

Evaluating the performance indicators of water channel projects related to user service

Iman Kadhim Oleiwi^{1*}, Assist. Prof. Dr. Abdulrahman Adnan Ibrahim¹

1- College of Civil Engineering, University of Tikrit, Tikrit, Iraq.

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Corresponding Author

E-mail:

eman.k.aliwy@tu.edu.iq

Mobile:

Abstract

Water management is a critical issue globally, especially in Iraq, where improving water resource management is essential. This study focuses on user satisfaction as a key indicator in enhancing water channel projects, which are vital for meeting the water needs of the population and agricultural lands. Through a two-stage questionnaire process, with 56 responses analyzed, the study found that 53.6% of users preferred water channels, particularly lined channels, for irrigation. Key issues identified include water interruptions and insufficient project capacity, with 43% of respondents advocating for large-scale irrigation projects to improve service. The research suggests implementing projects with high absorptive capacity and modern irrigation methods to mitigate water scarcity. Notably, 84% of users favored water-saving irrigation techniques. The results aim to guide designers and policymakers in optimizing irrigation infrastructure, ensuring continuous water supply, and improving user satisfaction. The study also highlights the need to update aging infrastructure, as 28.6% of respondents attributed water shortages to outdated projects. By addressing these concerns, the research provides recommendations for developing more efficient water management systems and projects that cater to user needs and promote sustainability.

Introduction:

The performance of water channel projects is linked to several concepts and indicators, the most important of which is user satisfaction for these projects, as this factor is considered one of the most important and influential factors on which the performance measurement of water channel projects depends. Identifying and measuring key performance indicators is an essential step to achieving the success of project performance. Users are the largest and most effective segment, and their opinions play an essential role in developing projects directly related to them, whether related to agriculture and irrigated areas or the direct use of water by residential areas or government institutions. According to [1], the two main elements that must be taken into consideration when evaluating customer satisfaction levels are the performance of the service provider and the quality of service provided by the service provider. Both affect customer

satisfaction levels and can be evaluated as positive or negative depending on the gaps in customer satisfaction levels. Customer satisfaction can be defined as the degree of customer satisfaction with the work provided to him. (Rahman & Alzubi and Jayesh Kumar, [1, 2] stated that the most important indicators of customer satisfaction are the number of rework incidents, the sequence of work according to the budget, and the investment opportunity. Likewise, the leadership skills of the project manager, the speed and reliability of the service to the owner, the number of disputes between the owner and the company, acceptable quality, and achieving the set goals are considered among the most important indicators of client or customer satisfaction (Enshassi, 2009) [3]. One of the most important previous studies on performance indicators stated that [11]' the construction sector suffers from the inability to evaluate project performance, as there is no agreement among researchers on a comprehensive measure of project performance. The main reason for this is that each project has different priorities and objectives, so there is a continuous need to understand and identify areas of performance that positively affect the success of the project. In this study, an integrated framework was developed to evaluate project success performance, where areas of project success are identified and elements of success are identified for each area through theoretical examination [12]. The UK evaluation showed practitioners' awareness of the importance of using appropriate performance measures and their role in supporting the implementation of lean construction concepts. While practitioners recognize the importance of non-financial performance measures, their applications have not been sufficient and widespread. The study identified the frequent performance measurement and methodologies used by the UK and construction organizations to evaluate a variety of key non-financial performance indicators. [13] also stated that the top key performance indicators for evaluating construction project performance (a descending system) were cost, time, safety, productivity, satisfaction, quality, knowledge and service.

Research justifications:

After reviewing previous studies, we found that the performance indicators for users of water channel projects were not addressed.

Research objectives:

The research objectives are the following:

- 1- Helping designers consider all the requirements of water channel users to arrive at a project with high productivity and achieve maximum benefit for the user.
- 2- Directing decision makers to deal with the issue of delivering water to the user in the best way in light of the current water scarcity.

Research Methodology:

Determining basic performance indicators is an important first step in the performance measurement process. To determine the performance indicators for the water channel user, the following methodology was followed:

1- The theoretical part: Previous studies on determining performance indicators were reviewed to determine the most important factors that help determine user performance indicators.

2- The practical part: The opinions of the most important beneficiaries and those who depend on water canal projects as a primary source for irrigating their lands were sought by conducting an open questionnaire and then a closed questionnaire for the beneficiaries and using the most important methods in analysing the results obtained by the researcher.

Literature review:

Irrigation system management refers to the proper use of irrigation water through an effective method of distribution and application across agricultural applications. The term "water management" does not only mean the flow of water in a channel or simply irrigating a field, but rather includes the management of knowledge, skills, and incentives to make water use appropriate, and activities related to crop management such as choosing crop patterns or timing various agricultural operations. It is the process of controlling water movement from the source Supply to the point of use in drainage [4]. Efficient use of irrigation water is vital in reducing water scarcity due to global warming [5, 6]. In this context, monitoring and evaluating irrigation projects is essential [7] in evaluating the performance of irrigation projects. Researchers have developed a number of performance indicators to evaluate irrigation projects [8] including an irrigation management modernisation methodology [9]. These performance indicators provide an overview of performance in irrigation projects. Performance indicators are considered very important in measuring and determining the performance of projects in general, and many researchers have defined them. The most recent definition of performance indicators in 2019 is that they are tools created from many measurements and organise the preparation of an industry, organisation, department, individual, or task. Specific project. It does not only determine whether there is something positive or negative, but it also determines what affects the achievement of goals and the difficulties that are supposed to be overcome, and whether these goals are coordinated within a specific strategy [9]. This shows the importance of user performance indicators related to water channel projects in particular, as this type is considered one of the most important projects directly linked to a large segment of users.

Van te Chow [10] explained in the book (Open Channel Hydraulics) that an open channel is a channel through which water flows with a free surface. A channel, classified according to its origin, can be either natural or artificial.

Natural channels include all watercourses that exist naturally on the Earth's surface and vary in size from small rivers on hillsides, through small and large streams and rivers, to tidal estuaries. Carrying underground currents Free-surface water is also a natural open channel. The channel is usually long and gently sloping embedded in the ground, which may be unlined and lined with stone, concrete, cement, or wood.

Work Study:

This part of the research includes conducting a comprehensive questionnaire in two stages:

(1) Open questionnaire:

This stage includes conducting an open questionnaire in which questions were asked, and opinions were exchanged between the researcher and a group of users who depend on open channel projects as the sole and primary source of water delivery to them. This helped the researcher arrange the closed questionnaire form later and made it smoother to ensure ease of answering.

(2) Closed questionnaire:

It represents the second stage and includes nine questions for users and beneficiaries of water channel projects. The questionnaire was conducted to determine the most important factors that help improve the service provided to them by the concerned authorities, in addition to identifying the most important symptoms that reduce the efficiency of the services provided to work to reduce these symptoms. Or avoid it with regard to establishing, operating, and maintaining the project.

The questionnaire specifically targeted a group of farmers and agricultural engineers in Salah Al-Din Governorate who own large agricultural areas, and this segment often relies on open channels as a source of water to irrigate their lands. 60 questionnaires were distributed and 56 of them were answered, all of them with valid answers. The questionnaire was relied upon to be distributed in both electronic forms. The data was collected and analyzed, and the most important points that help in better managing the process of delivering water services were identified.

Results and Discussions:

After obtaining respondents' answers to the questionnaire questions, the results are presented and discussed.

1- What is your preferred type of water channel for irrigation? The results for this question were as in Table 1.

Table 1: preferred type of water channel for irrigation

Indicator	Number of respondents	percentage (%)	Rank
Open irrigation channels	30	53.6	1
Closed irrigation channels	26	46.4	2

The results of the closed user questionnaire showed that the most significant percentage of users, represented by 53.6%, prefer to use open water channels, and 46.4% prefer to use different types of channels, indicating the importance of open channels for the user.

2- What is the best irrigation method that you use?

The results for this question are as shown in Table 2.

Table 2: best irrigation method

Indicator	Number of respondents	percentage (%)	Rank
Irrigation using sprinklers	34	60.7	1
Irrigation by distillation	13	23.2	2
Free flow Irrigation	9	16.1	3

Regarding the method of irrigation used and preferred, irrigation with sprinklers is considered the best and most effective method, representing 60.7% of the selected sample, and drip irrigation was 23.2%. These methods are considered among the modern irrigation methods that must be followed and adopted to reduce losses and ensure water availability in seasons of scarcity. They are reducing water waste and waste, producing a high-quality crop, preserving soil fertility, encouraging farmers to farm, and providing economic support to the country.

These results prove that free flow Irrigation, which is 16.1%, which is the old traditional method, is the least efficient method due to wasting water, increasing losses, losing amounts of water through evaporation, and causing leakage in the soil, especially if it contains high percentages of gypsum, and also reducing soil fertility through the loss of minerals. The soil is important because of digging and soil erosion. Users of this method are those who are very close to the water source and dam basins.

3- The approved water channel should preferably be? The results for this question are as shown in Table 3.

Table 3: The approved water channel

Indicator	Number of respondents	percentage (%)	Rank
Concrete lined channels	34	60.7	1
Earthen channels	22	39.3	2

60.7% of users prefer that the water channel be lined due to the rapid access of water, ease of maintenance, and minimal waste. In comparison, 39.3% believe that Unlined or earthen channels are the best in terms of delivering water, which is not a small percentage due to the ease of making gaps and opening the waterways easily.

4- What is your favorite irrigation project type that will provide the best service in continuous water saving? The results for this question are as shown in Table 4.

Table 4: Favorite irrigation project type

Indicator	Number of respondents	percentage (%)	Rank
Concrete lined channels	53	94.6	1
Earthen channels	3	5.4	2

94.6% of users prefer large projects that do not depend on open channels and cover large areas using large pipes and pumps with the best high specifications, which ensure the permanent availability of water and are sufficient to solve the problem of water scarcity.

5- What is the quality of the water service provided to you? The results for this question are as shown in Table 5.

Table 5: the quality of the water service provided

Indicator	Number of respondents	percentage (%)	Rank
Good	23	41.1	1
Not good	21	37.5	2
Very good	6	10.7	3
Bad	4	7.1	4
Very bad	2	3.6	5

It turns out that the percentage of good and very good is 51.8%, which is an average percentage, and this leads to the fact that the service provided to the user is average, which is not within the ambition. The goal is to raise this percentage to the highest possible level and reduce the percentage of bad evaluations to the lowest possible level.

6- What is the quality of the water service provided to you? The results for this question were as in Table 6.

Table 6: the quality of the water service provided

Indicator	Number of respondents	percentage (%)	Rank
Very satisfied	4	7.1	4
Satisfied	19	33.9	2
Moderately satisfied	24	42.9	1
Not satisfied	7	12.5	3
Not satisfied at all	2	3.6	5

A degree of satisfaction with the service provided is necessary. The questionnaire results showed that the average degree of satisfaction is the highest, at a rate of 42.9%. 33.9% of the answers showed that they were satisfied with the service provided, and 7.1% indicated that they were very satisfied with the service, while the results showed dissatisfaction at rates 12.5% and 3.6%, as shown in Table 6. By comparing the results of the questionnaire and theoretical studies, the researcher found the necessity of improving the reality of service by introducing new technologies for machines used in the maintenance of water projects, while working to increase the efficiency of operation and maintenance staff by introducing them In high-level training courses and the continuous provision of operational energy, this leads to raising the degree of satisfaction while reducing the degree of dissatisfaction.

7- To what extent do you cooperate with the relevant authorities to help improve the service? The results for this question are as shown in Table 7.

Table 7: improve the service

Indicator	Number of respondents	percentage (%)	Rank
I'm very cooperative	50	28	1
Cooperative	44.6	25	2
Uncooperative	5.4	3	3
Not cooperative at all	0	0	4

The extent of the citizen's cooperation with the providing agencies appears as their motivation to improve the service provided, as 50% of them believe that they are very cooperative, 44.6% are cooperative, and the lowest percentage is for those who are not cooperative, which was only 5.4%. The researcher finds, by comparing the results, that the user is ready to cooperate in order to get good service.

8- Water outage for long periods due to? The results for this question are as shown in Table 8.

Table 8: Water outage for long period

Indicator	Number of respondents	percentage (%)	Rank
The small carrying capacity of the irrigation project	24	42.9	1
The projects are old and worn out	16	28.6	2
Maintenance work	12	21.4	3
Rationing the use of water due to scarcity	4	7.1	4

The interruption of water for an extended period is attributed to several reasons, including the small carrying capacity of the water project, which is relied on by 42.9% of the opinions, and this indicates the necessity of increasing the carrying capacity of the projects. 21.4% find that maintenance work is a major reason for the interruption of water for long periods, and 28.6% believe that the existing water channel projects are Expendable and outdated, and 7.1% of them find that water rationing due to scarcity is the main reason for the lack of permanent availability of water. By comparing questionnaire results, the researcher finds that the reasons shown in Table 8 are all reasons that lead to water outages for long periods and must be avoided.

9- Water outage for long periods due to? The results for this question are as shown in Table 9.

Table 9: Water outage for long periods

Indicator	Number of respondents	percentage (%)	Rank
Establishing a new project with a very high capacity and covering large areas	24	42.9	1
Maintaining current projects continuously and more quickly	6	10.7	4
Improving operating personnel	6	10.7	5
Continuous energy saving	9	16.1	3
All of the above factors	11	19.6	2

The researcher suggested several solutions that could help improve services based on the discussions during the open questionnaire. Among these solutions, 42.9% of users believe that establishing large projects with a high absorptive capacity that covers large areas is the ideal solution to ensure the permanent availability of water. 10.7% also find that maintaining current projects continuously and more quickly, as well as improving operating staff, is necessary. In comparison, 16.1% believe that the availability of energy to operate pumps in projects is what makes the availability of water possible. Establishing projects and maintaining current ones, along with the availability of energy and highly efficient staff, are all important factors in achieving the best possible service.

Conclusions:

By reviewing previous studies, comparing the results of the questionnaire, and explaining the importance of water channel projects, the researcher concludes the following:

- 1- Water channels are important and vital projects. However, of users prefer large irrigation projects that cover large areas of land and depend on the system of pipes and pumps, which depend on a continuous water source.
- 2- The water service provided to the user is average. The degree of satisfaction with it on his part is average. This in turn leads to 50% of them being very cooperative and 44.6% only cooperative with the responsible authorities in order to improve the level of service.
- 3- Several reasons lead to the lack of sufficient supply of water to the user, the most important of which is the small absorptive capacity of current irrigation projects 43% of respondents believe that current projects do not cover their water needs, while 28.6% believe that they are old and worn out projects.
- 4- The urgent need to establish large projects covering large areas.
- 5- Users are largely turning to modern irrigation methods, with 84% stating that they prefer to use methods that reduce water waste, and this is taken into consideration when planning and designing new projects.

Recommendations:

Based on the previous results, the researcher recommends the following:

- 1- The necessity of actual study and developing the best designs to create large projects with a high capacity to ensure the availability of continuous water service.
- 2- Study the best plans that work to increase water storage during the airport season to reduce water scarcity.
- 3- The service quality index and user satisfaction are the most important indicators that must be considered when planning to establish any irrigation project.

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