

**Performance Evaluation of Water Supply Construction Projects: A Case
of Oromia Water and Energy Bureau**



Getahun Nagari Nukuse

**A Thesis Submitted to: Department Civil Engineering, School Civil
Engineering and Architecture**

**Presented in Partial Fulfillment of the Requirement for the Degree of
Master's in Civil Engineering (Specialization in Construction
Engineering and Management)**

**Office of Graduate Studies
Adama Science and Technology University**

**June, 2023
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DECLARATION AND RECOMMENDATION

I hereby declare that this Master Thesis entitled “Performance Evaluation of Water Supply Construction Projects: a cause of Oromia Water and Energy Bureau” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation. It is being submitted for the partial fulfillment for the award of the degree of Master of Science in civil engineering (construction engineering and management) at Adama Science and Technology University school of Civil engineering and Architecture.

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I/we, the advisor(s) of this thesis, hereby certify that I/we have read the revised version of the thesis entitled “-Performance Evaluation of Water Supply Construction Projects: a cause of Oromia Water and Energy Bureau” prepared under my/our guidance by Getahun Nagari Nukuse submitted in partial fulfillment of the requirements for the degree of Master’s of Science in Civil Engineering (Construction Engineering and Management) Therefore, I/we recommend the submission of revised version of the thesis to the department following the applicable procedures.

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I/we, the advisors of the thesis entitled “**Performance Evaluation of Water Supply Construction Projects: a cause of Oromia Water and Energy Bureau**” and developed by Getahun Nagari Nukuse, here by certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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ACKNOWLEDGEMENT

First of all I will like to thank the almighty God for all things he has done in my life .it is also my pleasure to express my deep appreciation to my advisor Dr. Bahiru Bewuket for his invaluable and dedicated supervision and advice from the beginning to the end of the research. I am deeply grateful to all who have given me assistants in finding the information and data related to this work. Particular tanks to Ato Mohamed Nura, Tesfaye Soressa and Lelisa Gutema for financial assistance for my thesis. It is also may pleasure to thank, consultants, client and contractors participating Oromia water supply construction projects, who made this thesis possible by responding to questionnaires. My special credit also goes to all instructors, for their high level of commitment, professional guidance, continuous encouragement, and support throughout the study period. In particular, my special tanks go to Dr. Engineer Habtamu Itafa who supports me to start this program. Finally I would like to extend my deepest gratitude to my family, for there continuous support and encouraging throughout the education level.

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ACRONYMS AND ABBREVIATIONS

OWEB	Oromia Water and Energy Bureau
WSC	Water Supply Construction
KPI	Key Performance Indicators
WS	Water Supply
WSCP	Water Supply Construction Project
MCDA	Multi-Criteria Decision Analysis
UK	United kingdom
PPE	Project Performance Evaluation
CSA	Central Statistical Authority
PCDA	Plan, Check, Do, Act
VIF	Variance Inflation Factors
TQM	Total quality management
5 S	Sort, set in order Shine, standardize, self-discipline
ANSI	American national standardization institute
ISO	International standard organization
IPMA	International project management association
PMI	Project management institutions
IWRM	Integrated water resources management

ABSTRACT

The awareness of construction performance evaluation which involves setting new operating target and standards has been raised among majority of water supply construction projects. This is to because of the ever increasing requirements and expectations of the clients which necessitated continuous improvement in the cost, timing and quality of construction output. Productivity as an important issue in any industry can only be improved when the effect of changes applied on method, effort and system that can be measured. This paper reviewed internal performance measurement which makes a water supply construction projects focuses on identifying improvement areas within its structure through comparing its business operations with others who do it better, through setting new targets to meet. The paper identified key performance indicators of internal performance evaluation which include; time, cost, quality, client satisfaction, lastly, the paper reviewed external performance evaluation which makes the water supply construction industry as a whole attempt to improve its productivity through designing lean management tools and techniques applicable to construction. The paper concluded that, in order to improve construction performance, it is essential to have accurate measurement reflecting current trends, applying lean construction management tools, cloud based water supply construction software and Mobil application, Engineering software, project management software, Innovative construction materials and equipment's and practice toward effective productivity. The construction industries should effectively take up internal performance measurement and be more open to external performance measurements that have been successful in other industries and assess if adaptable to construction projects

Keywords: Construction performance, Performance evaluation

CHAPTER ONE

1 INTRODUCTION

This study explores performance evaluation of water supply construction projects can facilitate management of activities within the Oromia water and energy Bureau. This section will therefore introduce the performance evaluation of the study, followed by stating the research question to be answered by the end of the report.

Bridget S. (2022), the water supply constructions industry is play primary role in advances and success of the target of society. The WS construction industry is one of the largest and it adds to contributes to for countries development. Water supply Construction industry is complex, in its nature as it involves large number of parties such as clients, contractors, consultants, stakeholders, shareholders and regulators. Performance is associated with several factors such as time, cost, quality, client satisfaction, productivity and safety. There are other genuine reasons like closures, modification of drawings and changes of the design. Other grounds affecting construction projects Performance are poor management and guidance; inapt participants; poor relations and co-ordination; lack of motivation, insufficient infrastructure, political problems, cultural problems and economic conditions. Found that factors like inadequate leadership, poor site management, lack of manpower skills, lack and breakdown of equipment plays very important parts in water supply constructions project performance in the Oromia region.

The Recognized Co-ordination Among Participants, Leadership, Skills And Co-ordination of Project Managers, Project Manager Competence, Support of The Top Management, Economic and Climatic Condition, Social Condition, Participants Co-ordination, Decision making As Key Factors.

WHO Drinking Water Fact Sheet.(2018) The water supply constructions industry performance is affected by national economies. WS construction industry is one of the largest single industries that contribute greatly to the developments of nation. The pace of the economic growth of any nation can be measured by the development of the physical infrastructures such as WSC building, road and bridge. Successful building of WS construction projects are those project finished on the time, within Budget, in Accordance With Specifications and to Stakeholders Satisfaction.

1.2 Back Ground of the study

The performance of the water supply construction projects is characterizing by multiple factors but three of them are the basic and most important, these are time, cost, and quality. These factors must be maintained in a proper balance to achieve the satisfaction of different participants of construction projects; that is ending the project on time, within the budget, and at the required quality. Water supply construction Project management tools and techniques play an important role in the effective management of a project. Therefore, management focuses on the management tools and techniques used to manage the project. Water supply construction Project management involves managing the resource, workers, materials, machines, money, and methods used (Ndunguru. D, Nyonyungu. F (2020), some of the projects are managed effectively and efficiently resulting in satisfactory results while others face many problems which led to cost and time overruns.

Performance Project evaluation is the process of measuring the success of a project, program or portfolio. This is will be done by gathering data about the project and using an evaluation method that allows evaluators to find performance improvement opportunities. Project evaluation is also critical to keep stakeholders updated on the project status and any changes that might be required to the budget or schedule. Performance evaluation of the project is a point of interest for firms whether in public or private sector. A well-planned project timeline guarantees a project's performance and offers a clear Overview of main reasons for performance. It allows project managers to and partners take the correct decisions and work for the progress of the project. Most important determinants of the research group's project accomplishments are project mission, top management support, scheduling of tasks program team consultancy workers technologies to help project customer approval tracking and collaboration problem-solving knowledge input channels Tetik et al., (2019),

Every water supply construction project has a defined goal or objective, defined task to be performed and a defined time frame and every construction contract considers time as the essence of the project Feyzbakhsh et al., (2018), Delay is a situation when the constructor and the project owner jointly or individually contribute to the non-completion of the project within the original or the stipulated or agreed contract period. Completing projects on time gives better Performance Measurement is regarded as a fundamental tool for managers to comprehend if the organization is successful or unsuccessful in its path to

accomplishing its goals Hidiroglu, D, (2021). Performance measurement is described as the method of quantifying actions within an organization that reflect operational efficiency and effectiveness; It is being achieved by using individual performance measures, which within the performance measurement system where performance is achieved and where attention is needed “What gets measured gets done” and “if you can’t measure it, you can’t manage it”, to illustrate its importance to managers for them to navigate properly and ensure alignment of strategic objectives. Historically, performance measurement has focused on financial and monetary measures but has in modern time also come to encompass other perspectives such as measuring quality of output in operations. Performance measurement is regarded as the procedure to quantify historical activities to monitor and sustaining organizational control to ensure that goals and objectives successfully are met results for both project owners and the contractors and reflects their efficiency.

The water supply construction projects face many problems, such as project overruns, time extensions, conflict among the parties, and the lack of a quality assessment system. The three main reasons that these problems are so widespread can generally be said to be the unique nature of projects, the fragmented and highly competitive nature of the construction industry, and the increasing challenges facing the industry. According to various studies, a construction project is commonly acknowledged as successful when it is completed on time, within budget, and in accordance with its quality specification. Bitamba B, (2020).

However, in the Oromia water and energy Bureau, many water supply construction projects are completed late, or are never completed. Therefore, this study aimed to identify and evaluate significant performance indicators that affect construction projects according to the relevant stakeholders, categorized as owners, consultants, and contractors. A quantitative study was organized and a questionnaire prepared as the system to collect information from the main stakeholders involved in water supply construction projects. After that, the descriptive and inferential analysis, regression analysis was used as a tool to classify the factors affecting construction projects’ and evaluate performance of water supply construction projects in the Oromia.

1.3 Statement of the Problem

The failure of any water supply project was mainly related to the problems and failure in performance. Moreover, there are many reasons and factors which attribute to this

problem. In the Oromia region, there are many water supply construction projects which are failing in performance. Despite the water supply construction industry's significant contribution to the economy of developing countries and the critical role it plays in those countries' development, the performance of the water supply project remains generally low Gadisa & Zhou,(2021).

In the Oromia region of Ethiopia WS construction projects performance problem appears in different directions. Many constructed projects fail in time performance, others fail in cost performance and others fail in other performance indicators. In the recent past, there are many projects which are completed with poor performance because of many evidential reasons such as obstacles by clients, non-availability of materials, roads closure, amendment of the design and drawing, additional works, waiting for the decision, handing over, variation order, amendments in the bill of Quantity and delay of receiving drawings. However, several projects are problems with performance in the Oromia region, Alemayehu Y,(2020).

Therefore, this research proposal will evaluate the performance of water supply construction projects in the Oromia region to assist owners, consultants, and contractors to overcome performance problems and to improve the performance of their construction projects. Hence, the performance of any construction project will be evaluated according to key performance indicators.

1.4 Research Questions

- 1 What are factors affect the performance of Oromia water supply construction projects?
- 2 What is the effect of factors on the performance of Oromia WSC projects?
- 3 How to improve the performance of Oromia water supply construction projects?

1.5 Research Objectives

1.5.1 General Objective

The aim of this research is to evaluate the performance of Water supply construction projects executed under the Oromia water and energy Bureau.

1.5.2 Specific Objective

1. To identify factors affecting the performance of Oromia WSC Projects
2. To analyze the level of factors' influence on the performance of Oromia WSCPs

3. To develop the performance improvement techniques in Oromia WSCPs

1.6. Significance of the study

The study is believed to be important since it is expected to evaluate the performance of water supply construction projects in the case of OWEB. Once the problems are identified it was easy to overcome the problem and exploit the prospect. The study is significant in terms of addressing the recommendation for the performance evaluation of water supply construction projects facing in the Oromia region as a result of lining the means of solving this problem.

1.7 Scope and Limitations of the Study

1.7.1 Scope of the study

This study was conducted in five areas of Oromia region namely –North oromia , South oromia , Central oromia , East oromia and West oromia . The study covered 48 out of 55 water supply construction projects was carried out in six months.

1.7.2 Limitation of the study

The study anticipated to encounter some limitations that might hinder access to information that the study sought. The respondents targeted in this study might be reluctant in giving information fearing that the information being sought might be used to intimidate them or print a negative image about them. The researcher hoped to handle this by carrying an introduction letter from the university to assure them that the information they gave was treated with confidentiality and was used purely for academic purpose. Due to limited time and resource availability, it is not possible to study the entire water supply construction project. Therefore, it is imperative to take representative for the generation of primary data on different variables.

1.8 Organization of the study

The paper has been divided into five chapters. The introduction is covered in the first chapter, and the review of related literature is covered in the second. The third chapter will be devoted to the study design and methods that will be employed. The analysis and presentation of the data collected will be part of the fourth chapter. While the final chapter will be concerned with the study's output in the form of a conclusion and recommendations that are appropriate based on the research's findings.

2 LITERATURE REVIEW

2.1 theoretical literature reviews

Definitions and Concepts

There are many written definitions of a project; however, all of them contain the key elements described above. For those looking for a formal definition of a project the Project Management Body of Knowledge PMBOKpp.5 (2008) defines: Project:- is a temporary endeavor undertaken to create a unique product, service or result. The temporary nature of projects indicates a definite beginning and end. The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists. A project has several characteristics: by Heldman, K , C. Baca, and P. Jansen,(2018)

- ✓ Projects are unique.
- ✓ Projects are temporary in nature and have a definite beginning and ending date.
- ✓ Projects are completed when the project goals are achieved or it's determined the project is no longer viable.

Performance Evaluation is a formal management system that provides for the evaluation of the quality of an individual's performance in an organization.

Performance means carrying out a task, the progress of which can be measured and compared using a set of stated requirements.

2.1.1 Overview of Performance Evaluation

The need to improve performance in construction industries worldwide has become topical. For instance, the UK construction industry initiated several calls in this regard. These calls include the Simon A (2023), reports. In the US construction industry, rework (defect) contributes significantly to cost performance problems and accounts for an average of 5% of the total construction cost Miles, Huberman, A.(1994).

Performance evaluation is one of the most important aspects of Project Management and Identification of the Key Performance Indicators that affect the success of PM can lead to success of the project. Performance can be considered as an evaluation of how well individuals, groups of individuals or organizations have done in pursuit of a specific objective Petrou, A. (2017).

These objectives vary significantly, but from WS construction industry or organizational perspective, they generally revolve around satisfying the key stakeholders such as customers, employees, shareholders, the various suppliers, government and society as a whole. Describing Performance relating such factors as increasing profitability, improved service delivery or obtaining the best results in important areas of project activities. In construction, because of the numerous participants who contribute towards the achievement of project objectives, performance has been defined in one sense as a participant's (client, consultant or contractor) contribution to the execution of the task required to complete the project Sons, Inc. (2018)

2.1.2 Purpose of Performance Evaluation

According to Posthuma, R and M Campion,(2018).), the concept of performance management is a new concept, however, performance evaluation in the past few decades has been the most controversial personnel services and managerial activities and can say that performance management to discuss a series of different perspectives and motivating emotion is one of the most complex activities and processes of human resource management.

In many WS construction organizations, performance evaluation is considered as inseparable part of human resource management programs and very efficient tool in professional development and is used for various purposes Zhang, X., J Qian, ., B Wang, Z .Jin., Y Wang, (2017). Evaluation objectives of employees are identified development of employees, establishing motivation, recruitment and manpower planning and effective communication between employees and supervisors.

Erin S (2021), The purpose of performance evaluation in constructions are planning and controls, a basic project management function, is to ensure a well-coordinated and successful project. A basic element of planning is the set-up of objectives. The objectives will guide the many decisions made during the project's life. These decisions involve trade-offs between schedule, cost, quality, and other performance attributes. Effective monitoring of the progress of construction projects requires the integration and quantification of the various aspects of performance. The performance indicators in the construction industry are completion time, cost, and quality.

Most current project control systems measure quantitatively cost and schedule status and forget other major aspects of project performance like cash flow, profitability, quality,

safety, project team satisfaction, and client satisfaction which are in some cases as important as cost and schedule. Very few project management systems quantify the later project attributes and they do so independently without proper integration to the overall project performance. The perception of failure and success of projects is usually based on personal indices and the experience of the project manager and it is not uncommon that two project managers would assess the performance of the same project using the same data differently Manlian R S, Agung (2018).

The disparity of judgment is mainly due to the lack of a clear and consistent evaluation procedures and methodology. There are many occasions where the project is under budget and progressing as scheduled. Yet it is considered a failure by upper management because of the low quality and safety performance records. Conversely, a project can be behind schedule and over budget and still be considered a successful one because it was completed with high quality, excellent safety record, and to the satisfaction of the client. Olawale, Y.A. (2020).

2.1.3 Performance Evaluation Management

Construction performance is necessary to the achievement of supportable development. Various techniques and management skills have previously been developed to help improving performance from implementing construction projects. However, these techniques seem not being effectively implemented due to the fragmentation and poor coordination among various construction participants Liu, Cheol. (2017).

There is a lack of consistency and holistic methods to help participants implementing construction practice at various stages of project realizations. The characteristics of the construction industry are such that a project is often a major business endeavor representing a major investment by the client, however the most research published in the construction management literature on performance in the construction context mainly focus attention on the contractor's role Kamaruzzaman M, (2019) This implies that ultimately it is the project performance that determines overall business performance. These characteristics make project performance critical.

Performance measurement is the process of determining how successful Water supply construction organizations or individuals have been in attaining their objectives and It is a means by which unnecessary causes of waste can be identified so that the organization knows where to focus its effort Amirsaleh A, (2019), The purpose of performance

measurement is to provide timely and accurate feedback on the efficiency and effectiveness of operations and to focus attention on continuous improvement.

2.1.4 Measures of Performance Evaluation

Performance measurement is defined as the process of evaluating performance relative to a defined goal. It provides a sense of where the project are and, more importantly, where they are going Mishra, A , & S Acharya, (2018). Rose further stated that measurement can guide steady advancement toward established goals and identify shortfalls or stagnation and maintained the importance of measuring performance because it will indicate status and direction of a project.

It is widely accepted view that, at a minimum, performance measures of a project are based on time cost and quality Mahamid, I. (2016) ,noted that these three components of project performance as the ‘ iron triangle ’ . However, Abdullah C, S Mohtar (2013) considered variety criteria in measuring a project. This includes meeting budget, schedule, the quality of workmanship, stakeholder’s satisfaction, transfer of technology, and health and safety. Similarly noted that various other key components also used in measuring project performance such as health and safety, environmental performance, user expectation / satisfaction, actor ’ s satisfaction and commercial value. Therefore, in this article, six variables have been identified for measuring project performance. They are cost, time, quality, clients’ satisfaction, health and safety and functionality.

Project managers often wonder if they are measuring the right things on a project. It’s difficult to know how much time to spend evaluating past performance and how much time to spend on keeping the work moving forward. Of course, there are many indicators of project success, but what do you need to be measuring while the project is in motion? Performance measures are vital signs of an organization which helps to recognize whether the activities of a process or the outputs of the process achieve the specified objectives. They can be used to translate the strategy of the organization into a set of goals and objectives and the results obtained through the measures reflect the successfulness of achieving the strategy Eccles,(1991)

Performance measures indicate the priority factors of the organization and the way the employees should behave to give maximum outcome to the organization Neely,(2002). Projects are becoming more complex with the passage of time. There are a number of reasons

- The simpler ideas have been exploited first and the need for innovation is vital
- The allowable time to market is reducing, which impacts on one of the important constraints of all projects.
- Businesses are becoming more complex
- Projects are also moving towards turnkey contracts, where the end user does not get involved with the interface between the parts of a system, but only deals with a single supplier in the provision of the entire system⁴. Maylor H (2018).

At various points during the project you want to evaluate five points: schedule, quality, cost, stakeholder satisfaction and performance against the business case. A formal project evaluation is of use during the end of a phase or stage as it can give you a clear indication of how the project is performing against the original estimates. The following table explains about measuring of performance evaluation: -

Table 1 Measure of Performance Evaluation,

List	Measurements	Descriptions
1	Schedule	Defined as the time to complete the project also the most frequent project oversight in developing projects. This is reflected in missed deadlines and incomplete deliverables. Proper control of the schedule requires the careful identification of tasks to be performed, an accurate estimation of their durations, the sequence in which they are going to be done, and how people and other resources are allocated.
2	Quality	The standards and criteria to which the project's products must be delivered for them to perform effectively. It must also meet other performance requirements, or service levels, such as availability, reliability and maintainability, and have acceptable finish and polish.
3	Cost	Its budget approved for the project including all necessary expenses needed to deliver the project. Within organizations, project managers have to balance between not running out of money and not under spending because many projects receive funds or grants that have contract clauses with an “use it or lose

		it” approach to project funds.
4	Stakeholder Satisfaction	The wider teams the stakeholders are essential in getting much of the work done, so it’s worth checking in with them. Find out how they are feeling about the project right now and what you could be doing differently. This is a difficult measure to document statistically, although there’s nothing to stop you asking them for a rating out of 10. Even if you are evaluating their satisfaction subjectively, it is still a useful exercise. If you notice that stakeholders are not fully supportive, you can put plans in place to engage them thoroughly to try to influence their behavior.
5	Performance to Business Case	Finally, you will want to go back to the business case and see what you originally agreed. How is your project shaping up? Check that the benefits are still realistic and that the business problem this project was designed to solve does still exist. It happens project team’s work on initiatives that sound great but by the time they are finished the business environment has moved on and the project is redundant. No one bothered to check the business case during the project’s life cycle and so no one realized that the work was no longer needed. Don’t work on something that nobody wants! Check the business case regularly and evaluate it in light of the current business objectives.

The water supply construction industry has numerous problems to deliver quality construction projects because it comprises of a multitude of professions, occupations and organizations. The quality of service delivered by consultants has often been a subject of thorough investigations. Some clients have underestimated the impacts of substandard consultancy service to the success of a construction project Abenet Y, N Maniha (2023).

Many delays, cost overruns, reworks, variations, claims and disputes can be traced back to erroneous design, poor contract administration or lax supervision of the client ’ s representative. Furthermore, the processes of construction projects are generally non-standardized; hence, it is difficult to ensure quality. According to Monika M, R Gitty (2020) , performance indicators specify the measurable evidence necessary to prove that a

planned effort has achieved the desired result. In other words, when indicators can be measured with some degree of precision and without ambiguity, they are called measures. However, when it is not possible to obtain a precise measurement they are usually referred to as performance indicators. Because the client is the principal stakeholder in the construction process, good performance has been defined typically in terms of the delivery of projects on time, to specification and within budget, providing good service and achieving reasonable life-cycle costs.

More recently, the requirements of the other stakeholders such as employees and society have come into focus with the need to promote sustainable construction and corporate social responsibility, and this is reflected in a more comprehensive set of industry. The theory of water supply project Performance develops and relates six foundational concepts to form a framework that can be used to explain performance as well as performance improvements. To perform is to produce valued results. A performer can be an individual or a group of people engaging in a collaborative effort. Developing performance is a journey, and the level of performance describes the location in the journey. The current level of performance depends holistically on 6 components: context, level of knowledge, levels of skills, level of identity, personal factors, and fixed factors Saraf D. (2013).

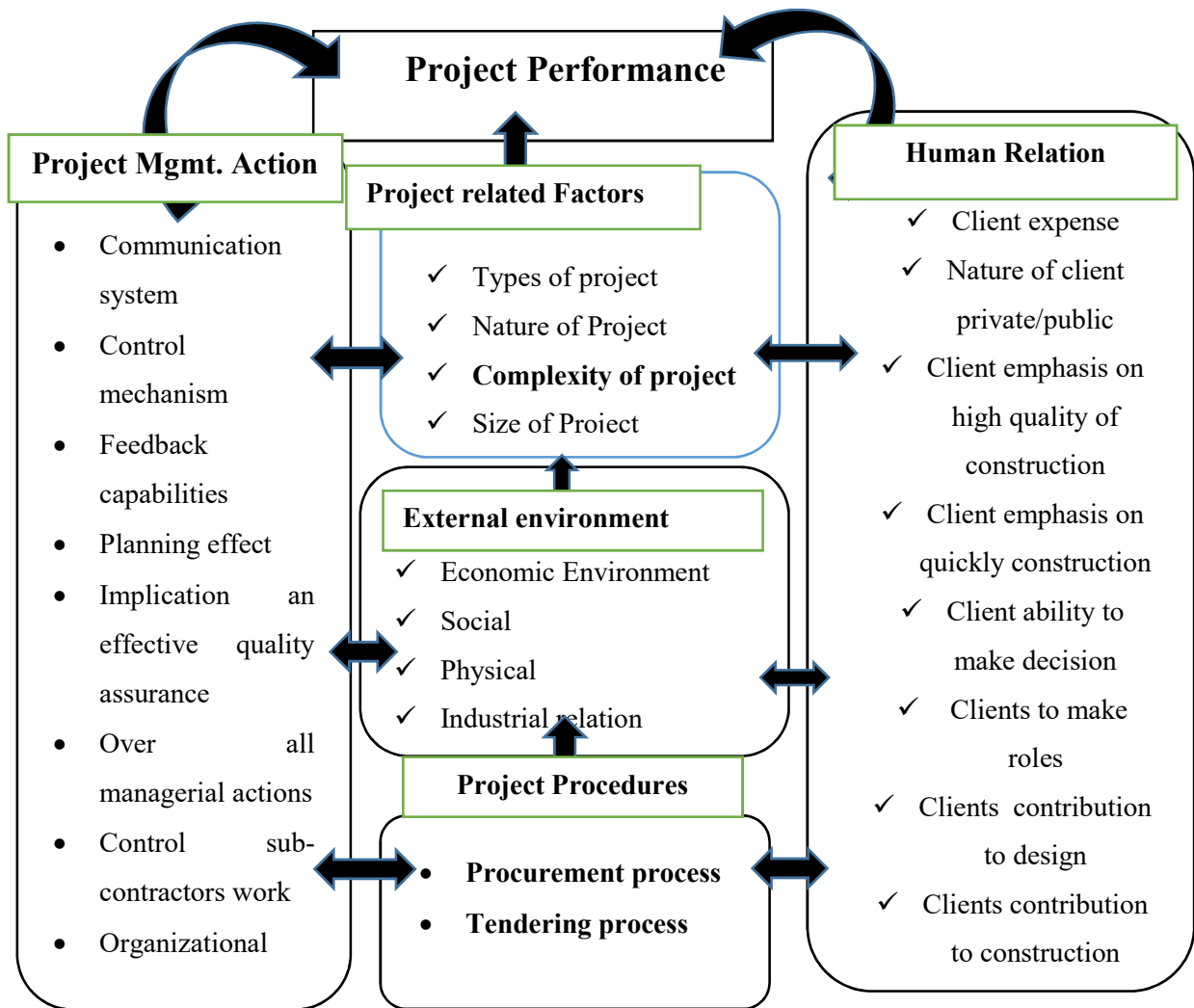
Three axioms are proposed for effective performance improvements. These involve a performer's mindset, immersion in an enriching environment, and engagement in reflective practice. Performance advancing through levels where the labels "Level 1," "Level 2," etc. are used to characterize the effectiveness of performance. That is, a person or organization at Level 3 is performing superior to a level two people or organization. Higher performance results in results that fall into the following categories: Quality improves; results or products are better at a meeting or exceeding stakeholder expectations; waste is reduced; capability improves; ability to take on more difficult performances or projects; capacity improves; ability to generate more throughput; knowledge improves; depth and breadth of knowledge improves; skills improve; ability to set goals, persist in achieving them, maintain a positive outlook, etc. increase in the scope of application and inefficiency, an increase in identity and motivation, people become more aware of their professional identities, and organizations discover their core values Zhou & Gadisa, (2021)

The timely completion of a project was one sign of success. The amount of time needed to finish a project's construction is frequently longer than the amount of time stated in the

contract. It is an undertaking that runs behind schedule, and it was thought to be a common problem in construction projects. Often, the delay or subpar performance leads to increased project costs and time overruns. Water source delays in construction projects also lead to disputes and mistrust amongst the affected parties (the designer, the contractor workers, and the consultants). Zhou & Gadisa, (2021)

Due to time extensions needed for projects as a result of delays or poor performance during the WS construction process, the impact on project costs is greater for the owners and has a detrimental effect on the economies of the countries. Due to the aforementioned and other factors, the building of a water supply was delayed or performed poorly, which had adverse effects on the contractor and the project owner Belassi & Tukul, (1996). The Effects include potential time and cost losses from project facilities, reliance on existing project facilities, an increase in contract administration costs, and increased project owner monitoring costs.

Augusto et al.,(2018) outlined a number of variables that influence how well construction projects perform in Iraq. The key elements which influence the manner in which contractors perform on construction projects are the cash flow of the projects, the average delay in regular payments, contractor experience, design team experience, and site preparation time, according to survey respondents. The performance assessment system Project has developed appropriate methods and tools to measure, monitor and improve delivery of water and sanitation in urban and rural area. The Project has three major components of performance measurement, monitoring and improvement. Water companies all over the country have various differences, such as water source conditions, pipe network configuration, and local economic development level and so on. Therefore, it is difficult to carry out benchmarking for the water industry. How to set reasonable performance indicators to make the horizontal performance comparison of water companies under different backgrounds is the primary problem to be considered in performance evaluation work.



Source Augusto et al., (2008) factors affecting the performance of construction projects

Figure 1 Factors affecting performance of projects

Raid A, Y Ali, (2018) discussed a number of variables that affect the contractor's performance on Iraqi construction projects in this study. The key elements that affect how well contractors perform on construction projects are the cash flow of the projects, the typical delay in regular payments, the experience of the design team and the contractors, as well as the time required for site preparation. Cash flow issues were viewed by both the clients and the contractors as important issues that required adequate solutions.

In this paper Babalola. I H,(2015) examines the performance of building projects in Akure as well as the attitudes of project clients, consultants, and contractors in the Nigerian construction sector. In the study, criteria were taken into account, and they were

categorized into groups based on the pertinent literature review and the information gathered. The results of using the average index approach to gauge how clients, consultants, and contractors felt about water supply building projects in Akure, Nigeria, were analyzed and debated, identifying the most crucial variables.

According to the respondent Melba alias, Dhanya R, (2015), inadequate labor and poor planning come in second and third place in the cost segment, behind the rising and expensive cost of machinery and materials. Increased material costs have an impact on the owner's liquidity and the contractor's profit margins. The time required fixing flaws, the average delay in owner payment to the contractor, and the average delay due to closures and material shortages have been ranked first, second, and third, respectively, under time factors. When it comes to variables affecting client satisfaction, the project manager's leadership abilities are quite important. Ineffective leadership has an impact on the performance of the water supply construction sector. The project partners must coordinate their information sharing as a second component because failure to do so will result in disagreements.

This study article argues that a completed facility's project management success depends on a wide range of difficulties and variables Smart Homthong, (2016). Identification of key success, criteria early on in the project, especially with regard to the operation and maintenance phase. This paper offers insight into the crucial success variables affecting the performance of water supply construction projects for various goals, with a particular emphasis on the operations and maintenance phase within the framework of project management.

2.2 Empirical literature reviews

The empirical literature has investigated the variables influencing cost performance by taking a questionnaire survey technique Tetik et al., (2019). Cruz Villazón and colleagues, (2020) studied the main performance indicators and put out a methodological decision-making model that is organized and analytical for evaluating sustainability in infrastructure projects in a developing nation like South Africa. The literature on sustainability research, case study project data, current government guidelines on environmental impact assessments and sustainable construction environments, structured interviews with industry professionals, and a questionnaire-based survey for indicator validation were all used in the research's execution.

Saleh A , S Wamuziri (2018) Project Performance assessment is important for improving performance of construction industry. Project performance metrics are not clearly defined and standardized in the industry. Different performance measurement models consider different metrics for performance evaluation. A review of literature thus focuses on cost, schedule and quality as three major performance areas out of several identified areas. Recently, authors focused on identifying several additional performance areas. Moreover, there is no standardized performance model followed by construction industry. It is observed that focus on organization outcome, customer satisfaction, leadership skill is given more importance compared with performance of construction project. Different studies vary from detailed level of metrics. There are additional performance metrics which should be contextualized considering in construction industry.

Ghadi A, M Khayyat (2020), In the construction industry Quality is an important issue to perform better service. The objective of any construction project is to finish the construction within the estimated budget, time and scope according to the quality that have been required. Poor quality of work leads to loss of money and time also it will take the construction company at risk in financial also in nonfinancial position. Based on their argument the owner has the right to ask for rework according to the plan and based on the standards. But if the required quality standards are not clearly defined in the contract, the client might overstate the quality requirement which will create problems with the contractor.

Management in construction industry is considered as one of the most important factors affecting performance of works. Ugwu and Haupt (2017) stated that documenting and archiving performance data could be useful for future reference, such as for settling disputes on claims, and in maintenance and repair works.

John K (2021) remarked that quantification of the impacts of the project management processes are identified through three steps of analysis: comparison of summary statistics of design performance, proof of statistical significance of any differences and calculation of least squares regression line of a plot of design performance measurement versus amount/application of project management as a means to quantify management influence to design phase cost performance.

Construction project performance evaluation continues to be one of the primary competitive issues of the new millennium. Performance measurement (PM) is an integral

part of management and defined as a process of quantifying both the efficiency and effectiveness of an action Neely et al., (2018). Some of the major concerns of performance measurement include “What to measure?”, “Which measures are used?”, “How to measure?” and “How to interpret results?” Sandana Y & Oduoza, (2017).

Traditionally performance has mainly been measured from the financial perspective. Therefore, traditional management accounting systems were highly criticized due to their functional behavior Ridgway, (2014). This dissatisfaction led to the development of “balanced” or “multidimensional” PM frameworks in the late 1970s Bourne et al., (2016). Kagioglou et al. (2018) stated organizations that rely on financial measures alone, can identify their past performance but not what contributed to achieve that performance.

2.2,1 conceptual frame work

Performance evaluation is a most important to all organizations. Performance appraisal is an official and evaluation of an individual performance and were checked an individual performance on a continuous, and Employees are a key element of any organization. The performance appraisal systems developmental tools used to measure the real performance in an organization and the strategic goals of the organization are associated to that individual performance Debadyuti D, (2015),

Pollack, J D Adler, (2018), Performance of construction projects has primarily been evaluated on the basis of cost, time and quality criteria, famously described as ‘iron triangle’. These traditional criteria have faced criticism due to their inadequate coverage of performance measurement, the perceived relationship among themselves and their short- In view of these criticisms a number of researchers have advocated for a wider focus of construction project performance to cover aspects of project safety, construction contract management, environmental impact and community satisfaction. The water supply construction industry is said to be one of the most unsafe industry because of its high rate of fatalities Patrick, (2011). Several researchers, therefore, consider safety of the project site as an important aspect of construction project performance.



Figure 2 conceptual frameworks, Source Pollack, J D Adler, (2018)

Yeung et al., (2013) developed a comprehensive model to incorporate all significant procurement sub-systems variables with non-procurement variables based on time and cost performance. The multiple regression technique was applied to analyze the data from 32 Hong Kong WSC projects and the results were compared with reality. (Department of Architectural Technology Mai Idris A, P Geidam, State, Nigeria, et al., (2021) a measurement of logistics performance proposed a new framework for measuring construction logistics. Two-dimensional models are grouped by the use of measures and by the focus of measures. The first dimension (use of measures) contains two kinds of measures. One of them is called improvement measures and the other kind is called monitoring measures. The second dimension of the framework is the focus on measures. It clarifies at which organizational level measures can be used.

Inayat et al, (2012), indicate that the success of a WS project is a very critical issue in the industry. Research has been vigorously done on successful projects in the hopes to discover the factors that contribute towards achieving project success. There are five critical success factors for WS construction projects, which are namely, the efficiency of the project manager, the appropriate scheduling of activities, a systematic responsibility and monitoring approach, project supervision and finally continuous project involvement. Charles et al., (2021) states that nine project success variables have been identified as a result of their research. These elements consist of a clearly defined project goal,

adaptability to technological change, community involvement, priority-based scheduling, finances, legal requirements, contractual links, and problem-solving. The success of a project can be related to a variety of elements, with a few factors being highlighted by various studies. Task and activity schedules as well as a clear understanding of a project's goals are examples of these common components.

According to Saraf (2015), the owner, contractor, and engineer all agreed that the following factors were crucial in determining how well the water supply construction project performed: poor planning, poor designing, site management, decision-making, construction methods, a lack of labor and technical personnel, a lack of quality materials, construction errors and defective work, and productivity. Engineers should carry out their tasks correctly in order to increase performance, which enhances water supply construction projects. Contractors shouldn't take on more projects that they can't complete properly. To increase the productivity performance of water supply construction projects, proper motivation and safety procedures should be implemented. Contractors are advised to reduce waste rates during project execution to reduce costs. To resolve disagreements, performance issues with timing and costs, they should be more concerned with conformity to project standards.

2.2,2 Project-Related Factors

According to Inayat et al. (2019), "a factor is any circumstance, fact, or influence which contributes to a result" and "factors for project effect" are influencing factors that can either promote or hinder the achievement of the project. These individual traits are described as being necessary to perform the job. While success criteria are the set of requirements needed to determine whether a project is successful,

The project's achievement is influenced by various elements Inayat et al.,(2018). There are groups of components that are pertinent for each stage of the project development process, according to the connection between factors associated with success, success criteria, and project success that is described. The conceptual and operational phases lay the groundwork for successful outcomes from a large-scale perspective. The project is conceptualized and then tested. From a micro perspective, the water supply construction phase and the contractual parties' objectives in terms of time, cost, quality, and safety serve as the foundation.

2.2.3 External Environment that Influence Performance

According to Feyzbakhsh et al. (2018), the term "environment" also refers to all external factors influencing the construction process, such as social, political, and technological systems. The factors that are measured for this component are the level of technology, the physical environment, the industrial relations environment, the social environment, and the political environment. Advanced external variables the success of the project is influenced by "environment," according to numerous academics Identified "environment" as all outside forces that have an impact on the construction process such as the political, social, and technical systems. The economic environment, social environment, political environment, physical environment, industrial relations environment, and level of technical advancement are the qualities utilized to measure this element. Most crucial for predicting the performance level of a construction project, before it starts are the development needs of the project team members.

2.2.4 Project Procedures: Procurement Related Factors

Gadisa & Zhou,(2021) describes that a number of researchers identified the importance of procurement factors and Defined the scope of procurement as the framework within which construction is brought about, acquired, or obtained. Therefore, two attributes are used to measure this factor; they are the procurement method (selection of the organization for the design and construction of the project) and tendering method (procedures adopted for the selection of the project team and in particular the main contract Previous studies of Fakhravar & Ouabira,(2021) suggest different procurement related factors that can affect project performance. These studies examined several procurement-related parameters without identifying any themes. In the Malaysian construction sector, procurement-related elements that have an impact on conventional, Design and Build, and Management Contracting procurement methods include reconstruction time, control of project design and cost, and client control of construction projects.

2.2.5 Procurement Selection criteria

The selection of suitable procurement practices for water supply construction projects is a very complex and demanding task for stakeholders in the construction industry. In spite of the overabundance of techniques and tools accessible to the stakeholders in selecting an appropriate procurement method, clients are faced with the decision as to which of the selection criteria can be adopted for a given construction project to achieve project goals

and objectives. Water supply Construction industry identifying and establishing parameters selection to improve contract delivery systems, Gunduz & Al-Naimi,(2022). Various writers have proposed various procurement selection criteria that can help customers select the optimal procurement technique and have shown that client characteristics, project requirements, and external environment are used as procurement selection factors. However, Fakhravar & Ouabira, (2021) reiterated the utilization of the three criteria collectively while also taking into account customer requirements that are time-related and cost-related. factors and quality-related factors. Several variables of client requirements were measured under cost, time, and quality-related factors. Project characteristics factors also include project type, size, cost, flexibility, complexity, site risk factors, and degree of innovative technology. All these above factors can influence the selection of an appropriate procurement method that can also affect project performance.

The procurement process for water supply construction projects were a very difficult and demanding task from management perspective in the water supply construction industry. The industry's inherent problems are as a result of its nature, structure and fragmentation, which was apparent most especially in the traditional separation of design and construction processes the unique nature of the water supply construction industry coupled with the impermanent nature of project organization places huge burden on the project team in making decisions as to which procurement process to adopt in construction process and in achieving the overall objectives of the construction project. Although, observed that there is a general agreement amongst researchers that certain procurement system is more appropriate for an individual project than all others, but there is no any procurement method that is better than the other in any project. Hence, the selection of suitable procurement system is largely dependent on the identification and establishment of client objectives and requirements, Richard .A, (2016)

Regardless of the chosen procurement method, a client may choose a collaborative approach for any given project, such as working with partners. Clients with numerous tasks to complete usually employ this type of method. The performance of both contractors and consultants can be evaluated and compared using pre-defined indicators for each project in which they participated Therefore, considering the proliferation of different procurement methods and the need to select and adopt more systematic methods of selecting suitable procurement systems for a specific construction project Luqman. O (2016).

2.2.6 Tendering Method Related Factors

Jeff G, (2022) The administrative process of sending specifications, bills of quantities, and drawings to contractors with the goal of receiving a price for the project's construction is known as tendering. Other considerations, such as the contractor's competency, financial capability, technical competence, and other variables, are utilized when choosing a contractor to carry out a construction project in addition to the project's cost. In order to solicit bids, various tendering procedures have been employed in construction projects. Different methodologies have been applied to water supply construction projects, including open selective, negotiation, competitive, open selective, and design and build tendering. 5-8 qualified contractors are requested to submit bids for projects in a selective tendering process. Criteria used in drawing up these competent contractors can include the standard of workmanship required, the equipment base of the firm, previous business records, and financial standing amongst other factors. Nyangwara & Datche, (2015) Selection of contractors through this approach may overcome the deficiencies in open tendering but may lead to higher quotations. The negotiation approach is used when a firm or client has previous satisfaction associated with a contractor and the client is prepared to give the contract to this contractor on the bases of a reasonable price for the project. Such an arrangement is also used if the project is of specialist nature. This approach is known to save time but may lead to higher prices for the quotation. Competitive tendering approach is used where various contractors of all categories are welcomed to submit tenders.

2.2.7 Project Management Actions

Tetik et al.,(2019a) suggested that Project management action is key for project performance by using management tools; the project managers would be able to plan and execute their construction projects to maximize the project's chances of success. Then, the variables in project management include adequate communication, control mechanisms, feedback capabilities, troubleshooting, coordination effectiveness, decision-making effectiveness, monitoring, project organization structure, plan and schedule followed, and related previous management experience, A project can be characterized by a few elements such as objectivity as it is definable with result, output or product, complexity with normally interrelated activities and the large number of different tasks, unique where it is usually a "one-off" assignment, uncertainty as it has an element of risk, temporary with its well-defined beginning and end, and lastly operate in a life cycle as emphasis and resource

needs change during the life of the project. On the contrary, project management is defined as the process of controlling the achievement of the project objectives, using the existing organizational structures and resources, and managing the project by applying a collection of tools and techniques without interrupting the routine operation of a company. Some of the functions of project management are defining the work requirement, allocating resource needs, planning the execution of work required, monitoring the progress of the work, and taking action to unexpected events that took. For each project, general contractors frequently collaborate with several subcontractors.

Ahmed A (2022), the success of a project depends on how well they are managed, including their timeframes and schedules, compliance records, and cooperation with other contractors. The efficiency of the water supply project advances thanks to clear expectations beforehand, promoting collaboration, including people in all project updates, and streamlining their procedures using technology and automation. Since many contractors still use outdated spreadsheets or on-premise software, data reporting between the field and office is frequently delayed, and individuals responsible for analyzing project productivity frequently use data that is several days, weeks, or even months old. This problem is resolved with a cloud-based, integrated construction management solution that automates activities and provides robust data and analysis capabilities in real time, Golabchi, M., (2020).

To improve project performance, construction delay-controlling elements must be thoroughly examined and effectively managed. Through all phases of the construction project, important delay sources were examined holistically and their dynamics were explored. The full dynamics of the project design cycle, changes that occur during construction, rework, and productivity that are encapsulated in the integrated work process are critically examined to weaken the threat and severity of project delay from the preconstruction to post-construction stages of the project as a quick and efficient way to deal with the project time. Abeku, D,(2016) Prior to discussing what happens after a decision, it is important to address the topic's relevance. Some may contend that discussing decision-making procedures when discussing what happens after the decision is inappropriate. After all, once a decision is made, the process itself ought to essentially come to a stop.

2.2.8 Problem of poor Performance in water supply Construction projects

Any construction project's failure is primarily due to issues and underperformance. Furthermore, there are numerous causes and contributing elements to this issue. The issues with the performance of WS construction projects in developing economies can be divided into three categories: issues with the infrastructure of the WSC industry (primarily the supply of resources), issues with clients and consultants, and issues with contractor incompetence/inadequacy. The performance issue is tied to ineffective time and budget management. Large construction projects frequently experience performance concerns because of a variety of factors, including incompetent designers and contractors, poor estimating and change management, social and technology issues, site-specific problems, and ineffective methodologies and tools Gadisa & Zhou, (2021).

2.2.9 Key Performance indicators

A water supply construction source to ensure supportable development, construction performance is required. Various management strategies and approaches have been created in the past to aid in enhancing the performance of construction project implementation. However, because of the disorganization and lack of coordination among the numerous construction participants, it appears that these strategies are not being applied properly. Narkunien & Ulbinait,(2018), Measurement of WSCP Performance Obtains an assessment framework to gauge the effectiveness of WS project management utilizing time, cost, and other traditional economic analysis metrics In WS construction enterprises, performance measuring methods will soon be implemented. (Architectural Technology Department)

According to Mai Idris Aloom P, G Yobe State, Nigeria et al. (2021), in order to assess, control, and enhance performance both now and in the future; contractors' project performance must be managed effectively and efficiently. Economics, management, and accounting are typically involved in performance measurement, which is a complicated topic. Recent years have seen a substantial increase in interest in performance measurement among practitioners and academics. The goal of the measurement, the amount of detail required, the time available for the measurement, the availability of preset data, and the cost of the measurement all play a role in the selection of an appropriate measuring technique. A framework for project performance evaluation includes several different performance metrics. Communication, timing, expense, quality,

safety, handling of complaints and difficulties, environment, and contractual relationships are PPE parameters. PPE's primary goal is to broaden project performance metrics to include soft characteristics like communication and conflict resolution. The UK Construction Industry Best Practice Program's KPI working group created a project performance measurement tool called the Key Performance Indicators (KPIs) that measures time, cost, quality, client satisfaction, change orders, business performance, health, and safety. The following are the three main steps in putting KPIs into practice: Choosing what to measure, Data collection, and KPI calculation. However, both the PPE and KPIs are useful instruments for tracking the progress of a project over time. Nevertheless, the previous study revealed that both PPE and KPIs can be used to gauge success because their respective indications are comparable. The performance will be evaluated in this study using the KPIs approach Eirini K, and K MacAskill,(2020).

According to Demartini & Taticchi, (2022), the expectations of the project owner and the service quality in construction provided by contractors are two critical factors in any project's success. Project success may depend on how well the construction is managed to ensure that all parties feel that benefits are distributed fairly. It is discovered that bad performance is a result of the utter disregard for owner satisfaction. Poor performance is also a result of declining market shares, low efficiency and productivity, and the quick rise in construction costs. The success of water supply construction building projects is dependent on technology, process, people, procurement, legal concerns, and knowledge management, all of which must be taken into account equally,

According to Miroslaw J. Skibniewski,(2021). The completion of a project in an appropriate amount of time, money, and quality, as well as obtaining client satisfaction, was considered project success. The accomplishment of the WSC project can be measured by how well its indicators perform. Success, therefore, refers to the accomplishment of a project, and performance to the accomplishment of metrics like project managers. Project success is correlated with performance. The performance of project management is determined to be the single point of project accountability, and project owners are found to play the most significant influence in determining project success. On a project, project managers frequently question whether they are measuring the right things. Knowing how much time to devote to reviewing previous performance and how much time to maintain the momentum of the task can be challenging. There are undoubtedly a wide

variety of project success indicators, but what should you be monitoring when the project is really underway? Performance indicators are key indicators of an organization's health that show if a process's activities or results meet the desired goals.

Fathi & Stevovic, (2016) they can be used to translate an organization's strategy into a set of goals and objectives, and the outcomes of the measurements show how successfully the plan has been implemented. Performance indicators show the organization's top priorities and how personnel should conduct themselves to produce the best results. As time goes on, projects become more complex.

Patrucco and others, (2022), there are a lot of causes, according to the simpler concepts have been utilized first and innovation is essential The permissible time to market is shortened, which has an effect on one of the key restrictions of all WSC initiatives. Projects are becoming more complex. Additionally, projects are going towards turnkey contracts, where the end-user simply engages with a single provider for the provision of the full system and is not involved in the interface between system components.

2.2.10 Effective project management

To be successful, effective project management needs to include a variety of engineering ideas, methodologies, theories, and cooperation. Project success and project management success, according to Radujkovi, M., & M. Sjekavica (2017), are two distinct ideas that must be assessed and managed separately. Project management success refers to the overall effectiveness in managing the many components of the WSC project, whereas project success is the overall efficiency of the project to fulfill user needs and specifications.

Robert K (2020), numerous factors related to project management define project success. These factors are referred to as water supply construction project success criteria and include the effectiveness of the WS project management process, project delivery within budget and time constraints, user satisfaction, net project benefits, meeting project quality specifications, satisfying project stakeholders, and meeting project service quality specifications. Water supply construction projects that satisfy these requirements will be praised for their efficient management. Delivering successful engineering projects begins with an understanding of how the engineering design cycle is managed, In order to deliver successful water supply construction projects; there are five key aspects in the engineering design cycle that must be managed well. Problem analysis, solution design, design

validation, design implementation, and implementation assessment are the many engineering processes. Since it establishes the scope of engineering projects and consequently directs project implementation and overall project quality, the requirements engineering phase of engineering design is crucial to managing the success of water supply construction projects.

Ibrahim and Saeed, (2022) Utilizing different technical tools and techniques, such as plain language, use case diagrams, feature diagrams, problem frame diagrams, scenarios, and state machines, is necessary to completely describe project requirements. Mobile devices, simulations, and video animations can all be used to elicit more complex user requirements in terms of both our capabilities and quality. Additionally, we are aware that during requirements engineering, attention must be paid to project aspects, functional needs, and quality attributes. In order to guarantee that engineering projects meet the highest standards of quality, attention must also be paid to the requirements' quality criteria. Additionally, poor project designs result from the engineering projects' late inclusion of quality attributes. It is advised to apply additional research techniques, such as simulation, modeling, action research, laboratory or field experiments, case studies, and pilot projects, to fully understand the project requirements. Tahami, H., A. Mirzazadeh, and A. Arshadi-Khamseh,(2016).

Taiquan Song (2020), Construction management of water supply projects plays a significant role in both urban and rural water supply engineering. It must be coordinated with rural and urban planning, regardless of whether it is in project management or design planning. The current water supply construction project should be built with water conservation and environmental protection in mind. The project can now meet the demands of social development through the use of integrated management. The construction of the water supply project is helpful in attaining the management objectives of the water supply project through integrated management. To fundamentally raise the utilization rate of water supply projects, it is therefore required to place the project in the same position in actual construction management. Yong L and Z Xiujuan,(2017), A professional management firm should be established for real management, as it is more professional and can significantly increase the effectiveness of construction management. To ensure the achievement of the integrated management objective, water affairs departments, construction units, and WS project monitoring stations should all carry out their responsibilities within the context of the construction organization.

Boost the overall quality of managerial personnel the management team must be trained before managing the water supply construction project. The management team should exercise all of their subjective initiatives, assess the overall caliber of the construction team, pay particular attention to the overall strength of the construction unit, and consider the enterprise's qualifications. To ensure that the construction employees are of a high standard overall, the management of the construction equipment is also crucial.

Li Yong, u Xiujuan (2017), When assessing the water supply construction unit, it is first necessary to determine whether the Water Supply construction project possesses all three certificates; To make sure that the chosen water supply construction unit has strong professionalism and can satisfy the actual requirements of the water supply construction project, the personnel, and equipment of the construction unit should be evaluated, and the certificate should be held. Thirdly, during the foundation water supply construction building, there was uneven settling, which resulted in the water pipe coming loose and a water leak; additionally gaps existed at the pipeline connection sites, the assembly procedures utilized during the WS building process were not acceptable enough, the materials and equipment used did not satisfy the actual requirements, and supervision The relevant inspection departments need to step up inspection efforts, particularly to strictly inspect the quality of construction materials, as they examine the construction quality of water supply construction projects. Once it is determined that the building materials do not match the required criteria for quality, they must be banned Yang Yuyong, (2018).

Yang J (2019), to avoid the incidence of leaks, the construction process must be tightly supervised on the water supply construction site. To offer a solid foundation for risk assessment, specific issues should be addressed effectively, and inspections ought to be organized into reports. To improve risk avoidance, avoid quality accidents, and guarantee project progress and quality, the construction unit can work with the equivalent professional quality inspection unit and hand over the risk assessment to a third party. Additionally, this can significantly enhance the social advantages of water supply engineering. Strictly monitor the construction's quality when inspecting the quality requirements of the materials, materials must be carefully examined and accepted in accordance with the applicable standard specifications. The quality of pipe fittings directly affects the overall quality of the water supply construction project and also affects the utility of water supply and engineering, so it is important to pay close attention to

materials. Materials must be examined and accepted in strict agreement with the applicable standard specifications when inspecting the quality specifications of such materials. When unqualified items are discovered, access to the site is forbidden. It is important to conduct a random check before the material enters the site and to ascertain by related experiments whether the substance complies with the standard. Sanjay S (2020), To guarantee that the material is used normally once it has been delivered to the construction site, it must be carefully maintained, kept, and preserved in accordance with its type and requirement. Because the corresponding mechanical equipment is frequently used in water supply construction and building projects, it is essential to manage the mechanical equipment effectively, minimize equipment failure as much as possible, and increase the mechanical equipment's operating efficiency. This creates a solid foundation for the effectiveness of the water supply construction.

2.2.11 Cost and Time factors on water supply construction projects

Every endeavor to build a water supply has one thing in common: cost. The risk of cost overrun, which can occasionally reach 100% of the projected budget, is one of the risks that affect construction projects the most frequently and severely (Negalign N, 2020). An unmanageable construction cost puts additional pressure on investments, raises construction costs, and influences the choice of investments. Therefore, it's critical to pinpoint the causes of cost overrun in order to prevent and mitigate issues. The focus of this section of the thesis is on theoretical methods for analyzing approaches and techniques used in the construction of public buildings. Also examined are related studies, a book review, a thesis, standards, and pertinent guidelines. An unanticipated expenditure that exceeds the budgeted amount because the real cost was underestimated when budgeting is referred to as a cost overrun, cost rise, or budget overrun. Cost escalation, which is used to represent an anticipated increase in a planned cost owing to factors like inflation, should be distinguished from cost overrun.

According to Harsh V, G Tivadi, M Nayak, (2021) many nations experience water supply construction project time and expense overrun issues, and studies on the root causes of these issues are also done in nations like Jordan and India. Eliminating the elements that contribute to water supply project escalation and cause delays in finishing them in the allotted period is vital to achieving high productivity and the best performance.

2.2.12 Quality management on water supply construction projects

Sharmin, M. Saquib, (2021) A quality management system needs to be continually updated, improved, checked, and maintained. Achieving a balance between the quality-cost-time connections is challenging while working on water supply construction projects, which demand higher quality at a lower cost and in less time. Contractors are under pressure to complete the water supply project efficiently and effectively. Being the three points of a triangle, time, cost, and quality are the three crucial factors that must be taken into account in order for a project to be successful. Ignoring one of these factors would have a proportional effect on the other two. The measurement of quality cost is thought to be a tool for its implementation since total quality management is claimed to be focused on continual improvement. Quality must be linked to price in order to meet these objectives. The level of expertise held by the site staff should be comparable to that of the management in order to properly gather and report high-quality cost data. As a result, there is a high need for inexpensive training that will increase the knowledge and abilities of construction site personnel. The requirement for a good Being the three points of a triangle, time, cost, and quality are the three crucial factors that must be taken into account in order for a project to be successful. Ignoring one of these factors would have a proportional effect on the other two. The measurement of quality cost is thought to be a tool for its implementation since total quality management is claimed to be focused on continual improvement.

Mosab E, (2018) Quality must be linked to price in order to meet these objectives. The level of expertise held by the site staff should be comparable to that of the management in order to properly gather and report high-quality cost data. As a result, there is a high need for inexpensive training that will increase the knowledge and abilities of construction site personnel. The requirement for a good Quality is outlined and linked to the project's scope, cost, and timeline in construction projects. Jason G, (2022) the overall expense incurred throughout the course of a construction project to avoid non-conformance with owner requirements is referred to as the cost of quality. Since the project budget is already set, it's crucial to keep it that way during construction. It is highly challenging to obtain approval for a variation when the project is being completed, so it is crucial to prevent this situation. Construction project quality costs can be summed up as follows: Cost of internal failure, Cost of external failure malfunction of the installed system, Repair, Maintenance, Warranty expense, assessment of the design and creation of shop drawings, creation of

coordinated or composite drawings, Pre-checklist inspection, Onsite material inspection/testing, Offsite material inspection/testing cost of prevention: Preventive measures Work processes, method declarations, and training Equipment and instrument calibration

2.2.13 Effect of Construction Material Management on Project Performance

The impact of material management on water supply project performance has been highlighted in passing in the current research on WS construction project performance Kalkidan M, (2021). The research concluded that poor material management has an impact on the project performance criteria. The impact of material management on project success. The project performance criteria are typically determined from both the positive and negative effects perspectives. Effective material management has a favorable effect on time optimization, cost savings, quality maximization, productivity improvement, and waste reduction, to name a few of the positive benefits. Conversely, using inadequate materials will result in project failures such as time delays, cost overruns, subpar quality, lost productivity, and excessive waste production. As a result, they highlighted how project performance was impacted by material managements.

According to the study done by Mat & Kasim et. al. (2015), material management is a crucial component of project management because materials make up a sizable amount of project costs. It also has a significant impact because having the right resources is essential to the success of any building project. The purpose of this article is to determine how various aspects of material management affect the success of a project. They came to the following conclusion: Time, quality, productivity, and performance are all impacted by the availability and sufficiency of materials and equipment. Time, money, and overall performance are all impacted by using appropriate quality materials.

In order to guarantee that there are enough water supply construction building materials in the right quantities, of the right quality, and at a price that is reasonable for the project's needs, material management is a planned process that combines identification, planning, purchasing, delivery, handling, storing, controlling, and distribution, Narimah Z,(2017).

Having the necessary construction supplies on hand at the point of usage is the aim of material management. In order to ensure that the right kind and amount of materials are properly specified in a timely manner, acquired at a price that is affordable, and, most importantly, available at the point of use when needed, a system for planning and

controlling all related activities is known as material management. Hemishkumar P and Pitroda, (2015).

2.2.14 Health and safety factor

The degree to which construction professionals are involved in the performance of construction works is reflected in how vulnerable they are to mishaps, injuries, and other site risks. When it comes to HS planning, controlling deaths on the job site, and managing them, it is essential to understand the trades with the highest accident-prone rate and the likely causes. Construction projects are carried out throughout the entire year, typically in a variety of atmospheric circumstances. These tasks are completed in the morning, afternoon, and evening. Some construction workers are required to work longer shifts than the typical eight-hour day; as a result, they face significant health and safety risks. Additionally, in the event of an accident, construction workers play three roles: the decision-maker, the accident's perpetrator, and the victim. Szostak, (2019)

The primary causes of accidents were divided by Arunkumar and Gunasekaran (2018) into five categories: risky conduct, unsafe working environments, communication hurdles, management commitment, and training. Failure to observe safety regulations, disregard for personal protective equipment, crowded spaces, incorrect use of safety equipment, and inappropriate equipment are all potential contributing reasons to accidents.

2.2.15 Labor productivity

Salihu, A, Y Ibrahim, (2022) concur that labor performance, which is mostly related to labor productivity, is one of the key components of every water supply construction project's success and competitiveness. The cost of labor, which accounts for between 30 and 50 percent of the total cost, is a significant component of the cost of building a water supply. Thus, it is necessary to carefully consider these labor productivity aspects and ascertain how they affect the price and duration of water supply building projects. Pornthe P and Charoen P (2019) have put a lot of work into the factors affecting construction labor productivity throughout the years. Water supply Construction is dominated by productivity since it promotes cost savings and efficient resource use. One of the main reasons for cost and time overruns in building projects is low labor productivity, which calls for attention. An important factor in the water supply construction sector is labor productivity, which may be used as a gauge for project effectiveness. A greater level of

productivity from the management of construction resources can contribute to time and cost savings. Construction in the WS is a labor-intensive sector. It greatly depends on the workforce's expertise. The most valuable resource in the water supply sector is labor. It is crucial to increase project productivity and project efficiency. The construction industry has always been quite concerned about project productivity declining.

2.3 Policy for strategy

Elena C, E Esteban, L Avella,(2016) The main issues of the water sector were improve quality water supply infrastructure and relatively qualified personnel for the management of the water supply infrastructure. The opportunities are availability of Donor's funding for the water sector projects and interest shown by foreign Private Sector Operators in the management of the sector. Edward M (2021), Despite its technical achievements, the water sector in a countries was characterized by the weak completion of water supply construction projects resulting in water allocations being guided by precedence rather than priorities, supply-side driven management instead of demand side management, absence of an Integrated Water Resources Management (IWRM) plan leading to low operating efficiency of the water supply systems, old legislations, inadequate surface water storage and inadequate funds for the development of the water infrastructure. The National Water Policy will also ensure that the future water demands constriction projects were equitably met for all sectors of the economy, in addition to promoting equity in terms of access to and benefit from the water resources potentials for the country.

2.4 Best Practices in Project Management

Mangaiah C , (2018) Projects, as a way to attain objectives, have been used since ancient times, generating important results to society and culture like The Great Wall of China, Ancient Roman roads, the first steam engine and many others. A project is a new, unique and temporary set of activities, with a defined beginning and end, which uses resources in a planned and organized way with the purpose of reaching certain objectives. The temporary nature of projects stands in contrast with repetitive or permanent activities. Project management has evolved over time, becoming the principal mean of dealing with change in modern organizations. Joe D (2021) Best practices have occurred as a result of business evolution and of practicing project management at a global level. Best practices in project management, if followed, increase the chances of success in achieving goals when dealing with projects. In this article we present the concept of best practice, the advantages

of using best practices in project management, which are the best practices used today and also a comparison between two of the mostly used best practices methodologies in project management, Project Management Body of Knowledge and Project Cycle Management Guidelines.

The characteristics of a project require a specific type of management. Project management is the application of knowledge skills, tools and techniques to project activities. Project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring and controlling, and closing Project Management Body of Knowledge, (2014, pp. 38). Project management is recognized to be the key enabler of business change and a vital contributor to future business success Whitty, Maylor, (2019, pp. 304). Best practice is based on experience and is used to describe the process of developing and following a standard way of doing things. In project management, best practice is a general term that includes: Guidelines; International standards. Both standards and guidelines are looking to improve project management. In practice most project managers do not make any difference between the two concepts, reason why we decided to write this article about both international standards and guidelines in project management, as methods that can contribute to goal achievement when dealing with projects, as best practices.

2.4.1 Best practices methodologies used today in project management

A wide range of best practices is currently available for project management, issued by diverse organizational bodies, such as the large national and international official standard-giving organizations (e.g. ISO, ANSI), project management associations all over the world and other associations that promote industry-specific standards Kerzner, H., & H Kerzner, (2017).

ANSI, (2019) the organizational bodies that have the most significant activity in developing project management are: American National Standardization Institute (ANSI), the International Standardization Institute (ISO), the Project Management Institute (PMI), the International Project Management Association (IPMA). Due to this diversity, the selection and application of project management guidelines and standards is a complex problem for organizations. The challenge is to identify a guideline or standard that: Is widely used among project partners and stakeholders so that a consensus can be established; Is applicable for this type of organization and the type of projects so that it can

be Implemented efficiently; Unfolds real benefits for the organization so that it is effective Ahlemann, Teuteberg, Vogelsang,(2009, pp. 292).

For a best practice to be really beneficial it is important that the group of stakeholders accepting it to be as large as possible. Here, an important role is played by the leader who should be able to send powerful messages to the stakeholders, this may be explained by the network effect theory, since each additional stakeholder applying a standard or guideline makes it more useful for the rest of the community Oliver B, M Glaser (2020)

2.5 Research gap

Previous research has concentrated on many facets of water project development. A research gap is a knowledge gap in the researcher's field of study; it is something that needs to be learned or done in the subject of research. Every research endeavor must aim to fill a gap, or some information that is lacking from the body of scientific literature, in some way. Otherwise, it is not unique research and does not further the study's main objectives.

Factors Affecting the Performance of Construction Projects Gunduz & Al-Naimi, (2022) and Feyzbakhsh et al., (2018) it is unclear which one is concentrating on actual performance review because the causes of delays in public building construction projects have not yet been identified to serve as a catalyst for performance evaluation. Cruz

Villazón and colleagues, (2020) WS Construction Projects in Kenya: Identification and Ranking of Key Performance Indicators Department of Architectural Technology Mai Idris Aloom Polytechnic Geidam, Yobe State, Nigeria et al., (2021) General contractors operating in Poland employ performance measurement, which is integrated into organisational project management, to identify the variables that hamper performance and do not directly affect project performance assessments.

Vipin P S.Rahima (2019) one of the primary components of the construction sector is materials. Material management refers to the availability of materials in the required quantity and quality at the required time so as not to impede construction activity. Material management includes activities in the construction cycle such as planning for the required materials, identifying the source for reasonable price procurement of materials, storing the materials without deteriorating in quality and quantity, and properly distributing the

materials to the precise usage point. The safe use of materials on the job site and the prevention of time and expense overruns can all be achieved through effective material the researcher focusing on materials management.

Samira M., P Ogolla, (2010) the researcher still focuses on implementation water- related initiatives have been carried out in Kenya. The management of water resources and supplies, however, continues to be a significant issue in the area, according to research on water services conducted within the sector. Given that the majority of the anticipated outcomes for the water sector have not been met, water projects have not been properly implemented as planned.

According to Z. Haiying (2018) with the fast growth of our nation's economy and cities in recent years, the process of water supply and drainage has accelerated however there are numerous issues. The installation of the pipeline does not adhere to the requirements, quality standards, waste, etc. In order to advance the improvement of water quality, energy conservation, and water quality development, these factors must be taken into consideration during the construction process. The majority of the literature examined comes from several nations, whose strategic stance and methodology differ from those of Oromia Ethiopia. Additionally, the studies do focus on the problem of performance assessment for water supply construction projects. The performance evaluation of water supply building projects in the Oromia area was not examined in any of the studies carried out in Ethiopia. As a result, there is a research deficit on the WSCP's performance assessment in Oromia, Ethiopia. The research aims to fill this gap.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology used to analyze the project performance evaluation on water supply construction projects in Oromia water and energy Bureau. The methodology deployed so as to conduct this study is described in this chapter. This chapter outlines the types of methods selected for data collection and analysis and the reasons for why these methods were chosen in comparison to the other alternative methods. About ten sections are contained here. The research approach and the survey design of the study are listed on the first two sections respectively. The third and fourth sections outline the study area map adopted for this study. Data Collection and Sampling techniques and identifications of the variables used in this study are depicted in section five and six respectively. Section seven is about analysis methods. The eighth section presents the descriptive and inferential statistics, regression model and measurement of the variables.

3.2 Research approach and method

Bhawna¹ & Gobind² (2015), The Research Approach to be followed for this particular research is Qualitative and quantitative Research approach. Qualitative research involves the use of qualitative data, such as interviews, documents, and observation data, and quantitative research also involves questionnaire apply regression model to understand and explain a social phenomenon which is Project performance evaluation in our case and lesson the influence of project performance evaluation inconsistencies .

Abdur R (2021), In this study descriptive, inferential statistics and regression model research design approach was implemented to explore and identify project management practices by assessing the project performance evaluation in Oromia water supply construction projects with issue and process related to Project Performance Evaluation activities. A qualitative and quantitative approach to research is concerned with evaluation of project performance, and circumstances involving attributes which considerably relates to the researchers. These will present a condition that the collection, analysis, interpretation of the data, and the final written report be flexibly designed and structured with a focus on individual meaning and the importance of rendering the complexity of a situation and in

this research qualitative and quantitative data were collected, analyzed, interpreted and presented.

3.3 Research Design

According to Bostley M (2019), a research design is the overall plan for relating the conceptual research problem to relevant and practicable empirical research. In order words, the research design provided a plan or framework for data collection and its analysis. The aim for a researcher was give as a correct picture of reality as possible by combining and analyzing empirical data in relation to theory. Different approaches exist and the approach most suitable for the research depends on the desired starting point of the researcher in relation to present theories.

Harish K,(2021) For this study it adopted a cross sectional survey design questionnaire survey, interviewing, focus group discussion, Since the research study is meant to test rather than generate theory, it adopted a quantitative and qualitative approach which focused on describing and drawing inferences from the findings on the relationships between water supply construction project performance, local factors affecting performance, Project related factors, external environmental factors, project procedure factors and project management actions Correlation and Regression approaches was used to investigate the relationships between the variables and the extent to which the independent variables explained effects of project performance.

3.4. Description of the study area

Oromia is the largest Region in Ethiopia. Stretching across Ethiopia from East to West, the Region consists of 34% of the land in Ethiopia and is home to over 37 million people FDRE Central Statistical Agency, (2017, Population Projection of Ethiopia for all Regions At district Level from (2014 – 2017). It is divided into 21 administrative Zones, 30 town administrations, 287 rural and 46 town districts. According to the last census, more than 65 ethnic groups and people from neighboring countries live in Oromia Region The regional state of Oromia shares boundary with all other regional states of the country except Tigray. It is the single largest state that accounts for over one third of the total population of the country. The region has a total land area of 363,136km² and on basis of 2017 CSA's census.

Oromia Water and Energy Bureau (OWEB) is one of the executing bureaus of Oromia Regional State, Ethiopia. The Bureau is mandated to manage, develop and control all water and energy resources of the region in support of socio-economic development.

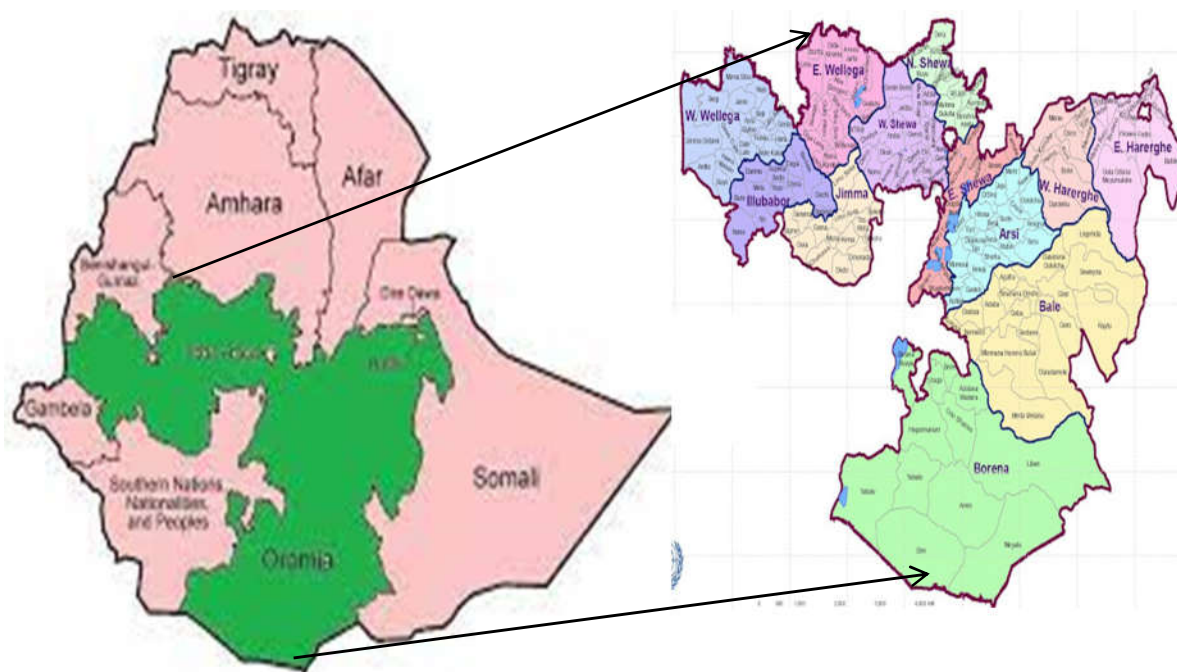


Figure 3 study area map

Source: Oromia Finance and Economic development Bureau

3.5 Study Population

The research was consists of the total of 55 water supply construction projects under Oromia Water supply construction projects in last twelve years from (2003-2014) Etc. Therefore, the study targeted all the 55 water supply construction projects being implemented in Oromia water and energy Bureau were part of the research populations.

3.6 Sampling Procedure

The importance of the sampling process is vital because it is necessary to collect the sample value or size in order to determine the population value from which the sample was drawn. In light of people who are directly or indirectly involved in projects and have experience in that subject, the sample size is therefore randomly distributed throughout the sample frame as shown. When conducting a random sample, your goal is to find people in the population who are more likely than not to share specific traits or experiences with you. You can then pick the people or situations that correspond with your research.

3.7 Sample size

Choosing the appropriate number of observations or subjects from a bigger group to include in a sample is the process of determining sample size. The objective of determining the sample size is to make sure that the sample is large enough to produce statistically significant results and precise estimates of demographic parameters while being controllable and economically viable. From the complete list of 55 WSCP, 48 will be selected as the sample size. Following is Slovin E (1960), Slovin's sampling formula for calculating sample size: $n = N / [1 + N * e^2]$.

Where: N = total number of populations from 55 WSCP (14 from east, 14 from west, 14 from south and 13 from north part of central Oromia)

n = number of sample size

e = error margin / margin of error, a 95% confidence level was taken and e = 0.05

- $n = N / [1 + N * e^2]$
- $n = 55 / [1 + 55 * 0.05^2]$
- $n = 55 / 1.1375 = 48$

3.8 Method of Data collection

3.8.1 Questionnaire

The easiest and most efficient way to get data from many responders was to use a questionnaire. When creating questionnaires properly to collect data from a big number of people for a scientific study. There were 48 WSCPs in the total sample sizes from the entire population. 184 professionals who are involved in the WSCPs were randomly distributed questionnaires, and of those, 48 engineers from consultants, 48 engineers from contractors, 48 engineers from clients, and 40 engineers from stock holders made up the research respondents.

3.8.2 Focus group discussion

The researchers, second strategy involved setting up focus groups, using the World Café method with engineers and procurement specialists from WSCPs (consultants, contractors, and clients). The focus group discussions also revealed the most prevalent elements in the Oromia water and supply construction projects. An inclusive environment can be created by recognizing and utilizing the different perspectives and skills of 12 participants (client,

consultant, contractors, and stockholders) were selected randomly selected from engineers and participated on a discussion. It is crucial to take into account the characteristics of productive discussions and the environments that encourage interaction and involvement in small groups in order to achieve important points.

3.8.3 Interview

The interviews were the main way that the data was gathered. Through the use of semi-structured interviews, the data was gathered. This was done in person 24 participants with everyone and ranged from taking a little more than 30 minutes to over an hour. The interviewee is given full rein to express themselves and offer their own thoughts using the semi-structured and open-ended question method, which allows for a more thorough investigation of the particular phenomenon. Nevertheless, introductory, probing, interpreting, and specifying questions were used throughout the interviews to avoid straying from the topic at hand and to gather depth and deeper insight into the interviewee's thoughts. The arrangement allowed the interviewees to be adaptable,

3.9 Method of Data Analysis

Using the proper methodologies for analysis, the qualitative and quantitative data gathered from the data-gathering gathering process will be examined. The analysis of qualitative data will involve conceptual generalization and interpretation. Regression modeling is used to examine the relationship between dependent and independent variables in descriptive statistics for quantitative data.

Table 2 Sampling method and analysis

	Sampling method	Analysis approach
1	Key informant interview	Qualitative
2	Focus group discussion	Qualitative
3	Questionnaire	Quantitative

3.9.1 Qualitative data analysis

Tim S, (2022), Qualitative analysis is a method to analyze a certain subject using non-numeric plus non-quantifiable indicators, behavior, and characteristics to determine its overall situation, quality, value, or any other parameter. It lies at the core of making business decisions and recognizing investment opportunities by investors and companies. Qualitative analysis in research is a method to analyse nontangible aspects of a subject to evaluate its characteristics, reputation, and performance. Subjective assessments are the

key to evaluating non-numeric attributes like human resources, leadership quality of management, company morale, and the company's brand image. It is a non-scientific approach to seeing things that are difficult to express in numbers. It takes the form of the art of assessing trends and business traits instead of a scientific approach. The tendency to analyse anything qualitatively comes from experience, understanding, and intuition over years of rigorous practice. Using quantitative and qualitative analysis to make the right investment decisions in securities is better Michael B (2018).

3.9.2 Quantitative data analysis

Adel. H (2023), Quantitative analysis is the process of collecting and evaluating measurable and verifiable data such as revenues, market share, and wages in order to understand the behavior and performance of a business. In the past, business owners and company directors relied heavily on their experience and instinct when making decisions. However, with data technology, quantitative analysis is now considered a better approach to making informed decisions. A quantitative analyst's main task is to present a given hypothetical situation in terms of numerical values. Quantitative analysis helps in evaluating performance, assessing financial instruments, and making predictions. It encompasses three main techniques of measuring data: regression analysis, linear programming, and data mining.

3.9.2.1 Descriptive and Inferential analysis

Frequency, mean, standard deviation, and maximum and lowest data were all used in the descriptive analysis. A t-test and chi-square test were used in inferential statistics to compare various explanatory factors. Using the proper methodologies for analysis, the qualitative and quantitative data gathered from the data-gathering method were examined. Through interpretations and conceptual generalization, qualitative data were analyzed. Descriptive statistics were used for quantitative data to examine the relationship between dependent and independent variables.

3.9.2.2 Regression model analysis

The Statistical Package for Social Science (SPSS) version 26.0 was used for data entry and analysis, regression analysis is utilized to find the variance in the dependent variable that is explained by the independent variables. The perception of project performance is influenced by multiple study variables, according to a correlation analysis tool. A linear

equation of the following form is being estimated with the use of multiple regression analysis: $Y = a + b_1 \cdot X_1 + b_2 \cdot X_2 + \dots + b_p \cdot X_p$.

In this equation, each independent variable's independent contribution to the prediction of the dependent variable was represented by the regression coefficients, also known as B coefficients. After adjusting for all other independent variables, another i.e. variable X_1 will be correlated with the Y variable. As a result of the practical mathematical features of Z, we forecast Z rather than p in logistic regression. We may convert the prediction Z, which is a linear function of the predictors, into a probability using the formula $Z = \log(p/(1-p)) = B_0 + B_1 \cdot X_1 + B_2 \cdot X_2 + B_3 \cdot X_3$. $E e$

3.10 Definition of variables

Dependent Variable: The dependent variable in the study is having the project performance of WS construction projects.

Outcome variable: The outcome variable in this study is Clients satisfaction for the use of on time, Cost, Quality completed projects

Performance: means carrying out a task, the progress of which can be measured and compared using a set of stated requirements.

Project Performance: performance is closely related to efficiency and effectiveness, and also it defining at the level of each individual within the organization or at organization level. This is for the simple reason that 'what gets measured gets managed' - and to measure is to know. By measuring the success of a project, you can also work to improve its performance further. Continuous measurement of a project's performance allows the team to fix attainable and realistic targets to it.

Independent Variables: Based on the finding of performance of WS projects theoretical back ground, the following variables will be hypothesis to determine WS construction project factors. The potential explanatory variables will be hypothesizes to influence WS construction projects in the study area is discusses as follows.

External environment: Akpomiemie A (2015), These forces include socio cultural, political and legal, technological, economic, and global influences, indirectly interactive forces may impact one organization more than another simply because of the nature of a particular business, external environment comprises of the factors that are outside the organization and which can have an impact on the operations, performance, decisions and profitability of the organization.

Labor and material related factor: Kesavan M (2022), the most significant problems affecting labor productivity were identified as a length of workday, equipment break down, lack of materials, lack of proper equipment's, lack of proper tools, in adequate supervision skill, material type, large volume of work, quality required, and work complexity.

Contractual relationship factor: Yemsirach, S, (2020) a contractual relationship is a legal bond between at least two people who agree to at least one term or promise. Misrepresentation False statement of fact that persuades someone to enter into a contract negligent verses fraudulent Misrepresentation Fraudulent misrepresentation (deceit) requires at least some guilty knowledge or willful disregard of the falsity of the information provided; negligent misrepresentation requires only a breach of the standard.

Project procedure/process factors: Hegazy, T. (2019) Project process corresponds to the project implementation that is divided into sub processes. The structure and process are defined in the project organization considering the attainment of the corporate objectives and therefore also project objectives. The components of the project process are: project start, project preparation, project planning, project implementation and project completion. The two last components should contain also the project decision. The process is success due to the following methods as personnel, resources, financial resources, establishments, techniques and methods, and present results at the end.

Client related factors: Ahmmed S, M Albarami ,(2020) The most important client-related factor is poor initial planning by the client, followed by late payments by the client, lack of knowledge on the part of the client regarding most recent staff progress, improper consultant selection by the client, contractor selection by the client with a poor cash flow, contractor selection's poor attitude, late payments by the client, lack of knowledge on the part of the client, new proposal requests by newly hired officers, and lack of financial strength. The inability to choose an experienced design team, which may include the provision of a strong brief by the architect, engineer, quantity surveyor, and numerous

contractors, Lack of top management support for energizing the project team members; failure of the client to obtain the designers' and project manager's consent; give the client's attitude toward ensuring timely availability of funding for the project and prompt payment for work completed; the client's influence in the selection of incompetent and ill-experienced contractors and sub-contractors; and the client's inability to minimize bureaucracy in decision-making as a yardstick. Others include the client interfering with the ability of the system designers and contractors.

Factors relating to contractors: Anil U (2016) these include inadequate project planning and scheduling, a lack of experience on the part of the contractor, and frequent changes in the subcontractors. Outdated technology, improper construction techniques, rework required because of mistakes, etc. When a construction firm is involved in a big construction project, a contractor is generally appointed for carrying out the construction work. Contractor Related Delay Factors type was recognized as one of the groups of causes of schedule delays of construction projects. Some factors of contractor related delay in Construction projects are: Ineffective project planning and scheduling, Lack of experience of contractor, frequent change of subcontractors, obsolete technology, and inappropriate construction method.

Factors associated to consultants: Glasser J (2012) the ineffective delivery of knowledge or strategic counsel that is being presented for consideration and decision-making. Lack of project follow-up and consulting experience Project characteristics related factors: A project is typically for a customer. The project is temporary in nature. It typically has a defined start and a defined end-point. The project will have a unique set of requirements that need to be delivered within the boundaries of this project. A project is typically a once off endeavor, a project is not business as usual, and a project can be cross-functional Safety and health related factors: Raja U (2022) Poor preventing people from being harmed or becoming ill by work by taking not right precautions, providing a poor satisfactory working environment. Workplace injuries can lead to increased employee absence, higher healthcare costs, workers' compensation payments, lost productivity and business disruption. These effects can have a significant financial impact on employers.

Adam E, (2023) A consultant's employment is project-based, and the duties they handle are frequently extremely specialized. Consultants are used in different construction projects. Project managers, architects, service engineers, and cost consultants are examples of

typical consultant positions. On a broad level, consulting tasks include developing and assisting in the development of the design, working on tasks relating to project management, contract administration, inspecting the work of construction contractors, providing advice on sustainability, and developing the project with advice.

Quality: Gabriella G (2020) the standard of something as measured against other things of a similar kind; the degree of excellence of something, and it is Conformance to Customer Expectations.” Why make this shift? The new definition makes customers' satisfaction even more central to delivery of quality. But the quality defect is the inverse of these definitions. Quality Defect in project means the non-conformance arising from poor construction materials, poor working process and negligence of workers. Quality Defects may be defined as attributes of a worker's negligence or component poor construction materials may affect the quality of project safety and/or efficacy of the project.

Alua O, (2019) Water supply Construction project faults are any issues with the plan, the contractor's work, or the materials employed. A flaw can have a wide range of effects, from minor cosmetic difficulties to hazardous structural problems that put locals at risk of harm. The owner often gets a certain amount of time to request that the contractor fix any defects that are found after the WSC building has been built.

3.11 Reliability and Validity

The purpose of the pilot test was to evaluate the acceptability or feasibility of a method that would be employed in a larger study, not to test hypotheses regarding the effects of an intervention. Staff from the OWEB WSC Projects in Oromia participated in the study instruments' pilot testing. The randomly selected respondents to the pilot survey were given 18 questionnaires to complete. In order to determine any differences between the results of the first and second tests, the same subjects were asked to complete the identical surveys after one day, but without prior notice. The term "content validity" refers to the degree to which data obtained using a certain instrument accurately reflects a particular domain or content of a particular idea. It was sought of experts to comment on the representativeness and applicability of the questions and to make adjustments to the design of the research tools. The results of a test study are therefore considered valid if they accurately reflect actual findings among comparable individuals outside the study. A pilot

group from the greatest population will be chosen using reliability in order to test the dependability of the study equipment. An internal consistency technique was used to evaluate the instrument's dependability Hamed T (2016).

3.12 Ethical Considerations

Marcelle C (2015) the researcher reflected on ethical issues in every aspects of the activity in doing this study. When distributing the questionnaire, purpose of the study has been explained to the respondents so that they will be contented to reply and respondents are guaranteed that the information they provide is confidential and used for academic purpose only. Moreover a statement conform the prohibition of including any identity detail or personal references in the questionnaire. This was to avoid any biased response and to make participants safer in filling the questionnaire. Thus the gathered data is kept confidential and would not be used for any personal interest.

4 RESULT AND DISCUSSIONS

4.1 Introduction

It is important to define performance evaluation in the context of this study before we analyze the survey results with regard to the performance evaluation of water supply building projects. During the project, the project manager and the project team's performance will be evaluated. The process of learning about the participants, evaluating their contributions to the project, and giving stakeholders performance feedback is structured and comprehensive.

The conclusions of the questions designed to pinpoint the relevance of project performance evaluation causes and gauge the degree of their seriousness significances are shown in the results and discussion that follow. Out of a total of 55 WSCP in the region, 48 WSC projects factors were chosen. They were divided into 14 categories and included project characteristics related factors, client related factors, contractor related factors, consultant related factors, labor and equipment related factors, safety and healthy related factors, contractual relationship related factors, and external environment related factors. Factors related to project procedures, leadership, cost and time overruns, quality problems, and productivity.

4.2. Demographic characteristics of respondents

Specific facets of a population are referred to as demographics. The word is a combination of the Greek words for people and images, demos and graph. Age, race, gender, ethnicity, religion, income, education, house ownership, sexual orientation, marriage status, family size, health and disability status, and psychiatric diagnosis are a few examples of demographic factors. These are some of the most common qualitative methods: Observations: recording what you have seen, heard, or encountered in detailed field notes. Interviews: personally asking people questions in one-on-one conversations. Focus groups: asking questions and generating discussion among a group of people.

4.2.1 Interview participants

The number of participants in the interview was 24 engineers from clients, contractors and consultants selected through random sampling procedure. From the total number of participants who participated in the interview, 8 project managers, 8 Sight Engineer, and 8 site project supervisors. In addition, interviews were conducted and discussed the most

common factors affect performance in the WSCP and to suggested solutions for the factors identified. Thus, researchers interviewed 8 workers from each sector (clients, contractors, and consultants) which have been experienced to participate in water supply construction projects. The results of the interviews are presented in figure 4

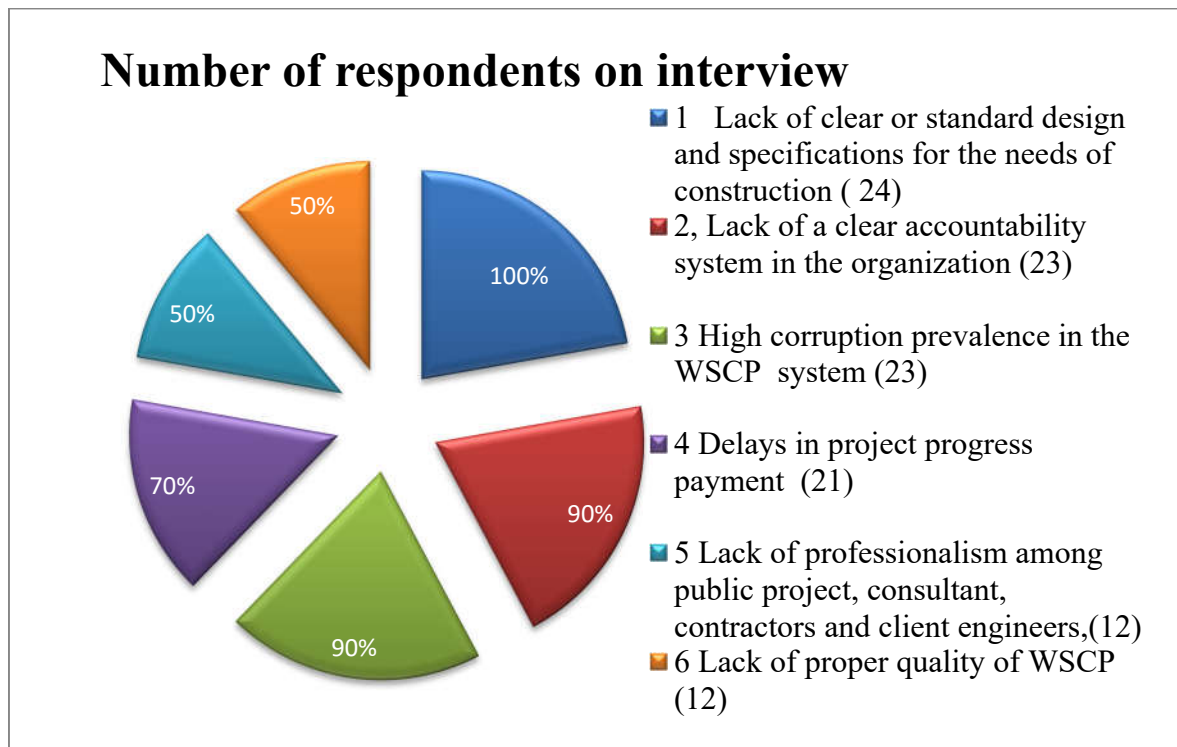


Figure 4 Respondents on interview

Source: Author 2023, Number of respondents participated on interview

Some of the problems raised in the interview were similar to those in the secondary data and the focus group discussions. As indicated in figure 3, the water supply construction projects executed under OWEB do not have clear or standard specification and evaluation criteria that are identified by 100% of the respondents. A lack of clear accountability and a high corruption rate are ranked second, identified by 90% of the respondents. Delays in payment by the procuring entity ranked third, identified by 70% and a lack of professionalism among public projects (consultant, contractors and clients) and lack of proper quality of water supply construction projects ranked fourth, identified by 50% respectively.

4.2.2 Questionnaire Respondents

The sample was purposively and conveniently distributed among the sample frame as shown in table below based upon those who are directly or indirectly involved in projects and have expertise in that field. The questionnaire was distributed from the total list of 48 WSCP workers such as 48 for contractors, 48 for consultants, 48 for client and 40 for stakeholders. A total of 184 questionnaires were returned back 100% to researcher. The result was showed on figure 5

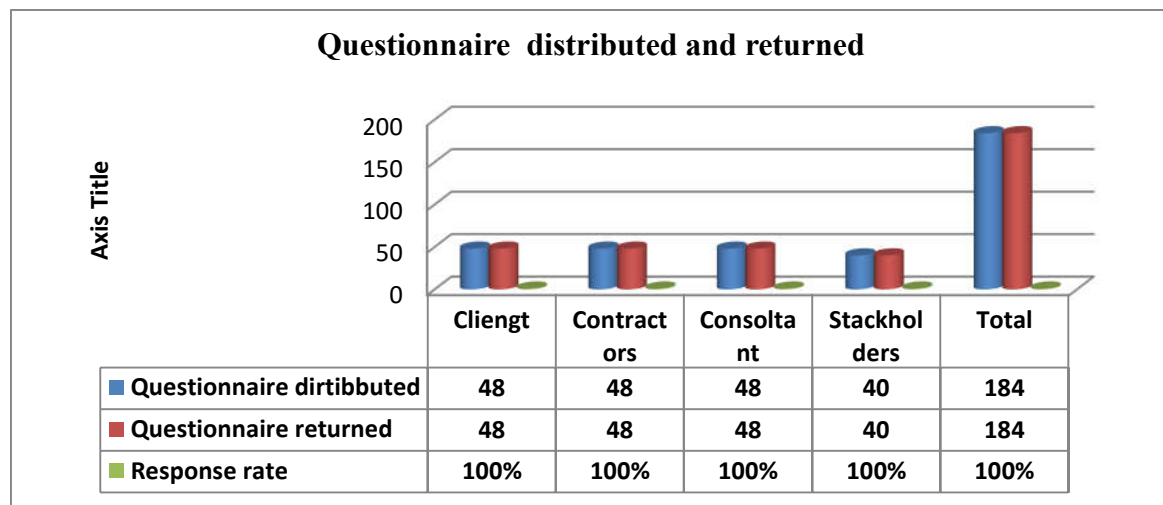


Figure 5 Questionnaire distributed and returned

4.2.3 Respondents according to Education level

This section presents levels of education, experience or years worked and clients, contractors, consultants and stakeholders. As we can see 2 (1%) respondents were diploma holders, 100 (54%) of the respondents are first-degree holders and 80 (44%) were master's degrees and 2(1%) Ph.D., Holders. Therefore, the finding verifies that the respondents are qualified to understand the questions concerning the performance evaluation of WSCP at OWEB. Generally, the finding regarding the characteristics of respondents confirms that the respondents are qualified and experienced. So, the researcher believes that the response obtained from them is reliable and trust full and enables the researcher to move toward the intended research finding. There were 184 engineers from clients, contractors, and consultants that answered the questionnaire. Project managers, Site Engineers, Site Project Supervisors, and Senior Experts were selected from the total number of survey respondents. Additionally, during the data gathering process using questionnaires, the most prevalent factors affecting performance in the WSCP were reviewed, and remedies for the

factors discovered, were recommended. Consequently, the educational background of survey respondents who had prior experience working on water supply building projects outcomes are shown in figure 6.

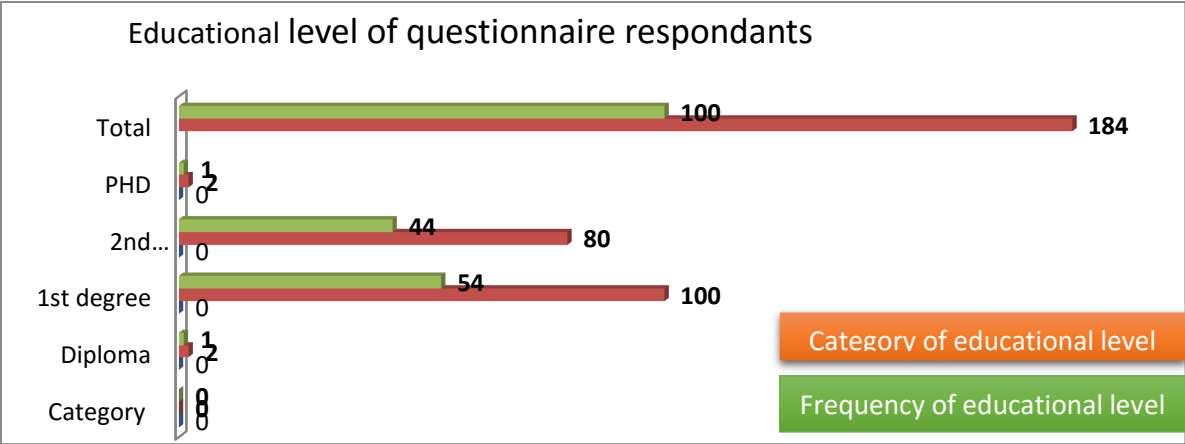


Figure 6 Educational level questionnaire distributed

4.2.4 Group discussion

Focus groups are a type of qualitative research. Observations of the group’s dynamic, their answers to focus group questions, and even their body language can guide future research on consumer decisions, products and services, or controversial topics. Focus groups are often used in marketing, library science, social science, and user research disciplines. They can provide more nuanced and natural feedback than individual interviews and are easier to organize than experiments or large-scale surveys.

Step 1: Choose your topic of interest

Focus groups are primarily considered a confirmatory research technique. In other words, their discussion-heavy setting is most useful for confirming or refuting preexisting beliefs. For this reason, they are great for conducting explanatory research, where you explore why something occurs when limited information is available.

Step 2: Define your research scope and hypotheses

Once you have determined that a focus group is the right choice for your topic, you can start thinking about what you expect the group discussion to yield. Perhaps literature already exists on your subject or a sufficiently similar topic that you can use as a starting point. If the topic isn’t well studied, use your instincts to determine what you think is most worthy of study. Setting your scope will help you formulate intriguing hypotheses, set clear questions, and recruit the right participants.

Step 3: Determine your focus group questions

The questions that you ask your focus group are crucially important to your analysis. Take your time formulating them, paying special attention to phrasing. Be careful to avoid leading questions, which can affect your responses.

Step 4: Select a moderator or co-moderator

It is important to have more than one moderator in the room. If you would like to take the lead asking questions, select a co-moderator who can coordinate the technology, take notes, and observe the behaviour of the participants. If your hypotheses have behavioural aspects, consider asking someone else to be lead moderator so that you are free to take a more observational role.

Step 5: Recruit your participants

Depending on your research topic, there are a few sampling methods you can choose from to help you recruit and select participants' randomly. Numbers of participants on these most focus groups have 6 to 10 participants. It's a good idea to over-recruit just in case someone doesn't show up. As a rule of thumb, you shouldn't have fewer than 6 or more than 12 participants, in order to get the most reliable results.

There were 12 participants in the group discussion, three from the customer, three from the contractors, and three from the consultant. The key challenges in the performance of WSC projects raised on discussions are: Lack of alignment, Lack of measurement, Poor Leadership, Lack of management commitment, and Poor Managing of performance system. A well-facilitated discussion enables the participant to explore new ideas while appreciating and respecting the contributions of others. Numerous difficulties are encountered in the region's WS construction projects. The majority of them are characterized by schedule overruns, cost overruns, and poor construction, primarily as a result of the contractor's poor performance. Developmental initiatives, such as capacity-building programs, have been implemented to address the issues and enhance the employees' performance. The building of the WSCP in Oromia also displayed poor WS construction project performance. Major and minor construction flaws are noticed in finished and ongoing WSCP, which result in unforeseen maintenance expenditures.

Table 1 summarizes the conclusions of the discussions. The majority of the issues brought up in the World Cafe focus groups have been seen and are comparable to those found in the secondary data. This demonstrates the presence of such variables that influence how poor water supply construction projects turn out. Focus groups were helpful for exposing through interaction the participants' views, attitudes, experiences, and feelings in ways that would not be possible using other methods,

Table 3 Factors identified by focus group discussions

Factors	Description of the factors
Lack of proper need identification Specification (un define clear design and specifications)	Public organizations are not properly scrutinizing their needs in line with their work plan and are unable to define design and specifications, unable specify their needs with performance and functional parameters
Low quality of construction materials acquired	The public organizations usually acquire inferior quality goods, works, and services. Due to this factors the WSCP were had sustainability problems
Competency problem of public procurement officials	The procurement officials working in OWEB are not professionally qualified to manage the contemporary needs of the contract administration
Lack of defined accountability	Does not create a clear accountability system between the bidders and the procuring entity or between individuals within the public Organization.
Time and cost overrun in the contract performance process	In OWSC projects, contract extension and overpayment beyond the Allocated budget is the common practice.
WSCP design problem	In designing peer-based programs which can present challenges including unclear aims and objectives, choosing inappropriate design and setting, limited evaluation and a lack of clarity around program and individual boundaries.
Lack of commitment of contractors	Lack of Commitment is one of the five team dysfunctions. In this case, team members have not bought into the team goals, or they don't understand those goals. The team is unable to make decisions, they lack confidence, and they are afraid of failure because they don't understand what success is.
Poor Monitoring and evaluation	Most monitoring and evaluation systems

	fail to provide scalable solutions to aggregate results regularly in WSCPs. Those that do may require a significant amount of customization or manual data aggregation.
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Source: researcher result based on group discussion

4.3 Factors identified that affect the performance of water supply construction project

Factors affecting the performance of water supply construction projects idea generated from group discussion, Interview were summarized and that lead to construction projects not being finish (completed), according to planned schedule. A group of factors identified in the study area of WSCP leads to Poor performance of a project were articulates it's similar to failure.

In order to determine the causes of poor performance and the severity of those causes according to public owners, this study is being done to look into how WSCPs are performing in Oromia.

There are many components of factors that cause poor Performances are 1.project characteristics related factor, 2 labor and material related factor, 3 contractual related factor, 4 project procedure related factor, 5 external environment related factors, 6 client related factors, 7 contractor related factor, 8 consultant related factor, 9 healthy and safety related factor,10 leader ship related factor, 11, time over run related factor, 12 cost overrun related factor, 13 poor quality related factor, 14 productivity related factor were listed in table 4

Table 4 Factors affecting performance of WSCPs identified

No	Group of factors	Reflection of factors
1	Project characteristics	• Type and nature of projects, • complexity of projects,
2	Labor and material	• Un availability of skilled worker • Improper quality control of materials
3	Contractual relation ship	• Poor communication system • Poor contract mechanism of project
4	External environments	• Economic, social, political, technological
5	Client related factor	• Client interference, poor commitment • Delay in progress payment
6	Project procedure	• Poor tendering, poor engineering estimate • Poor Procurement method
7	Contractors related factors	• Poor motivating skills of project staff • Poor Project staff commitment • Low capacity of contractors

8	Safety and healthy factor	• Poor application of safety and healthy equipment • Accident reported in project
9	Consultant related factors	• Preparation of poor approval of drawing • Contract measurement problem • Lack of experience in consultancy
10	Leadership related factors	• Un relevant professional of leader • Low experience of leader
11	Time over run	• Delay of project time • Time over loaded
12	Cost overrun	• Cost of variations • Cost due to poor performance
13	Quality defect	• Poor design and specifications • Poor WSCP • Poor decision making
14	Poor productivity	• Poor Sequencing of work according to plan • Un use of new technology • High absenteeism rate on WSCP

Source: factors identified based on interview, group discussion, and questionnaire

4.4 Analysis the effect level on performance of water supply construction project

Several effects were identified such quality defect due to poor inspection, a delay in completion of projects, a loss of customer/stakeholder satisfaction, a loss of productivity, cost overrun caused by change of scope and time overrun caused by the variation orders, conflict needs to be manage all the time to avoid disputes between owner and contractor, loss of skilled workers due to several reasons such as death, turnover and retirement always occurred within the organization, therefore, skills transfer is needed so that skilled workers can pass the knowledge to the new manpower before they retire; poor performance creates stress on the contractor as the contractor will experience problems such as reworks, termination of contract, default on loan repayment, abandonment of projects, liquidation/bankruptcy and damage to company's reputation. It is recommended therefore, to do it right the first time to avoid reworks, bad reputation, liquidation or even legal actions should be taken to avoid the all effects encountered in the project study area. Hence, effective communication is the key of any project success. Productivity is about units of work executed per man-hour ratio earned to actual hours. Uncertain weather has a huge impact on the decrease of productivity, if weather is too hot, cold and rainy season safety regulations should be applied. Poor productivity can be caused by lack of planning and poor management of resources in WS construction projects.

4.4.1 Measurement of performance evaluations

Time, quality, cost, stakeholder or community satisfaction, and project performance relative to the project case are the four factors that you should periodically assess during the WSC project. At the conclusion of a phase or stage, a formal project evaluation is helpful since it may show you clearly how the project is doing in comparison to the initial estimates. The performance evaluation measurement information is provided in the table below:

Table 5 Performance measurement and description of performance evaluations

No	Measurement	Descriptions
1	Time	Its time approved for the project including all necessary duration needed to deliver the project. Within organizations, project managers have to balance between not running out of time and not over spending because many projects receive time overload or grants that have contract clauses with an “use on time or extra time it” approach to project time
2	Cost	Its budget approved for the project including all necessary expenses needed to deliver the project. Within organizations, project managers have to balance between not running out of money and not under spending because many projects receive funds or grants that have contract clauses with an “use it or lose it” approach to project funds.
3	Quality	The standards and criteria to which the projects must be delivered for them to perform effectively. It must also meet other performance requirements, or service levels, such as availability, reliability and maintainability, and have acceptable finish and polish.

4	Customer /stockholder satisfaction	The wider teams the stakeholders are essential in getting much of the work done, so it's worth checking in with them. Find out how they are feeling about the project right now and what you could be doing differently. This is a difficult measure to document statistically, although there's nothing to stop you asking them for a rating out of 10. Even if you are evaluating their satisfaction subjectively, it is still a useful exercise. If you notice that stakeholders are not fully supportive, you can put plans in place to engage them thoroughly to try to influence their behavior.
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4.4.2 Time over run in water supply construction projects

Delay is one of the most general, major and serious issues affecting the time factor in WS construction projects in the region. Time overload is a crucial factor, even with technical advancements and improved understanding of project management by project managers, time overrun is a critical factor. The explanations for the delay in projects are different. Delays are caused by factors such as “postponement of material delivery to the site, malfunction of equipment, political problems, and several weather conditions. Delays in some circumstances make the situation much more difficult. Recognizing the delay causes and selecting precise and correct measures to minimize the detrimental effect of delays on the length of projects is important for a thorough monitoring and evaluation.

The data item used for the analysis were: project name, contract time (days), actual time (days) and rate of time over run. The summary are, presented in detail on appendix.

Table 6 Summary of Contract Time and Actual time completion of projects

No	Quantity of Water supply construction projects	Time over run
1	1 Water Supply Construction Projects	< 49%
2	7 Water Supply Construction Projects	50% - 99%
3	40 Water Supply Construction Projects	100% - 2130%

Source: own estimation result based on contractor, consultant, client and stockholder response, 2023

Project time over run leads to delay of projects contribute to distraction of work, loss of construction materials, progress loss, and increased value of construction projects, construction claims and including termination of contracts. Furthermore, 48 projects in the

study area as shown in table 4 were a constantly showing signs of delays and poor performance, such that 1 WS projects range less than 49% were seen time over run and also 7 projects rate of time over run were range between 50 - 99% and 40 WSCPs range between 100 – 2130%. The project work was highly time overloaded and still many of the WSC project were ongoing except one project. That is why the project in the study area was sick and it needs attention before it comes to halt.

4.4.3 Cost overrun in water supply construction projects

The basic component of every water supply construction project was a cost. Cost overruns are, one of the most commonly occurring in water supply construction projects. A cost overrun, also known as a cost rise or budget overrun, entails unexpected costs incurred due to poor planning ,an underestimation of the actual cost during budgeting, lack of communication, lack of clarity in project scope, inefficiency in site management, poor site coordination and lack of commitments. It was found that 48 out of 48 water supply projects had cost overruns indicated in table 7.the detail analysis were attached on appendix.

Table 7 Summery of projects cost overrun under study area

No	Water supply construction projects	Rate of cost overrun
1	3 Water Supply Construction Projects	40% _ 49%
2	14 Water Supply Construction Projects	50% _ 99%
3	31 Water Supply Construction Projects	>100%
	48 WSCPs were highly cost overrun.	

Source; researcher own estimation, 2023

A cost overrun is a major problem in both developed and developing countries. Hence, this problem is a critical factor to be studied to alleviate the issue in the future. Performance can be measured using different indicators such as progress (time), value (cost), standard of something (quality), client satisfaction, health and safety factors among others. As indicated on table 5 due to Poor performance the project were incured extra cost, and it affect cash flows, actual cost of a project far outweighs, money spent on project exceed the estimated cost, the contractors image can be destroyed if the contractors cannot full-fill the contract obligations. The negative effect identified factors are a brief background of the effects of poor performance on WSCP. The factors identified in the study area were effect on the performance of water supply construction projects encountered: Poor construction performance, Loss of productivity, Loss of skilled worker, Cost overrun, Time over run, Poor quality of project, Loss of customer /community satisfaction.

The definition of a cost overrun is an excess of actual cost over budget. Other names for cost overrun include "cost escalation," "cost increase," and "budget overrun." Cost overrun is defined for the purposes of this study as the difference between the ultimate real cost of a construction project after completion and the contract amount, as agreed by and between the client (the project owner) and the contractor during the contract signing. The data item used for the cost analysis were: project name and year, contract amount in birr, actual completed or executed cost, project status and rate of cost over run in percent. The summary are, presented in the Table 5.

Cost is very important and it has to be considered throughout the project life circle and is one of the factors that cause projects to delay and fail. Project cost overruns shown in the study area caused by number of issues such as poor performance by the service providers, poor commitment of contractors, consultant, and client and also increase in material prices and current inflation. The 48 water supply construction projects were observed in the study area indicates the rate cost overrun of 3 projects were between range of 40%-49%, 14 projects were with the range between 59% -99% and 31 projects were range greater than 100%. The poor performance of the project under the study area were leading to delay in completion of water supply construction projects and also incurred extra cost.

4.4.4 Quality defect of water supply construction projects

Measuring quality enable managers to know how close they are to their target and how to make the right decisions for improving work process. Continual measuring of project performance for further improvement also helps in meeting customer expectation on the project outcome. And also affirms that the WSCP quality levels are critically at dangers. Hence it is important for the project team to understand what the water supply construction projects were under poor quality. This poor quality of water supply construction projects in Oromia water supply construction projects were reduces productivity due to rework and waste. Workers attitude and Confidence is important factor influencing construction productivity.

Work that is not executed in accordance with the specifications of the construction contract is typically considered a defect under a contract for water supply construction projects. Examining the contract's provisions to understand what was expected of the contractor is necessary to determine what a defect is. Basic elements of quality management, mistakes

made by suppliers and vendors, incorrect handling by contractors, complex designs, and inadequate teamwork. Fishbone cause and effect diagram:

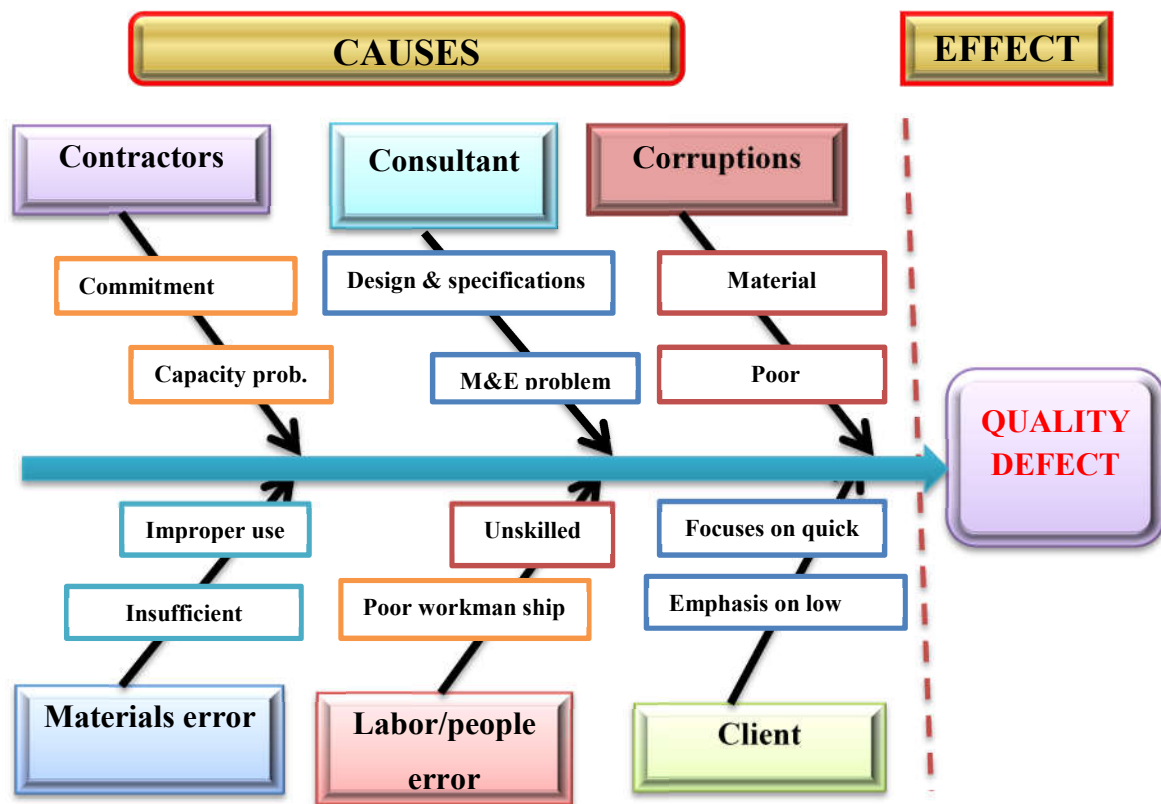


Figure 7 a causes and effect diagram

Source: Own Quality Defect measurement frame work

A cause-effect diagram is shown in Figure 7; the phenomenon to be explained is “Lost control of WSCP.” Some of the possible major factors contributing to that lost control are a contractor, consultant, client, corruptions, materials and labor error. Each of these major categories of causes may, in turn, have multiple causes. A contractor may come from a poor commitment and poor capacity, a consultant may causes from design and specification and monitoring and evaluation problems, Client may causes from focus on quick and emphasis on low cost, materials may causes from insufficient supply and improper use, labor error may causes from poor work man ship and un skilled labor.

Causes of defect in this research work all the data has been collected from water supply construction site. While collection of data it is found that there are various type of defects occur in water supply building construction and these defects are categorized in six parts.

Defective Material: In some cases the use of materials may cause disadvantages but in others it is sufficient to be used. When the WSC building defect is perceived to be defect in the material, there is a proposal that the material was faulty in the conditions in which it was to be utilized and may be improper use of materials, poor quality of materials may causes defects. Each material has its own features, which can be used under various circumstances.

Factoring in the contractor Poor oversight and management of water supply contractors have hampered the project's quality. Human mistake was the primary cause of problems in water supply construction projects. In other words, we can claim that throughout the construction of a water supply project, poor craftsmanship by contractors, supervisors, and site engineers led to human error.

The failure of a design professional to create precise and well-organized construction papers is the cause of design faults (consultant). Design flaws are errors or omissions in the work. While omissions can be fixed by expanding the scope of a contractor's work through change orders, errors typically call for redesigning and replacing a water supply construction component element. Additionally, there is a lack of efficient scheduling, monitoring, and assessment of water supply building projects.

Craftsmanship: When people think of water supply construction flaws, they often think of poor craftsmanship. When a contractor doesn't follow the construction documents when building a structure or component part of a water supply construction project, defects occur. Workmanship defects can range from little decorative errors to issues with the structural integrity of the design problem. It can be very difficult to assign blame and determine how (and even who) the property standard of care was broken.

Clients: seek for a lower price and quick to construct their water supply construction projects. These, however, may compromise the quality of the water supply structure. An inadequate budget causes a project to become finance-driven, where cheaper options are preferred over more sustainable alternatives.

Corruption: abuse the water supply construction projects quality, Corruption can have serious consequences for water supply construction infrastructure projects across three areas. First, corruption in water supply project infrastructure provision is likely to increase prices and inflate project costs. Secondly, corruption can cause delays in project completion and lead to poor quality water supply project infrastructure. Corruption in the

WS construction of public infrastructure has particularly serious implications for developing countries. Inappropriate project choice, high prices, poor quality, excessive time and cost overruns, inadequate maintenance, and low returns, among other challenges, impact negatively on economic growth and poverty alleviation.

Additionally, Design too hard to construct well: The degree to which relies upon the contractual worker's involvement and the quality and accessibility of its development assets, some construction subtleties are harder to construct well than others.

Bad Site Practice and Lack of Supervision: The contractor's bad construction methods such as the utilization of bad formwork and early evacuation pipe line and reservoir site, deficient concrete curing, inability to remove entrapped water and poor execution of water proof layer could cause defects in the finished structure of WSCPS.

Defects in Management: the administration system alludes to operational and the management procedures of the project system. Building deformities can emerge if this framework isn't appropriately maintained. Improper laying of pipe line It contains the following components.

Flawed Documentation: Documentation may be inaccurate either because the data in it is incorrect or because it is insufficient or completely lacking. Inaccurate and ambiguous designs that contain conflicting data and inadequate references are an important wellspring of flawed documentation that could prompt structure imperfections and mistake.

Poor Communication: Poor communication may happen in the construction procedure in various ways between different parties. It emerges when one gathering expects learning and involvement in the other and in this manner does not attract adequate regard for specific subtleties that may be basic for appropriate development.

Lack of Training and Capabilities: The lack of training and skills development has an impact on operators ' operational abilities in a manner that reduces workmanship quality and can lead to more construction errors and faults. This could be aggravated by the expanding multifaceted nature of the developments, which has brought about an ascent in the measure of expert contractual workers offering to supply and introduce certain parts of the development work. While these experts may possess outstanding technical knowledge in their respective areas, the people who work in the field are not familiar with the special requirements of the water supply construction projects.

Lack of Motivation: Negligence or the lack of care is the most frequently used label to describe human error in the cause of WSCP defects. The person needs to discover motivation to behave and to carry out his job properly and with the correct quantity of care and accountability. This would directly affect the nature of workmanship and measure of development errors made resulting in defects.

Lack of Knowledge: Ignorance can exist as not comprehending what to do or not knowing why it is done in a specific way. The rapid development of technology and the complexity of WS construction mean that this industry can be affected by such perceived differences. When large numbers of new materials are introduced a few years later, new devices and new technologies mean that the demands of this industry meant to educate their participant's constantly their characteristics and proper methods of use to avoid wrong applications that could cause defects.

4.4.5 Loses of Customer Satisfaction

Successful organizations need to meet their customer expectations through superior implementation of their quality construction projects; however, the currently observed in the study area many customers are still not satisfied with the quality of constructed water supply projects. The responsible body cannot properly apply customer satisfaction quality dimension. These Customer satisfactions consist of five satisfaction quality dimensions: safety, project management (ability to plan schedules, manage and execute), contractor/customer relationship, cost, and prepared/skilled workforce. Clients have a substantial role to play in setting demanding and insisting upon improvements. Ultimately, they have the most to gain from ensuring the implementation of the best practice.



Figure 8 Customer or client satisfaction process

Source: own estimation result based on contractor, consultant, client and stockholder response,

Improving customer satisfaction has received considerable attention in recent years. This water supply construction in terms of customer satisfaction framework is developed to elaborate the dynamics of low customer satisfaction. The analysis was conducted to explore low customer satisfaction in water supply construction projects. The contractors to improve performance of water supply construction projects to avoid low satisfaction of customers. Customers were found to be less satisfied with the contractor's performance due to different factors identified.

4.4.6 Delay in completion of water supply construction projects

Water supply construction projects delay are known to be amongst the most occurring problem faced by the region. This sprouts negatively impact on both parties involved in the project itself. The main causes of these delays should be pinpointed to work on reducing and eradicating them as well as matching outlays, construction projects continue to face the challenge of delays even in this current phase of knowledge in technology as well as organization management problem. Delays in WSCPs were reducing customer satisfaction, increase extra cost variance, increase in time duration out of schedule.

4.4.7 Loss in productivity of WSCP

Changes to water supply projects can have a range of effects on labor productivity. Different site circumstances, delays, resource availability, suspensions, accelerated schedules, and changes in scope are a few examples. Any project could experience several of these changes, the effects of which are frequently underappreciated and cause significant disruptions to the construction process. Projects to build a water supply could become less productive as a result of these factors. Multitasking, workplace stress, a lack of a sense of belonging, a lack of recognition, toxic workplace behavior, and damaged work relationships are some causes of employees' low productivity. Organizational One of the essential components of total quality management (TQM) is customer satisfaction.

The strategy prioritizes total satisfaction through ongoing WS construction improvement. TQM is being adopted by WS construction companies to increase performance satisfaction. However, due to its failure to precisely identify client requirements and properly translate these requirements into the completed facility structure, too many meetings, and poor management, WS construction has lagged behind other industries in applying comprehensive quality control.

One of the main problems in construction arbitration and litigation is productivity loss claims. Although there are many reasons that contribute to lost productivity, as well as the complaints and additional expenditures that result frequently during a construction project, they continue to be infamously challenging to verify. A project's labor productivity may be impacted by a number of modifications to the project. Different site circumstances, delays, resource availability, suspensions, accelerated schedules, and changes in scope are a few examples. Any project could experience several of these changes, the effects of which are frequently underappreciated and cause significant disruptions to the construction process.

Top six critical challenges and problems needs to improvement in WSCPs

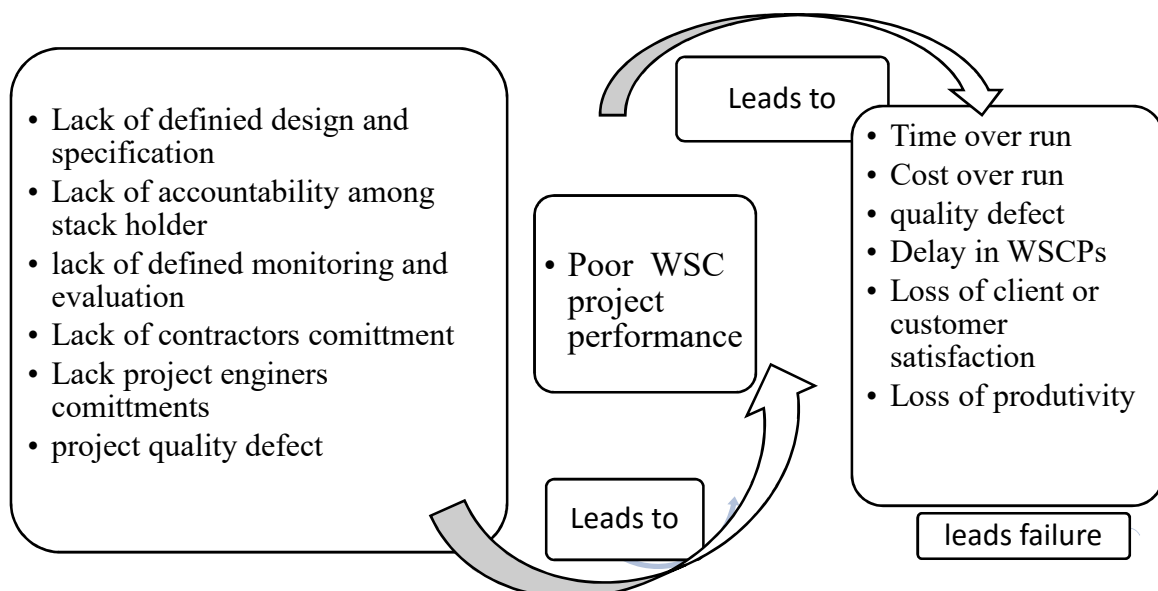


Figure 9 Reflections of factors and effect frame work

Source: Author 2023 adopted from reflection of factors and effect due to poor project performance

Cost is the budgeted expenditure, which the client has agreed to commit for creating/acquiring the desired construction facility. Cost overrun is the amount by which actual costs exceed the baseline or approved costs. In this study time and cost overrun had been a major frequent problem of water supply construction in the Oromia region. They concluded that, tender cancellation, weak contractor mobilization, equipment erection, delay in supply of water supply construction equipment, project scope change, slow construction progress, and cost escalation were the main source of delay and overruns.

In water supply construction projects the triple project constraints, cost, time and quality are the expectations of the client. But water supply construction industry is well known in Cost and time overruns. This is due to the nature of the industry i.e. it has different a complex activates, different parties and internal and external factors. These reflections of factors have negative impacts for the performance of water supply construction projects, end users, participants and the industry as a whole. The client enforces to incur more money and wait for more time than what had been estimated.

Clients, contractors, and consultants suffer from poor relationships, mistrust, and litigation, arbitration, and cash flow problems as a result of delays in building WS projects. Project risks include construction delays, which are typically the result of poorly handled events. To achieve positive outcomes and reduce the probability of further delays, risk could be managed, controlled, shared, mitigated, or accepted.

The performance has a substantial impact on customer satisfaction both directly and indirectly since it establishes the magnitudes of deviation from the intended performance. Customer satisfaction will be strongly impacted by both the performance itself and its effects. Building of a water supply the project's technical success will automatically ensure that the project's execution scope is pertinent to the demands and expectations of the client, which has a substantial positive impact on customer satisfaction.

One of the major problems in water supply construction project arbitration and litigation is productivity loss claims. While there are numerous things that can lead to lost productivity, complaints, and extra costs that are frequently made throughout a construction project, they are nevertheless infamously hard to verify. The measured mile technique is typically used to value worker productivity losses caused by disruptions. In this study, loss productivity is calculated as a result of more input being needed to produce the same or less output. As a result, when a unit of work requires more resources than anticipated to complete, the procedure may be considered inefficient.

Greater productivity translates to fewer man hours used per unit of work since productivity in the construction sector is typically stated in man-hours per unit of work. Contractors are very interested in labor productivity as they plan projects and enter into fixed-price contracts. A project's labor productivity may be impacted by a number of things. Different site circumstances, delays, resource availability, suspensions, accelerated schedules, and changes in scope are a few examples. Any water supply project can experience many of

these changes, the consequences of which are often underestimated and result in significant disruption to construction work. To improve productivity, we need to be able to measure it. And we need to be able to measure the impact of the changes made on methods, effort and systems. The measured productivity values can then be compared either to those used to make the estimate or to some production standards

Table 8 Variables definition and measurements

Variables	Types definitions	Measurements
Dependent variable		
WSCP Performance	Dummy	1 if good performed 0 other wise
Independent variables		
Project procedure	Dummy, status of the project	1 if good procedure, 0 other wise
Labor and material	Dummy, good supply of labor& material	1 if yes 0 other wise
Contractor	Dummy good performance	1 if yes 0 other wise
Consultant	Dummy good performance	1 if yes 0 other wise
Time	Dummy time over run	1 if yes 0 other wise
Client	Dummy good facilitating	1 if yes 0 other wise
Cost	Continuous cost overrun	1 if yes 0 other wise
External environment	Dummy Ex. environment problem	1 if yes 0 other wise
Quality defect	Dummy quality of project	1 if yes 0 other wise

The use of descriptive statistics can be utilized to characterize both a sample and the entire population. As a result, we've learned that descriptive statistics emphasize emphasizing a data set's salient characteristics. Inferential statistics, on the other hand, focuses on making generalizations about a larger population using a sample that is representative of that group. Because the primary objective of inferential statistics is to make predictions rather than providing facts, the results usually take the form of probabilities.

Essentially, descriptive statistics are used to report or describe the characteristics or properties of data. They summarize a specific numerical data set or sets and provide quantitative insights into that data through numerical or graphical representation. Inferential statistics are used to make inferences or inferences based on the available data from a smaller sample population. This is often done by analyzing a purposive sample

from a much larger dataset, such as a larger population. The conclusions drawn from this sample are applied to the entire population.

Table 9 Descriptive and inferential statistics analysis

Variable	Total n(48) =184	Proportion/mean difference test	Levels proportion/mean test
	Mean (STD)		
Dummy variables		χ^2 - value	
Healthy and safety	0.07 (0.27)	13.70***	10%
Leadership	0.85 (0.28)	14.71***	10%
Project procedure	0.57 (0.46)	10.02**	5%
Labor and material	0.53 (0.50)	11.48***	10%
client	0.55 (0.50)	13.75***	10%
Consultant	0.85 (0.27)	8.59*	1%
contractor	3.97 (7.01)	8.12*	1%
External environment	0.92 (0.28)	13.06***	10%
Quality defect	0.56 (0.50))	10.41**	5%
Client/cus. satisfaction	0.56 (0.58))	10.71**	5%
Continuous variables		t- value	
Time	0.87 (0.43)	8.47*	1%
Cost	0.79 (0.49)	8.06*	1%

Own estimation result based on contractor, consultant, client and stockholder response, 2023

Sampled respondents are characterized in Table 9, which reports descriptive and inferential statistics of socioeconomic, demographic and institutional characteristics of the sample respondents. The table column 2 compares respondents who have suggested performance of WSCP (column 3) using standard t and χ^2 - tests for the difference in means and proportions. For instance, committed engineers are more likely to have knowledge about performance of WSCP. They are as likely contractor, client and consultants to spend on performance of the WSCP. In terms of initial standardized differences, 4 of the 12 covariates have initial standardized differences at more than 1% and 3 of 12 covariates have 5%, and 5 of 12 covariate have 10% Probability level.

4.4.8 Multicollinearity and Heteroscedasticity Test

You can decide whether to correct multicollinearity if you are able to identify which variables are impacted by it and how strongly the correlation holds true. Fortunately, there is a fairly straightforward test to determine whether your regression model is multicollinear. The variance inflation factor (VIF) determines if two independent variables

are correlated, and the strength of this correlation. Statistical software calculates a VIF for each independent variable. VIFs start at 1 and have no upper limit. A value of 1 indicates that there is no correlation between that independent variable and others. VIFs between 1 and 5 indicate that there is a moderate correlation, but it is not severe enough to warrant corrective action. VIFs greater than 5 represent critical levels of multicollinearity where coefficients are poorly estimated and p-values are questionable.

The presence of multicollinearity between explanatory variables was checked to eliminate its impact on the estimate. The presence of multicollinearity among explanatory variables was examined using the variance inflation factor (VIF). If the value of VIF is greater than 10, the relationship is said to be strong. However, when the VIF is one, there is no multicollinearity between the explanatory variables. Accordingly, the result of VIF shows that there is no multicollinearity between the explanatory variables. In the table, on the thesis appendix, multicollinearity tests using VIF are shown for all explanatory factors. Additionally, the Breach-Pagan/Cook-Weisberg test for heteroscedasticity was used, and the P-value was 0.697, which is insignificant and indicates that there is no heteroscedasticity issue.

4.4.9 Regression model analysis

In terms of the original units of the data, regression assesses the average association between two or more variables. In order to give a method for prediction or forecasting, it also makes an effort to define the nature of the link between variables by examining their functional relationship. Three crucial benefits of regression analysis. From the values of the independent variables, it produces an estimate of the values of the dependent variables. Multiple regressions are possible when it comes to two or more variables. It demonstrates the type of connection between two or more variables. The formula for multiple regressions Thompson (1991), $Y = mx_1 + mx_2 + mx_3 + b$.

Where: Y= the dependent variable of the regression,

m= slope of the regression,

x₁=first independent variable of the regression

x₂=second independent variable of the regression,

x₃=third independent variable of the regression,

b = constant

A progression from simple linear regression is multiple regressions. When predicting the value of a variable based on the values of two or more other variables, this technique is employed. The variable we aim to forecast is known as the dependent variable, which is also referred to as the outcome, target, or criteria variable in some cases. The independent variables (or occasionally predictor, explanatory, or repressor variables) are the factors we are utilizing to forecast the value of the dependent variable. Additionally, you can use multiple regressions to calculate the model's overall fit variance explained as well as the relative contributions of each predictor to the overall variance explained. Multiple regressions are a technique for making predictions about the dependent variable using two or more independent variables. The principal goal of this analysis is to determine the link between the dependent and independent variables.

To evaluate the strength of a link between one dependent variable and one or more independent variables, regression analysis is performed. By using one or more independent variables, it aids in predicting the value of a dependent variable. Regression analysis aids in determining how much variance in a single answer (the dependent variable) is being accounted for by a collection of independent variables.

Multiple regressions may capture the complex and varied nature of real-world occurrences, which is one of its key benefits. You can account for more variables that have an impact on the dependent variable and lower estimation error and bias by using several independent variables.

Regression model refer to the residuals from running factors affecting the performance of WSCP. Results of the regression model are presented in Table 10.

Table 10 Regression model analysis

Variable	Coef.	Std. Err.	z	P>z	Marginal effect
Safety & Healthy	0.165*	0.798	1.090	0.011	0.024
Leadership	0.173*	0.057	-1.180	0.010	0.209
Project procedure	0.050**	0.826	3.730	0.056	0.245
Labor and material	0.146*	0.206	0.310	0.014	0.064
Contractor	0.010***	0.742	5.000	0.102	0.016
Consultant	0.014***	1.196	1.750	0.140	0.000
Time	0.012 ***	0.786	4.650	0.100	0.004
Client	0.124*	1.162	1.930	0.053	0.173
Cost	0.018***	0.814	4.160	0.170	0.080

External environment	0.130*	0.737	1.530	0.012	0.021
Quality defect	0.052**	0.743	4.000	0.050	0.082
Customer satisfaction	0.058**	0.548	2.305	0.057	0.045
Constant	-7.872**	3.053	-2.580	0.050	13.857

Number of observation 48 WSCP

LR ch2 (10) 66.370

Prob ch2 0.000***

Pseudo R² 0.248

Adjusted R² 0.239

Log likelihood -138.629

Source: own estimation result based on contractor, consultant, client and stockholder response,2023

*, **, *** indicate 1%, 5% and, 10% significant level

Results of the regression model show that performance of WSCP is significantly affected by leader ship, safety and healthy, labor and materials, external environment, quality defect, customer satisfaction, project procedure, Contractor, consultant, time, client and cost of the WSCP. The discussion about the significant variables is given below:

Safety and health related factors: The result revealed that lack of awareness about site safety and negligence of workers in wearing Personal Protective Equipment were the main causes of poor safety practices. Employer's and contractor's interests in safety management and enhance awareness on possible risk factors to reduce these risk factors among workers were weak and poor in water supply construction projects were significant effect at 1% probability level.

Leadership related factors: the leadership was the most important role to facilitate and lead water supply construction projects and the situation of the internal environments was also the critical issue for water supply construction performance. The poor leadership and bad situation of the environment may lead to project delay. According to the result of the study the variables were significant were significant effect at 1% probability level.

Project procedure related factors: project procedure process corresponds to the project implementation that is affect the tendering and procurement method and engineering estimates process ability of information processing and interpretation so as to adopt and

use for WSCP. In this study area the project procedure status of projects are all ways not open bid, this affects. The result of regression model indicates that Project procedure is negatively affect use of WSCP and significant effect at 5% probability level.

Labor and material related factors: The result showed that shortage and lack of skilled labor force were major challenges in WSCPS. The results revealed that unskilled labor has a significant negative impact on WSC project performance during the WS construction phase, these results could be used by WS construction experts to elaborate a broader and rooted view of the labor skills affecting the project performance. Material management on project performance of construction projects were weak and the poor material planning, material procurement, material handling, and material logistic and stock and waste control, skilled labor force on water supply construction projects performance were significant effect at 1% probability level.

Contractor related factors: Perceptions related to the issue of contractor of water supply construction projects the most important role to build the projects in poor performance of WSCP. This is may be due to lack of commitment of project manager and site engineer. The binary regression model identified Contractors to WSCP and highly significant effect at 10 % probability level.

Consultant related factors: Perception about the consultant of WSCP by the government positively and significantly affects the performance of WSCP at 10% probability level. Those who perceive that WSCPs are of more poor consulting the projects that leads to poor performance of the projects. Consultant related factors: The result looks that Construction consulting firms and professionals in WS construction projects were poor designing, managing, scheduling, quality assurance, and other key issues they face in water supply construction.

Time over run: The cause for failure of WSCPs could be attributed to the sources failure to give the required time over run of the projects. This may lead to the projects to Mal-functioning of any components of the projects. Thus, sustainability of the project of water supply projects are the problems of appropriate planning, designing, site selection of projects, construction and handling of the project implementation cycle. According to this study the variable is a highly significant effect at 10 % probability level.

Client related factors: the client of water supply construction projects the most important

role to facilitate the projects. According to this study identified the client was under taking poor performance of facilitating project payments on time. This is may be due to lack of commitment of project coordinator and leadership. The regression model identified client at a statistically significant effect at 5 % probability level.

Cost overrun: The cause for failure of WSCPs could be attributed to the sources failure to give the required cost overrun of the projects. This may lead to the projects to extra expenditure on any components of the projects. Thus, the water supply projects are the problems of appropriate, designing, cost estimate, and handling of the project implementation cycle. According to this study the variable were highly significant effects at 10 % probability level.

External environment related factors: The external project environment is made up of all the factors that are not under the direct control of the organization. Even though these factors exist outside your project, they can have a great influence on it. External environmental factors, which include political environment, economic environment, technological environment and social environment, affect the performance of water supply construction projects were significant effect at a 1% probability level

Quality defect: Perceptions about the quality of WSCPs are positively and significantly affect the performance of water supply construction projects. But the result of the study indicated that the quality of the water supply projects under the study area indicating poor quality of WSCPs were significant effect at a 5% probability level.

Customer satisfaction related factors: A client or customer satisfaction of some attributes of the water supply construction projects seems to reflect very strongly poor. The WSCPs were incurred highly cost overrun, time over run, quality defect and project delay that is why the client often dissatisfied with their WSC project outcomes. The result shows that client or customers satisfaction were significant effect at 5% probability level. The graphical presentations of regression analysis were indicated on figure 10.

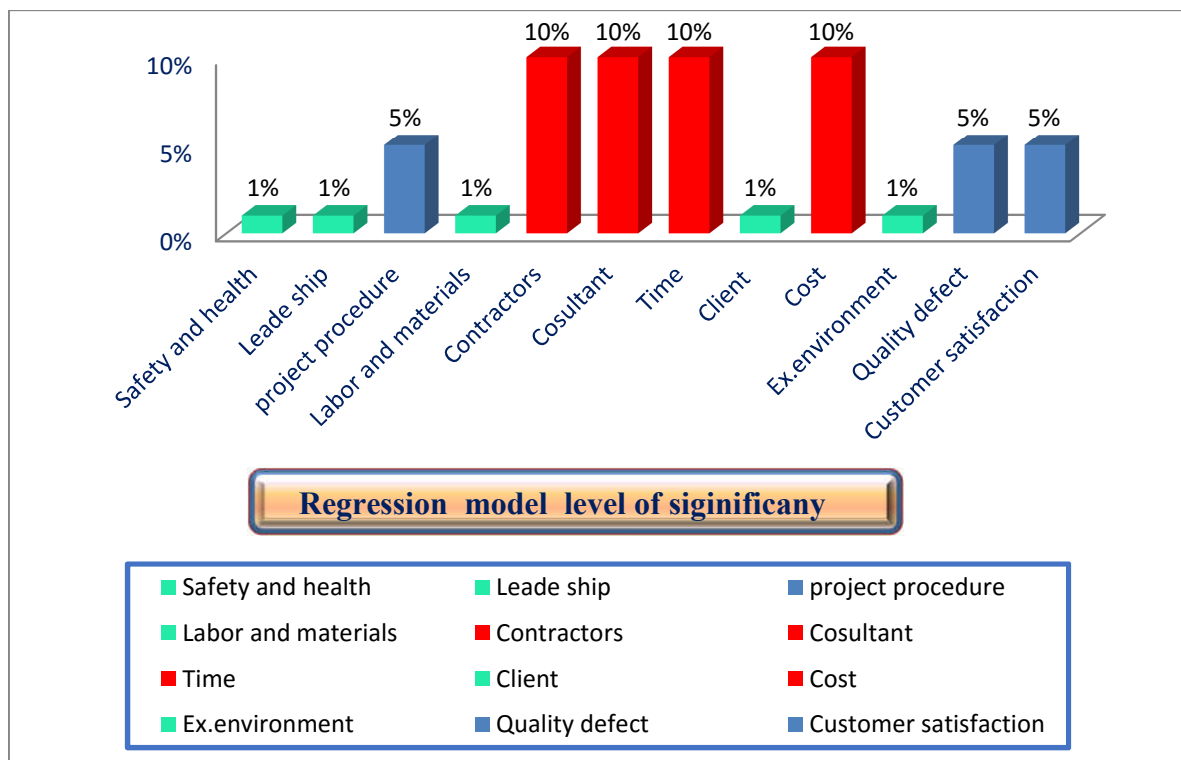


Figure 10 graphical presentation of Regressions model level of significances

Source: researcher analysis regression result

4.4.10 Sensitivity analysis for unobserved biases

Results on Appendix reveal that even if respondents were given the freedom to vary in odds up to $e r = 2$ (100%) in terms of unobserved factors, the influence of performance changes in water supply building projects can be inferred. This indicates that for outcome variables estimated, the p-critical values are significant at different levels of gamma's critical value (i.e., there is no hidden bias caused by an unobserved confounder). This also shows that we have considered important covariates that affected performance to water supply construction projects and outcomes variables, client satisfactions. In the analysis set the maximum value for $e r = 2$ (100%) with increment of 0.05. These values are a good starting point for many data sets in social sciences. Thus, we can conclude that our performance measurement are not sensitive to unobserved selection bias and are a pure effect of performance of project status.

4.4.11 Implication of the finding

The performance evaluation water supply construction work was carried out in 2023. It included investigating the current poor performance conditions of bad implications in water supply construction industries, conducting performance evaluation and optimizing

the whole performance evaluation methodology. The complete performance evaluation reports were compiled for academic purpose. Finally, including some professional performance improvement suggestions were incorporate in the thesis paper.

The performance evaluation work was supported strongly by the factors affecting performance of water supply construction projects. The comparison of various evaluations of the 48 water supply construction projects in the study area were poor management foundations, and all kinds of performance management work were not standardized and in place, which reflects the overall poor level of water supply management in oromia region

Poor water supply performance Implications refer to the potential consequences, applications, or outcomes of the findings and conclusions of a research study. These can include both theoretical and practical implications that extend beyond the immediate scope of the study and may impact various stakeholders, such as policymakers, practitioners, researchers, or the general public. These refer to the negative outcomes or risks that may result from a study's findings. For example, a study that finds a harmful side effect of a poor progress of water supply construction projects can have negative implications for customers, or water supply providers, and the wider society.

4.5 Performance improvement strategy and techniques

Diana C (2021) Continuous improvement strategy is an ongoing plan to improve an organization's production and products, service and customer satisfaction. A culture of continuous improvement that is embedded in an organization empowers employees to constantly imagine how to improve and work smarter

4.5.1 Construction contractor's performance improvements strategy

David B (2019) Best Practices to Improve Your Contract Management Process

- ✓ Standardize Contract Creation
- ✓ Set Contract Management KPIs.
- ✓ Balance Storage Security and Visibility Requirements.
- ✓ Track Contract Approval Time.
- ✓ Automate Contract Communications.
- ✓ Review Finances.
- ✓ Conduct Regular Compliance Reviews.
- ✓ Resolve Disputes Promptly.

- ✓ Improve your estimating process.
- ✓ Use your project management software properly
- ✓ Listen to staff.
- ✓ Establish your performance metrics and review progress frequently.
- ✓ Finally, Improve your communication and training

4.5.2 Consultant related factor improvement strategy

Karan S (2023) As a performance improvement consultant, you observe current company production numbers, find gaps or inefficiencies within their processes, and provide advice and recommendations on how to reduce and eliminate production issues. Five C Consultants leverage Critical Thinking skills; a commitment to Core Values; a Consciously Human approach; a Co-Creative process; and an uncanny Communication style to each engagement applying lean management tools

- Kanban practice
- Value stream mapping
- TQM
- Gemba check list
- Gemba walk
- Engineering software, project management software

4.5.3 Project related factors improvement strategy

Ayodeji O, (2022) Improving procurement performance can have a significant impact on water supply construction bottom line. Procurement is the activities and processes used to acquire goods and services needed by an organization. By improving procurement performance, you can reduce costs, speed up deliveries, and improve customer service.

The water supply construction projects can improve tender process efficiency by:

- Developing and approving the scope of the tender before going to market.
- Avoiding using bidders' tender submissions as a pricing service for options.

There are several ways to improve procurement performance:

1) Implement best practices: By following best practices, you can ensure that your procurement process is efficient and effective. Best practices include using standardized contracts, establishing clear decision criteria, and conducting market research.

2) Improve communication: Make sure your employees are aware of what needs to be purchased and when. Additionally, make sure that all stakeholders are kept up to date on progress made in negotiating contracts.

3) Review procurement procedures: Are all steps required for contracting appropriately documented? Can procedural issues be resolved more quickly by streamlining the process? reviewing procedures may uncover areas where improvements can be made.

4) Manage inventory: Inventory represents a major financial burden for organizations. By managing inventory effectively, you can avoid costly losses due to stock outs and improved ordering lead times. Additionally, by managing inventory efficiently you can enable organizations to continue operating at full capacity during periods of high activity and involving new products/services initially introduced through contracts of market launches.

5) Utilize technology: Technology has revolutionized many aspects of our lives, including procurement. By using technology

4.5.4 Time factor performance improvement strategy

Hanne K (2023) Strategies for improving your time management skills by incorporating some, or all the ten strategies below, you can more effectively manage your time.

- Know How You Spend Your Time.
- Set Priorities.
- Use a Planning Tool.
- Get Organized.
- Schedule Appropriately.
- Delegate: Get Help from Others.
- Stop Procrastinating.
- Manage Time-Wasters.

4.5.5 Cost factors performance improvement strategy

Mohammed M (2021) Running a construction business isn't cheap; It requires a significant capital investment. In construction, you possibly cannot cut corners because this mostly would mean spending more money in the long run. However, there are few ways to reduce the expenses. Read on to know more about how you can be smart with your money without skimping on the necessities. To improve cost related factors drastically reduce construction costs

- Reduce scope.
- Reduce complexity.
- Change materials or systems.
- Consider material alternatives.
- Use software to stay on budget.
- Streamline communication.
- Reduce excess construction waste.
- Eliminate change orders.
- Hire Multi-Tasking Employees
- Implement Energy-Efficient Sustainable Practices
- Replace Old Technology with New
- Manage Your Fleet Cost-Efficiently

4.5.6 Quality improvement strategy

Christopher C (2018), the Concepts provide a framework for project centered site assessment transformation. Each change concept includes multiple “key changes.” These provide a practice undertaking the transformation with more specific ideas for improvement. Each practice must decide how to implement these key changes in light of their water supply construction project structure and context. The key changes for “Quality Improvement Strategy” are:

- Choose and use a formal model for quality improvement.
- Establish and monitor metrics to evaluate improvement efforts and outcome; ensure all staff members understand the metrics for success.
- Ensure that employees, labors providers, and project team members are involved in quality improvement activities.
- Optimize use of project information technology to meet Meaningful Use criteria
- The second component of the Model for Improvement is the Plan-Do-Study-Act (PDSA) cycle.
- Applying value stream mapping, total quality management
- Applying construction lean methodology

4.5.7 Client related factor improvement strategy

David M (2023) Inspire of this, most client project managers often struggle to keep their clients happy. They are constantly juggling multiple client expectations while ensuring that

projects are delivered within the defined timeline and project budget. Here are some client project management tips that you can implement for improving client relationships without putting in too much effort.

- Engage With Your Clients to Build Better Client Relationships
- Adopt a Professional Services Tool to Manage Clients Effectively
- Listen to Your Clients' Expectations
- Be Transparent in Dealing With Your Client
- Request Timely Feedback for On-Time Project Delivery
- Respect Your Client's Time
- Turn Down Client Requests Politely
- Show Sincerity Towards Fulfilling Business Needs
- View project progress via Gantt chart, Kanban board, and more
- Give instant feedback using task comments
- Apply lean management tools PDCA ,Kaizen lean six sigma

4.5.8 Customer satisfaction improvement strategy

Tomas M. V. Morgeson (2023) A successful customer strategy needs to articulate the distinctive value and experience your organization will deliver to those customers over three to five years, along with the offerings, channels, operating models, and capabilities you will need. Let's take a look at the strategies for providing excellent customer service here:

- Understand customer's needs.
- Train empathy.
- Encourage honest customer feedback.
- Set up a framework to measure your team's performance.
- Set individual and team goals.
- Streamline manual processes.
- Set and communicate service standards.

4.5.9 Leadership related factor improvement strategy

William P (2023), E Goldman (2021) Six ways to improve your leadership skills here are a few suggestions to get you on the path to becoming a better leader:

- Identify your strengths and weaknesses: Consider keeping a journal to track your successes and failures over time. By taking stock regularly, you'll develop a better understanding of yourself and learn how to make the most of your talents.
- Take management and leadership courses: One of the best ways to improve your leadership skills is to take online courses that can provide you with the knowledge and skills needed to be an effective leader. Taking courses will also help you network with other professionals.
- Brush up on your hard skills: It's no secret that technical skills are becoming increasingly important. It's essential, therefore, that leaders have a strong grasp of the skills relevant to their industry.
- Find a mentor: A mentor can provide you with guidance, support and advice when you need it most. They can also help you develop a better understanding of yourself and your goals.
- Determine your goals : To determine your goals, start by thinking about what you want to achieve in both the short-term and long-term. Then, you can start to develop a detailed plan by setting goals that are specific, measurable, achievable, relevant and time-bound.
- Admit when you fail and move on Everyone makes mistakes. As a leader, it's important to admit when you've failed and learn from it. This shows your team that you're human and willing to learn from your mistakes. If you're willing to accept responsibility, it builds trust and credibility with your team.
- Final thoughts: Leadership is a complex topic. From setting goals to admitting failure, there are many ways to improve your leadership skills. It's important to remember that there is no one-size-fits-all approach to leadership. It's a self-development process that takes introspection, time, and commitment. Well, the truth is, you don't have to. Leaders may have to give instructions to team members, but that is only a small part of their job. You can focus on displaying the other key leadership skills that will help others, such as:
 - ✓ Offering to help a colleague who is having problems
 - ✓ Being supportive and encouraging
 - ✓ Praising fellow workers for good work
 - ✓ Giving credit to others

- ✓ Showing empathy for people with difficult tasks
- ✓ Communicating effectively
- ✓ Working to improve team morale in difficult times

In terms of WSC "process improvement projects," projects are those temporary or short-term activities meant to improve a process and resulting in improved performance in a key performance indicator of the project. After all, the WSC project leaders are concerned with improving results.

4.5.10 labor and material related factor improvement

Lakew G. (2017), how can the productivity of Labour be improved? Labor productivity is largely driven by investment in capital, technological progress, and human capital development. Business and government can increase labor productivity of workers by direct investing in or creating incentives for increases in technology and human or physical capital. Here are the main approaches:

- Measure performance and set targets – it is often claimed that "what gets measured, gets done!"
- Streamline production processes.
- Invest in capital equipment (automation + computerisation)
- Invest in employee training.
- Make the workplace conducive to productive effort.

4.5.11 Safety and health related factor improvement

Lina A (2015), the following seven steps safety improvements focus on the basics of formal program for construction businesses; these key steps to a safe work environment will be the basic components of your health and safety program.

- Create a Plan for Improving Health and Safety
- Inspect Your Workplace
- Train Your Employees
- Train Your Employees
- Keep an Open Dialogue
- Investigate Accidents
- Maintain Records

Make Improving Health and Safety a Key Part of Business

Safety improvement shouldn't be an after-thought; it's just as important to a successful construction business as customer service, inventory control, and financial planning. A commitment to health and safety makes good construction business sense because it's the one way to protect your greatest resource your people. American Occupational Safety and Health Administration www.osha.gov (2016) Employers will find that implementing these recommended practices also brings other benefits. Safety and health programs help businesses:

- Prevent workplace injuries and illnesses
- Improve compliance with laws and regulations
- Reduce costs, including significant reductions in workers' compensation premiums
- Engage workers
- Enhance their social responsibility goals
- Increase productivity and enhance overall business operations

4,5,12 external environment related factor improvement strategy

Hassan F, O Aigbogun (2022) Enhance environmental quality (clean air, clean water, managing chemicals and pesticides) Improve the use of resources (minimize waste and use natural resources sustainably) Help mitigate the impacts of climate change (adapting to climate change challenges and reducing environmental hazards) Improve biosecurity. Construction technology refers to the collection of innovative tools, machinery, modifications, software, etc. used during the construction phase of a project that enables advancement in field construction methods, including semi-automated and automated construction equipment.

- Create Balance Between Water Withdrawals and Available Supply. Ethiopian water resources are unevenly distributed.
- Build Water Resilience Strategies.
- Plan for Transformation across Sectors.
- Recycle old technology
- Watch your energy consumption.
- Making construction projects smarter.
- AI could be used to analyze data from WSC building systems to optimize energy efficiency, construction quality, and other performance metrics

- Engineering software, project management software
- Innovative construction materials and equipment's
- cloud based WS construction software and Mobil application

Table 11 Top six critical challenges and problems needs improvements in WSCPs

no	Critical Gaps in WSCPs	challenges	Management action	Improvement strategy
1	Lack of defined Design and specification	• Design copy pest • Negligence of experts • Expert Skill gap • Professional bias	• Management should prepare design and specification training • Recruit committed and skilled experts • Motivate experts • Avoid design copy pest • Check the design before bid announcement	○ Define project goals. In the first step, define your project goals. ○ Determine outcomes. Next, narrow down the outcomes of the project. ○ Identify risks and constraints. ○ Refine your project strategy with a visual aid. ○ Estimate your budget. ○ Create a contingency plan. ○ Document your milestones. ○ Apply fully software engineering ○ Specifications must be clear, concise, complete, correct, and consistent.
2	Lack of defined monitoring and evaluation	• Negligence of leader ship • Negligence of experts • Expert Skill gap	• Management prepare monitoring and evaluation training to fill the skill gap • Aware M&E experts critically to follow the projects • Prepare monitoring and evaluation plan • Procure the most and skilled M&E experts or organizations	○ Know your project inside and out. ○ Start planning M&E during project design phase. ○ Make M&E an on-going process. ○ Explore different M&E tools and methodologies. ○ Set up relevant indicators. ○ Collect quality data from multiple sources. ○ Employ a participatory and inclusive approach. ○ Disseminate periodic results to a broad audience monitoring and evaluation can help to identify areas for improvement in order

				to achieve better results. By consistently tracking progress against defined objectives and implementing corrective actions when needed, organizations can ensure that they are maximizing their benefits
3	Lack of contractors commitment	• Lack of capacity • Negligence of experts • Skill gap	• Select and procure efficient and skilled contractors • Communicate and prepare session program weekly •	○ Improve your estimating process ○ Use your project management software properly ○ Listen to staff. ○ Establish your performance metrics and review progress frequently ○ Finally, improve your communication and training. ○ Numbers don't lie
4	Lack Project engineer commitment	• Negligence of experts • Skill gap	• check for scheduling of projects • Aware project engineer to follow up projects strictly	○ Say it with: communication, communication, communication. ○ Be a safety advocate. ○ Quality control. ○ Learn our scheduling software. ○ Get to know the foremen. ○ Paperwork. ○ Stay on top of requests for information,. ○ Master Autodesk.
5	Project quality defect	• Poor quality of material • Poor work man ship • Material reduction	• Purchase quality of materials • Recruit skilled manpower • Control project quality	○ Say it with me: communication, communication, communication. ○ Be a safety advocate. ○ Quality control. ○ Learn our scheduling software. ○ Get to know the foremen.

				○ Paperwork. ○ Stay on top of requests for information, or ○ Master Autodesk.
6	Lack of accountability	• Negligence of leadership • Negligence of expert • Skill gap	• keep your entire team on the right track • aware the leadership experts sense of accountability	○ Lead by example ○ Give solid, clear feedback – often ○ Hold each other accountable ○ Have the tough talks with team members ○ Consider how your employees view things ○ Set clear, achievable goals ○ Improving accountability in the workplace should be a consistent effort for team leaders no matter the state of the organization.

This studies additionally suggested that water supply construction firms react to institutional pressures and to improve factors differently depending on how they understand the influence that factors pressures exert on the performance outcomes. Kaizen, also known as continuous WSCP improvement, is a method for identifying opportunities for work streamlining and waste reduction. The approach was developed as a result of the accomplishments of Lean, Agile, and Kaizen in projects, and it is being used by hundreds of construction businesses across the world to identify cost-saving options. Many of these philosophies match well together. For example, Kaizen and Kanban can collaborate to support ongoing improvement for local water supply construction projects.

4.6 Kaizen and lean management Application

Wei P, M Pan, **2022**, in any construction industry, construction project management creates standards that employees must follow to perform the job. In a Kaizen environment,

maintaining and improving standards is one of the main goals of management. When standards are improved, there should be an observable improvement in the output of a process or procedure. The objective is to maintain that improvement and then to improve upon it again. This cycle never ends. The desired outcome will inevitably regress if the standard is not upheld, creating the "two steps forward, one step back" effect. Only when people work to greater standards can improvements last. Because of this, upkeep and improvement go hand in hand. In general, the more senior the management, the more focused on improvement they should be. An unskilled worker at the lowest rung can spend the entire day merely following directions. However, as he gets better at his job, he starts to consider ways to make it better or simpler. In doing so, he discovers ways to increase the effectiveness of his labor, which contributes to the overall improvement of the water supply building projects.

The kaizen application on water supply construction management is dedicated to the improvement of productivity, efficiency, quality and avoid wastage in general of different projects not only in construction industry (Aditya, K, 2017). The kaizen method acknowledged as method of improvements applied to key processes will generate the major of water supply construction industry's profit, while constituting a secure way to obtain the clients loyalty and fidelity. The kaizen application represents a solid strategic instrument, with a view to reach and surpass the sector's objectives.

Kaizen is a process of promoting continuous improvement through small changes in daily work or water supply construction process culture. It involves all employees from the newest junior member right up to the top level. Kaizen focuses on improving quality, productivity, and efficiency through small, measured shifts in how the business operates and teams collaborate.

The 5S's constitute a basic method that enables improvement of productivity and efficiency while ensuring pleasant conditions for water supply development in Tunis M. 2022. The study is presented in a tangible form in the article, showing how it was applied to actual water supply building projects using the kaizen principle to increase the sector's success throughout construction. The name "Five S" is taken from the first letters of five Japanese terms that describe five procedures for maintaining a tidy and functional workspace: Organization, neatness, purity, cleanliness, and discipline are all referred to as seiri, seiton, seiso, and seiketsu. The five S's stand for sort, straighten, sweep, sanitize, and sustain in

English. Five S assessments affect how workers feel about the water supply construction business and about themselves, and they are now crucial for any sector involved in productive, development-oriented operations.



Figure 11 Five S representation of Kaizen

5S representation of Kaizen frame work

Seiri /Sort: Identify what is not needed, then give everyone a chance to indicate if the items really are needed.

Seiton/ Straighten: what must be kept? Make things visible. Put tools on pegboard and outline the tool so its location can be readily identified.

Seiso/ Scrub: Means cleaning the working environment, including machines, tools, floors, walls and other areas of work place.

Seiketsu /Systematize: Extend the concept of cleanliness to oneself and continuously practice the above three steps. Keeping one's person clean, by such means as wearing proper clothes, safety glasses, gloves, shoes, and as well as maintaining a clean , healthy working environment. Shitsuke/standardize and self-discipline: Established a cleaning schedule. Use downtime to clean and straighten area.

Water supply Construction project is a dynamic work; lay down area change dramatically as production is moving forward, hence, the material layout plan should be a continuous effort that includes all trades involvement. Throughout the project, Sort, Straighten, and Standardize are the winners in this category mainly due to management eagerly making efforts. Conversely, the traditional working behavior became an obstacle for the enforcement of shine (clean up) and sustain. General Contractor realized that behavior change, commitment, and discipline are the keys to the success of housekeeping. The material layout is commonly used for acceleration of 5S implementation on the

construction site. (Beyene T, 2017) indicates that 5S is an are abased system of control and improvement. The benefits from implementation of 5S include improved safety, productivity, quality, and set-up-times improvement, creation of space, reduced lead times, cycle times, increased machine uptime, improved morale, teamwork, and continuous improvement (kaizen activities)

4.7 PDCA Cycle application

Plan, Do, Check, and Act, or PDCA, is another component of the Kaizen approach. When organizations identify processes that require modification, it makes them more effective. You must first identify the problem (plan). Then you develop a viable solution (do), test it, and assess the effectiveness of the results (check). Finally, you record the ultimate outcomes and, if the plan is successful (act), put it into action.

The scientific approach of proposing a change in a process, implementing the change, observing the outcomes, and taking necessary action is the foundation of the PDCA improvement cycle. The project management and process improvement problems can be approached and solved using the PDCA cycle. It can therefore be used for a wide range of purposes. The PDCA cycle is a tool to ensure continuous improvement and apply the iterative process, and teams that utilize it effectively embrace the element of continuous improvement rather than using it for an end-to-end process. The Plan-Do-Check-Act cycle is especially helpful when you want to: Simplify and enhance an ongoing repetitious task, create a fresh business procedure, Start a continual improvement program, quickly iterate on change to get results right away, optimize results while minimizing errors, Try out several options quickly. The acronym PDCA stands for plan-do-check-act. The Deming cycle, a four-step process, was the previous name for it. The PDCA approach seeks to enhance business operations and aid in the eradication of repeated errors.

It serves as a tool for project planning and is essential to lean management (Paulo P, 2021). In order to enhance the likelihood of delivering and maintaining the targeted gains, or to discontinue the intervention and try something else, the PDCA cycle's goal was to learn as rapidly as possible whether and how an intervention worked in a specific situation. Plan-do-check-act, often known as the deeming wheel or deeming cycle, is a well-known technique for acquiring important learning and knowledge for ongoing process improvements of project process.

The Plan-Do-Check-Act model is a practical technique that may be applied to a variety of situations, including: examining and evaluating several options in a limited, controlled trial, preventing waste by identifying and changing inefficient, solutions before implementing them widely putting change into action and ongoing improvement, implementing Six Sigma or Total Quality Management projects creating or enhancing a procedure. The PDCA cycle has the advantage of being adaptable to different WS construction projects.

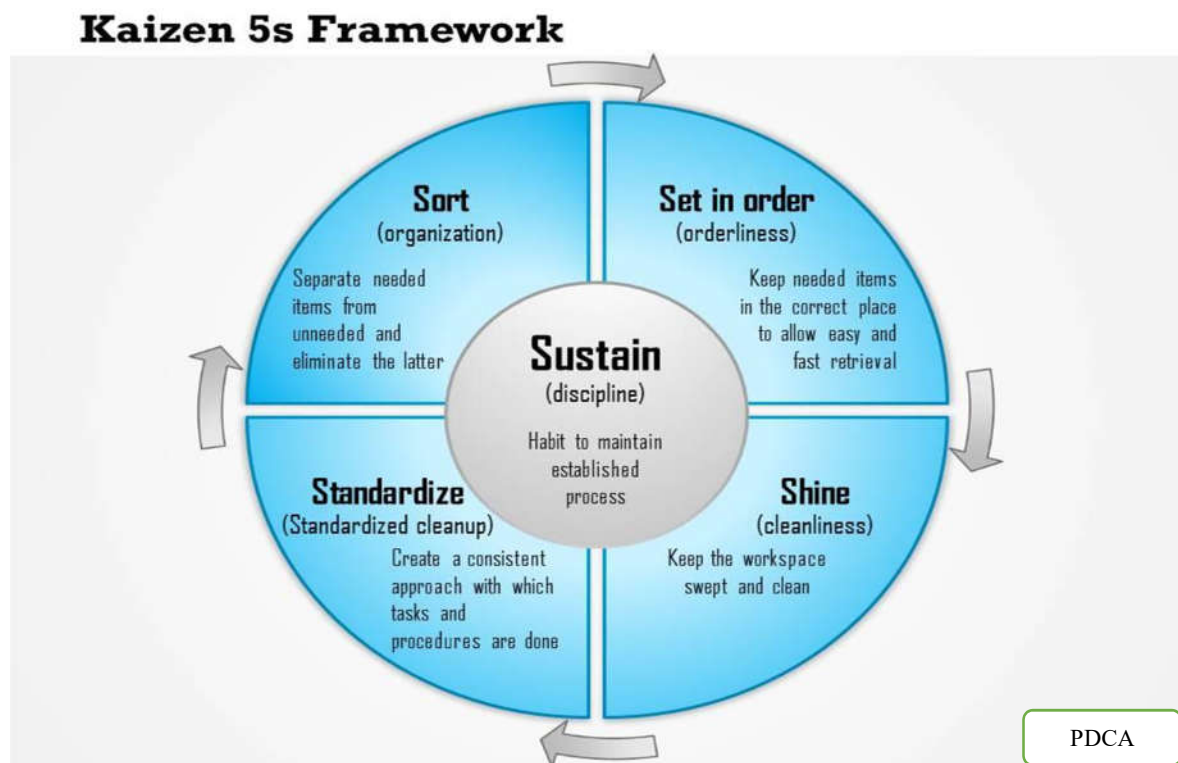


Figure 12 the plan do check act cycle frame work

The Plan Do Check Act continuous improvement cycle is demonstrated here. For instance, the integration of Kaizen and Kanban can enable continuous improvement through the display of WSCP workflow. Continuous improvement is a fundamental focus in all Lean / Agile approaches, along with high WS project execution standards and the elimination of waste in the form of money, time, and defects (rework). Plan: Recognize a chance and make a change. Test the modification. Conduct a small-scale investigation. Check: Review the exam, examine the outcomes, and then state what you've discovered. Act: Put what you learnt in the study step into practice. The method starts with a planning phase in which issues are precisely identified, comprehended, and an improvement theory is established.

In the Do phase, potential solutions are tested on a small scale, and the results are then examined and verified.

4.8 Streamline workflows

The main strategy used by many WSP to lower operating overhead is continuous improvement. Workflows can be made more efficient by using the Lean improvement technique of continuous improvement (sometimes referred to as "rapid improvement"). You may cut down on wasted time and effort by using the lean way of working to create effective workflows that save time and money. Projects with varying timelines, shifting priorities, and additional complexity, for instance, frequently present chances for improvement. Just nobody has taken advantage of that chance. Here are the top five advantages of optimizing your workflow, particularly when you utilize Scribe or other workflow automation tools.

Productivity has increased as a result of the automation of tedious, repetitive jobs through digital processes. Most of these jobs involve entering data, performing computations by hand, routing requests based on rules, etc. Any process that follows rules can be automated. You can spend more time on jobs that require true human attention and decision-making when repetitive tasks are automated.

Price effectiveness Consider how much you could save if you held meetings online instead of flying. The automation of workflows follows the same general rule. The days of printing tons of paper and designating a clerk to move it to the subsequent department are long gone. These days, everything is digital, and workflow automation software makes it possible to complete tasks with a small staff. As all papers are processed digitally with the utmost accuracy, digital processes ensure there are no errors and reduce paperwork as well as the investment spent in growing the workforce.

Better preparation Data is one of the main benefits of optimizing company processes. You receive comprehensive data on your operations, including information on how long it takes to complete activities, where errors occur most frequently, and the proportion or frequency of requests, among other things. It is simpler to predict, plan, and allocate resources more effectively for the future with this type of data.

Improved communication: Your team may now communicate with one another more easily than ever thanks to a centralized workflow automation software package. Your staff members no longer need to physically approach one another to exchange information or hound their colleagues for status updates till they want to rip out their hair in anger. Additionally, efficient communication guarantees that every member of various teams may easily stay in touch with one another while saving time and avoiding inconveniences

Boost data security and openness. The development of the water system was a transparent, automated project activity. More people than ever are aware of the procedure. Controlling access to data is another capability offered by automation. For designated users or user groups, you can reveal or conceal a specific piece of information. This offers more openness and tighter regulation of data access.

Simplifying staff worker training, enhancing organization-wide productivity, agility, and efficiency are further advantages for the improvements. Assisting companies to adhere to WSC industry standards, specifying the duty hierarchy for various jobs within a process, enhanced client satisfaction and continued version control

Simplify internal processes by breaking them down into smaller, easier-to-manage steps, keeping them brief and focused on the desired output. Make careful you document what's happening and offer proof that it's happening. In this manner, you can guarantee that optimized workflows run as they should and are free from unforeseen problems. This is where a central office comes in handy because everyone can keep informed and contribute .Use project management tools, such as Scribe, for your workflow and daily operations to do this. No one can recall the specifics of every process workflow, regardless of their knowledge or expertise. To efficiently accomplish the work in each phase, it is crucial to spell down all the necessary steps in detail.

4.9 Applying MS project and p6 software

A project manager needs to be knowledgeable about the costs involved in completing a body of work. Therefore, it is beneficial for most project management offices to be aware of the average completion times for specific jobs. Project managers can reduce project costs and prevent overages by using forecasting software (MS Project, Primavera P6). If project limitations are anticipated to be exceeded, project management offices can perform better overall for the business by forecasting (as opposed to estimating).

4.10 Lean Management Tools

Zhaoxi Z, (2022) applying Lean principles to your project management process won't happen automatically or without a concerted effort from the entire team or business. Adopting one of the following tools, which might quicken the change, might be a good place to start. Lean methodology is forcing construction companies to reevaluate how they plan, manage, and carry out projects. Construction projects for water supplies benefit from lean's increased production and quality. Project managers for the construction of water supply systems have been interested in the Lean methodology as a way to cut costs, accelerate project completion, and better manage materials.

The Lean methodology seeks to address the underlying causes of variability that result in bottlenecks and inefficiencies in the building of water project systems. Utilizing lean construction techniques has a variety of advantages, such as higher productivity, better quality outcomes, enhanced safety procedures, and more client satisfaction.

The basic principles of a Lean water supply construction project apply to construction processes: Achieve higher quality results and processes by defining values: In Lean WS construction, the definition of values begins and ends with the customer. According to Lean methodology, value is always defined by your customer's wants and needs. Better cost control through value stream mapping: Value stream mapping is a key principle of lean construction that leads to better cost control. Value stream mapping eliminates waste from construction processes based on the customer's perception of value. This allows companies to meet customer expectations and control costs.

Reducing Risks by Creating Flow One way teams can implement lean concepts in the development of water supply systems is by reducing workflows. Any WS construction project must effectively manage risk. Additionally, there are numerous chances to include risk management into WS construction procedures.

Establishing a Pull Planning System for Planning and Scheduling a pull planning system is yet another essential component of lean construction management. A successful building project is built on careful planning and timing. Creating a pull planning system guarantees that the materials and information are accessible whenever and to whoever wants them.

With this proactive strategy, time wasters like bottlenecks, delayed transit, and potential disruptions are eliminated.

Better Employee and Customer Satisfaction through Continuous Improvement: The cornerstone of lean construction approach is the idea of continuous improvement. The lean approach to continuous improvement means that WSCPs rely on worker and customer views to spur innovation and continue to deliver beneficial results. Visual management enhances communication between teams building water supply systems and promotes a welcoming workplace for all employees. Greater collaboration is possible thanks to clear visual overviews that help teams see how each contractor or construction team contributes to project milestones. Staff development is a part of lean construction's continuous improvement process. As tools and technology advance in the building industry, front-line construction skills change. To successfully complete construction jobs using waste reduction and root cause problem-solving methodologies, projects require competent people.

Enhance the monitoring, appraisal, and follow-up of construction projects for quality water supplies. When a project is entering the late stages of construction, the construction quality needs to be examined and acknowledged. Water supply construction management should be done routinely to achieve the quality project. Spot checks on building materials like pipelines, concrete, or technology should be done by management staff once everything is finished. To ensure the regular operation of the water supply and projects, they must promptly implement appropriate actions whenever shortcomings are discovered. In order to ensure that the supply of water to the project can meet the needs of social production and daily water consumption, it is also necessary to perform the necessary maintenance work, regularly check the water supply, and quickly address any hidden safety hazards, according to Zheng Weifeng (2018).take prompt action to ensure the regular operation of water projects and supplies.

4.11 Kanban for Lean Project Management

One of the most popular workflow management techniques, kanban helps you visualize your job, enhance your workflow, and ultimately boost productivity. Lean teams and organizations can practice continuous improvement and respect for people because Kanban provides the visibility, measurements, and focus they require. Everyone in the organization is brought together by visibility around a single shared reality. Metrics give teams and their

stakeholders the ability to find areas for improvement and track the results of their efforts. Last but not least, focus enables everyone to perform at their highest level and realize the Lean objective of maximizing value for the client. L. Koskela (2020). Modern-day Kanban methods and ideas are distinct from those created in the 1940s, when the approach was first developed. As industries have changed as a result of technological and innovative breakthroughs over the years, just-in-time and pull systems from Kanban have become more widespread than simply in the construction sector.

Table 12 Kanban principles and practices

Kanban Principles		Kanban Practices
- Start with what you do now - Agree to pursue incremental evolutionary change - Respect the current process ,rules, responsibilities and titles		- Visualize the work flow - Limit work in progress - Manage flow - Make process policies explicit - Implement feedback loops

You and your team structure will be able to arrange and carry out work in general in a new way by implementing the Kanban principles and practices in project management. The advantage of Kanban is that it respects the existing strategy and suggests gradual, evolutionary modifications, allowing for a smooth transition to Lean, one step at a time. The visual representation of work is essential to Kanban. Project management with Kanban boards will make work visible, organize communication in one location, and foster a transparent workplace with fewer interruptions. The Kanban board will eventually develop into a real-time status reporting for the WSC project, allowing you to learn about what is happening without having to ask questions. Potential bottlenecks will also instantly emerge, and every team member will have a greater understanding of the work state and WSC project status (Murithi, S. & H. Silas, 2017).

4.12 Kaizen Vs Kairyo

One of the main tenets of Lean is continual improvement, as was already established. It's not something you can simply cross off your to-do list, however, Kaiyry and Kaizen stand for the combination of ongoing personal development efforts and ongoing project team efforts at the WSC that can lead to actual performance and efficiency improvement. Contrary to popular misconception, Kaizen is best described as "continuous self-

development" while "Kairyo" is the literal translation of "continuous improvement." "The act of making bad points better" is the literal translation of the Japanese word "Kaizen"'s original meaning, according to the Shoga kukan (Japanese English Dictionary). It's interesting that the Japanese word for "continuous improvement" literally translated as "Kairyo" implies an external mechanism for attaining improvements. The kaizen mindset, on the other hand, is an internal drive that encourages one to continually question the status quo and make improvements Carlos, (2016).

It entails consciously seeking out methods to better yourself, and this usually manifests itself in your work. In other words, Kaizen has an external effect that is continuous improvement, or Kairyo. Nakamuro's interpretation of the connection between Kaizen and Kairyo is depicted in the artwork below:

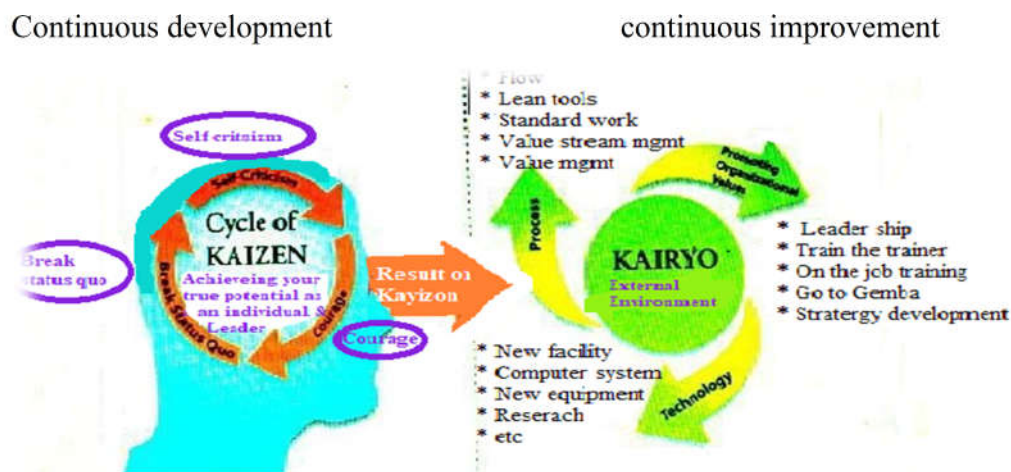


Figure 13 Kaizen and Kairyo continuous improvement

It's crucial to remember that Kaizen advocate implementing change only for the sake of it. Additionally, using less is not always the best option. It's all about maximizing what you already have. When implemented correctly, Kaizen gives the following advantages: improves one's sense of pride in their profession, the standard of water supply projects, the effectiveness of WSCPs, and finally, user or customer happiness.

In the context of WSC project management, practicing Kairyo would entail conducting Gemba walk to find possible areas for process improvement or routinely reviewing the project process to cut out waste and increase productivity and efficiency. The idea of monitoring work as it is done and where it is done is applied in the Gemba walk. The

fundamental tenet is that the WSCP actual work environment is the ideal place to determine the possibility for work process improvement. The goal of the Gemba in Lean is to observe, participate in, and improve, and it should take place where the most important activity takes place. Although the Gemba walk is frequently exclusively spoken in relation to and applied to WSCPs because there is a real-world WS construction line that can be seen, it is also an effective project management tool. Gemba refers to the location of the work. To better understand the issues that need to be fixed, it is intended to go around and speak with everyone involved in the processes. What are you working on right now? is on the gemba walk checklist. Exists a set procedure for this kind of work? Why is a problem present? How can the issue be resolved? What steps do you take to identify the problem's underlying cause? Who do you contact if there is a specific issue?

The Japanese word "gemba" means "the actual place." Gemba walks, an excellent Lean tool, call for a manager or other designated individual to physically walk around a space and look for areas that can benefit from improvement. The employer or management will have a greater understand of what is going on in the facility if they are present, and they will then have the authority to make the required changes. Gemba is used in water supply construction building project processes to evaluate the underlying reasons for the discrepancy between the existing state and the planned state and to then deliberate on the most promising countermeasures to narrow the discrepancy. Gemba largely relies on visual evaluation.

Using the Kaizen technique, all contractors involved in a water supply construction project actively collaborate to create ongoing, small-step improvements to the project's workflow. In a sense, it brings together the individual abilities inside a water supply project to produce an effective improvement engine. Rapid improvement techniques, or kaizen, are frequently regarded as the "foundational element" of all lean techniques. By focusing on specific activities and processes inside a company, kaizen aims to reduce waste, boost productivity, and achieve persistent, ongoing improvement. Our way of life, whether it be at work, in our social circles, or at home, deserves to be continually improved, according to the kaizen principle. Instead than making radical, demanding changes, Kaizen emphasizes tiny, incremental gains. The Kaizen process produces little, gradual improvements, but over time, the method produces enormous changes. Furthermore, the Kaizen method is cheap and low-risk. It calls for small-scale capital investments in process improvements.

Kaizen promotes experimentation and trying out fresh ideas among employees as a result aizen cycle for ongoing development implemented in a cycle of seven steps to foster a culture of continual development. The steps in this methodical approach are as follows:

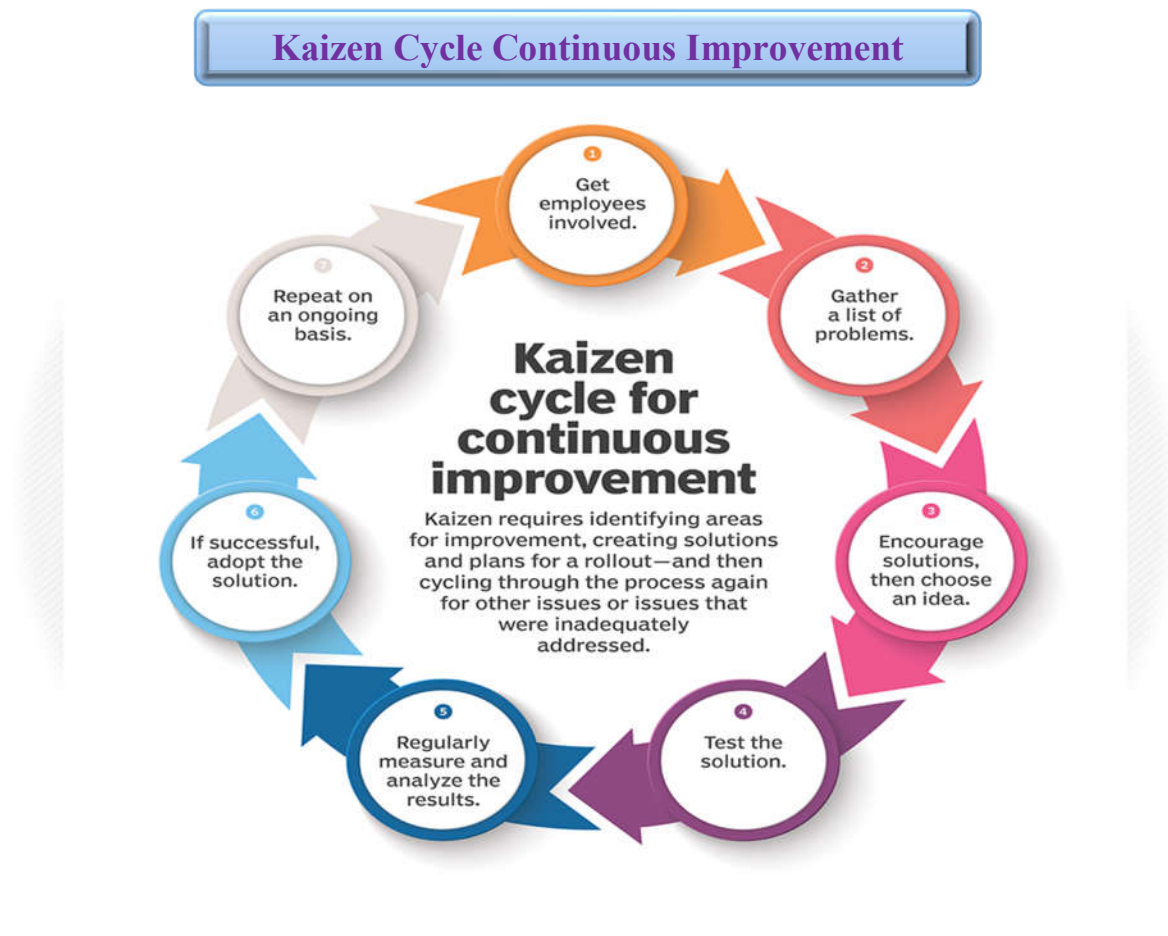


Figure 14 Kaizen continuous improvement cycle

Gets staff member's involved Encourage employee participation including asking for their assistance in identifying difficulties and problems? This encourages support for change. This is frequently set up as certain teams of people tasked with obtaining and disseminating data from a larger group of employees.

Find issues: Make a list of the issues and potential solutions based on the general feedback from all employees. If there are lots of problems, make a list.

Develop a resolution: Encourage staff to come up with innovative solutions, open to all kinds of suggestions: Choose one or more of the suggested answers as the best ones.

Test the answer: With everyone taking part in the rollout, implement the winning solution that was selected above. To test the solution, start pilot programs or take other simple actions.

Examine the outcomes: Check on progress frequently, with clear plans for who will be the point of contact and how to keep low-level personnel interested. Analyze the effectiveness of the change. If the outcomes are favorable, the organization should implement the solution.

Repeating these seven processes over time is advised, with new solutions tried when necessary or fresh lists of problems to be solved. The tenet of kaizen is that nothing is static and that everything can be improved. Additionally, it is based on the respect for people idea. Kaizen entails locating problems and opportunities, coming up with solutions, implementing them, and then repeating the process for difficulties and problems that weren't sufficiently resolved. A cycle with seven steps can be used to implement continuous improvement and can offer a methodical way to carry out this process. The Japanese word "kaizen" is a combination of two other words that mean "good change" or "improvement."

A water supply construction firm uses and applying continual cost minimization as part of its Kaizen costing process to enhance project efficiency and effectiveness and without compromising project quality. This approach has a beneficial effect on a WSCP's general effectiveness. Continuous improvement is really spelled "Kairyo" in Japanese, which is the literal translation. The process of kaizen is mostly one that takes place internally, in your own head. The aim is to achieve improvement through realizing your potential, challenging the status quo, and doing so.

4.13 Lean construction Technology improvement

Zhaoxi Z, Y. Tang, and C Wang, (2022) Lean construction relies heavily on having an effective performance management system. Large-scale water supply building initiatives are intricately planned activities. It is challenging to handle communication between on-site staff, middle management, and high-level decision-makers, which makes it challenging to obtain a clear picture of progress. Without sufficient transparency, significant issues may not be identified until it is too late, resulting in expensive rework, bottlenecks, and disruptions.

In the WSC industry, lean construction technology is frequently disregarded, yet a strong performance or WS project management system can significantly change project outcomes. Teams are kept on track, on schedule, and within budget with the support of improved visibility to the water supply construction project progress, deadlines, and root cause investigation. Web-based project management software, an automated scheduler, customizable accounting software, worker augmentation tools and equipment, and VDC (Virtual Design and Construction) are some examples of lean construction technology that may be valuable for your construction project.

Improvements in field construction techniques, such as the use of semi-automated and automated construction machinery, are made possible by the use of a variety of cutting-edge tools, machines, modifications, software, etc. during the WS construction phase of a project. Now that you are aware of the "how" WS construction businesses should approach implementing new technology, let's discuss the "why." Technology can also help raise construction efficiency and improve the performance of the project. The use of technology to boost productivity and cut costs is transforming how construction teams operate. Here are five tested methods for using technology to improve the effectiveness of the building industry (Machado, R., & C. Vilela, 2020).

Xichen C, (2021) Thanks to technology, everyone involved in the WS project can collaborate more quickly and effectively. Using technology on the construction site makes it easier for contractors to communicate with consultants, owners, and their teams, as well as to collaborate with them. They can collect information on the job site, share it with others, and receive immediate feedback as well as responses to their questions. Useful technology includes online and mobile apps for reporting, document sharing, project management, auto-archiving, and data collection.

Antony P, (2021) with the aid of technology, project managers and contractors may base choices on cost and labor data more quickly and accurately: Users can alter the build model in real-time using intelligent modeling to evaluate how changes will affect labor and cost. With the ability to better envision how various design scenarios alter the appearance of the building and the ability to take into account budgets and time limits, designers and builders may better plan their projects. Project teams can ultimately make quicker, more informed decisions with the aid of these technologies. The likelihood that the project will remain on schedule and within the allocated budget is also increased.

Technology simplifies and automates the information capturing process while integrating data back into company systems in real time: Supervisors can use a mobile device to record employee hours and wirelessly send this information to the field office. This technology eliminates the need to complete paperwork and streamlines the timesheet-approval process. This information is then seamlessly integrated into the WSCP main system, which decreases the errors and inefficiencies involved in paper-based record keeping. Using a mobile software solution to track employee-time data can help WSC industries significantly improve accuracy and reduce processing costs.

David S ,(2020) Technology can help teams follow documentation and compliance guidelines properly and promptly: Water supply construction teams are better equipped to comply with documentation and compliance standards by using technology on the job site to produce pertinent documents more quickly, precisely, and completely. Electronic document management systems, for instance, can store digital photo, video, and webcam documents. Then, these systems can be accessed from any mobile device via a secure online document portal. This reduces the risk, which can be quite expensive and saves a significant amount of time.

Henry A (2029) Teams can use mobile and cloud-based technology to obtain real-time project data: Workflows on the job site are more efficient when mobile technology, such as tablets and smartphones, is combined with cloud-based data storage and management systems. The ability for contractors to access designs, paperwork, contracts, and other crucial information instantly from the job site reduces wait times that could result in significant delays and enables contractors to avert expensive mistakes.

Dingayo M (2018) Keeping up with all the new technologies emerging in the construction sector can be difficult, not to mention that the adoption process often requires a significant investment of time and money. Before acceptance, these technologies must be thoroughly tested by specialists in the water supply and construction industries after learning about them. Coordination of a project's planning, collaboration, monitoring, and delivery is accomplished via cloud-based project management software. Instead of using a plain old white board and sticky notes, it enables project managers and teams to complete their job using a network of tools provided within the software. Software for project management is used at varying levels by different businesses and teams. But overall, it's intended to make

scheduling tasks and deadlines simpler and more efficient. Akponana H,(2018) The market has seen a constant influx of new and enhanced software solutions, making it challenging for enterprises to select the best one. But it's crucial to consider all the benefits a cloud-based project management system has to offer before you start shopping for a project management tool.

Nikolay G (2018) Project management has altered as a result of technology. Now that there are so many choices, it might be difficult to know where to begin. All of us are searching for the finest free project management software, something with all the features we require to manage projects successfully. A water supply construction project's planning, collaboration, monitoring, and delivery are all coordinated via cloud-based project management software. Instead of using a standard whiteboard and sticky notes, it enables project managers and teams to complete their work using a network of tools available within the software.

Ben Aston,(2023) Software for project management is used at varying levels by different businesses and teams. Overall though, it's intended to make scheduling and managing deadlines for water supply building projects simpler and more efficient. Using cloud-based project management software for your construction has the following advantages: Easy to use, simple to start with, Highly economical, increased productivity and teamwork, no additional hardware or installations low-upkeep technology, dependable and safe, free trials each month, allows integrations over the web, assistance with remote teams, time-saving master,

Nik E, M Shirley,(2023) Adopting a quality management system is known as adopting water supply construction project quality improvement. It involves managing a process to produce maximum customer satisfaction at the least expensive overall cost to the company while continuously improving the process. In the construction business, the concept of "total quality control" implemented through quality control has replaced the traditional approach of quality control because it is insufficient. He should define the phrase "perfect quality control" and then construct four perfect quality control principles based on this description. His explanation of quality control is tied to a distinctive quality of the WS construction sector. Conceptual circle. Realizing this idea will boost performance, cut prices, and improve quality in the water supply construction sector. In order to ensure that the facility performs as intended, quality control in construction often involves ensuring

that minimal requirements of material and craftsmanship are met. The fulfillment of the owner's requirements per the established scope of work within the allocated budget and time frame is what is meant by the quality of a construction project.

Hassan A, (2018) Benefits of Kaizen: In addition to the obvious advantage of improving procedures, Kaizen fosters ownership and teamwork. Teams take ownership of their work and are capable of improving water supply construction projects to improve their own working environment. The majority of individual's desire success and pride in their profession, and Kaizen assists them in achieving these goals while enhancing the water supply construction industries.

Sushanta M (2022) When all engineers seeks Kaizen for opportunities for improvement and make recommendations based on their views and experience, Kaizen as a Lean WSCP practice is successful. Management's responsibility is to explain the need for change, show personal commitment to process improvement, teach and train workers in Kaizen, and oversee the improvement process in order to make this happen. Here are some things to bear in mind when using Kaizen for the first time:

Vesna J, (2019) Beginning with training everyone needs to be aware of what Kaizen is and how it may enhance the work environment on initiatives to build water supplies. Support Kaizen from the top down; workers on the water supply construction project must feel confident that they will receive assistance when required. Elicit creative thinking Utilize suggestion boxes, quality circles, and Kaizen boards? Employees need a mechanism to effectively discuss and record their suggestions for change Continue to offer suggestions Allow employees to implement their own recommendations whenever possible? This will encourage participation. Remove obstacles: Here, kaizen boards and software are particularly helpful. They let staff members offer suggestions, monitor their development, and take advantage of each improvement.

Bojan K,(2019)Measure impacts: By monitoring the kaizen process' positive effects, the water supply construction projects are more likely to keep supporting and sustaining it. The long-term approach of kaizen is to increase employees' competence and self-assurance. It integrates the various abilities within a WSCP to create a powerful engine for development, acting proactively to produce frequent, incremental gains. Management can support the growth and success of a Kaizen program by putting the proper system in place.

Employees will feel more ownership over their work and be more engaged in every part of the project. In the end, this will result in improved procedures, greater client happiness, and increased improvements. Benefits of increased performance: Improved employee productivity, reduced work errors, Better work quality, enhanced employee satisfaction, Less time spent redoing tasks. Construction projects involving the provision of water must have effective performance management. They are able to integrate their systems, resources, and personnel with their strategic goals through both formal and informal approaches.

Jasmina R (2019) as was already noted, Kaizen can generally be categorized as a philosophy, but it also incorporates elements of a practical approach. It can be presented through a succession of techniques or tools, and effective application of these techniques or tools results in an improvement cycle that is raised gradually. Even if some tools, like 5S or Kanban, can be referred to be Kaizen tools, it is still more of a mindset than a collection of tools. Employees actively endeavor to make consistent improvements in the projects through kaizen activities, which is visible through the flow. to improve the logistics process or the construction project process. Kaizen, on the other hand, represents a procedure that a single person may utilize as a tool for detecting and fixing a wide variety of issues.

Nita P,(2021) Kaizen, a continuous improvement philosophy, fosters a workplace environment where all employees work together to enhance certain project work processes or operational aspects. Lean thinking is a management style that focuses on reducing process waste while increasing process speed and quality.

Marijana M, (2020) Choosing a plan for process improvement Determine the area or procedure to be improved It is important to clearly identify the scope of the process when developing a process improvement plan because, in many circumstances, tackling the entire WS construction supply chain or process can be challenging and put a lot of stress on the business or lean team. Once the scope is established, it can be used to assess how satisfied customers are with the construction's range, services, and quality or flaws in the construction. These customer-side problems that came up in these discussions can help

identify priority areas. Workers and construction crews are a great source of information and brainstorming for places that might be improved.

Matthew C, (2023) Participate the appropriate individuals - Just as crucial as comprehending the process in issue is involving the appropriate individuals in the development of the WSCP process improvement approach. The continuous improvement team should include site managers, major engineers, and professionals, but it should also include a significant number of floor staff and engineers who work closely with customers or on specific projects because they can offer very valuable information about the WSC improvements. Greater workforce engagement and the drive to maintain the outcomes at a later time will arise from the selection and balance of participants in a WSC project improvement initiative.

The team's goal in continuous water supply construction project improvement is to set targets or benchmarks. These objectives may have an influence on operations, effectiveness, costs, or performance of projects. Goals for cultural change may occasionally qualify as objectives in a culture of continuous improvement. The WSCP process improvement strategy is the vision, set of objectives, and series of actions that will allow a project processes to gain a sustainable competitive advantage by addressing inefficiencies, waste, plant and asset condition, and culture within the project process and its stakeholders. JessicaR,(2022),

Sururah A., (2021) Kaizen discovered that assessments and evaluation methods don't have to be difficult or overly technical during our continuous improvement journey. Since they are not complicated, laborious, or time-consuming, straightforward tools like the Gemba walk, lean management, PCDA, and kanban theory and practice are helpful for quality improvement efforts. Gemba, and it can be planned for and completed swiftly, in a short amount of time, at a low cost, and with fewer resources.

The Nigerian construction industry can use the methods other scholars have recommended for implementing kaizen in nations all around the world. These tactics can be grouped according to how they relate to the various stages of the kaizen process for the business and the construction process in the construction industry.

5. CONCLUSION AND RECOMMENDATION

5.1 Introduction

When compared to other construction sectors in Oromia, the WS construction projects now exhibit notable defects and project delays. The main ongoing issue, though, was that it was challenging to complete the project within the allocated money and time frame. This study's main goal was to assess the effectiveness of water supply construction projects in the Oromia region (specifically, public WSC projects in Oromia). to achieve this objective deferent research methodology was used as discussed in chapter three, data obtained through desk study and questioner, analyzed and presented in detail in chapter four. Moreover, Conclusion of research finding, and recommendation, presented in the last chapter. Finally, suggestion of research area for future study also encompassed.

5.2 Summary

The intention of this study has been to expand the understanding of how a performance evaluation can be used within a public sector organization These studies identified that 48 samples WSCPs causes of performance problems in Oromia water and energy Bureau, the causes of poor performance were grouped in to 12 categories. Such as contractor related, consultant related , cost related, time related, leadership related, client related, project procedure related, customer satisfaction related, external environment related, quality defect related, labor and material related, safety and health related. The result reveled the top six critical causes of poor project performance in WSCPs were undefined clear design and specification, lack of defined accountability among stockholders, lack of contractor commitments, lack of defined monitoring and evaluations, project quality defects, material quality problem. Finally the result further revealed that the most important are contractor, client and consultant were unable to point out mitigation practice required to minimize the occurrences and effect of causes project performance and highly needs to improvement strategy.

5.3. Conclusions

In this study performance evaluation of water supply construction projects on satisfaction of clients have been analyzed using cross sectional data from 48 WSCPs (10 each project from east, west, and south of Oromia. 9 each from north and central Oromia of different direction. The main research question of the study was “what are the factors that affect the

performance of Oromia WSCPs? What the effect of factors on the performance of WSCPs in the Oromia water supply construction projects? How to improve performance of WSCPs in the region? Answering this question requires observing outcomes of matched respondents of different actor's indifferent groups. The main objective of this study was to evaluate the performance of WSCP executed under the Oromia water and energy Bureau. Client satisfaction, Time, cost and quality were to measure the performance of WSCP in the study area.

In this study, purposive sampling procedure was adopted for the selection of sample respondents. First, the sample size of 48 WSCPs had been taken from total population of 55WSCPs based on solvin's sampling formula. Finally the empirical analysis used respondents from client, contractors, consultant and stack holders data gathered from 184 respondents selected following purposive sampling method from respective engineers based on their proportion to the size of population. The study has applied a regression model technique, which is capable of extracting comparable treatment.

Performance of water supply construction projects and the client's satisfaction were affected by different factors. These include project procedure, labor and material, contractual relationship, external environment, client, contractor, consultant, safety and healthy. These factors of variables were statistically significant effect on project performance. This means that those who have poor performance of WSCPs were more likely to have spent higher time over run and cost overrun and admitted low quality of projects and low client satisfaction.

Thus, obtaining a valid estimate of the performance evaluation of WSCPs requires good control over all explanatory variables In terms of initial standardized differences, 4 of the 12 covariates have initial standardized differences at more than 1% and 3 of 12 covariates have 5%, and 5 of 12 covariate have 10% Probability level.

And the result of regression model shows that performance of WSCPs were affected by contractor, consultant, time, cost and were (10%), project procedure ,customer satisfaction, client and quality defect (5%) , safety and healthy, Leader ship, labor and material and external environment, and safety and health (1%) probability level . Clearly, what we suggesting that they are related to some self-commitments of contractors, consultants and clients on WSCPs were the essential point and administrative targeting process on projects was the first priority.

Finally, the study investigated how to improve project performance by articulating factors that cause project poor WSCP performance can be broadly summarized as Design issues, cost and time issues, quality defect issue, and. The study thus advises that professionals fully apply lean management tools, Kanban principles and practice (kaizen, kairyo, PDCA) principles and also adopt management software (for instance building information modeling, drones, cloud based WS construction software's, etc.) that helps for creating and managing data during the design up to completion of projects, in order to solve the design issue challenges. Prior to the commencement of the project, design will be completed and synchronized among the team thus reducing or totally eliminating change orders. Diligence and taking responsibility for their roles is also expected from professionals. It is worthy of note that some factors mitigating project performance as identified by this study are under the control of the project team if the project teams were committed. However, clients need to work on the payment process in their organizations to ensure project performance.

5.4 Recommendations

1. Recommendation for contractors

- The contractors should be dedicated to change existing working culture to improve the project practices by adopting cloud-based WSC project management software
- It is recommended to develop human resources in the WS construction projects through proper and continuous training programs about WS construction projects performance improvements.
- The contractors give special attention to understand and adopt the lean management tools (PDCA, kaizen, kairyo) and Kanban principles to improve the WSCP performance
- The contractor should also consider the proper use of project management tools and integration of new technology to ensure the successful project performance.

2. Recommendation for consultant

- Consultants evaluate project overtime through project construction in order to enhance and improve time, cost and quality performance of WS projects.
- Consultants should be done clear design and specifications of projects in order to improve their performance. And to gives special attention to understand the basic key project management software to monitor and evaluate project performance,

- The consultant should be dedicated to change existing working culture to improve the project practices by using performance improvement strategy lean management tools (PDCA cycle, Kanban principles and practice) in WSCPs.

3 Recommendation for Owners

- The project manager should follow the scientific thinking mechanisms to solve problem, and apply lean management tools, PDCA cycle approach extensively for process control and improvement.
- The Water supply construction project owners should establish kaizen and kairyo team to have scheduled visiting project in all projects implemented areas to give his assistance when it needed.
- Owners facilitate monthly, quarterly meeting for progress evaluation of WSCPs.

Areas of Further Research

The research work suggests a further study to be conducted in this angle of knowledge, by looking into

1. The influence of water supply construction materials management
2. The roles of the project procedure on performance of WSCPs in Oromia

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APPENDEXS

Annex i. Questionnaire

Part One: General Information: Please add (✓) as appropriate:

Which organization do you represent?

☐

Client [Owner]

☐

Contractor

☐

Others

(specify) _____

2. Respondent Designation in the organization

Owner

☐

Project Manager

☐

Others

☐

Office Engineer

☐

Site Engineer

☐

3. Years of Work Experience

0 to 5 years

☐

6 to 10 years

☐

11 to 15 years

☐

16 to 20 years

☐

above 20 years

☐

4. Number of executed projects in Oromia water and energy resource development Bureau

1 to 2

☐

3 to 5

☐

More than 5

☐

Part Two: Factors Affecting the Performance of Water supply Construction Projects

Below are numbers of factors affecting the performance of water supply construction projects. From your experience, please express your opinion on the importance of the following factors as key performance indicators of construction projects within the Oromia water and energy Bureau. (Please say YES or NO) in the appropriate box).

N	Groups/Factors	Yes	No
1	Project characteristics related factors		
a	The project is Complex?,		
b	The WSCP is completed based the contract signed?		
2	Labor and material related factors		
a	Is there unavailability of Skillful workers?		

b	Proper Quality of construction materials are delivered?		
c	Sufficient construction materials are supplied?		
d	Experienced engineers assigned on WSCP?		
3	Contractual relationship		
a	Is there communication system among project participants?		
b	Your Contract type, Full contract (Material +Labor) ?		
c	Control mechanism of the project management is active?		
4	Project procedures		
a	The Tendering method of the project is transparent?		
b	Procurement method is free from corruptions?		
c	Engineering estimate is clear and free from defect?		
5	External environment		
a	The project is dominated by Economic environment?		
b	The project is dominated by Social environment on sites?		
c	The project is dominated by Political environment?		
d	Is there new technology applied to improve WSCP?		
6	Clients related factors		
a	Size of client's organization is Large?		
b	Client's emphasizing on low construction cost?		
c	Clients emphasize on quick construction instead of quality?		
d	Client's ability to make project decisions good?		
e	Is there Client's interference during construction?		
f	Clients delay of progress payment to contractors?		
7	Contractors related factors		
a	Project team leaders working relationship with others?		
b	Contractors Motivating skills of the project staffs?		
c	Project team leaders are experienced?		
d	Project staffs commitment to meet cost, time and quality?		
e	Contractors project work Planning effort good?		
f	Contractors are monitoring budget progress?		
g	Technical skill of the project staffs is appropriate?		
h	Project leader's early and continuous involvement in the project?		
i	Contractor is Implementing an effective safety, quality assurance and environmental program?		
j	Contractors Control of subcontractors works?		
8	Healthy and safety related factors		
a	Safety and health equipment is applied in the construction WSCP?		
b	Water supply Project location is safe to workers?		
c	Is there accident rate required in WSCP site?		
d	Is there On going safety training and provision of personal protective equipment?		
9	Consultant related factors		
a	Is there lack of experience on the part of consultant?		
b	Is there contract management problem?		
c	Consultant Preparation and approval of drawing is active?		

d	Consultant control the WSCP on site?		
e	Consultant supervises and monitors the WSCP properly?		
f	Is there waiting time for approval of test and inspection?		
10	Leader ship factors		
a	The leader of the WSCP is professional?		
b	Leader of WSCP have relevant experience?		
c	Larder assign experts on right place at right time?		
d	Is there a promotion of experts on a good progress of performance?		
11	Time over run		
a	The WSCPs are completed on time schedule?		
b	The project is executed following time schedule?		
c	Is there delay because of poor monitoring WSCP and closures to material shortage?		
12	Cost over run		
a	Is there high cost variance in the projects?		
b	The cost variance is occurred due to poor performance?		
c	Is there cost schedule associated with the estimated time?		
13	Quality defect		
a	Is there factors confirm design and specification of WSCP?		
b	The completed or ongoing WSCP quality is assured?		
c	Is there quality assessment system in organization?		
d	The stockholders are satisfied on the quality of WSCP executed?		
14	Productivity of projects		
a	The WSCPs completed and serve the communities are productive?		
b	Is there sequence of work according to schedule, to become project productive?		
c	The completed WSCPs are sustainable?		

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Annex ii. Interview question

1. Is there clear or standard design and specifications for the needs of water supply construction projects? Do you have a comment on quality of design and specification of WSCPs?

2. Is there lack of a clear accountability system in the Oromia water supply construction projects?

3. Is there high corruption prevalence in the Oromia water supply construction projects?

4. The project progress payment is delay or paid on time?

5. Is there Lack of professionalism and skilled engineers among WSCPs, consultant, contractors and client engineers?

6. What do you feel about the quality of water supply construction projects? (quality of work executed by contractors),

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Annex iii. Multicollinearity test for explanatory variables

Variables	VIF	1/VIF
Safety and health	1.60	0.63
Leadership	1.45	0.68
Project procedure	1.43	0.70
Labor and material	1.37	0.73
Contractor	1.28	0.78
Consultant	1.24	0.81
Time	1.22	0.84
Client	1.10	0.91
Cost	1.18	0.93
External envt	1.04	0.96
Quality	1.13	0.88
Client/cus. Satisfaction	1.46	0.68
Mean VIF	1.23	

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Annex iv. Sensitivity analysis of unobserved bias

Gamma	Sig+	Sig-	t hat+	t-hat-	CI+	CI-
1	2.20E-16	2.20E -16	255a9	-2559	2928	-2186
1.05	0	1.10E-15	-2593	-2532	-2967	2152.5
1.1	0	5.10E-15	2638.5	-2491	-3009	2128.5
1.15	0	2.10E-14	2678.5	-2457	-3048	2096
1.2	0	7.30E-14	-2716	-2428	-3076	-2056
1.25	0	2.40E-13	-2741	-2402	-3111	2028.5
1.3	0	7.00E-13	-2772	-2371	3148.5	1997
1.35	0	1.90E-12	-2807	-2341	-3172	1964
1.4	0	4.90E-12	-2831	-2310	3194.5	1941
1.45	0	1.20E-11	-2857	-2278	-3217	1916
1.5	0	2.60E-11	-2878	-2251	-3247	1881
1.55	0	5.60E-11	-2903	-2221	3266.5	1841
1.6	0	1.10E-10	-2928	-2185	-3288	1822
1.65	0	2.20E-10	-2957	-2166	-3309	1795
1.7	0	4.20E-10	-2976	-2146	-3341	1766
1.75	0	7.60E-10	-3001	2132.5	-3367	1742.5
1.8	0	1.30E-09	3025.5	-2116	-3387	1726
1.85	0	2.30E-09	-3047	-2097	3406.5	-1706
1.9	0	3.80E-09	-3060.5	-2076	-3421	-1684.5
1.95	0	6.10E-09	-3077	-2053.5	-3439	-1656
2	0	9.60E-09	-3097	-2041	-3457	-1631

Gamma(er)	- log odds of differential assignment due to unobserved factors
sig+ -	upper bound significance level
sig- -	lower bound significance level
t-hat+ -	upper bound Hodges-Lehmann point estimate
t-hat- -	lower bound Hodges-Lehmann point estimate
CI+ -	upper bound confidence interval (a= .95)
CI- -	lower bound confidence interval (a= .95)

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Annex v. Contract amount and actual completion cost amount of some WSCP under OWEB

N o	Name of WSCP	Project started	Contract (birr)	Actual (Birr)	Rate of cost overrun	Status of projects
1	Bote-E/Shoa	2004	93,081,710.75	187,043,967.36	100	Completed
2	Tyiffe-W/Hararghe	2007	135,171,467.38	239,926,442.28	77.5	On going
3	Mino-E/Haraghe	2007	564,168,782,.7	884,162,256.05	57	On going
4	Bordode-W/Hararge	2007	141,521,720.94	198,483,249.88	40.25	On going
5	Kercha-W/uji	2013	486,824,506.50	683,157,519.70	40.33	On going
6	Babu-Jima	2009	25,472,595.53	44,153,845.94	73.33	On going
7	Bedeale-B/Bedeale	2012	146,895,971.64	248,208,228.40	69	On going
8	Dhadach rarasa-Bale	2012	475,603,390.32	680,474,815.65	43.1	On going
9	Dadar-E/Hararghe	2004	175,758,306,66	395,896,914.95	125.3	On going
10	Kebe- K/Wollega	2009	150,675,345	250,765,644	66.4	On going
11	Ficha'a-HGW	2009	170,265,349	425,689,320	150	On going
12	Wachile-Borena	2011	518,432,187.50	982,211,120.50	89.46	On going
13	Chanco- N/shoa	2012	435,643,270	712,654,912	64	On going
14	Sululta-SZ Sourr.Finf	2009	320,234,564	797,876,675	149	On going
15	Asalla- Arsi	2012	476,342,578	912,654,987	92	On going
16	Halogoba(W/Hararge	2010	29,752,019.10	44,432,984	49.34	on going
17	Sigmo/ Jima	2014	3,671,893	14,471,076	294.1	ongoing
18	Mandii W/Wollega	2014	22,092,184	104,353,920	372.4	on going
19	Agaro/ Jimma	2014	25,120,871.58	110,182,025	338.6	on going
20	Hojja-Dure/ F.S.Z	2011	4,472,729.50	8,912,112	99.3	on going
21	Tulu Milki/N.Shoa	2011	27,427,969.58	51,316,613	87.1	on going
22	Dodola/W.Arsi	2011	86,854,249.80	152,927,393	76.1	on going
23	Kombolcha/HGW	2011	8,271,900	19,809,876	139.5	on going
24	Harato/HGW	2011	33,693,038.62	54,996,167	63.2	on going

25	Arjo/ E.Wollega	2011	8,626,218.36	23,028,664	166.9	on going
26	Anole Salam/Arsi	2011	2,292,350	8,454,462	268.8	on going
27	Oda/ Bale	2011	3,922,501.80	10,341,184	163.6	on going
28	Bonda/Borena	2007	2,177,251.29	10,513,737	382.9	on going
29	Sire Buqe/Guji	2009	3,422,977.57	6,150,312	79.6	on going
39	Awubaree/E.Harag gh	2007	2,426,415.82	8,297,323	241.9	on going
31	Oda Qabana/E.Harag h	2009	1,800,751.16	6,297,324	249.7	on going
32	Awubaree/E.Harag gh	2007	2,426,415.82	13,297,323	448	on going
33	Iddo Janata/W.Haraghe	2005	1,458,221	4,848,448	232.5	on going
34	Bage town/Jima	2014	10,405,632	21,367,403	105.3	on going
35	Qacame/N.Shoa	2011	4,910,717.24	6,680,812	126.1	on going
36	Maja Qimixa/S.W.Shoa	2009	4,628,039.65	11,261,001	143.3	on going
37	H. Gabaya/ W.Shoa	2007	4,203,700.26	10,217,617	601.4	on going
38	Gallo/ E.Wollega	2011	4,288,472	10,177,321	137.4	on going
39	Horda kawisa/E.Wellaga	2011	1,542,495	11,704,710	657.3	on going
40	Ifa-bas /K.Wallaga	2011	2,642,432.85	6,565,353	148.5	on going
41	Bokkol/ E.Bale	2011	4,165,599.99	9,321,439	123.8	on going
42	Qarcha town/Guji	2013	2,462,500	19,473,883	690.7	on going
43	Cawwaaqaa	2011	4,022,412	17,462,818	334.1	on going
44	Waadaraa/Gujii	2009	8,132,498.26	25,775,584	216.9	on going
45	Bareedi /Bale	2007	39,949,584	95,121,628	138.1	on going
46	Ajjee /W.Arsi	2012	1,080,523.82	6,300,000	483.1	on going
47	Ali-Doro/N.Shoa	2011	11,837,990.30	31,214,949	163.7	on going
48	Hamus Gabaya/S.W.Shoa	2007	4,203,700.26	10,217,617	143.1	on going

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Annex Vi. Contract time and actual completion time of some WSCP under OWEB

N o	Name of WSCP	Project start date	Contract start day	Actual day	Time overrun %	Status of projects
1	Bote-E/Shoa	2004	455	5475	622	Completed
2	Tyiffe- W/Hararghe	2007	730	3285	350	On going
3	Mino-E/Haraghe	2007	1095	3285	200	On going
4	Bordode- W/Hararge	2007	912	3285	260	On going
5	Kercha-W/uji	2013	820	1095	34	On going
6	Babu-Jima	2009	365	2555	600	On going
7	Bedele-B/Bedele	2012	760	1460	92	On going
8	Dhadach rarasa- Bale	2012	830	1460	76	On going
9	Dadar-E/Hararghe	2004	485	4380	803	On going
10	Kebe- K/Wollega	2009	765	2555	233	On going
11	Ficha'a-HGW	2009	775	2555	229	On going
12	Wachile-Borena	2011	1095	1825	67	On going
13	Chanco- N/shoa	2012	730	1460	100	On going
14	Sululta-SZ Sourr.Finf	2009	910	2555	179	On going
15	Asalla- Arsi	2012	830	1460	76	On going
16	Halogoba(W/Hara ge	2010	405	2190	441	on going
17	Sigmo/ Jima	2014	365	730	100	ongoing
18	Mandii W/Wollega	2014	415	730	76	on going
19	Agaro/ Jimma	2014	430	730	70	on going
20	Hojja-Dure/ F.S.Z	2011	365	1825	400	on going
21	Tulu Milki/N.Shoa	2011	430	1825	324	on going
22	Dodola/W.Arsi	2011	730	1825	150	on going
23	Kombolcha/HGW	2011	450	1825	306	on going
24	Harato/HGW	2011	515	1825	254	on going
25	Arjo/ E.Wollega	2011	430	1825	324	on going
26	Anole Salam/Arsi	2011	365	1825	400	on going
27	Oda/ Bale	2011	368	1825	400	on going
28	Bonda/Borena	2007	365	3285	800	on going
29	Sire Buqe/Guji	2009	369	2555	592	on going
39	Awubaree/E.Hara	2007	365	3285	800	on going

	gh					
31	Oda Qabana/E.Haraghe	2009	180	2555	1319	on going
32	Awubaree/E.Hara gh	2007	365	3285	800	on going
33	Iddo Janata/W.Haraghe	2005	180	4015	2130	on going
34	Bage town/Jima	2014	460	730	59	on going
35	Qacame/N.Shoa	2011	395	1825	362	on going
36	Maja Qimixa/S.W.Shoa	2009	395	2555	547	on going
37	H. Gabaya/ W.Shoa	2007	395	3285	734	on going
38	Gallo/ E.Wollega	2011	395	1825	362	on going
39	Horda kawisa/E.Wellaga	2011	180	1825	914	on going
40	Ifa-bas /K.Wallaga	2011	365	1825	400	on going
41	Bokkol/ E.Bale	2011	395	1825	400	on going
42	Qarcha town/Guji	2013	365	1095	200	on going
43	Cawwaaqaa	2011	395	1825	362	on going
44	Waadaraa/Gujii	2009	430	2555	494	on going
45	Bareedi /Bale	2007	550	3285	497	on going
46	Ajjee /W.Arsi	2012	180	1460	711	on going
47	Ali-Doro/N.Shoa	2011	630	1825	189	on going
48	Hamus Gabaya/S.W.Shoa	2007	395	3285	732	on going

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Annex Vii. Points on group discussions

1. Is there Lack of proper need identification or specification?

2. Is there a quality of construction materials for water supply construction projects?

3. Is there competency problem of public procurements?

4. Is there defined accountability in WSCP in the region?

5. IS there time and cost overrun in water supply construction projects?

6. Is there water supply construction design problems?

7. Is there progressive commitment of the client, contractors and consultant?

8. Is there monitoring and evaluation on time?

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Annex viii

Table of Educational level of respondents

Section	Category	Year of experience	Frequency	Frequency Percentage %
Educational Level	Diploma	8-10	2	1
	1 st degree	3- 25	100	54
	2 nd degree	7- 20	80	44
	PHD	17-21	2	1
	Total		184	100

Table of factors affect Performance of WSCP from the Interviews

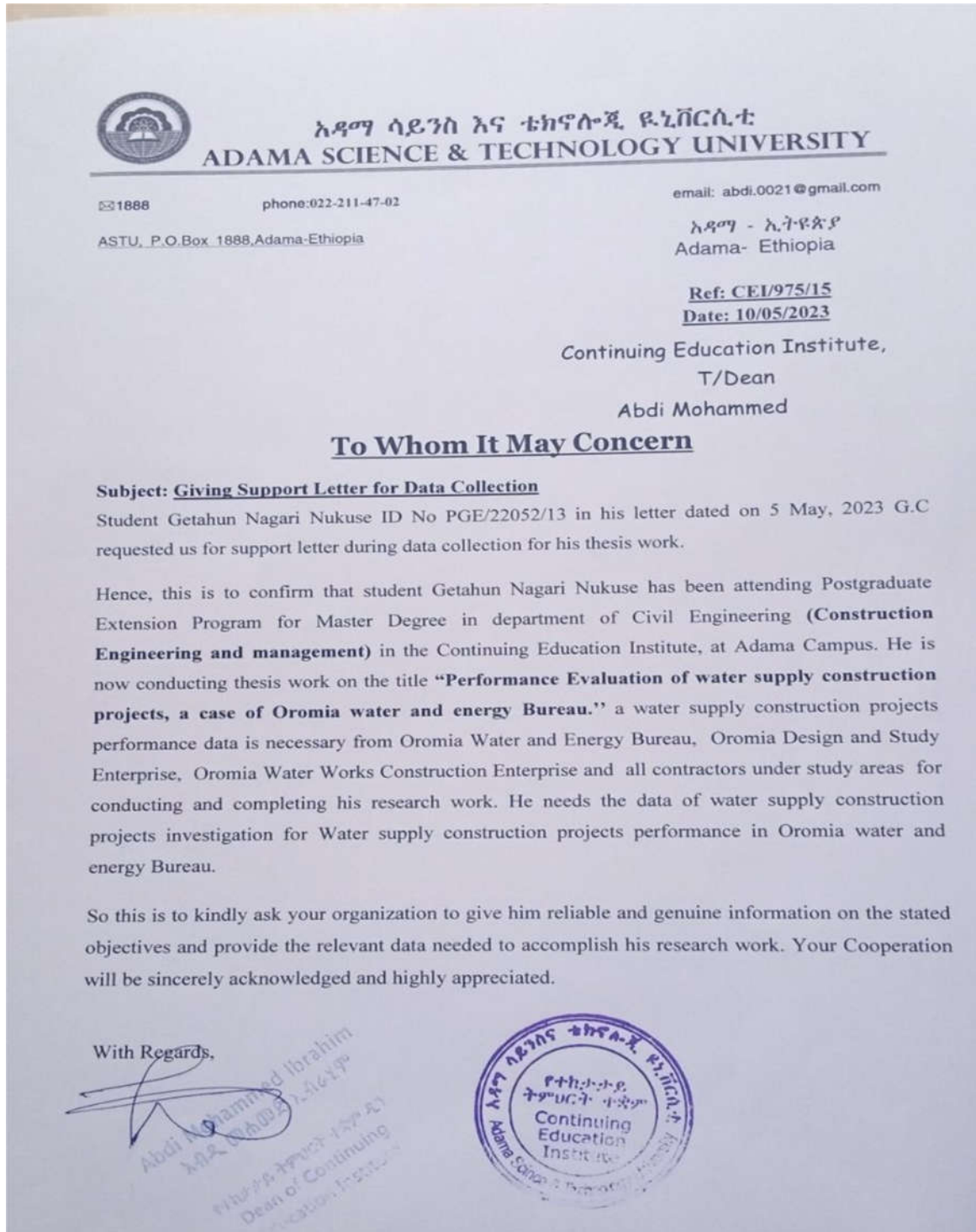
No	Factors in current WSCP practice	number of respondents
1.	Lack of clear or standard design and specifications for the needs of communities	24 =100%
2,	Lack of a clear accountability system in in the organization	23=90%
3	High corruption prevalence in the WSCP system	23=90%
4	Delays in project progress payment	21= 70%
5	Lack of professionalism among public project, consultant, contractors and client engineers,	12=50%
6	Lack of proper quality of WSCP	12=50%

Source: researchers own estimation result based on interview

Figure 2 Questionnaire distributed and returned			
Respondent	Questionnaire distributed	Questionnaire returned	Response rate
Client	48	48	100%
Contractors	48	48	100%
Consultant	48	48	100%
Stockholder	40	40	100%
Total	184	184	100%

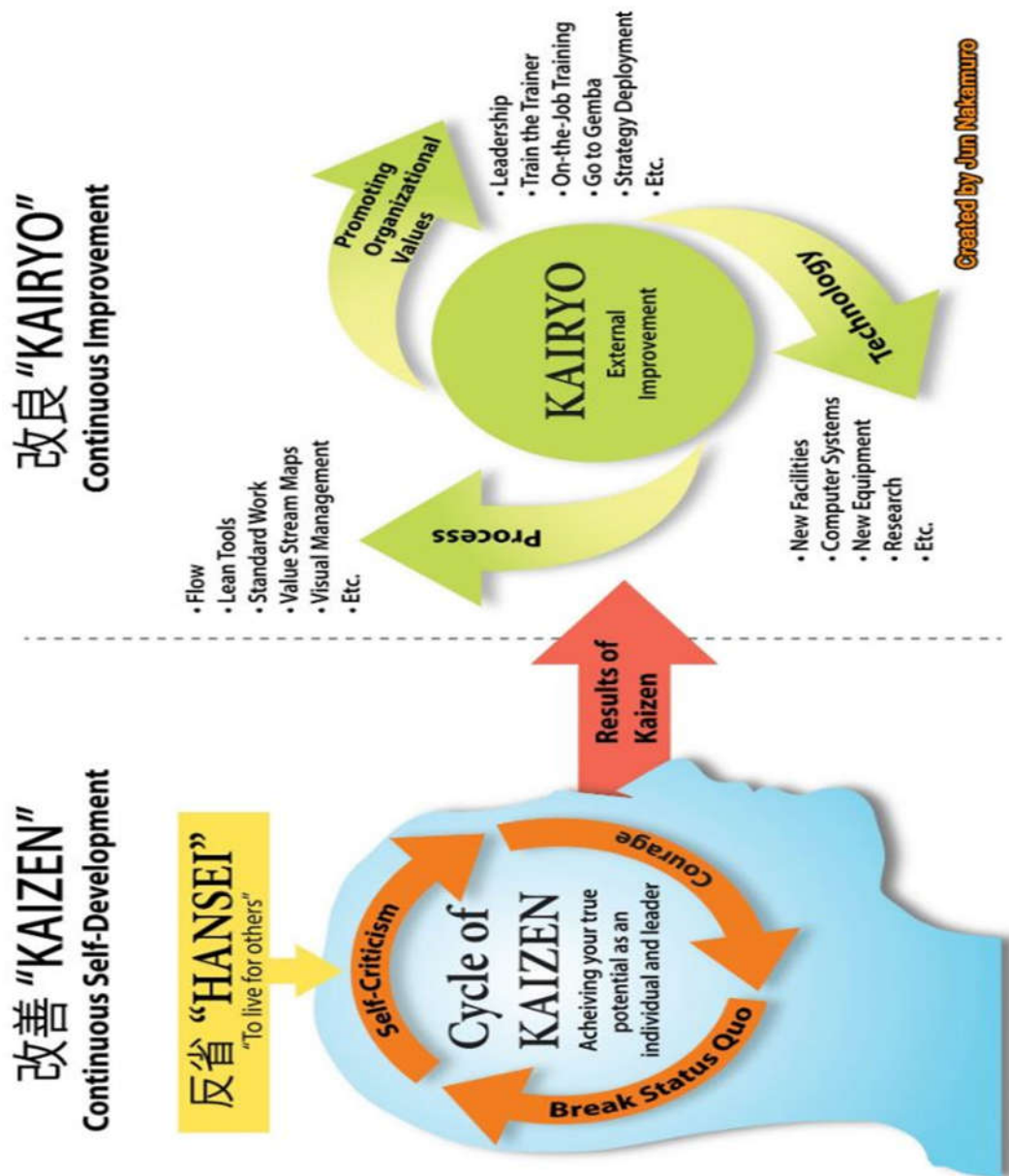
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Anbex-ix



Kaizen is a Japanese word meaning "change for better." And the original meaning of the Japanese word "Kaizen" from the Shoga kukan Dictionary could be literally translated as "The act of making bad points better."

While that is true, there is much more to it. Regardless of what you might have heard before, continuous improvement is not the sole definition of Kaizen. Instead, it is the result of it. In fact, the literal translation of continuous improvement in Japanese is "Kairyo".



Annex Xi

The 7-Step Kaizen Process (Cycle) for Continuous Improvement

The implementation of Kaizen can be accomplished through a seven-step cycle that aims to establish a culture of continuous improvement. The process involves the following steps:

1. Foster employee involvement. Encourage the participation of employees by empowering them to identify issues and problems. This approach generates a sense of ownership in the change process. Often, this is achieved by creating specific teams responsible for collecting and sharing information throughout the organization.
2. Identify problems. Utilize feedback from all employees to identify areas that require improvement or present potential opportunities. If there are multiple issues, create a comprehensive list to address each one systematically.
3. Develop a strategic solution. Foster a culture of innovation by encouraging employees to generate creative ideas. Evaluate all ideas, and select one or more winning solutions to implement.
4. Pilot the solution. Involve all stakeholders in the implementation of the chosen solution, and initiate pilot programs or other small-scale tests to assess its effectiveness.
5. Evaluate the outcomes. Regularly monitor progress and engage ground-level workers to ensure their continued involvement. Evaluate the success of the implemented change and identify opportunities for improvement.
6. In the event of positive outcomes, it is recommended to implement the solution organization-wide
7. It is advisable to continuously repeat these seven steps to test new solutions as needed or address new problem lists.