5 | Weather conditions effect (Hot and cold ) on construction activities | 27 | 24 | 18 | 10 | 3 | 75.12 |
| 6 | Different political and factional affiliation of workers | 30 | 19 | 22 | 9 | 2 | 76.10 |
| 7 | Ageing of site workers | 19 | 23 | 28 | 9 | 3 | 71.22 |
| 8 | construction methods is Inappropriate in Iraq | 20 | 16 | 28 | 14 | 4 | 68.29 |
| 9 | lack of Highly bureaucratic organization | 21 | 15 | 18 | 24 | 4 | 66.10 |
| 10 | Inconsistency between the project and its environmental due to donor agenda | 21 | 24 | 21 | 14 | 2 | 71.71 |
| 11 | Poor site safety | 23 | 26 | 20 | 10 | 3 | 73.66 |
| 12 | poor Government relations in Building regulations | 34 | 20 | 19 | 7 | 2 | 78.78 |
| 13 | poor Government relations Bureaucracy in government agencies | 21 | 21 | 17 | 15 | 8 | 67.80 |
| 14 | absence of Security measures | 21 | 15 | 18 | 24 | 4 | 66.10 |
| 15 | changing regulations and bureaucracy by government | 19 | 21 | 20 | 20 | 2 | 68.54 |
| 16 | Problems with local community | 20 | 16 | 28 | 14 | 4 | 68.29 |
| 17 | Poor communication between all parties in the project | 30 | 19 | 22 | 9 | 2 | 76.10 |
| 18 | site conditions and geological factors are unforeseen | 24 | 20 | 28 | 6 | 2 | 72.68 |
| 19 | Delays in resolving contractual issues | 24 | 20 | 23 | 12 | 3 | 72.20 |
| 20 | Conflict between contractor, consultant and owner | 28 | 26 | 19 | 7 | 2 | 77.32 |
| 21 | Public agencies in roads, utilities and public services needing external work | 27 | 28 | 22 | 4 | 1 | 78.54 |
| 22 | Low speed of decision making within each project team | 21 | 15 | 18 | 24 | 4 | 66.10 |
| 23 | Back of follow up for the project schedule and absence of continuous tracking. | 18 | 23 | 26 | 5 | 10 | 68.29 |
| 24 | Poor judgment in estimating time and resources | 29 | 32 | 8 | 6 | 7 | 77.07 |
| 25 | Lack of personnel training and management support | 18 | 21 | 20 | 14 | 9 | 66.10 |
| 26 | The provision of information is poor to parties involved in project | 32 | 34 | 9 | 7 | 0 | 82.20 |
| | | | | | | | 72.17 |

**Table 6:** Five important factors ranking by the owner

| | **Hypothesized factors** | **RII%** |
|---|---|---|
| 1 | O1= Low performance according to the lowest bidder contractors in the tender system | 85.85 |
| 2 | O2= Contract duration is very short for the project of construction. | 83.41 |


Licensed Under Creative Commons Attribution CC BY

| | | |
|---|---|---|
| 3 | O3=Changing Design by the owner | 82.44 |
| 4 | O4= lack qualification of supervision owner's engineers | 82.20 |
| 5 | O5=Poor planning of the project | 81.95 |

**Table 7:** Five important factors ranking by the contractors

| | Hypothesized factors | RII% |
|---|---|---|
| 1 | C1= Poor experience on the part of the contractor staff in managerial and supervisory personnel. | 86.59 |
| 2 | C2= Lack communication and miss understanding with the parties involved in the project | 84.63 |
| 3 | C3= Lack controlling to select the subcontractors by the contractor | 84.39 |
| 4 | C4= Equipment availability and tool shortage on site | 83.41 |
| 5 | C5= Lack experience in supervision and site management by the contractor | 82.93 |

**Table 8:** Five important factors ranking by theconsultants

| | Hypothesized factors | RII% |
|---|---|---|
| 1 | S1= Delay in approval of drawings | 79.27 |
| 2 | S2= Bad past reputation and history (corruption) of the consultant | 78.78 |
| 3 | S3= Deficiency in drawings details | 78.54 |
| 4 | S4= Errors in design due to unfamiliarity with local specification and conditions of environment | 78.54 |
| 5 | S5= Consultant site staff is absence in construction site | 78.54 |

**Table 9:** Five important factors ranking by the additional parties

| | Hypothesized factors | RII% |
|---|---|---|
| 1 | A1= The provision of information is poor to parties involved in project | 82.20 |
| 2 | A2= Poor Government relations in Building regulations | 78.78 |
| 3 | A3= Public agencies in roads, utilities and public services needing external work. | 78.54 |
| 4 | A4= Official and non-official holidays | 77.32 |
| 5 | A5= Conflict between contractor, consultant and owner | 77.32 |

**Table 12:** ANP ranking of the model element

| Component | Factors | Local priorities | Global priorities |
|---|---|---|---|
| Additional parties 0.0871 | A1= The provision of information is poor to parties involved in project | 0.336 | 0.029275 |
| | A2= Poor Government relations in Building regulations | 0.15906 | 0.013858 |
| | A3= Public agencies in roads, utilities and public services needing external work. | 0.1884 | 0.016415 |
| | A4= Official and non-official holidays | 0.16901 | 0.014725 |
| | A5= Conflict between contractor, consultant and owner | 0.14753 | 0.012854 |
| Consultant 0.3641 | S1= Delay in approval of drawings | 0.29116 | 0.106004 |
| | S2= Bad past reputation and history (corruption) of the consultant | 0.21677 | 0.078919 |
| | S3= Deficiency in drawings details | 0.14753 | 0.053713 |
| | S4= Errors in design due to unfamiliarity with local specification and conditions of environment | 0.17867 | 0.065047 |
| | S5= Consultant site staff is absence in construction site | 0.16587 | 0.060387 |
| Contractor 0.3852 | C1= Poor experience on the part of the contractor staff in managerial and supervisory personnel. | 0.33614 | 0.12948 |
| | C2= Lack communication and miss understanding with the parties involved in the project | 0.19812 | 0.076313 |
| | C3= Lack controlling to select the subcontractors by the contractor | 0.13355 | 0.051441 |
| | C4= Equipment availability and tool shortage on site | 0.16283 | 0.062723 |
| | C5= Lack experience in supervision and site management by the contractor | 0.16936 | 0.065238 |
| Owner 0.1636 | O1= Low performance according to the lowest bidder contractors in the tender system | 0.36653 | 0.059967 |
| | O2= Contract duration is very short for the project of construction. | 0.15651 | 0.025606 |
| | O3=Changing Design by the owner | 0.12533 | 0.020505 |
| | O4= lack qualification of supervision owner's engineers | 0.17061 | 0.027913 |
| | O5=Poor planning of the project | 0.18102 | 0.029617 |
| | | | 1 |

**Table 11:** Unweightedsupermatrix for the research model

| | | Additional parties | | | | | Consultant | | | | | Contractor | | | | | Owner | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | A5 | S1 | S2 | S3 | S4 | S5 | C1 | C2 | C3 | C4 | C5 | O1 | O2 | O3 | O4 | O5 |
| Additional parties | A1 | 0.000000 | 0.507440 | 0.552284 | 0.449868 | 0.453172 | 0.168239 | 0.442674 | 0.419184 | 0.415112 | 0.080797 | 0.431437 | 0.360218 | 0.408176 | 0.223443 | 0.327459 | 0.348595 | 0.312323 | 0.300754 | 0.430382 | 0.455382 |
| | A2 | 0.445623 | 0.000000 | 0.250089 | 0.271616 | 0.100670 | 0.369565 | 0.128282 | 0.079723 | 0.077753 | 0.072908 | 0.229284 | 0.155213 | 0.122936 | 0.064347 | 0.064772 | 0.085641 | 0.067084 | 0.080232 | 0.072603 | 0.233773 |
| | A3 | 0.346029 | 0.171401 | 0.000000 | 0.191632 | 0.124129 | 0.266503 | 0.251017 | 0.232267 | 0.214737 | 0.438423 | 0.072775 | 0.093362 | 0.217791 | 0.184741 | 0.169114 | 0.073976 | 0.167835 | 0.169857 | 0.117678 | 0.156261 |
| | A5 | 0.147835 | 0.090274 | 0.117629 | 0.000000 | 0.322028 | 0.082045 | 0.118493 | 0.142633 | 0.178256 | 0.234115 | 0.141247 | 0.226662 | 0.167104 | 0.325256 | 0.244812 | 0.192877 | 0.113478 | 0.126443 | 0.218291 | 0.074429 |
| | A5 | 0.060513 | 0.230885 | 0.079998 | 0.086885 | 0.000000 | 0.113649 | 0.059534 | 0.126193 | 0.114141 | 0.173756 | 0.125257 | 0.164544 | 0.083993 | 0.202212 | 0.193843 | 0.298910 | 0.339279 | 0.322715 | 0.161046 | 0.080154 |


Licensed Under Creative Commons Attribution CC BY

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Consultant | S1 | 0.518140 | 0.073588 | 0.067227 | 0.287610 | 0.261709 | 0.000000 | 0.315705 | 0.554381 | 0.518909 | 0.430884 | 0.064312 | 0.342830 | 0.288291 | 0.385001 | 0.378868 | 0.393474 | 0.412826 | 0.099212 | 0.429432 | 0.183517 |
| | S2 | 0.215530 | 0.277674 | 0.097294 | 0.067614 | 0.063420 | 0.566599 | 0.000000 | 0.221741 | 0.228435 | 0.121138 | 0.363201 | 0.075740 | 0.067144 | 0.308722 | 0.172031 | 0.097311 | 0.110269 | 0.426811 | 0.105998 | 0.062149 |
| | S3 | 0.152771 | 0.149763 | 0.164493 | 0.349862 | 0.114139 | 0.244774 | 0.193518 | 0.000000 | 0.100882 | 0.181277 | 0.149667 | 0.143658 | 0.107572 | 0.106164 | 0.098786 | 0.212222 | 0.093876 | 0.230069 | 0.072684 | 0.070338 |
| | S4 | 0.063795 | 0.105790 | 0.430473 | 0.127023 | 0.153302 | 0.072886 | 0.411666 | 0.126603 | 0.000000 | 0.266700 | 0.240088 | 0.324955 | 0.152179 | 0.062412 | 0.104113 | 0.111237 | 0.218348 | 0.155292 | 0.162511 | 0.233037 |
| | S5 | 0.049764 | 0.393184 | 0.240513 | 0.167892 | 0.407429 | 0.115740 | 0.079111 | 0.097276 | 0.151774 | 0.000000 | 0.182732 | 0.112817 | 0.384814 | 0.137701 | 0.246202 | 0.185756 | 0.164681 | 0.088616 | 0.229375 | 0.450960 |
| Contractor | C1 | 0.346724 | 0.422610 | 0.067381 | 0.364802 | 0.438869 | 0.330834 | 0.412093 | 0.185819 | 0.209147 | 0.415514 | 0.000000 | 0.451487 | 0.578224 | 0.508845 | 0.416115 | 0.401558 | 0.400986 | 0.416177 | 0.405716 | 0.482098 |
| | C2 | 0.231195 | 0.282788 | 0.162837 | 0.167720 | 0.110576 | 0.214980 | 0.182503 | 0.062924 | 0.065966 | 0.184017 | 0.462062 | 0.000000 | 0.242819 | 0.296463 | 0.189004 | 0.075790 | 0.251784 | 0.094377 | 0.063565 | 0.234474 |
| | C3 | 0.256823 | 0.150396 | 0.426705 | 0.085883 | 0.252673 | 0.055678 | 0.081290 | 0.171320 | 0.104532 | 0.117438 | 0.208591 | 0.104732 | 0.000000 | 0.109104 | 0.282835 | 0.094241 | 0.143165 | 0.065797 | 0.157999 | 0.055504 |
| | C4 | 0.109449 | 0.086689 | 0.229254 | 0.088563 | 0.139263 | 0.090778 | 0.204172 | 0.169378 | 0.389768 | 0.073924 | 0.251060 | 0.136637 | 0.102208 | 0.000000 | 0.112047 | 0.254306 | 0.083088 | 0.250377 | 0.225933 | 0.087816 |
| | C5 | 0.055810 | 0.057518 | 0.113823 | 0.293032 | 0.058619 | 0.307730 | 0.119941 | 0.410559 | 0.230586 | 0.209107 | 0.078287 | 0.307145 | 0.076749 | 0.085588 | 0.000000 | 0.174106 | 0.120978 | 0.173272 | 0.146787 | 0.140107 |
| Owner | O1 | 0.477697 | 0.179888 | 0.412910 | 0.415119 | 0.186842 | 0.471685 | 0.398585 | 0.246058 | 0.176746 | 0.436757 | 0.432158 | 0.418296 | 0.440278 | 0.241048 | 0.416842 | 0.000000 | 0.281143 | 0.595112 | 0.522970 | 0.519150 |
| | O2 | 0.230173 | 0.419319 | 0.230877 | 0.096486 | 0.440838 | 0.111750 | 0.165980 | 0.060702 | 0.341618 | 0.110075 | 0.067928 | 0.065779 | 0.114726 | 0.074826 | 0.187590 | 0.546139 | 0.000000 | 0.124808 | 0.078714 | 0.062593 |
| | O3 | 0.155072 | 0.244770 | 0.101590 | 0.204559 | 0.217005 | 0.059374 | 0.120578 | 0.116530 | 0.279104 | 0.101149 | 0.131475 | 0.085626 | 0.063354 | 0.114722 | 0.094385 | 0.252484 | 0.067681 | 0.000000 | 0.106871 | 0.120540 |
| | O4 | 0.096969 | 0.097880 | 0.193804 | 0.166256 | 0.059144 | 0.203055 | 0.081242 | 0.180620 | 0.088308 | 0.208864 | 0.252994 | 0.234383 | 0.209414 | 0.210961 | 0.102641 | 0.128058 | 0.183120 | 0.073051 | 0.000000 | 0.297717 |
| | O5 | 0.040089 | 0.058143 | 0.060819 | 0.117580 | 0.096171 | 0.154135 | 0.233616 | 0.396089 | 0.114224 | 0.143156 | 0.115445 | 0.195916 | 0.172229 | 0.358443 | 0.198541 | 0.073320 | 0.468056 | 0.207028 | 0.291445 | 0.000000 |

Table(12 )weightedsupermatrix for the research model

| | | Additional parties | | | | | Consultant | | | | | Contractor | | | | | Owner | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A1 | A2 | A3 | A4 | A5 | S1 | S2 | S3 | S4 | S5 | C1 | C2 | C3 | C4 | C5 | O1 | O2 | O3 | O4 | O5 |
| Additional parties | A1 | 0.000000 | 0.044211 | 0.048118 | 0.039195 | 0.039483 | 0.014658 | 0.038568 | 0.036522 | 0.036167 | 0.007040 | 0.037589 | 0.031384 | 0.035563 | 0.019468 | 0.028530 | 0.030372 | 0.027211 | 0.026203 | 0.037497 | 0.039676 |
| | A2 | 0.038825 | 0.000000 | 0.021789 | 0.023665 | 0.008771 | 0.032199 | 0.011177 | 0.006946 | 0.006774 | 0.006352 | 0.019977 | 0.013523 | 0.010711 | 0.005606 | 0.005643 | 0.007462 | 0.005845 | 0.006990 | 0.006326 | 0.020368 |
| | A3 | 0.030148 | 0.014933 | 0.000000 | 0.016696 | 0.010815 | 0.023219 | 0.021870 | 0.020236 | 0.018709 | 0.038198 | 0.006341 | 0.008134 | 0.018975 | 0.016096 | 0.014734 | 0.006445 | 0.014623 | 0.014799 | 0.010253 | 0.013614 |
| | A4 | 0.012880 | 0.007865 | 0.010249 | 0.000000 | 0.028057 | 0.007148 | 0.010324 | 0.012427 | 0.015531 | 0.020397 | 0.012306 | 0.019748 | 0.014559 | 0.028338 | 0.021329 | 0.016805 | 0.009887 | 0.011016 | 0.019019 | 0.006485 |
| | A5 | 0.005272 | 0.020116 | 0.006970 | 0.007570 | 0.000000 | 0.009902 | 0.005187 | 0.010995 | 0.009945 | 0.015139 | 0.010913 | 0.014336 | 0.007318 | 0.017618 | 0.016889 | 0.026043 | 0.029560 | 0.028117 | 0.014031 | 0.006983 |
| Consultant | S1 | 0.188639 | 0.026791 | 0.024475 | 0.104710 | 0.095280 | 0.000000 | 0.114939 | 0.201833 | 0.188919 | 0.156872 | 0.023414 | 0.124814 | 0.104958 | 0.140167 | 0.137935 | 0.143252 | 0.150297 | 0.036120 | 0.156343 | 0.066813 |
| | S2 | 0.078468 | 0.101093 | 0.035422 | 0.024616 | 0.023089 | 0.206282 | 0.000000 | 0.080729 | 0.083166 | 0.044103 | 0.132231 | 0.027575 | 0.024445 | 0.112397 | 0.062631 | 0.035428 | 0.040146 | 0.155389 | 0.038591 | 0.022626 |
| | S3 | 0.055619 | 0.054524 | 0.059887 | 0.127374 | 0.041555 | 0.089115 | 0.070454 | 0.000000 | 0.036728 | 0.065998 | 0.054489 | 0.052302 | 0.039164 | 0.038651 | 0.035965 | 0.077264 | 0.034178 | 0.083761 | 0.026462 | 0.025608 |
| | S4 | 0.023226 | 0.038515 | 0.156722 | 0.046245 | 0.055813 | 0.026536 | 0.149875 | 0.046092 | 0.000000 | 0.097098 | 0.087409 | 0.118306 | 0.055404 | 0.022722 | 0.037904 | 0.040498 | 0.079494 | 0.056537 | 0.059166 | 0.084842 |
| | S5 | 0.018118 | 0.143147 | 0.087563 | 0.061124 | 0.148333 | 0.042137 | 0.028802 | 0.035415 | 0.055256 | 0.000000 | 0.066527 | 0.041073 | 0.140099 | 0.050133 | 0.089635 | 0.067628 | 0.059956 | 0.032262 | 0.083508 | 0.164181 |
| Contractor | C1 | 0.133556 | 0.162788 | 0.025955 | 0.140520 | 0.169051 | 0.127436 | 0.158737 | 0.071577 | 0.080563 | 0.160054 | 0.000000 | 0.173911 | 0.222729 | 0.196005 | 0.160286 | 0.154678 | 0.154458 | 0.160310 | 0.156280 | 0.185702 |
| | C2 | 0.089055 | 0.108929 | 0.062724 | 0.064605 | 0.042594 | 0.082809 | 0.070299 | 0.024238 | 0.025410 | 0.070883 | 0.177984 | 0.000000 | 0.093533 | 0.114196 | 0.072804 | 0.029194 | 0.096986 | 0.036354 | 0.024485 | 0.090319 |
| | C3 | 0.098927 | 0.057932 | 0.164365 | 0.033082 | 0.097328 | 0.021447 | 0.031313 | 0.065992 | 0.040265 | 0.045237 | 0.080348 | 0.040342 | 0.000000 | 0.042027 | 0.108947 | 0.036301 | 0.055146 | 0.025345 | 0.060860 | 0.021380 |
| | C4 | 0.042159 | 0.033392 | 0.088308 | 0.034114 | 0.053643 | 0.034967 | 0.078646 | 0.065244 | 0.150137 | 0.028475 | 0.096707 | 0.052632 | 0.039370 | 0.000000 | 0.043160 | 0.097957 | 0.032005 | 0.096444 | 0.087029 | 0.033826 |
| | C5 | 0.021498 | 0.022156 | 0.043844 | 0.112875 | 0.022580 | 0.118536 | 0.046201 | 0.158146 | 0.088821 | 0.080547 | 0.030156 | 0.118311 | 0.029564 | 0.032968 | 0.000000 | 0.067065 | 0.046600 | 0.066744 | 0.056542 | 0.053969 |
| Owner | O1 | 0.078155 | 0.029431 | 0.067556 | 0.067917 | 0.030569 | 0.077172 | 0.065212 | 0.040257 | 0.028917 | 0.071457 | 0.070705 | 0.068437 | 0.072033 | 0.039438 | 0.068199 | 0.000000 | 0.045997 | 0.097365 | 0.085562 | 0.084937 |
| | O2 | 0.037658 | 0.068604 | 0.037773 | 0.015786 | 0.072125 | 0.018283 | 0.027156 | 0.009931 | 0.055892 | 0.018009 | 0.011114 | 0.010762 | 0.018770 | 0.012242 | 0.030691 | 0.089353 | 0.000000 | 0.020420 | 0.012878 | 0.010241 |
| | O | 0.025 | 0.040 | 0.016 | 0.033 | 0.035 | 0.009 | 0.019 | 0.019 | 0.045 | 0.016 | 0.021 | 0.014 | 0.010 | 0.018 | 0.015 | 0.0413 | 0.011 | 0.000 | 0.017 | 0.019 |


Licensed Under Creative Commons Attribution CC BY

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 371 | 046 | 621 | 468 | 504 | 714 | 728 | 065 | 664 | 549 | 510 | 009 | 365 | 770 | 442 | 08 | 073 | 000 | 485 | 721 |
| | O4 | 0.015865 | 0.016014 | 0.031708 | 0.027201 | 0.009677 | 0.033222 | 0.013292 | 0.029551 | 0.014448 | 0.034172 | 0.041392 | 0.038347 | 0.034262 | 0.034515 | 0.016793 | 0.020951 | 0.029960 | 0.011952 | 0.000000 | 0.048709 |
| | O5 | 0.006559 | 0.009513 | 0.009951 | 0.019237 | 0.015734 | 0.025218 | 0.038222 | 0.064804 | 0.018688 | 0.023421 | 0.018888 | 0.032054 | 0.028178 | 0.058644 | 0.032483 | 0.011996 | 0.076578 | 0.033872 | 0.047683 | 0.000000 |


Licensed Under Creative Commons Attribution CC BY