

EVALUATING PERFORMANCE IN RESIDENTIAL COMPLEX PROJECT

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ABSTRACT

Performance is an essential factor in construction projects, residential complex building projects are widely constructed recently in Iraq. The research objective is to identify and evaluate key performance indicators (KPIs) relevant to assessing these projects' success.

the key performance indicators (KPIs) were specified according to the literature and the expert's opinions. a questionnaire was distributed to extract the most important KPIs and factors. The questionnaire was carefully designed to ensure accuracy. KPIs were specified using the Relative Importance Index (RII)

The research investigated and identified the top ten factors influencing performance in construction projects. The findings revealed that the availability of highly qualified and experienced personnel ranked first, followed by the importance of reviewing failures and resolving them. The cost of materials and equipment, the organization's quality assessment system, and the coordination of information between the owner and project parties were also identified as significant factors. Additionally, the quality of equipment and raw materials, planned time to build the project, compliance with specifications, training human resources on project-specific skills, and the application of health and safety factors in the organization were recognized as crucial considerations. the work sequence according to schedule and the availability of resources as planned during the project duration have an impact on project performance. These findings contribute to understanding the key factors that influence successful outcomes in construction projects.

KEYWORDS: performance; complex buildings projects; KPIs; construction projects; construction management.

1. INTRODUCTION

Performance measurement refers to the process of assessing how successful organizations or individuals have been in achieving their goals. It is a way of identifying any inefficiencies or waste in processes and helps organizations to focus their efforts on areas that need improvement. The main objective of performance measurement is to provide timely and accurate feedback on the effectiveness and efficiency of operations, which enables organizations to concentrate on continuous improvement. (Patience-2016)

1.1 Research objectives

The objective of this research is to identify

and define the criteria for evaluating performance in residential complex building projects

- The first objective is to identify and evaluate the key performance indicators (KPIs)
- The second objective is to use RIIs to rank criteria and factors for evaluation performance.

1.2 Research questions

The research questions can be formulated as the following:

Question 1: What is the ranking of KPIs according to their degree of importance?

Question 2: What is the ranking of factors and criteria according to their degree of importance?

To answer this question, a structured questionnaire is conducted to investigate the

suggestions and expectations of the relevant parties

1.3 Research Methodology

The research methodology consists of four steps in order to fulfill the research objectives:

1. review of literature.
2. meeting with specialists
3. Design questionnaire form.
4. Result analysis.

2. MATERIALS AND METHODS

Based on literature a comprehensive questionnaire created that covers all the relevant topics. The questionnaire will be designed to be clear and concise and will be structured in a way that makes it easy for participants to respond

this questionnaire will be a valuable tool in helping the researcher to gain insights into the KPIs and factors discussed in the lectures. By analyzing the responses, we will be able to identify the most important and relevant factors that contribute to successful outcomes in the field

2.1. Questioner development

To ensure the quality and accuracy of our questionnaire, we will seek the confirmation and approval of our advisor before proceeding with the distribution. The researcher has to ensure that the questionnaire is comprehensive and effective in extracting the necessary information. any necessary revisions were made based on their feedback to ensure that the questionnaire meets our research objective.

Table (1):- Personal Information of Engineers Interviews

RESPONDENT INFORMATION	Frequency	Percentage
Bachelor's	31	%83.8
Master's	5	%13.5
PhD	1	%2.7
PROFESSION		
Civil eng	25	%67.6
oil eng	1	%2.7
chemical eng	1	%2.7
architecture	3	%8.1
other	7	%18.9
Organization		
Client	15	%40.5
Consultant	16	%43.2
Contractor	6	%16.2
Working Experience		
5-0 years	30	%81.1
10-5 years	5	%13.5
above 10 years	2	%8.1
sector		
governmental	10	%27
private	18	%48.6
mixed	9	%24.4

The respondent information shown in Table 1 gathered from the survey indicates that the majority of participants hold a Bachelor's degree followed by those with a Master's degree (13.5%) and one respondent with a Ph.D. . In terms of profession, the largest group (2.7%) consists of civil engineers (67.6%), while other occupations such as oil engineering, chemical engineering, and architecture are also represented. The participants are affiliated with various organizations, including clients (40.5%), consultants (43.2%), and contractors (16.2%). Regarding working experience, the majority of

respondents have 0-5 years of experience followed by 5-10 years (13.5%) and over 10 years (8.1%). The sector distribution shows that respondents are associated with government organizations (27%), private sector entities (48.6%), and mixed-sector organizations (24.4%)

2.2. The Relative Importance Index (RII)

method is a commonly used technique in social science research to evaluate the relative importance of factors or variables. The RII method is particularly useful when trying to analyze and understand complex data sets with

multiple factors and variables. The RII method involves assigning scores to each factor or variable based on its perceived importance. These scores are usually on a Likert scale ranging from 1 to 5 or 1 to 7, where 1 indicates that the factor is not important, and 5 or 7 indicates that it is very important. Once scores are assigned to each factor, the RII is calculated by summing up the scores for each factor and

dividing by the maximum possible score. The resulting RII scores will range between 0 and 1, with higher scores indicating greater relative importance. The RII method is a useful tool for prioritizing factors or variables and identifying the most critical factors that influence the outcome or performance of a particular process or system

Table (2):- Data analysis

S\N	factors	KPIs criteria	Mean	RIIs	Rank
1	Availability of highly qualified and experienced people	Quality	4.72972973	0.9459	1
2	Review failures and resolve them	,Productivity learning	4.594594595	0.9189	2
3	Cost of materials and equipment	Cost	4.567567568	0.9135	3
4	Organizational quality assessment system	Quality	4.540540541	0.9081	4
5	Coordination of information between the owner and the parties to the project	Customer Satisfaction	4.540540541	0.9081	4
6	Quality of equipment and raw materials	Quality	4.513513514	0.9027	5
7	planned time to build the project	Time	4.486486486	0.8972	6
8	compliance with specifications	Quality	4.459459459	0.8918	7
9	Training human resources on the skills] [required by the project	,Productivity learning	4.459459459	0.8918	7
10	Applying Health and Safety Factors in Organization	Health, Safety, Environment and Sustainability	4.432432432	0.8864	8
11	Work sequence as per schedule	,Productivity learning	4.405405405	0.8810	9
12	availability of resources as planned during the] [project duration	Time	4.378378378	0.8756	10
13	[high material wastage]	Cost	4.324324324	0.8648	11
14	[Leadership Skills]	Customer Satisfaction	4.324324324	0.8648	11
15	learning from own experience and past] [history	,Productivity learning	4.324324324	0.8648	11
16	[project profit rate]	Cost	4.297297297	0.8594	12
17	[Cost Due to Corruption]	Cost	4.27027027	0.8540	13
18	number of disputes between the owner and] [the project parties	Customer Satisfaction	4.27027027	0.8540	13
19	[High Material Prices]	Cost	4.243243243	0.8486	14
20	[speed and reliability of service for the owner]	Customer Satisfaction	4.243243243	0.8486	14
21	Applying sustainability standards during] [implementation	,Health ,sustainability environment	4.216216216	0.8432	15
22	[management-labor relationship]	,Productivity learning	4.216216216	0.8432	15
23	[Regularly Update Project Budget]	Cost	4.162162162	0.8324	16
24	[Site Accessibility (Project Site)]	Health, Safety, Environment and Sustainability	4.162162162	0.8325	16
25	[Project Incident Reported Rate]	Health, Safety, Environment and Sustainability	4.162162162	0.8324	16
26	[Sustainable Building Materials]	Health, Safety, Environment and	4.162162162	0.8324	16

Sustainability					
27	level of managerial involvement in decision-] [making	Quality	4.027027027	0.8540	17
28	[Number of New Projects/Year]	,Productivity learning	4.027027027	0.8054	17
29	[Waste around the site]	Health, Safety, Environment and Sustainability	4	0.8000	18
30	[Number of Reworks]	Customer Satisfaction	3.972972973	0.7945	19
31	[Absenteeism Rate by Project]	Productivity, Learning	3.972972973	0.7945	19
32	[delayed decision making]	Time	3.945945946	0.7891	20
33	[Cost Security]	Cost	3.945945946	0.7891	20
34	Average Delay in Payment from Owner to] [Contractor	Time	3.891891892	0.7783	21
35	[Poor Security Conditions]	Time	3.891891892	0.7783	21
36	[Poor Budget Estimation]	Cost	3.891891892	0.7783	21
37	[State of the Climate]	Health, Safety, Environment and Sustainability	3.783783784	0.7567	22
38	[Cost of Change Orders]	Cost	3.72972973	0.7459	23
39	[bureaucracy within client departments]	Time	3.648648649	0.7297	24
40	[Lack of Regulatory Liquidity]	Cost	3.648648649	0.7297	24
41	[Project Complexity]	Productivity, Learning	3.621621622	0.7243	25
42	lack of quality control, assurance and control] [system	quality	3.540540541	0.7081	26
43	[Use fewer natural resources]	Health, Safety, Environment, and Sustainability	3.513513514	0.7270	27
44	[No Quality Crew Competent]	Quality	3.189189189	0.6378	28
45	[unofficial holidays]	Time	3.162162162	0.6324	29

2.3 .The Relative Importance Index (RI)

method is a commonly used technique in social science research to evaluate the relative importance of factors or variables. The RII method is particularly useful when trying to analyze and understand complex data sets with multiple factors and variables. The RII method involves assigning scores to each factor or variable based on its perceived importance. These scores are usually on a Likert scale ranging from 1 to 5 or 1 to 7, where 1 indicates that the factor is not important, and 5 or 7 indicates that it is very important. Once scores are assigned to each factor, the RII is calculated by summing up the scores for each factor and

dividing by the maximum possible score. The resulting RII scores will range between 0 and 1, with higher scores indicating greater relative importance. The RII method is a useful tool for prioritizing factors or variables and identifying the most critical factors that influence the outcome or performance of a particular process or system

$$RII = \sum W/A \times N$$

Where: W is the weight given to each factor ,by the respondents and ranges from 1 to 5

A = The highest weight = 5

N = The total number of respondents

Table (3):- the highest priority factors

SIN	factors	KPIs criteria	Mean	RIIs	Rank
1	Availability of highly qualified and experienced people	Quality	4.72972973	0.9459	1
2	Review failures and resolve them	Productivity learning	4.594594595	0.9189	2
3	Cost of materials and equipment	Cost	4.567567568	0.9135	3
4	organization quality assessment system	Quality	4.540540541	0.9081	4
5	Coordination of information between the owner and the parties to the project	Customer Satisfaction	4.540540541	0.9081	4
6	Quality of equipment and raw materials	Quality	4.513513514	0.9027	5
7	planned time to build the project	Time	4.486486486	0.8972	6
8	compliance with specifications	Quality	4.459459459	0.8918	7
9	Training human resources on the skills [required by the project	Productivity learning	4.459459459	0.8918	7
10	Applying Health and Safety Factors in Organization	Health, Safety, Environment and Sustainability	4.432432432	0.8864	8
11	Work sequence as per schedule	Productivity learning	4.405405405	0.8810	9
12	availability of resources as planned during] [the project duration	Time	4.378378378	0.8756	10

i. Availability of highly qualified and experienced people

The availability of highly experienced and qualified personnel has obtained the top rank with an RII value of 0.9459. This availability plays a vital role in assisting project parties in achieving their project goals in a professional manner, leading to improved performance in terms of quality, time, cost, productivity, and safety of projects. Notably, Samson and Lema Cheung et al. (2004), and Iyer and Jha (2002) support our findings, highlighting the significant impact of this factor on the quality performance of construction projects

ii. Review failures and resolve the:-

The issue of reviewing failures and resolving them still holds significant importance, with an RII value of 0.9189, placing it in the second position. This factor plays a crucial role in project management as it involves identifying and addressing shortcomings or errors in order to improve project outcomes

By diligently reviewing failures, project parties can gain valuable insights into the root causes of problems encountered during the project

lifecycle. This analysis allows them to implement effective corrective measures and preventive actions, minimizing the likelihood of similar failures occurring in the future

iii. Cost of materials and equipment

With an RII value of 0.9189, the factor of cost escalation has been ranked in the third position. This component significantly impacts the liquidity of owners and project budgets. When material and equipment prices experience escalation, it can have detrimental effects on the cost performance of projects, ultimately leading to suboptimal outcomes

Cost escalation poses challenges to project stakeholders as it increases the overall expenses and can strain the financial resources allocated for the project. This, in turn, can hinder the project's ability to meet its objectives within the allocated budget. When material and equipment prices continue to rise, it becomes increasingly difficult to maintain cost control, resulting in a negative impact on the project's financial health

iv.organization quality assessment system

With an RII value of 0.9081, the organization quality assessment system has been

ranked fourth among the factors evaluated. This system plays a crucial role in evaluating and ensuring the quality of the organization's processes, products, and services

An effective organization quality assessment system serves as a framework for monitoring and continuously improving the quality performance of the organization. It involves the implementation of robust quality control measures, adherence to established standards and best practices, and the utilization of quality management tools and techniques

v.Coordination of information between the owner and the parties to the project

Ranking fourth with an RII value of 0.9081, the factor of information coordination between the owner and project parties holds significant importance. This factor directly influences the overall project performance, particularly in terms of client satisfaction

Effective information coordination is vital for all parties involved in a project, as it facilitates proper communication and collaboration throughout the construction process. Establishing clear channels of communication and ensuring the smooth flow of information is essential to avoid misunderstandings and disruptions

When communication difficulties arise, it can result in severe misunderstandings that have a strong impact on the client's perception of the project's performance. Miscommunication can lead to delays, rework, and ultimately affect the project's success and client satisfaction

vi.Quality of equipment and raw materials

Obtaining the fifth position with an RII value of 0.9027, quality control emerges as a crucial responsibility for consultants on construction project sites. Both contractors and consultants share the common objective of ensuring that materials used in a project meet high-quality standards. This dedication to quality directly contributes to owner satisfaction and the successful implementation of the project in line with specifications

The significance of quality control in construction projects is supported by Cheung et al. (2004) and Iyer and Jha (2005), affirming its impact on project performance and the level of

satisfaction experienced by owners. Consultants play a key role in overseeing and enforcing quality control measures throughout the project lifecycle

vii.planned time to build the project

With an RII value of 0.8972, the planned time to build the project has been ranked sixth among the evaluated factors. This factor pertains to the predetermined timeframe set for completing the construction project

Accurately planning the time required for project completion is crucial for successful project management. It enables effective resource allocation, scheduling, and coordination of activities, contributing to the timely delivery of the project

A well-defined and realistic project timeline serves as a roadmap for all stakeholders involved, ensuring that activities progress smoothly and deadlines are met. It allows for efficient utilization of resources, minimizes delays, and facilitates effective project monitoring and control

viii.compliance with specifications

Ranking eighth with an RII value of 0.8918, compliance with specifications emerges as a significant factor in construction projects. This factor holds particular importance for owners, as it directly influences client satisfaction. Owners typically prioritize the implementation of projects according to the specified requirements and standards

Aligning with our findings, Iyer and Jha also emphasize the importance of (2005) compliance with specifications, highlighting its strong relationship with client satisfaction. Meeting the specified project specifications ensures that the final deliverables meet the desired quality and functionality expected by the client

ix.Training human resources on the skills required by the project

Ranked seventh with an RII value of 0.8918, the training of human resources on the skills required by the project holds significant importance. This factor emphasizes the need for providing appropriate training and development opportunities to ensure that project personnel possess the necessary skills and competencies

x. Applying Health and Safety Factors in Organization

Earning the eighth position with an RII value of 0.8864, the application of health and safety factors in the organization is a crucial consideration. This factor emphasizes the importance of prioritizing the health and safety of all individuals involved in the project

Implementing robust health and safety measures is essential to protect the well-being of employees, contractors, and other stakeholders. It involves adhering to applicable regulations, conducting risk assessments, providing appropriate safety training, and maintaining a safe working environment

xi. Work sequence as per schedule

Ranking ninth with an RII value of 0.8810, the work sequence as per schedule is a significant factor in construction projects. This factor emphasizes the importance of adhering to the planned work sequence outlined in the project schedule

Maintaining the proper work sequence is crucial for project success as it ensures a logical and efficient progression of activities. Adhering to the scheduled work sequence enables effective coordination of tasks, minimizes delays, and optimizes resource utilization

xii. availability of resources as planned during the project duration

Ranked tenth with an RII value of 0.8756, the availability of resources as planned during the project duration is a significant factor in construction projects. This factor highlights the importance of ensuring that the necessary resources are readily available and allocated as per the project plan throughout its duration

The availability of resources plays a critical role in project execution, as it directly impacts productivity, efficiency, and overall project performance. This includes resources such as manpower, equipment, materials, and finances

3. conclusion

In conclusion, this study aimed to identify the local factors influencing the performance of residential complex building projects in Iraq. Through the use of a structured questionnaire, the attitudes of clients, consultants, and contractors towards key performance indicators

in the construction industry were examined

Forty-five factors were considered and categorized into six groups based on an extensive literature review. These groups encompassed time, cost, quality, productivity, client satisfaction, and health-safety and environment. Data were collected from 15 clients, 16 consultants, and 6 contractors

The results were analyzed to determine the most significant performance indicators. The relative importance index (RII) was utilized to gauge the stakeholders' perceptions of the relative importance of these indicators in construction projects

Based on the overall responses, the ten most significant performance factors in Iraqi projects were identified. These include the availability of highly qualified and experienced personnel, the review and resolution of failures, the cost of materials and equipment, the organization's quality assessment system, the coordination of information between the owner and project parties, the quality of equipment and raw materials, the planned time to build the project, compliance with specifications, the training of human resources on project-specific skills, the application of health and safety factors in the organization, the work sequence as per schedule, and the availability of resources as planned during the project duration

4. Recommendation

- Prioritize the recruitment and retention of skilled professionals who possess the necessary expertise and experience in their respective roles. Invest in training and development programs to enhance their skills and knowledge
- Implement a robust system for identifying and addressing project failures promptly. Conduct thorough root cause analyses to understand the underlying reasons behind failures and implement corrective actions to prevent their recurrence
- Conduct thorough market research to identify cost-effective suppliers without compromising on quality. Maintain a diligent procurement process to secure materials and equipment at competitive prices

- Establish a comprehensive quality assessment system to monitor and evaluate project performance at various stages. Regularly review and update quality standards and procedures to ensure compliance and continuous improvement
- Foster effective communication channels and information-sharing platforms to promote collaboration and coordination among all stakeholders. Utilize digital tools and technologies to facilitate real-time information exchange
- Implement stringent quality control measures to ensure that all equipment and raw materials meet the required specifications. Establish partnerships with reliable suppliers who can consistently deliver high-quality products
- Develop detailed project schedules with realistic timelines and milestones. Regularly monitor progress against the schedule and take proactive measures to mitigate delays. Implement efficient project management practices to optimize time management
- Ensure strict adherence to project specifications and standards throughout the construction process. Conduct regular inspections and quality checks to verify compliance and address any deviations promptly
- Invest in comprehensive training programs to enhance the skills and capabilities of project personnel. Align training initiatives with the specific requirements of the project to improve performance and productivity
- Establish a strong culture of health and safety by implementing robust safety protocols, conducting regular training sessions, and providing necessary protective equipment. Promote awareness and accountability for health and safety among all project participants
- Efforts to ensure resource availability involve proactive resource management, effective supply chain management, and maintaining strong relationships with suppliers and contractors. By optimizing resource allocation, project teams can overcome potential challenges, improve project outcomes, and meet project objectives

efficiently

- Efforts to maintain the work sequence as per schedule involve effective communication, collaboration, and coordination among project stakeholders. By fostering a culture of adherence to the work sequence, project teams can optimize project outcomes and achieve project objectives effectively

By implementing these recommendations, stakeholders in complex building projects in Iraq can enhance overall project performance, achieve client satisfaction, and ensure successful project outcomes. It is essential to prioritize these factors throughout the project lifecycle, fostering a culture of excellence, continuous improvement, and collaboration among all stakeholders involved

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