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SCHOOL OF POST GRADUATE STUDIES

DEPARTMENT OF PROJECT MANAGEMENT

**Effect of Work Efficiency in Building Construction Projects Success: The
Case of Addis Ababa Administration City**

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Declaration

I hereby declared that this thesis is my original work and that all sources of information used for the thesis have been duly acknowledged.

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Abstract

The objective of this study is to assess of Work Efficiency in Building Construction Projects in Addis Ababa Administration City. . To address the main factor that affect work efficiency, To evaluate the level of work efficiency and to identify that work efficiency is calculated in building construction projects Undertakings in Addis Ababa Administrative City of the study questions, a descriptive research design was employed with a mixed approach. This study uses both primary and secondary data i.e. questionnaire and interview conduct with key contractors or project workers that are associated with Addis Ababa Administrative City building projects side is done and as a secondary data project documentations including journal books, reports and different articles are used. The sampling design used is a random sampling, the review was done on construction site that are on-going at the hour of overview. The all out quantities of on-going building construction projects were (49). Also, from these, (32) are being built by level one (G-1) contractors, (13) of them are being constructed by level two (G-2) contractors, and (4) of them are being constructed by other junior grades. To get a delegate test size, projects which are under construction by grade one and grade two contractors were taken as data hotspot for the review. This infers that, the total number of test project is (45). The data obtained from interviews and intensively gathered project data were analyzed in both qualitative and quantitative aspects. Qualitative data were gathered through interview from construction makes men, though; quantitative data were gathered utilizing questionnaires from construction contractor experts at various hierarchical levels (project manager, site engineer, office engineer, administrator and foreman) to assess factors that influence work efficiency. There is a lack of comprehensive reported examinations regarding work efficiency in the building construction industry in Addis Ababa Administration City. The existing efficiency standards from the Ministry of Works and Urban Development (MoWUD) are outdated and do not reflect current practices and technological advancements. A comparison with MoWUD standards revealed a significant increase in output, particularly in in-situ solid slab concrete casting, wall plastering, and floor slab formwork. This discrepancy is attributed to advancements in construction methods, materials, and equipment used by contractors, such as the use of steel props and timber beam floor formwork.

Key words: *Work, Efficiency, Estimation, Contractor, Building construction, Activity sampling, Observation time*

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Acronyms or Abbreviations

AEE = Absolute Element Efficiency

EEA = Ethiopian Economic Association

ESB = Empty Substantial Block

ESE = Expert Survey Examining

MEM = Multifaceted Efficiency Measure

MoWUD = Minister of Works and Urban Development

MS = Mean Score

OECD = Organization for Economic Cooperation and Development

PMI = Project Management Institute

SPSS = Statistical Package for Social Science

TVET = Technical and Vocational Education Training

WFS = Work Force Study

Chapter One

1. Introduction

1.1 Background of the Study

At present, construction industry is filling in Ethiopia because of significant framework projects including numerous public buildings, business buildings, lodging advancement programs and so forth. The development business in Ethiopia is a crucial constituent of the economy and the convenient beginning and finishing of the genuine item meaningfully affects the conveyance. The area likewise sets out enormous business open doors there by supporting an extremely huge part of the whole workforce (Ashenafi, 2020).

There are many difficulties that are looked by the construction business in Ethiopia, and one of the significant difficulties is work efficiency. Efficiency is a primary worry of each and every association; where, viable and effective change of assets into final results oversees the productivity. Work efficiency is perhaps of the main variable that influences the actual advancement of any construction project. Development workers are capable to work an assortment of gear. To play out their positions successfully, they should be known about the obligation of other specialty laborers and with the material, devices and hardware they use (Frehiwot, 2019).

It is thusly crucial to comprehend the proportion of construction work efficiency. Besides, ongoing institutional and modern marking requires an expansion in efficiency and is in a urgent need to get the estimation of efficiency levels right. A prior study underlined that under half of the business quite measure and screen efficiency levels, with a larger part of those organizations that case to gauge. It was discussed that efficiency estimation methods could be obvious as hypothetical, since it is costly for development organizations to take on (P. Chan & A. Kaka, 2018). To completely comprehend work efficiency, it must be estimated. There are a few strategies to gauge efficiency; most of which rely upon understanding how time is successfully utilized in the development projects (R. Akhavian & Bahezadan, 2015). The work efficiency is impacted by many elements like time plan, relegated spending plan, and required quality. ID and assessment of variables influencing work efficiency are difficult issues which are experienced by the undertaking chiefs during the execution of tasks (PMI, 2018).

Recognizable proof and assessment of elements influencing work efficiency on building locales have been finished across the world, at this point in Ethiopia, there is no complete reported examinations directed on work efficiency. Study done in Addis Ababa by (Mekides, 2016), in late year was the main

report zeroed in on factors influencing work efficiency showing significantly more exertion is expected, in request to discover the legitimate elements which are more intended for our own development climate. Information and comprehension of the different variables influencing development work efficiency is expected to decide the focal point of the fundamental stages with an end goal to decrease project cost invade and project fulfillment delay, accordingly expanding efficiency and in general task execution.

This study meant to distinguish factors influencing or adding to the postponement of undertaking finishing and cost overwhelm and the remaining of work efficiency on five work things in Addis Ababa Administration City. The discoveries would be helpful devices to further develop construction efficiency in the review region.

1.1 Statement of the Problem

There are no thorough reported examinations done concerning work efficiency as for the building construction industry in Addis Ababa Administration City. As per (MoWUD, 2018) studies made are the main report that lays out efficiency principles in Ethiopia. This standard is as yet being utilized by the construction area regardless of the way that this standard requirements update. Consequently two things are missing; one is the improvement of standard by fitting logical strategies and the other is persistent refreshing of the norm with an adjustment of strategy for construction and asset capacity. With an end goal to attempt to address what is happening it was found important to do efficiency rate estimation study to lay out efficiency rate for the fundamental exchanges the construction business and study factors adversely influencing work efficiency in building construction. Since work is more factor and unusual than other task cost parts, it becomes important to grasp nearby work efficiency measure and the influences of other various variables.

Construction projects in Addis Ababa, Ethiopia, face significant challenges related to work efficiency. Although the construction industry in Ethiopia is rapidly growing, there is a lack of comprehensive research regarding work efficiency specifically within the context of building construction projects in Addis Ababa.

While the Ministry of Works and Urban Development (MoWUD) has established efficiency standards, these standards are outdated and have not been updated to reflect changes in construction methods and resource availability. This reliance on outdated standards results in a lack of reliable benchmarks for measuring and improving work efficiency in the industry.

There is a lack of comprehensive reported examinations done concerning work efficiency within the building construction industry in Addis Ababa Administration City.

Existing efficiency standards established by the Ministry of Works and Urban Development (MoWUD) are still being used by the construction sector despite needing an update. These standards are outdated and do not reflect changes in construction methods and resource capacity.

The development of new standards using appropriate scientific methods is missing, as is the continuous updating of the norm with changes in construction methods and asset capacity.

Relying on these outdated standards results in a lack of reliable benchmarks for measuring and improving work efficiency in the industry.

Limited research has been conducted on work efficiency in Addis Ababa, and what exists does not provide a complete understanding of the factors influencing productivity on building construction sites³. More effort is needed to identify the legitimate factors that are more relevant to the local construction climate.

These points highlight the **research gap**: a need for updated, context-specific knowledge regarding work efficiency in Addis Ababa's building construction projects and the factors that influence it. There is no comprehensive understanding of the specific factors impacting work efficiency in this context.

The researcher aims to fill this gap by conducting a thorough investigation to identify the most significant factors impacting work efficiency in this specific context and to develop targeted strategies for improvement. Specifically, the study seeks to address the need for updated efficiency standards, the lack of comprehensive research, and the need to identify key factors influencing work efficiency in the Addis Ababa context. By addressing these problems, the study aims to provide valuable insights, contribute to the development of updated industry standards, and guide stakeholders in implementing effective measures to enhance productivity.

The fundamental objective of this study is to Assess Work Efficiency in Building Construction Projects in Addis Ababa Administration City. The specific objectives include surveying and assessing the main factors that affect work efficiency, evaluating the level of work efficiency, and identifying how work efficiency is calculated in these projects. This involves estimating efficiency rates for fundamental construction trades and studying factors that negatively influence work efficiency.

1.3 Objectives of the Study

1.3.1 General Objective

The fundamental objective of this study is to Effect of Work Efficiency in Building Construction Projects Success in Addis Ababa Administration City.

1.3.2 Specific Objectives

The specific objectives of the study are:

1. To Survey and assess the main factor that affect work efficiency in building construction projects Undertakings in Addis Ababa Administrative City.
2. To evaluate the level of work efficiency in building construction projects Undertakings in Addis Ababa Administrative City.
3. To identify that work efficiency is calculated in building construction projects Undertakings in Addis Ababa Administrative City.

1.4 Research questions

The accompanying inquiries are advanced to assist the accomplishment of the targets with setting above:

1. What are the main factors that affect work efficiency in building construction projects Undertakings in Addis Ababa Administrative City?
2. What is the level of work efficiency in building construction projects Undertakings in Addis Ababa Administrative City?
3. How is work efficiency calculated in building construction projects Undertakings in Addis Ababa Administrative City?

1.5 Scope of the Study

This concentrate fundamentally centers on building construction projects just and didn't take in to think other construction areas. The review covers both private and public projects in Addis Ababa Administrative City which are on-going at the time of study. The review focused entirely on work efficiency and on assessing factors that make a general difference. It focuses on estimation of work efficiency on five essential building construction exchanges of work just, which are: floor slab concrete (in-situ solid slab) work, 20 cm thick Hollow Substantial Block work, stone brick work (sub-structure) work, wall putting (second coat) work and floor section formwork tasks.

1.6 Significance of the Study

Work efficiency has a basic significance for the progress of the construction business. Estimation of work efficiency information could be involved by the board for arranging, assessing, and controlling the undertaking exercises; to decide the expected length to complete different exercises as indicated by determinations and time span of the agreement; to decide the quantity of laborers to be doled out for an errand; to decide the unit rate for different tasks; and to give premise to cost control. Knowing and understanding the elements that adversely influence work efficiency in building site is essential to limit, control, and if conceivable to stay away from those variables to increment work efficiency.

For the most part, the study will make mindfulness; particularly for recently arising construction companies to know the universe of work efficiency and the reason factors. This will at last assist these companies with understanding the circumstance more than the current constructions companies.

1.7 Limitation of the Study

Focus on Specific Construction Area: The study primarily centers on building construction projects only and did not take other construction areas into consideration.

Limited to On-Going Projects: The review covers both private and public projects in Addis Ababa Administrative City which were on-going at the time of the study. It does not include completed or planned projects.

Specific Trades Studied: The study focused on the estimation of work efficiency on only five essential building construction trades of work. These trades are floor slab concrete (in-situ solid slab) work, 20 cm thick Hollow Substantial Block work, stone brick work (sub-structure) work, wall putting (second coat) work, and floor section formwork tasks. It did not include other trades like bar bending and setting work, tile work, painting work, plumbing work, electrical work, etc.

No Comparative Study of Training Backgrounds: Although the study noted that most skilled laborers were trained informally on-site. It did not perform an efficiency analysis specifically comparing officially trained workers (from TVET) and informally trained workers (trained on-site by seniors).

Limited Scope for a Comprehensive Database: While the study provides measured efficiency rates for five specific activities, there is a need for additional examinations on work efficiency in the Addis Ababa construction industry to set a work efficiency normal result based on genuine site estimation. This suggests the study itself is not extensive enough to establish a comprehensive industry-wide database.

1.8 Operational Definition

Cronbach's Alpha: is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability.

Frequency: the frequency (f) of a particular value is the number of times the value occurs in the data.

Ordinal Scale: an ordinal scale is a positioning or a rating of information that regularly involves numbers in climbing or slipping request.

Score: refers to a method or tool used to assign scores or ratings to certain aspects or components of a research study. These scores are used to assess the credibility, quality, or level of performance of the research.

1.9 Organization of Study

This study paper is coordinated into five parts. The first chapter deals with the introduction part which encompasses, background of the study, statement of the research problem, objectives of the study, research questions, scope of the study, significance of the study, and organization of the study. The second chapter deals with the review of related literature. Chapter three focused on the research methodology whereas the fourth chapter presented the result analysis and discussion of the data. Finally, conclusions and recommendations were presented under the fifth chapter.

Chapter Two

2. Review of Related Literature

2.1 Introduction

As indicated by (PMI, 2018), the discipline of task the board can be characterized as follows: project management is the craft of coordinating and organizing human and material assets over the lifetime of an undertaking by utilizing current administration methods to accomplish foreordained goals of extension, cost, time, quality and fulfillment (PMI, 2018).

Hence, project management the board focuses to design, sort out and control to make a project effective. The most straightforward approach to characterizing a task as effective is to show that three essential goals have been met. These could be known as the three graces of task the executives and they are (Mekides, 2016);

Time: - Conveyance or finish at the latest the date concurred with the client

Cost: - Finish inside the planned expense

Quality: - A structure that satisfies the set guidelines of value.

This section is contains eight primary sub-parts as a writing survey. The primary sub-section portrays about efficiency and execution. The last parts outline the construction business in Ethiopia. The rest in the middle between, which are levels of construction efficiency, kinds of efficiency, work efficiency, proportions of work efficiency, factors influencing work efficiency, and efficiency file; separately.

2.2 Theoretical Literature Review

2.2.1 Efficiency and Execution

A project's exhibition can be evaluated utilizing the accompanying (Shounak, 2016):

Quality consistence alludes to meeting the details concurred in the agreement.

Plan consistence includes following through with jobs on time by adhering to the guaranteed course of events of undertaking achievements

Wellbeing consistence targets accomplishing a mishap free undertaking

Efficiency tends to the test of conveying the venture at a fair cost to the proprietor with sensible benefit to the project worker.

Efficiency is normally characterized as a proportion of a volume proportion of result to a volume proportion of info use. While there is no conflict on this overall idea, a glance at the efficiency writing and its different applications uncovers rapidly that there is neither a one of a kind reason for nor a solitary proportion of efficiency (OECD, 2018).

In the expression of (Ashenafi, 2020), efficiency is characterized by the connection between finished work set up or yields and how much exertion put in to achieve it, in the construction business. Nonetheless, contingent upon the extent of work, organizations and setting, meaning of unit of result and info can fluctuate. More often than not, yield is a unit of the actual result set up, when a unit of info is characterized by unit cost of work, hardware and material or work hours. To assess consistency, a few organizations' action "Execution Efficiency" which is a proportion of genuine work hours to planned or anticipated work hours on a venture.

Execution is one more idea that is frequently mistaken for efficiency. While efficiency is a genuinely unambiguous idea connected with the proportion between yield amount (for example delivered items) and information amount (for example assets that are consumed in the activity cycle), execution is a more extensive idea that covers both the financial and functional parts of an industry. Execution alludes to greatness, and incorporates benefit and efficiency among other non-cost factors, for example, quality, speed, conveyance and adaptability (Mekides, 2016).

2.2.2 Degrees of construction Efficiency

At this point from (Mekides, 2016), the idea of the construction cycle focuses to a requirement for proportions of construction efficiency at three levels: (1) task; (2) project; and (3) industry. Undertakings allude to explicit construction exercises like substantial situation or primary steel erection. Projects are the assortment of errands expected for the construction of another office (e.g., the construction of another business place of business) or redesign (i.e., augmentations, adjustments, and significant substitutions) of a current built office. Industry measures are for the construction area and address the absolute reach arrangement of ventures.

The essential idea hidden construction industry efficiency a measure is a correlation of the result of an errand, task, or industry with the comparing variables of creation (inputs) expected to produce that

result. The result and contributions of creation consequently comprise the fundamental parts of each and every efficiency measure. Regularly, efficiency measures are formed as a proportion of result to at least one data sources. If by some stroke of good luck one of the information sources is utilized, then, at that point, the proportion is a solitary component efficiency measure. A typical illustration of this sort of measure is yield each work hour. On the off chance that the information sources are all utilized, the proportion is a multifaceted efficiency measure (Chan P., 2018).

2.2.2.1 Undertaking Level Efficiency Measures

Errands allude to explicit construction exercises like block/block work, wall putting, substantial arrangement or primary steel erection, etc. Task-level efficiency measurements are broadly utilized in the construction business (Mostafa, 2017).

Most errand level measurements are single element measures and spotlight on work efficiency. Run of the mill task level efficiency estimates gauge how much a given result is created by an assigned team in an ordinary 8-hour. For this situation, the denominator is the quantity of hours related with an assigned "group day." Subsequently, for an assigned team day, higher result is better. For this situation higher result likens to higher undertaking work efficiency. For certain errands, hardware might be involved (OECD, 2018).

2.2.2.2 Project Level Efficiency Measures

Since a project is an assortment of errands, project level efficiency Measures are more muddled when contrasted with task level efficiency estimation. The sources of info and results for a given errand, say substantial situation, contrast from those of another undertaking, and say underlying steel erection. Subsequently, it is beyond the realm of possibilities to expect to total the singular crude errand efficiency measurements into project efficiency metric except if changes are made (Mostafa, 2017).

One method for making these changes is to involve a reference informational collection to work out pattern values for each undertaking. Data is as yet expected to compute a significant project level efficiency metric. For example, data yielding the errand weight (share that it addresses to the general project) is expected, just like a comprehension of the undertaking streams. Since certain undertakings are finished in equal, while other in series, the organization of the errand streams influences generally speaking project efficiency. In this way, every part of the undertaking efficiency metric contains: (1) the errand weight; (2) the crude undertaking efficiency gauge esteem in the denominator; (3) the crude undertaking efficiency an incentive for that venture in the numerator; and (4) a proportion of the errand

blend (in equal versus in series task streams). The task efficiency list esteem is an element of the singular parts (PMI, 2018).

The project level efficiency metric just portrayed is valuable in estimating how a singular project thinks about to the general typical in the reference informational index. Likewise, information from all projects can be incorporated into a circulation. Further examinations can then be directed to distinguish attributes related with the best performing or most horrendously awful performing projects (Mekides, 2016).

2.2.2.3 Industry Level Efficiency Measures

Industry level efficiency measures can be produced for various building types or framework types. For each building or framework type, efficiency measures can be made, and these efficiency measures can act as benchmarks for specialists who participate in such ventures. Industry level efficiency measures can be either single component (for example work) efficiency or multifaceted efficiency. Expansions in labor efficiency might be because of expansions in labor quality or work endeavors. Be that as it may, it can likewise increment essentially because of different factors, for example, innovation, in any event, when work quality and laborer endeavors are held steady (Mostafa, 2017).

2.2.3 Sorts of Efficiency

According to (Chan P., 2018), referenced that there are three sorts of efficiency, in particular single element efficiency, absolute component efficiency, and complete efficiency. Then again, (Attar et al., 2018), show that efficiency measures can be placed into two classifications: Single Variable or Incomplete and Multifaceted Efficiency Measures (MEM).

And furthermore per crafted by (Odesola et al., 2019), it tends to be estimated in light of two general classifications of single component efficiency like Normal Work Efficiency (Snowcapped mountain) and Multifaceted Efficiency or Absolute Element Efficiency (AEE). While single component efficiency estimates the effect of one information (for example work), multifaceted or absolute element efficiency estimates the effect of all contributions on yield.

2.2.3.1 Single Variable Efficiency

Single variable efficiency measures connect with specific proportion of result to a solitary proportion of information, for example, work or capital (Attar et al., 2018). Single component efficiency is a proportion of results to one sort of information. For instance, work efficiency is the proportion of results to work input. Additionally, capital efficiency is the proportion among results and capital info. Single

element efficiency is broadly utilized as proportions of financial proficiency and enjoys basically the benefits of effortless however it experiences a shortcoming in that it does exclude the complete useful cycle and it doesn't sufficiently manage the effect of mechanical change and variable replacement (Mostafa, 2017).

2.2.3.1.1 Work Efficiency

Work efficiency is the most generally utilized proportion of functional productivity. This doesn't suggest that work is the best information component for efficiency estimation yet just mirrors the trouble or inconceivability of getting mathematical qualities for different determinants of efficiency. In this manner, large numbers of the articles on efficiency appear to expect that work efficiency is the main reasonable measure. One normal proportion of normal work efficiency is a proportion of result for each work (Shounak, 2016).

According to (Odesola et al. 2019), saw that, there is neither an agreement concerning the significance nor a generally acknowledged proportion of efficiency and that the reverse of work efficiency, worker hours per unit (unit rate) is likewise ordinarily utilized.

Execution factor, creation rate, unit individual hour (p-h) rate and different measures might be utilized to depict efficiency in the construction business. In any case, the most dependable proportion of efficiency is the result each man-hour accomplished by the specialists at the building site (for example work efficiency) (Mojahed M., 2020).

2.2.3.1.2 Capital Efficiency

According to (Mostafa, 2017), Capital efficiency is typically characterized as far as a rate return on capital contributed, either utilizing a conventional technique, for example, normal pace of return or a limited income strategy, for example, the inner pace of return technique. To compute capital efficiency, a gauge will be expected of the worth of the proper capital stock. Issues exist since various techniques for esteeming capital resources exist and since all evaluations will be somewhat emotional, in that the directors of an organization might have an alternate view from the investors, as may a potential resource client. Regardless, such data is probably not going to be promptly accessible. Capital efficiency is in this manner less generally utilized than work efficiency.

Regardless of these viable hardships, capital efficiency is an undeniably more valuable basis than work efficiency for passing judgment on the exhibition of an undertaking working inside a market economy. Most confidential firms will try to guarantee a sufficient profit from capital contributed to their

investors; in this way, an exceptional yield on capital contributed is undeniably more significant than high results per usable (PMI, 2018)

2.2.4 Absolute Component Efficiency

To conquer the limits of the single variable methodologies, absolute factors efficiency estimation was created. Complete element efficiency is the proportion of net result to the amount of related work and capital info (Kaka A., 2018).

In the expression of US Intergraph Enterprise (2019), MEM connects with a specific proportion of result to a gathering of data sources, or all out inputs utilized. These actions are not free of one another. For instance, it is feasible to distinguish different main thrusts behind work efficiency development, one of which is the pace of MFP change.

2.2.5 Work Efficiency

Work is a secret weapon on building projects. Nonetheless, to see full monetary worth from work, efficiency issues should be tended to in all contracting associations. Efficiency is one of the critical parts of each and every organization's prosperity and seriousness in the market (Chigara B. and Moya T., 2021).

Despite the various investigates on work efficiency there is no agreement among researchers and experts with respect to the definition and estimation of construction work efficiency. The Association for Monetary Co-activity and Improvement characterizes efficiency as a proportion of a volume proportion of result to a volume proportion of information use (OECD, 2019).

As per Attar et al. (2018), efficiency in construction is typically interpreted as meaning work efficiency. This stems from the way that construction projects are for the most part work based with fundamental hand instruments and gear. Furthermore, efficiency means the estimation of how well a singular substance utilizes accessible assets to create yields from inputs.

The American Relationship of Cost Specialists characterizes efficiency as a "relative proportion of work productivity, either positive or negative, when contrasted with a laid out base or standard" (US Intergraph Corporation, 2019). Work efficiency reflects how proficiently work is joined with different variables of creation, the number of these different data sources are accessible per laborer and how quickly typified and incorporeal specialized change continue (OECD, 2019).

2.2.6 Measures of Work Efficiency

There are two basic roles for estimating efficiency: (1) to control project cost and timetable; and (2) to acquire information for arranging future undertakings. The three most normal measurements to portray efficiency are factor efficiency or unit rate (the proportion of work, material, and gear expenses for units of result); work efficiency (the proportion of work hours to units of result); and efficiency factor (the proportion of timetable to genuine work hours) (Gouett et al., 2020).

For the most part, the idea of efficiency estimation is established in what is called work study or time-and-movement study. Work study is a classification of tasks the executives yet it is fundamentally not quite the same as activities research (Mostafa, 2017). According to (Odesola et al., 2019), considered work concentrate as the coordinated investigation of work frameworks for the motivations behind finding and normalizing the most minimal expense strategy, deciding standard times, and helping with preparing in the favored technique. The idea targets further developing efficiency by looking at exhaustively specific pieces of a framework instead of the framework overall. A work concentrate on comprises of two primary parts: a strategies study and a work-estimation study. Work-techniques study (in some cases called a movement study) includes tracking down the favored strategy for accomplishing the work while work-estimation or time study is utilized to decide the standard opportunity to play out a given errand.

Chigara B. and Moya T. (2021) recognized two most significant proportions of work efficiency as: the viability with which work is utilized in the construction cycle and the general effectiveness of work doing what it is expected to do at a given overall setting. Notwithstanding, they contended that workers for hire are more worried about the last option, that is to say, the overall proficiency of work.

Work productivity is the foundation of most delicate appraisals, as well as the benchmark by which execution is estimated and checked. Be that as it may, to further develop work adequacy different variables ought to be tended to; including inspiration, work wellbeing, ecological elements and actual impediments (Gouett et al., 2020).

A portion of the normal work-estimation strategies for efficiency estimation and getting data about the time spent on useful and non-useful exercises by laborers are; work samplings, brief evaluations, specialists polls, foreman postpone overviews, time pass photography or video accounts, and gathering timing procedures (Odesola et al., 2019).

Work efficiency estimations strategies are work samplings, brief appraisals, field rating, foreman postpone reviews, time studies, nonstop time study, general media, time pass photography, and gathering timing procedures (Kisi, 2019).

Workface evaluation strategies, similar to foreman postpone reviews and expert questionnaires; have been created trying to distinguish efficiency issues right away. In any case, neither foreman defers reviews nor specialist polls measure every type of effort levels of an art laborer. Ceaseless perception is a method that evaluates every type of effort levels yet is rarely utilized because of the uneasiness caused to make laborers. Because of this worry, work examining was applied in the development business as a way to recognize pain points in a reasonable way than the efficiency measurements (Gouett, 2020).

Per the exploration of (Mostafa, 2017), there are two unique procedures of creating work efficiency guidelines, bookkeeping based and designing based technique. Bookkeeping put together norms depend with respect to the examination of authentic bookkeeping information to lay out work hour necessities for explicit sort of work while designing based principles include separating complex work processes into little sensible parts and breaking down these parts for the period of time expected to finish these cycles.

There are four efficiency estimation strategies frequently utilized for estimating work efficiency in development projects. These techniques are time study, action inspecting, expert poll, and

2.2.6.1 Work Estimation Procedures

There are many kinds of work estimation strategies recorded in various examinations. Also, out of those sorts just time study, work examining/movement testing, foreman postpones reviews; expert's surveys, brief evaluations, and field rating are talked about in this paper. Foreman postpones review (Ashenafi, 2020).

2.2.6.1.1 Time Study Procedure

Time study, as evolved by Frederick W. Taylor in 1911, is characterized as the most common way of deciding the time expected by a talented, thoroughly prepared administrator working at a typical speed doing a particular errand. The motivation behind time studies is to set time norms in the creation region and record the steady seasons of the different advances or assignments that make up an activity (Kisi, 2019).

Time study is a procedure that utilizes stopwatches as well as camcorders to decide efficiency yields. Notwithstanding, there are various difficulties experienced while utilizing this strategy. Absence of work-concentrate on encounters impacted the utilization of this procedure in non-industrial nations (Moya et al., 2021).

Time study was the essential way to deal with efficiency improvement presented by Taylor and Gilbert in the late nineteenth and mid twentieth hundreds of years, and it is the standard strategy of work estimation even today. Time study is utilized to decide the time expected by a certified and thoroughly prepared individual working at ordinary speed to do a predefined task (Shounak, 2016).

The primary benefit of time studies is that it is extremely financially savvy and simple to utilize. It requires a stopwatch and a span clock that can record a predetermined grouping of occasions. In any case, the significant disadvantage is that it tends to be valuable provided that the movement includes a couple of laborers or machines. It is intrinsically challenging for a solitary onlooker to cover exercises precisely when it includes a significant time of perception over various cycles. A limit of five laborers in a team for every onlooker is suggested (Chigara B et al., 2021).

2.2.6.2 Work Examining/Action Inspecting Procedure

As (Mostafa, 2017), noticed that, movement testing can be characterized as a strategy in which an enormous number of immediate observations are made throughout some undefined time frame of laborers, machines, or cycles. Every perception records what's going on right then and there and the level of observations recorded for a specific movement or postponement is a proportion of the level of time during which that action or deferral happens. According to (Picard, 2018), expressed that perceptions should be irregular and liberated from predisposition or precise observation mistakes that will more often than not run in a similar heading. And furthermore the more noteworthy the quantity of observation, the more precisely will testing results surmised genuine circumstances.

Work examining is a viable approach to social event information to quantify and order the use of specialty laborers time on construction projects. During work testing on a place of work, create laborer's action time is characterized into either direct work or useful work, steady work or semi-useful work, and non-useful work or inadequate work to recognize specific regions that require improvement (Shounak, 2016).

The work examining includes occasional observations of laborers, machines, or cycles to break down an undertaking. Rather than managing the entire populace, the system is to gather an example, examine it, and construct a certainty limit around it (Kisi, 2019).

Movement testing is a strategy through which data can be gotten rapidly and monetarily as well as to foreordain level of precision. A strategy estimates the time work spent in different classes of exercises. Movement examining is otherwise called (Picard, 2018):

Proportion survey;

Observation proportion;

Snap understanding technique;

Irregular perception strategy; and

Work examining.

Work examining is a measurable strategy that can be really utilized for breaking down the construction and upkeep work process. The application has demonstrated compelling on many development and support projects, accomplishing work cost reserve funds of 20 to 30 percent, and more (Picard, 2018).

Work inspecting is a strategy that should give important data to a construction manager with respect to areas of low efficiency that need restorative activity (Thomas H & Daily H., 2019).

According to (Liou and Borcharding, 2018), in USA measurably checked the viability of work examining in exhibiting genuine work execution and furthermore revealed that it gives ideal data to the board to decide if restorative activity or nitty gritty review is expected to accomplish a more serious level of effectiveness. In India, further concentrated on that work testing had been acknowledged as a significant strategy for surveying the efficiency of labor force in building destinations (Joshua and Varghese, 2017). In Palestine, used action examining to embrace efficiency estimation benchmark for block work to further develop construction efficiency (Enshassi et al., 2019). In Nigeria, utilized action testing to decide the work result of painting movement so as to lay out a norm for the monetary worth of a painter's everyday result (Udegbe, 2018). In Canada, report on a system to foster group level efficiency examination utilizing work testing as they suggest it being less expensive, simple to take on and ready to benefit fast data (Tsehaye and Feyek, 2017). In addition to, work testing has gotten expanded accentuation as chief's battle to control development costs as its straightforwardness and

minimal expense makes it a strong strategy for efficiency improvement (Bandyopadhyay and smith, 2019).

The principal benefit of utilizing movement examining is that it permits a bigger number of machines or men to be learned at one time that cannot be overseen utilizing a ceaseless time study. This prompts a more extensive image of the productivity of a specific activity than that got from a more focused yet persistent concentrate on a more modest gathering (Mostafa, 2017).

2.2.6.3 Foreman Defer Study

Foreman defer study (FDS) is one such strategy by which creation issues are uncovered by foreman's through the recognizable proof of causes and evaluation of postpones in the day to day daily practice of their labor force. The basic role of this method is to feature issues that are outside the obligation and control of individual foreman (OECD, 2018).

In the expression of Kisi (2015), there are frequently improves and delays at a building site. The deferral might be a material postponement, looking out for hardware, or hanging tight for different groups, while the revamps may be because of plan mistakes, plan changes, field blunders or harm. The standard approach to following this sort of postpone data is by finishing up some sort of poll overview. Foreman postpone overview depends on a poll, which is to be finished up by the gig foreman toward the finish of a functioning day as per a specific study plan, e.g., multi week in every month. When the overview is gathered, data, for example, the deferral of improve is separated and introduced with regards to rates. This rate will assist the board with recognizing the quantity of hours of a day lost because of deferrals and give prominent data.

The fundamental benefit of a foreman defer review is that it is a somewhat minimal expense strategy for examining the wellsprings of postponement during construction. This technique is adaptable and simple to carry out. The drawback is that it just measures misfortunes because of postponement and revamp and doesn't work with other boundary estimations helpful for deciding effectiveness of exercises (Odesola, 2019).

Contingent upon situation FDS can be led in more than one way like day to day, with week by week announcing, day to day for quite some time, or on a case by case basis. The aftereffects of FDS will show the significant reasons for work delay for each art and the quantity of hours lost and by corresponding the announced lost time with the reasons for delays, project the executives can make a move to determine the issues and to dispose of the deferrals. The review is generally utilized on the

grounds that it is straightforward and foreman can finish the structure shortly yet the expected shortcoming of this procedure is found in the study dependence on gross assessments by foreman of how long they really lose and consequently there is uncertainty on its legitimacy (Attar et al., 2018).

2.2.6.4 Expert Survey

Specialist survey (CQ) used to explore the issues that unfavorably influence laborer's efficiency and inspiration. The poll ordinarily expects experts to appraise loss of time because of different causes, positioning the seriousness of the issues and give likely answers for efficiency issues. One more way to deal with CQ has been called expert survey examining (ESE) by which an example of laborers chose and questioners question them about a movement in which they were locked in (Moya T., 2021).

2.2.6.5 The Five-Minute Rating

Kisi (2015), characterized the five-minute rating strategy as a fast and less precise evaluation of action that depends on the summation of the perceptions made in a short report period, with the quantity of perceptions generally excessively little to offer the factual dependability of work examining. The onlooker that does a five-minute rating ought to have a watch and a structure for recording perceptions during work. The upside of this procedure is that since the laborers won't know whether they are being watched, the specialists won't respond to the eyewitness' presence. Extended the definition as though the postponement noted for a person in any block of time surpasses 50% of the time of perception, then, at that point, the rating for that individual is grouped under delay; on the off chance that not, then the suitable block is classed as successful.

At long last, the viability rate for the entire team is found by duplicating 100 to the proportion of the amount of compelling times for every person and for the group partitioned by the absolute season of perception, which is additionally called the adequacy proportion. The detriment of this strategy is that this procedure did not depend on factual examining hypothesis and depends on just noticing an activity for a brief time frame. Likewise the outcome doesn't matter to reaching determinations from the huge examples and may not be taken as a dynamic instrument (Mangore et al., 2021).

2.2.6.6 Field Rating

The basic idea of field rating, otherwise called the efficiency rating, is utilized to gauge a development activity at movement level; in any case, the rating gives just an unrefined assessment. The field rating strategy arranges the noticed laborer into various stages: either working or non-working; and powerful,

contributory, or not-valuable work, or inactive. The activities are compelling or working provided that they enhance total the occupation (Mojahed M., 2020).

2.3 Empirical Literature Review

2.3.1 Factors Influencing Work Efficiency

Throughout the long term, the elements impacting construction efficiency have been the subject of request by numerous analysts. The frequencies and significance of these variables changes starting with one country then onto the next and starting with one venture then onto the next. A few methodologies have been embraced corresponding to the characterization of elements influencing construction efficiency. Different variables have been recognized by various scientists from a long time back that influence construction work efficiency in created nations, for example, Canada, UK, New Zealand and emerging nations like Nigeria; Indonesia, Malaysia, Palestine, Kuwait, Thailand, and Uganda. Extensively, work efficiency is impacted by outer and interior elements, addressing those external the control of the company's administration and those beginning inside the firm separately (Chigara B. et al, 2021).

Per the examination of Enshassi et al. (2019), the concentrate on factors adversely influencing work efficiency in the Gaza strip, noticed that the ten most significant factors adversely influencing work efficiency are: material deficiencies; absence of work insight; absence of work reconnaissance; misconception among work and directors; drawings and detail modifications during project execution; installment delay; work unfaithfulness; review delay; working seven days out of every week without occasion; and device/gear deficiencies. One more review done on factors influencing efficiency in Nigeria uncovered that low wages positioned top firmly followed by absence of materials and threatening working climate (Haruna et al., 2019).

2.3.2 Efficiency List

In the past efficiency changes over the long run were first estimated utilizing a 'file' approach. This approach includes the development of record numbers which can be utilized to demonstrate the fractional or all out factor efficiency of an industry. Incomplete efficiency markers enjoy the benefit of being not difficult to figure, require just restricted information and are naturally straightforward. They can, notwithstanding, be misdirecting while checking out at the adjustment of efficiency of a firm or industry. For example it very well may be workable for an organization to raise efficiency as for one contribution to the detriment of lessening the efficiency of different information sources. Records of

result to work, for example, frequently will generally exaggerate the construction of absolute component efficiency (that is the joined efficiency of work, capital and different variables). Further, capital efficiency measures are hard to work out given the trouble in estimating capital data sources, and the frequently extremely lengthy existence of certain resources (Briscoe G., 2016).

2.3.3 Outline of the construction Business in Ethiopia

2.3.3.1 The Role of the construction Business

In Ethiopia, the construction business is creating at a quick speed. Simultaneously, resulting movement of construction companies is universally noticed. In our nation Ethiopia, the rising interest for the construction business has followed a comparable example as seen in the pattern of the world. Presently, construction is one of the areas driving the way towards modernization and industrialization in Ethiopia (Mekides, 2016).

As referenced on EEA (2020), the job of the construction business in the Ethiopian economy has the accompanying commitments.

Commitment to public pay

The construction business has significant commitments to the Ethiopian economy, as shown by its portion in the Gross domestic product. For example, the portion of the area in the complete Gross domestic product found the middle value of at around 5.2 percent in the period 2002/03 - 2006/07 the area has enlisted generally higher development when contrasted with the development of Gross domestic product during this period. Over this period, there has been expanded venture on the turn of events and development of different foundation projects like streets, air terminals and private and non-private lodging units.

Commitment to business

The job of the construction business as far as setting out work open doors particularly in urban regions is becoming apparent. As per the 1999 Work force Study (WFS), of the absolute utilized people in the country which was assessed at around 25 million, 0.9 percent was assessed to be in the construction business. The commitment of the business as far as making work has somewhat worked on throughout the long term. For example, as per the 2005 WFS, of the all-out utilized populace in the country (31.4 million), 1.4 percent was assessed to be in the construction business.

Commitment to government income

The construction business additionally adds to the age of income for the public authority. The rental personal assessment is one of the significant income sources inside the construction business to the public authority. The rental personal expense which was Birr 15.2 million out of 1997/98 has expanded to Birr 78.3 million of every 2004/05 yet brought down to Birr 32 million out of 2005/06 producing almost a portion of a rate point of the all-out government income in the period 1997/98-2005/06. However there are numerous other immediate and backhanded incomes that are produced from the construction business, the scarcity of information has restricted this report to show the complete income that is created.

Multiplier impact

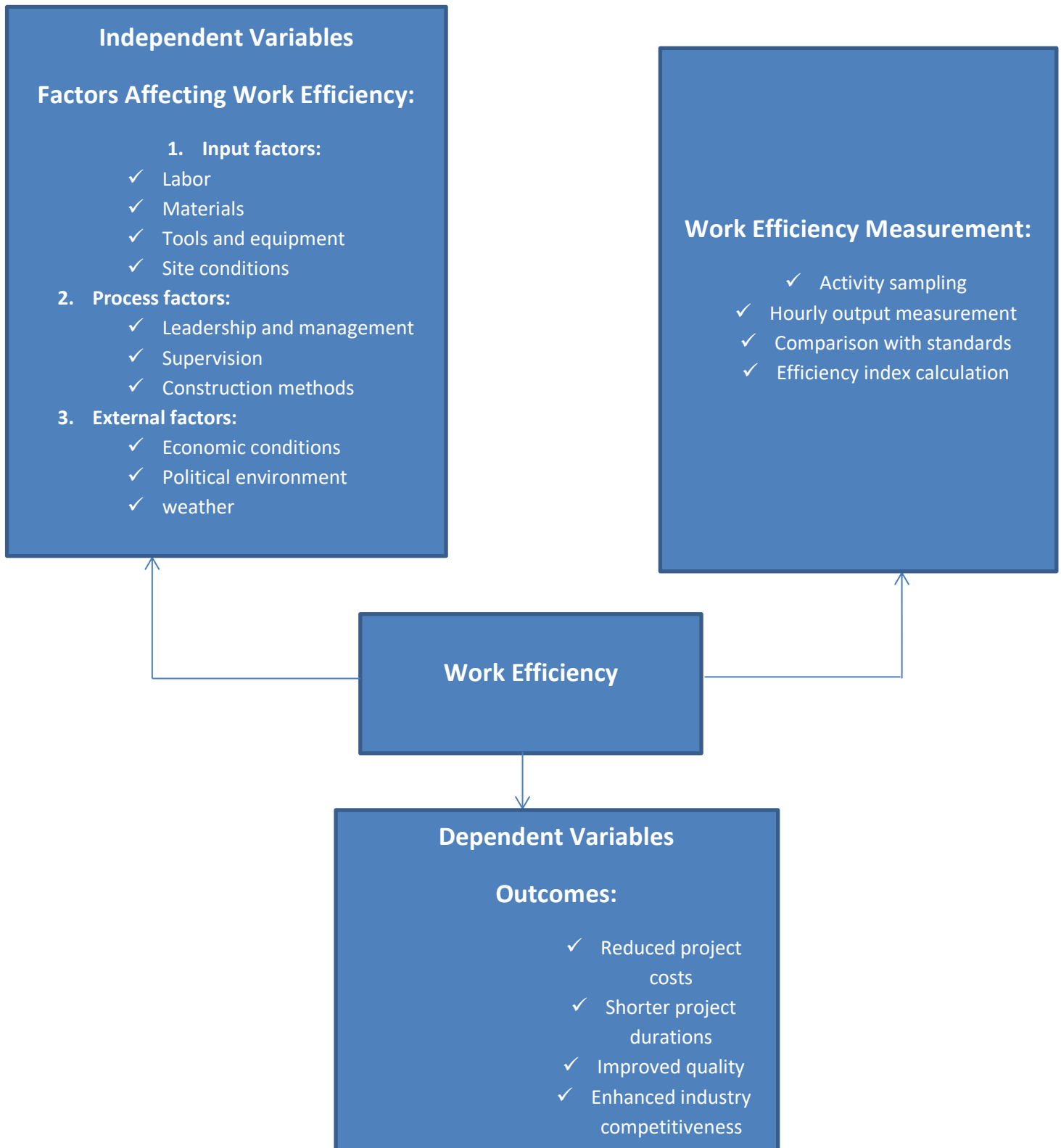
Exact investigates support areas of strength for the between the construction business and other financial areas. The construction business creates one of the greatest multiplier impacts through its broad in reverse and forward linkages with different areas of the economy. The World Bank as cited in (EEA, 2020) additionally contends that the significance of the construction business originates from major areas of strength for it's with different areas of the economy.

2.3.3.2 Efficiency in the Ethiopian construction Industry

Different explores show that the construction projects the board in Ethiopia isn't logical. In accordance with this as it was affirmed during past examinations the exhibition of most construction projects were bad. The presentation of undertakings was generally estimated with the propensity of activities to be finished inside the predefined time, planned cost and quality norms expressed in the particular and agreement reports. The effect of low work efficiency on the presentation of construction projects is a critical variable that brings down the general execution of the project (Mangore et al., 2021).

2.4 Conceptual Framework of the Study

Figure 2.1: Conceptual Framework of the study



Source: Field study, 2025

Chapter Three

3. Research Methodology

3.1 Introduction

In this section, a point by point methodology and tools used are described. The main topics included are research design, questionnaires design, research population, sampling, data collection, analysis method, reliability of measures, and pilot study.

3.2 Research Design and Study Map

For the review, information was gathered from both primary and secondary sources. The primary data were gotten through work/activity sampling technique, questionnaire and interview coordinated to contractors that are associated with Addis Ababa Administrative City building projects. The secondary data were acquired from recently done different investigates, web sources, journals, books, reports and different articles. The secondary data were utilized as a hotspot for problem identification and measures setting for the turn of events and resulting examination of the primary information. Qualitative data were gathered through interview from construction makes men, though; quantitative data were gathered utilizing questionnaires from construction contractor experts at various hierarchical levels (project manager, site engineer, office engineer, administrator and foreman) to assess factors that influence work efficiency. Movement inspecting alongside the actual estimation of result each hour was utilized for efficiency data gathering.

3.2.1 Study Map

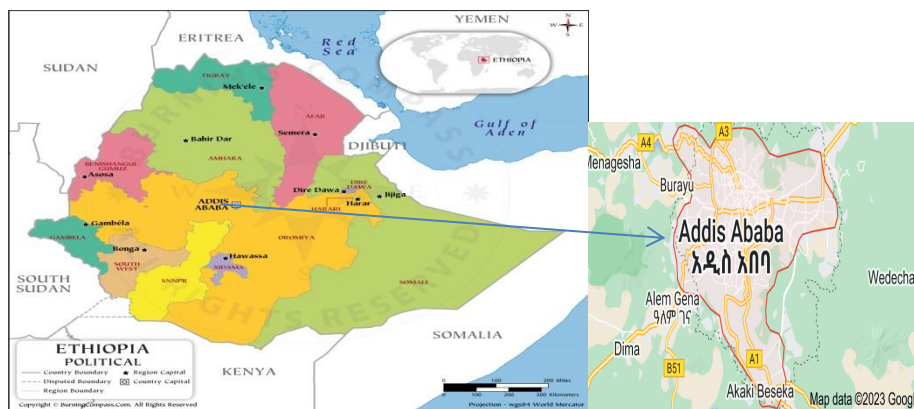


Figure 3.1: Location of Addis Ababa city

Source: Google map (2024)

3.3 Data Collection Methods

3.3.1 Questionnaires

Questionnaires were planned in view of the way that it must be straightforward, clear and justifiable for the respondents and simultaneously they ought to be interpretable by the analyst. The questionnaire contains only close ended questions. It had various options of potential responses and the respondents chose anything they believed was generally fitting. The close ended questions were chosen since they are simpler to reply and survey.

3.3.2 Interview

Interview questions were directly asked to the official by face to face interview with respondents. These questions are also attached on the appendix.

3.4 Study Population, Sampling Techniques and Sampling Size

3.4.1 Study Population

Study or target Population refers to the set of all elements belonging to a certain defined group to be studied or to which research results are going to be generalized to (Haimanot, 2017). The target population of this study is considered to be actors of the construction industry that are engaged in on-going building construction projects in Addis Ababa city Administration from all building department's top and middle organizational managers, project managers, construction engineers, and office engineers, follow up engineers, and site engineers. Therefore, the target populations for this study are project manager, office engineer, site engineer and foreman. These individuals were selected from both private and public projects that were ongoing at the time of the study within Addis Ababa Administrative City. The study aimed to gather data from these key personnel associated with the building projects.

3.4.2 Sampling Techniques and Sampling Size

Sampling is the method involved with choosing various review units from characterized concentrate on population. Since, it is accepted that anybody can respond to the subject of this study out of on-going building construction projects in Addis Ababa city Administration saw at the hour of the review and to expand the possibility being chosen; random selection is utilized. The review was done on construction site that are on-going at the hour of overview. The all out quantities of on-going building construction projects were (49). Also, from these, (32) are being built by level one (G-1) contractors, (13) of them are being constructed by level two (G-2) contractors, and (4) of them are being constructed by other junior

grades. To get a delegate test size, projects which are under construction by grade one and grade two contractors were taken as data hotspot for the review. This infers that, the total number of test project is (45).

A stratified sample can be defined as one in which every member of the population has an equal chance of being selected in relation to their proportion within the total population (Denscombe, 2007:14). A stratified sampling is chosen as the target population comprises of two strata, managerial staff and non-managerial staff. If the population from which a sample is to be drawn doesn't constitute a homogeneous group, then stratified sampling technique is applied so as to obtain a representative sample (Kohtari, 20004). Therefore, in this study the research will used stratified sampling techniques.

Therefore, for this research the researcher will be adopted stratified sampling to gather the research data.

Subsequently, a delegate test was drawn from the complete population utilizing Mostafa (2017), example size computation equation at 95% of certainty level;

$$m = \frac{Z^2 x P^* (1-P^*)}{\epsilon^2} \dots\dots\dots (3.1)$$

ϵ^2

$$n = \frac{m}{N}$$

$$1 + \frac{m-1}{N} \dots\dots\dots (3.2)$$

N

Where:

m = sample size of unlimited population

n = sample size of limited population

$Z = 1.96$ for 95 % confidence level

$P^* =$ Degree of variance between the elements of population (0.5)

$\epsilon =$ maximum error of the point estimate

Number of observations expected to decide the extents of useful, contributory and non-productive or useless times of in-situ substantial projecting (solid slab) work, ESB laying work, stone workmanship

laying work (sub-structure), wall plastering/putting work, and section formwork posse were determined from the accompanying condition (Enshassi et al., 2019).

$$N = (Z^2 * P * (1 - P)) / L^2 \dots\dots\dots (3.8)$$

Where:

N = sample size

Z = value obtained from statistical tables depending on the confidence level. This research used 95 % confidence level (Z = 2).

L = limit of accuracy which will be ± 5 %

P = percentage of activity observed; P = 0.5; the value of proportion of the total operation being observed, for construction work usually falls within the limits of 0.4 to 0.6 (Mostafa, 2017).

Substituting P = 0.5, L = 0.05 and Z = 2 into equation-3.8 gives:

$$N = (22 * 0.5 * (1 - 0.5)) / 0.05^2 = 400$$

Subsequently, if $N \geq 400$ is utilized, all potential extents of P would meet the exactness standards and which permit measurably huge outcomes to be gotten. A central rule of work testing is that the quantity of observations is relative to the level of time the work force is participated in an action. Test size of N is taken to appraise the extent P. Further to action inspecting, evaluation of gifted work efficiency each hour was recorded through genuine actual estimation of the work.

3.5 Method of Data Analysis

The analyses of the data acquired from questionnaires were performed involving statistical Package for Social Sciences (SPSS) Variant 22 in light of the picked estimation scale. The data that were examined and deciphered with the SPSS are introduced as tables, figures and graphs to delineate the outcomes for a simple seeing plainly.

The most famous scales are nominal and ordinal. Nominal scale is a numbering that infers to an order. Then again, ordinal scale is a positioning of rating information that typically involves numbers in rising or plummeting request (Odesola, 2019).

In this examination, ordinal scales were utilized. An ordinal scale is a positioning or a rating of information that regularly involves numbers in climbing or slipping request. The numbers allotted (1, 2, 3, 4, and 5) are basically mathematical names.

Dissecting the data utilizing ordinal scale, an overall significance index (RII) was utilized. RII can be registered with the accompanying condition (Picard, 2018).

$$RII = \frac{(5n_5+4n_4+3n_3+2n_2+1n_1)}{5(n_1+n_2+n_3+n_4+n_5)} * 100 \dots\dots\dots (3.3)$$

Where:

n1 = number of respondents who answered "little effect"

n2 = number of respondents who answered "some effect"

n3 = number of respondents who answered "average effect"

n4 = number of respondents who answered "high effect"

n5 = number of respondents who answered "very high effect"

We can likewise compute RII by partitioning mean score (MS) got from SPSS result to the quantity of rates (for example 5 for our case). Mean score is the system utilized in dissecting the outcomes pointed toward laying out the mean score of the different boundaries of elements which influence work efficiency. The score for each component is determined by summarizing scores relegated to it by respondents. In this manner, MS can be utilized to gauge the degree of significance of each element. The MS for each element that adversely influences work efficiency was registered by utilizing condition 3.5 or 3.6 (Megha D & Rajiv B., 2018);

$$RII = \left(\frac{\sum W}{A*N} \right) * 100 \dots\dots\dots (3.4)$$

Where:

W = the weighting given to each factor by the respondents (ranging from 1 to 5)

A = the highest weight (i.e. 5 in this case)

N = total number of respondents.

$$MS = \Sigma W / N \dots\dots\dots (3.5)$$

Or

$$MS = \Sigma (f * s) / N \dots\dots\dots (3.6)$$

Where;

W = the weighting given to each factor by the respondents (ranging from 1 to 5)

N = total number of responses in the respective factors

s = score given to each factors (1, 2, 3, 4, 5)

f = frequency of responses to each factors.

From the above equations 3.4, 3.5 and 3.6, we can rearrange that:-

$$RII = MS / A \dots\dots\dots (3.7)$$

Where; A = the highest weight (i.e. 5 in this case).

RII for all variables would be determined and positioned. Also, the gathering record had been determined by taking the normal of elements in each gathering. As per Muhawiz et. al. (2014), the variables that enrolled with $RII < 0.599$ are considered unimportant [35]. Also, as referenced by Akadiri (2011), there are five significance levels that are changed from RI (relative file) values: high (H); ($0.8 \leq RI \leq 1$), high - medium (H-M); ($0.6 \leq RI \leq 0.8$), medium (M); ($0.4 \leq RI \leq 0.6$), medium - low (M-L); ($0.4 \leq RI \leq 0.2$), and low (L); ($0 \leq RI \leq 0.2$) (Raja et al., 2018).

3.6 Reliability of study

Reliability is an assessment of the consistency of a bunch of things when the things are controlled to a specific report populace at a particular time under specific circumstances for a particular reason Shiken (2019). An inquiry is solid in the event that it brings out a predictable reaction (for example an individual would respond to the inquiries the same way consequently). One reason for trickiness is equivocal phrasing of the inquiries (Murodif A. et al., 2018).

As per Litwin (2017), Cronbach's alpha estimates the inner consistency of a gathering of things by estimating the homogeneity of the gathering of things. "It means that how well the various things complete one another in their estimation of various parts of a similar variable or quality". Cronbach's

Alpha reaches in esteem somewhere in the range of nothing and one. Esteems more like one demonstrate a higher interior consistency; esteems more like zero show a lower inward consistency (Litwin, 2017).

To help the reliability and validity, Cronbach's Alpha strategy was utilized. Cronbach's Alpha ought to be > 0.7 for the outcome to be solid (Brcka A., 2021).

3.7 Pilot Study

A pilot study was directed before the beginning of information assortment to test reaction rate, degree of impact, validity and fittingness of questionnaire as well as areas of vagueness. A pilot concentrate on offers a preliminary attempt for the questionnaire, which incorporates testing the phrasing of inquiries, distinguishing equivocal inquiries, testing the methods that are utilized to gather information and estimating the viability of standard greeting to respondents (Ismail et al., 2018). Five structures were disseminated to test of five project workers as a study pretest. The picked test was called to take part in the directing; so they got an explanation about the review and had been approached to finish the questionnaire. Some of them need a clarification on specific things. Finally, conversation with concentrate on example about the significance of inquiries occurred to affirm the validity and reliability quality of questionnaire. The pretest shows the need to revise phrasing of certain inquiries, and eliminate a few inconsequential inquiries. Various expressing changes were made to make it more reasonable. This pretest was helpful to fit and manage the point of the questionnaire.

3.8 Ethical Consideration

The security of human subjects through the utilization of proper moral rule is significant in any examination work and remembering that, all the data cooperation made during this research has thought about the accompanying issues like assents of the respondents, deliberate support, classification, no mischief and namelessness, etc. It's likewise plainly expressed as the basic piece of the questionnaire notwithstanding the inquiries questions made up close and personal. Subsequently, likewise, the analyst followed morally and ethically adequate cycles all through the exploration interaction. Likewise, all reports which are referred all through the examination are completely recognized.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1 Introduction

This chapter analyzes data collected from interviews, questionnaires, and work sampling observations to assess work efficiency on building construction sites in Addis Ababa. The analysis focuses on identifying key factors influencing work efficiency and quantifying the actual hourly output for common construction activities.

4.1. Background to Respondents

In the review, interview was utilized as a qualitative instrument; while, questionnaire and work/movement testing for the purpose of quantitative tools were utilized to accomplish the expressed goals. Questionnaires were dispersed to construction contractors at project destinations and interviews for crafts force who are working with the chose projects. Utilizing condition (3.1) and (3.2) the study populations considered for this study work are revealed on Table 4-1 below.

Table 4-1: Sample Size

Study Population	Sample Size	Grade 1 Contractors	Grade 2 Contractors
No.	41	28	13

The reliability of the returned questionnaires was checked for fulfillment prior to beginning the examination; two questionnaires were dismissed because of reaction inadequacy and; consequently, out of the 36 questionnaires 34 were viewed as reasonable for data investigation. As it is displayed in Table 4-2, a sum of (41) questionnaires were conveyed to construction projects that are active and progressing; and only 34 (82.9%) were viewed as valid for examination.

Table 4-2: Summary of Questionnaire Distribution and Response Rate

Total Questionnaires Distributed	Qualified Responses	Response Rate (%)
41	34	82.9

To test the reliability and validity of the perspective on respondents in factors influencing work efficiency in building construction projects in Addis Ababa City Cronbach's Alpha coefficient strategy was utilized utilizing SPSS programming and the got result shows that the reliability of the instrument equivalents to 0.851, which is satisfactory since, Cronbach's Alpha coefficient is more prominent than 0.7. Cronbach's Alpha coefficients of the relative multitude of factors are in Appendix- 3.

4.2. Respondents' Information

4.2.1. Companies' Profile

4.2.1.1. Grade of Construction Companies

The greater part (70.59%) of the chose organizations are grade one (G-1), and more than one-fourth (29.41%) of them are grade two (G-2) contractors. This infers that, most of the information were gathered from grade one contractors.

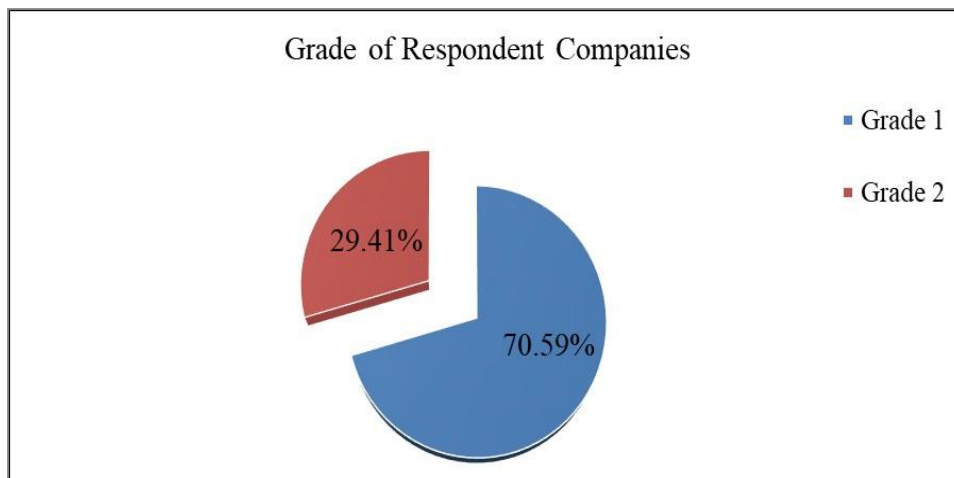
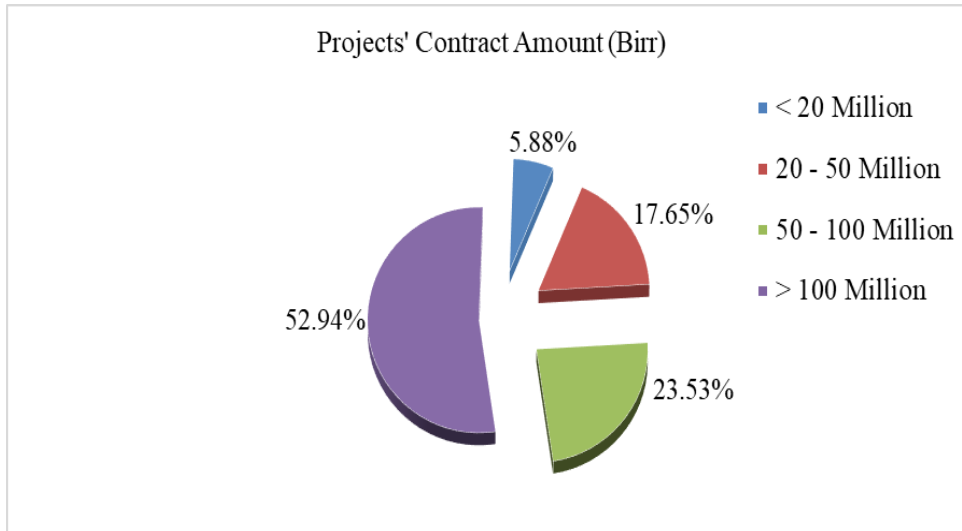


Figure 4.1: Grade of Respondent Companies
Source: Field Study, 2025

4.2.1.2. Projects' Contract Amount

The greater part (52.94%) of the respondents were from projects with an agreement measuring over 100 Million Birr, 23.53% of the respondents were from projects with a contract amount or agreement measure of between 50-100 Million Birr, 17.65% of the respondents were from projects with an agreement measure of between 20-50 Million Birr and 5.88% of the respondents were from projects with an agreement measure of under 20 Million Birr.

A higher level of the respondents runs projects with a measure of over 100 Million Birr. This shows that most respondents handle huge projects having different sort of works. In such undertakings, the commitment of different work types is high.



Source: Field Study, 2025

Figure 4.2: Projects' Contract Amount

4.2.1.3. Projects' Contract Duration

Fifty percent of the respondents run projects with an agreement time over 18 months, 29.41% of the respondents run projects with an agreement time between 12-18 months, 17.65% of the respondents run projects with an agreement time between 6-12 months and 2.94% of the respondents run projects with an agreement time under a half year. The project cost and term are straightforwardly corresponding to one another,

i.e. at the point when the project is large obviously it will require longer investment and greater expense. For this, results show that projects with an agreement sum over 100 Million Birr takes an agreement time over 18 months and projects with an agreement sum under 20 Million Birr takes an agreement time under a half year.

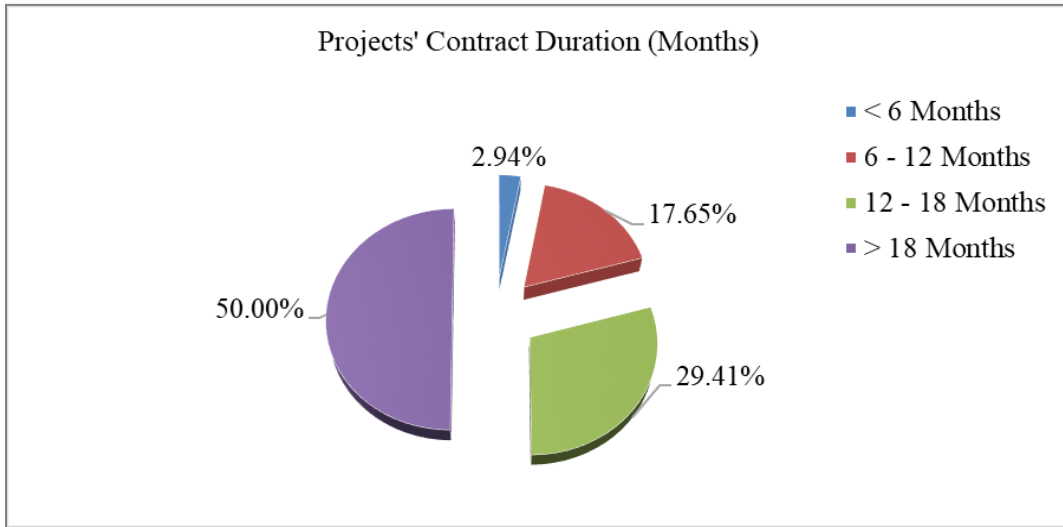


Figure 4.3: Projects' Contract Duration

Source: Field Study, 2025

4.2.2. Personal Information

4.2.2.1. Respondents' Working Position

As it is outlined in Figure 4.4, among the respondents 29.41% were Project Managers, 38.24% Site Engineers, and 32.35% Office Engineers of the overviewed construction firms. Thusly, the accompanying investigation and discussion of the review are performed in view of the reactions got through questionnaires from these experts.

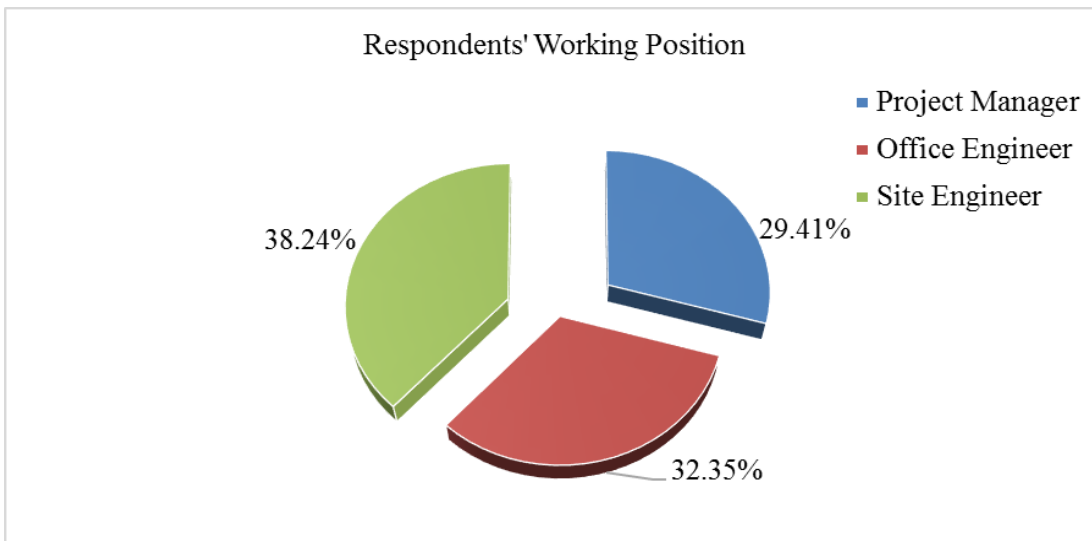


Figure 4.4: Respondents' Working Position

Source: Field Study, 2025

4.2.2.2. Experience of Respondents in the Construction Industry

Working experience of the respondents in the construction firms are assessed and viewed as: 17.65% have more than decade of work insight, 35.29% from five to a decade, again 35.29% from two to five years and 11.76% under two years.

The general respondents' profile shows that more than half of the respondents have over five years of working experience. This demonstrates the way that, the respondents could convey the expected data for all things included for the questionnaire.

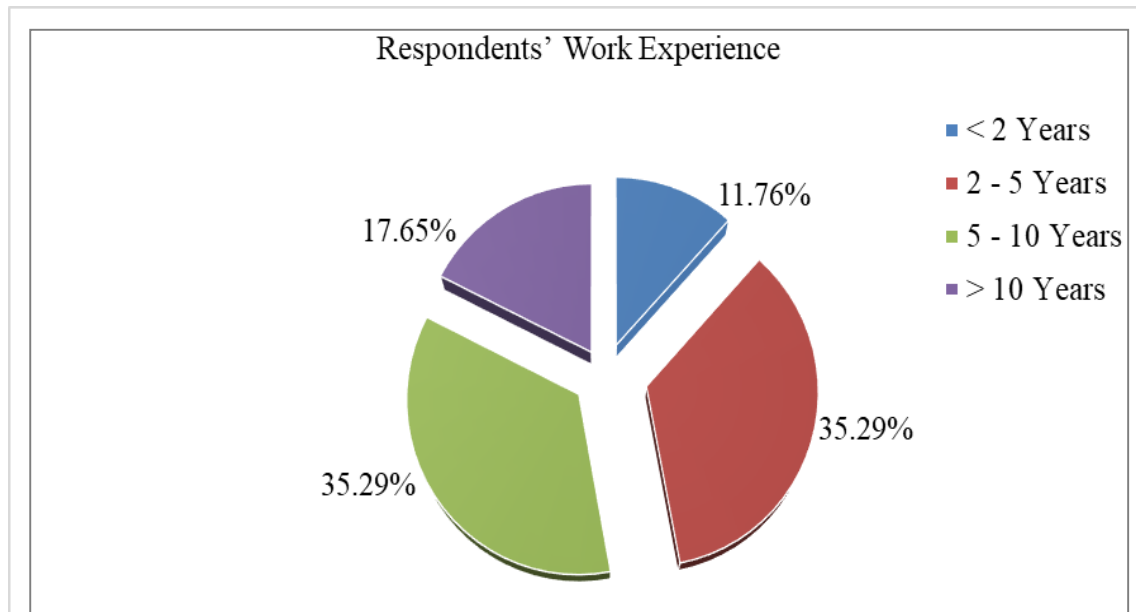


Figure 4.5: Respondents' Work Experience

Source: Field Study, 2025

4.3. Factors that Influencing Work Efficiency

The questionnaire included 49 factors, which were gotten from past examinations by taking in to think their loads given by the particular researchers. In this review the factors were arranged into nine groups by binding together material related gathering and equipment related bunch or group as material/equipment/tools related bunch and taking into account quality related bunch independently and barring plan and particular related bunch by remembering those factors for management related bunch. Yet, past review done by Mekides A. (2016), ordered the factors in to ten by considering material related group and motivation related bunch independently.

The review done by Mostefa (2017), likewise characterized the factors in to ten with an unmistakable contrast in considering time related group and inspiration related bunch independently. Having that behind the scenes, this study considered both group factors in to leadership and the management related bunch since those factors are generally related with authority and the executives and furthermore accepting that those factors can be constrained by managers.

4.3.1. Labor Related Factors

As could be seen from Table 4-3 underneath, labor absenteeism is the profoundly evaluated factor from work related bunch with RII 85.80%; absence of work experience is rated second with RII 78.20% while labor disloyalty rated third in this group with RII 71.80%. Increment of labor age is the least factor adversely influencing work efficiency in this group with RII 55.80%.

Labor absenteeism affects work efficiency while this outcome isn't upheld by past examinations done by different analysts (Mostafa, et. al, 2017). This outcome may be legitimate as individuals living in the City have a custom of not accomplishing any work at least one of the days. Absence of work experience significantly affects work efficiency. This outcome is upheld by past investigations by different specialists (E. Agbo, 2019) who referenced that absence of work experience influences efficiency exceptionally, which is additionally appropriately affirmed by this review. Different examinations (Khahro, et. al, 2018) have mirrored that increment of labor age affects work efficiency.

Table 4-3: Ranking Labor Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Labor Related Factors	Labor absenteeism	4.29	85.80	1
	Increment of labor age	2.79	55.80	7
	Absence of work experience	3.91	78.20	2
	Labor personal problems (e.g. use of Alcohol, Drugs...)	3.38	67.60	4
	Labor disloyalty	3.59	71.80	3

Misconception among worker	3.29	65.80	5
Absence of competition	3.29	65.80	5

Source: Field Study, 2025

4.3.2. Leadership and Management Related Factors

As displayed in Table 4-4, payment delay, poor wage and absence of clear and everyday undertaking task are vital factors adversely influencing work efficiency with a relating RII bunch worth of 90.60%, 87.00% and 83.60%; separately. Then again, respondents trust that absence of place for eating and relaxation, strategy for business, and expanding number of work to speed up work significantly affects work efficiency from this group with RII worth of 55.80%, 52.40%, and 50.60%; individually.

That's what the outcomes demonstrate; payment delay significantly affects work efficiency. This is likewise upheld by the examinations done before (Mostafa, 2017 and Khahro, 2018) who referenced that payment delay (postpone in compensation) influences efficiency. This result may be legitimate as postpone in compensation makes demotivation in the workforce. Poor compensation affects work efficiency. Past investigations have mirrored a similar on the issue (Kharo, 2018 and E. Agbo, 2019), by referencing that poor wage of laborers influences efficiency exceptionally.

Table 4-4: Ranking Leadership and Management Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
	Misunderstanding between labor and administrator	3.65	73.00	7
	Absence of work close observation	4.12	82.40	4
	Absence of clear and everyday undertaking task	4.18	83.60	3
	Absence of monetary inspiration system(incentive, intermittent reward ...)	4.06	81.20	6
	Absence of work progress follow up	4.09	81.80	5

Leadership and Management Related Factors	Non-providing of transportation means	3.32	66.40	8
	Absence of place for eating and relaxation	2.79	55.80	12
	Payment delay	4.53	90.60	1
	Poor wage	4.35	87.00	2
	Stay at work longer than required	2.85	57.00	11
	Working for 7 days of week without holiday	2.94	58.80	10
	Increasing No. of labor in order to increase work efficiency	2.53	50.60	14
	Misuse of time schedule	3.18	63.60	9
	Method of employment	2.62	52.40	13

Source: Field Study, 2025

4.3.3. Materials /Tools/ Equipment Related Factors

All materials/tools/equipment related factors have high impact on work efficiency as displayed in Table 4-5. As a matter of fact, lack of material is the exceptionally evaluated factor from this group with RII 91.20% and furthermore tool and equipment shortages adversely affect work efficiency with RII 88.20%. Then again, "unacceptability of materials stockpiling area and out of date tools and equipment has less effect from this group with RII: 70.60%, and 66.40%; individually".

Discoveries in (Mekides et. al, 2016) expressed that, materials/tools/equipment related factors have extremely high adverse impact on work efficiency. As upheld by many explores done previously and the finding can be legitimate as a base number of material/tool/equipment required for a work to be more useful and on the off chance that there is a lack of material/tool/equipment, the efficiency will diminish exceptionally.

Table 4-5: Ranking Materials /Tools/ Equipment Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Materials /Tools/ Equipment Related Factors	Lack of materials	4.56	91.20	1
	Unacceptability of materials stockpiling area	3.53	70.60	4
	Tool and equipment shortages	4.41	88.20	2
	Interruption of power and water supply	3.97	79.40	3
	Out of date tools and equipment	3.32	66.40	5

Source: Field Study, 2025

4.3.4. Supervision Related Factors

Brings about Table 4-6 show that, drawings and detail change during execution is the profoundly evaluated factor among management related bunch factors with RII 81.20%. Inadequate and inaccurate drawings positioned second with RII 80.60 %, while delay in decision making positioned third with RII 76.40%. The least evaluated factor from this group are, "investigation delay and supervisors non-attendance with RII; 74.20% and 64.80%; separately". All supervision related factors have high effects on work efficiency.

Drawings and particulars modification during execution has high adverse impact on work efficiency. This outcome is likewise reflected by many explores done beforehand (Khahro et. al, 2018) by referencing there is a deficiency of efficiency when there is a difference in work while working. Drawings and details adjustment during execution demands extra investment and asset and it influences work moral. Deficient and wrong drawings has likewise high adverse impact on work efficiency and mind ought to be given by the partners to have clear and complete attracting request to stay away from inactive season of workers.

Assessment deferral and supervisors' non-attendance affects work efficiency. Different investigations (Sangole et. al, 2018) likewise mirrored a similar on the issue. This shows that, supervisors ought to assess the work intently and follow the work progress every day to stay away from postponement of work.

Table 4-6: Ranking Supervision Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Supervision Related Factors	Delay in decision making	3.82	76.40	3
	Supervisors non-attendance	3.24	64.80	5
	Investigation delay	3.71	74.20	4
	Drawings and detail change	4.06	81.20	1
	Inadequate and inaccurate drawings	4.03	80.60	2

Source: Field Study, 2025

4.3.5. Project Related Factors

The level of significance of project related factors is introduced in Table 4-7. The exceptionally positioned factor from project related factors are construction method and incomplete facilities (water, power supply, clean) with RII 86.40% and 81.20%, while working in bound space in the project related bunch has low significance in influencing work efficiency with RII 59.40%.

Discoveries in (Y. Hashem et. al, 2018) referenced that; project related a factor has high adverse impact on work efficiency. That's what the sign is, this outcome can be legitimate as the project workers working in Addis Ababa would change their technique for construction and the public authority ought to satisfy the need of water and power supply to work with the advancement of the Capital of Ethiopia, Addis Ababa. The concentrate by Mekides A. (2016), in Addis Ababa additionally upholds this finding by referencing deficient offices (water, power supply, clean) influences work efficiency exceptionally.

Table 4-7: Ranking Project Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Project Related Factors	Size & Complexity of the Project	3.79	75.80	3
	Construction method	4.32	86.40	1
	Incomplete facilities (water, power supply, clean)	4.06	81.20	2
	Working in bound space	2.97	59.40	4

Source: Field Study, 2025

4.3.6. Health and Safety Related Factors

From this group accident during construction significantly affects work efficiency with RII 70.00% positioned as first, absence of safety tools positioned second with RII 67.00%, while violation of wellbeing insurance positioned third with RII 63.00%. The least evaluated factor from this group is unemployment of safety officer in construction site with RII 49.40% as displayed in Table 4-8.

The outcomes in here were reflected in other past works (E. Agbo et. al, 2019) and it very well may be legitimate as though an accident lead to a demise of the harmed individual, it could prompts all out stoppage of work for various days. Absence of safety tools has additionally a normal adverse impact on work efficiency and contractors ought to satisfy personal protective equipment (PPE) for the works to work securely as expressed on work wellbeing. Unemployment of safety officer in construction site adversely affects work efficiency. A past report (Mostafa, 2017) saw something similar and can be noted as contractors are not utilizing safety officer in building projects, which shows that anything they know the significance of safety in construction work, they disregard the significance of wellbeing officer in building construction sites.

Table 4-8: Ranking of Health and Safety Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Health and safety Related Factors	Violation of well-being insurance	2.62	52.40	4
	Un employment of safety officer in construction site	2.47	49.40	5
	Absence of safety tools	3.35	67.00	2
	Accident during construction	3.50	70.00	1
	Bad health of labors	3.15	63.00	3

4.3.7. Quality Related Factors

As displayed in Table 4-9, from this group inefficiency of equipment adversely affects work efficiency with RII 78.20%, which is positioned as first. Besides, high quality of required work affects work efficiency with RII 65.80% and low quality of raw materials meaningfully affects work efficiency with RII 57.60% in third spot.

Inefficiency of equipment affects work efficiency and furthermore different investigations (Mostafa, 2017 and Y. Hashem, 2018) have mirrored a similar on the issue. This outcome may be legitimate as efficiency pace of wasteful equipment is low and it antagonistically affects work efficiency. Low quality of unrefined components meaningfully affects work efficiency and it is upheld by a past report (E. Agbo, 2019) which referenced a similar on the issue. This outcome may be legitimate as utilizing inferior quality materials would take an excess of time than top notch materials as it very well may be harmed effectively and prompts modify. High quality of required work makes likewise a normal difference and a past report (Mostafa, 2017) upholds this outcome. This finding may be legitimate as work needs additional opportunity to complete the work when the permitted resistance of required work is extremely low to stay away from inadmissible mistakes.

Table 4-9: Ranking Quality Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Quality Related Factors	Low quality of raw materials	2.88	57.60	3
	High quality of required work	3.29	65.80	2
	Inefficiency of equipment	3.91	78.20	1

4.3.8. Stakeholders Related Factors

That's what tables 4-10 shows, payment delay from client side effects work efficiency from this group with RII 88.20%. Owner interference and absence of communication between parties (Proprietor, Expert and contractor) significantly affects work efficiency with RII 70.60%, 65.20%; separately.

Payment delay from client side makes extremely huge negative difference and it is likewise expressed a similar by a past report (Mekides, 2016) and this outcome may be legitimate as payment delay from client side, influences income of project workers which thusly influences the payment to laborers. At long last, this cause essentially influences works' inspiration and prompts low efficiency. Moreover, results demonstrate that proprietor obstruction and absence of communication between parties (Proprietor, Expert and contractor) moderately affects work efficiency. The issue was deduced similarly in past examinations [Mekides, 2016 and E. Agbo, 2019) this outcome may be legitimate as misconception among work makes conflict among parties and this conflict prompts postponement of work which subsequently diminishes work efficiency.

Table 4-10: Ranking Stakeholders Related Factors

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
	Payment delay from client side	4.41	88.20	1

Stakeholders Related Factors	Owner Interference	3.53	70.60	3
	Absence of communication between parties (Proprietor, Expert and contractor)	3.26	65.20	2

4.3.9. External Factors

That's what table 4-11 shows, Holidays/Holydays positioned first from outer factors bunch with RII 78.80% and Political situations of the nation positioned second with RII 70.60%, while bad atmospheric condition (rain, wind, high/low temperature, etc.) affects work efficiency from this gathering with RII 45.20%. Occasions/holydays exceptionally affect work efficiency as this issue was deduced similarly on a past report (Mekides, 2016), referencing that occasions moderately affect work efficiency in Addis Ababa. This finding may be legitimate as work for the most part needs extra chance to rest when occasion. Bad atmospheric condition (rain, wind, high/low temperature, and so forth) adversely affects work efficiency. Rain, wind, and temperature in Addis Ababa is typical, along these lines there is no awful weather pattern to influence efficiency of works.

Table 4-11: Ranking External Factors

Group	Factors	Mean Score (Ms)	$RII = Ms/5*100$ (%)	Rank
External Factors	Bad atmospheric condition (rain, wind, high/low temperature,etc.)	2.26	45.20	3
	Holidays/ Holydays	3.94	78.80	1
	Political situations	3.53	70.60	2

4.3.10. Overall Ranking of Factors Negatively Influencing Work Efficiency

As portrayed in Table 4-12, the most rated top five factors that adversely influence work efficiency are lack of material, payment delay/compensation deferral of works, payment delay from client side,

tools and equipment shortages, and poor wage with RII 91.20%, 90.60%, 88.20%, 88.20%, and 87.00%; separately. While the least-five factors that adversely influences work efficiency are violation of wellbeing insurance, strategy for business, increasing No. of labor in order to increase work efficiency, unemployment of safety officer in construction site, and bad atmospheric condition (rain, wind, high/low temperature, and so on) with RII 52.40%, 52.40%, 50.60%, 49.40%, and 45.20%; separately. Also, discoveries demonstrate that construction method, labor absenteeism, absence of clear and everyday undertaking task, absence of work close observation, absence of work progress follow up meaningfully affects work efficiency and ought to be kept away from to further develop work efficiency.

Table 4-12: Overall Ranking of Factors Influencing Work Efficiency

Group	Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Labor Related Factors	Labor absenteeism	4.29	85.80	7
	Increment of labor age	2.79	55.80	43
	Absence of work experiences	3.91	78.20	17
	Labor personal problems (e.g. use of Alcohol, Drugs...)	3.38	67.60	28
	Labor disloyalty	3.59	71.80	23
	Misconception among worker	3.29	65.80	32
	Absence of competition	3.29	65.80	32
	Misunderstanding between labor and administrators	3.65	73.00	22
	Absence of work close observation	4.12	82.40	9
	Absence of clear and everyday undertaking task	4.18	83.60	8

Leadership and Management Related Factor	Absence of monetary inspiration system (incentive, intermittent reward)	4.06	81.20	11
	Absence of work progress follow up	4.09	81.80	10
	Non-providing of transportation means	3.32	66.40	30
	Absence of place for eating and relaxation	2.79	55.80	43
	Payment delay	4.53	90.60	2
	Poor wage	4.35	87.00	5
	Stay at work longer than required	2.85	57.00	42
	Working for 7 days of week without holiday	2.94	58.80	40
	Increasing No. of labor in order to increase work efficiency	2.53	50.60	47
	Misuse of time schedule	3.18	63.60	37
	Method of employment	2.62	52.40	45
Materials / Tools/ Equipment Related Factors	Lack of Materials	4.56	91.20	1
	Unacceptability of materials stockpiling area	3.53	70.60	24
	Tool and equipment shortages	4.41	88.20	3
	Interruption of power and water supply	3.97	79.40	15
	Out date tools and equipment	3.32	66.40	30
Supervision Related Factors	Delay in decision making	3.82	76.40	19
	Supervisors non-attendance	3.24	64.80	36
	Investigation delay	3.71	74.20	21
	Drawings and detail change	4.06	81.20	11

	Inadequate and inaccurate drawings	4.03	80.60	14
Project Related Factors	Size & Complexity of the project	3.79	75.80	20
	Construction method	4.32	86.40	6
	Incomplete facilities (water, power supply, sanitary)	4.06	81.20	11
	Working in bound space	2.97	59.40	39
Health and safety related Factors	Violation of wellbeing insurances	2.62	52.40	45
	Unemployment of safety officer in construction site	2.47	49.40	48
	Absence of safety tools	3.35	67.00	29
	Accident during construction	3.50	70.00	27
	Bad health of labors	3.15	63.00	38
Quality Related Factors	Low quality of raw materials	2.88	57.60	41
	High quality of required work	3.29	65.80	32
	Inefficiency of equipment	3.91	78.20	17
Stake Holders Related Factors	Payment delay from client side	4.41	88.20	3
	Owner Interference	3.53	70.60	24
	Absence of communication between parties	3.26	65.20	35
External Factors	Bad atmospheric condition (rain, wind, high/low temperature, etc.)	2.26	45.20	49
	Holidays/ Holy days	3.94	78.80	16
	Political situations	3.53	70.60	24

**4.3.11. Comparison of Critical Factors
Affecting Construction Efficiency
(This Study Vs Others)**

This sub-segment analyzes the aftereffects of the basic elements influencing work efficiency distinguished by this review with prior examinations. Table 4-13, records the main five factors influencing work efficiency in construction projects of the demonstrated nations (Ethiopia (prior), Nigeria, Egypt, Gaza, India, Indonesia and Ethiopia (this review)).

Table 4-13: Top Five Factors from different Studies

Rank	Ethiopia, (A.A.) Mekides A. (2016)	Nigeria, Edwin and Calistus (2014)	Egypt, Shady (2010)	Gaza, Mostafa (2003)	India, Sangole andRanit (2013)	Indonesia, Soekimanet al. (2011)	Ethiopia, This Study (2019)
1	Lack of materials	Designed shape and Size	Labor experience and skill	Material shortage	Payment delay	Lack of material	Material shortage
2	Delay in Decision Making	Alteration Of drawings and specification during execution	Incentive programs	Lack of labor experience	Skill of labor	Labor strikes	Payment delay
3	Inadequate And inaccurate drawing	Working at high Places	Availability of the materials and their ease of handling	Lack of labor surveillance	Clarity of technical specification	Delay in arrival of material	Tools and equipment shortage
4	Absence of follow up the work progress	Lack of experience	Leadership and competency of construction managers	Misconception between labor and administrators	Material shortage	Financial difficulty of the owner	Payment delay from client side
5	Financial difficulty of the owner/ Payment Delay	Poor wages	Competency of labor supervision	Drawings and specification alteration during execution	Motivation	Unclear instruction to laborer	Poor wage

That's what table 4-13 shows, the discoveries of each study appear to be unique from each other. This disparity may be because of the distinctions in environment condition, culture of work, and accessibility of innovation advancement and different conditions from one country to another.

By and by, there are a few normal factors saw among the investigations of various nations, which are: lack of materials, payment delay, absence of follow up the work progress, change of drawings during execution, absence of experience, inadequate and inaccurate drawings, poor wage and absence of inspiration. The three elements distinguished in this study are among the five most normal factors analyzed in the chose nations which are lack of material, payment delay from client side and poor wage.

Lack of materials is the highest level factor by the greater part of the above examinations from various nations. Thus, it is better for the contractors to convey all materials which are vital for their work to extend site prior to beginning work to stay away from efficiency misfortune by anticipating materials. Payment delay from client side is additionally the second factor with in the best five variables referenced above and which thus unfavorably influences compensation of works. In the event that the client doesn't pay break payments to the contractor, works pay would be delay. The deferral of compensation makes demotivation of works moral and it influences work efficiency unfavorably.

Furthermore, absence of clear and everyday undertaking task, absence of work close observation, and absence of work progress follow up affect work efficiency. A past report (Mekides, 2016)) also backings the outcome by referencing absence of follow up meaningfully affects work efficiency in Addis Ababa as positioned at fourth spot from the general factors. Every one of the over three factors are administrators obligation; they have some control over and limit their adverse impact in labor efficiency.

4.3.12. Rank of the Group Which Negatively Influences work Efficiency

That's what table 4-14 depicts, materials/tools/equipment related factors positioned first among all gatherings of efficiency factors with RII 79.16%. In the opposite, wellbeing and safety related factors bunch positioned last with RII 60.36 %, while project related factors bunch positioned second with RII 75.70% and supervision related factors bunch positioned third with RII 75.44%.

Incredible consideration would be given to materials/tools/equipment related factors bunch, since it is positioned first among the nine factors. This finding is upheld by other prior study [8] and can be legitimate as it is truly challenging and difficult to do any building construction projects without the

accessibility of materials/tools/equipment.

There is no question to say that contracting organizations in Addis Ababa has little mindfulness on wellbeing and safety issues, since they evaluated wellbeing and safety related factors bunch as the least. Nevertheless, wellbeing and safety issues ought to be focused entirely on limit or on the other hand if conceivable to stay away from construction risks. This finding is upheld by other prior study [8] by deducing similarly.

Table 4-14: Ranking of the Group which negatively influences Work Efficiency

Group Factors	Mean Score (Ms)	RII = Ms/5*100 (%)	Rank
Labor Related Factors	3.51	70.11	6
Leadership and Management Related Factors	3.52	70.3	5
Materials /Tools/ Equipment Related Factors	3.96	79.16	1
Supervision Related Factors	3.77	75.44	3
Project Related Factors	3.79	75.70	2
Health and safety Related Factors	3.02	60.36	9
Quality Related Factors	3.36	67.20	7
Stakeholders Related Factors	3.73	74.67	4
External Factors	3.24	64.87	8

4.5 Work Efficiency Measurement

The work efficiency estimation on building construction destinations depended on surveying empty substantial block laying, masonry stone laying (sub-structure), carpentry work (for slab formwork), and concrete casting/substantial projecting (in-situ strong section) work in Addis Ababa. The primary purposes behind thought of the efficiency investigations of these deals with building construction sites were:

These exchanges of works are ordinarily finished on various building construction projects all through the city;

The meaning of the expense commitment of these exchanges of works according to other building work exercises;

Can give a valuable chance to concentrate on various factors;

Can concentrate on efficiency of various craftsmen; and

It is a generally simple action to notice and measure.

Work efficiency observations and efficiency factors in chosen exchange of works were assessed by utilizing movement testing alongside the actual estimation of result each hour. An assessment of efficiency factors during the cycle was likewise performed. Work would regularly begin every day at 8 A.M and finish at 5 P.M. there is one hour break for lunch from 12 A.M to 1 P.M, Thusly, the day to day working time frame in the activities in Addis Ababa is all 8 hours out of every day.

4.5.1 In-situ Solid Slab Concrete Casting Work Labor Efficiency

Strong slab is a level individual from a construction and it is a typical primary component of contemporary buildings. Floor slabs and beams, which are coordinated with sections are solidly poured concrete underlying components for cast in-situ construction. Floor slabs substantial thickness goes from 10cm or more. In floor slab substantial work, day to day worker and bricklayer are the essential human-power required.

4.5.1.1 Study of Sample Characteristics

Figure 4.6 portrays that, more than 33% of the sample (38.89%) are matured somewhere in the range of 30 and 40 years, 33% of the sample (33.33%) are matured under 30 years, and 27.78% of the sample are somewhere in the range of 40 and 50 years of age. This shows that substantial/concrete work trade labor age is in many somewhere in the range of 20 and 50 years.

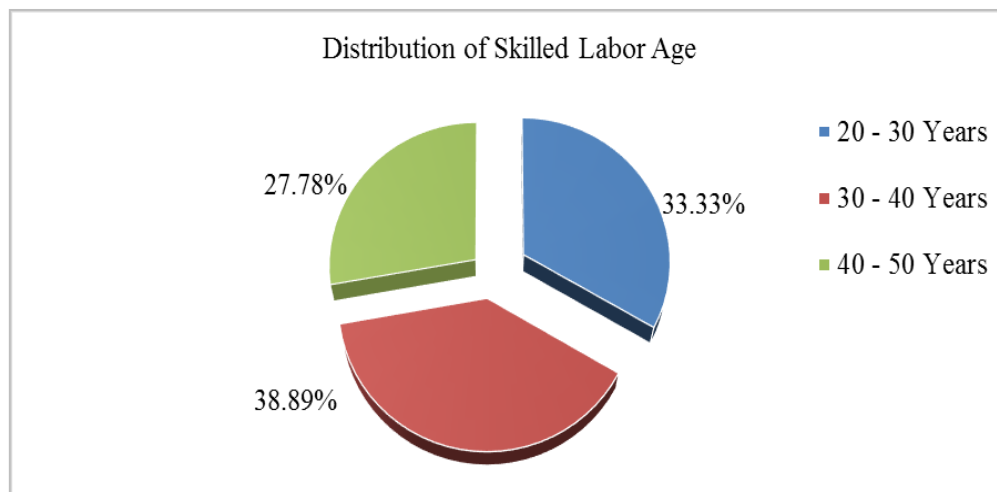


Figure 4.6: Distribution of Skilled Labor Age for In-situ Solid Slab Work

Figure 4.7 outlines that, a big part of the sample (50%) has in the middle of somewhere in the range of 5 and 10 years, 22.22% of the sample has in the middle of somewhere in the range of 2 and 5 years, 22.22% of the sample has experience over 10 years, and 5.56% of the sample has experience under 2 years.

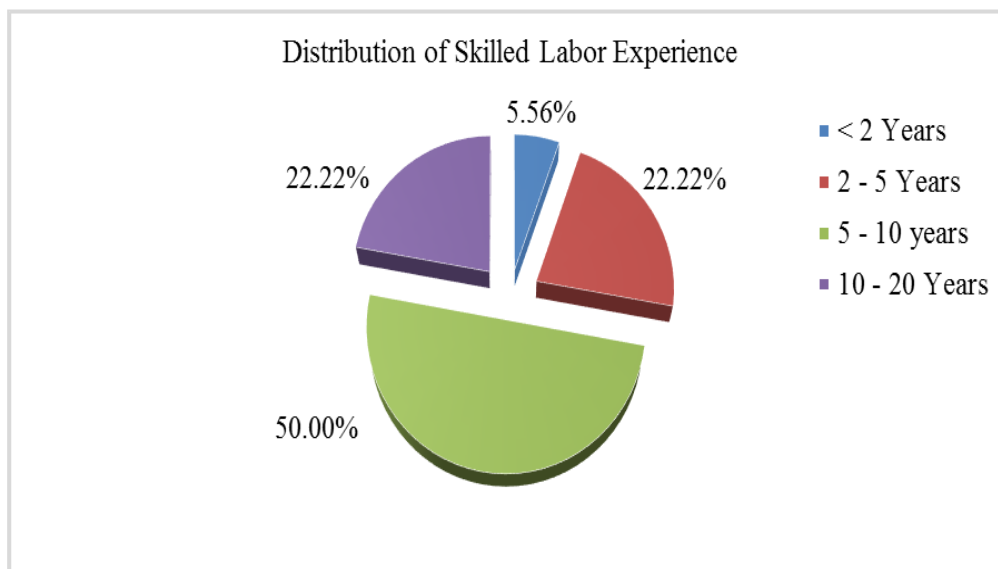


Figure 4.7: Distribution of Skilled Labor Experiences for In-situ Solid Slab Work

Figure 4.8 shows that, 44.44% of the samples are instructed up to grade four, 22.22% of the samples are taught up to grade eight, 5.56% of the sample finished grade ten, 11.11% of the sample has TVET confirmation and 16.67% of the sample are uninformed. This implies that the vast majority of the substantial work trade labors are from the elementary school as it were.

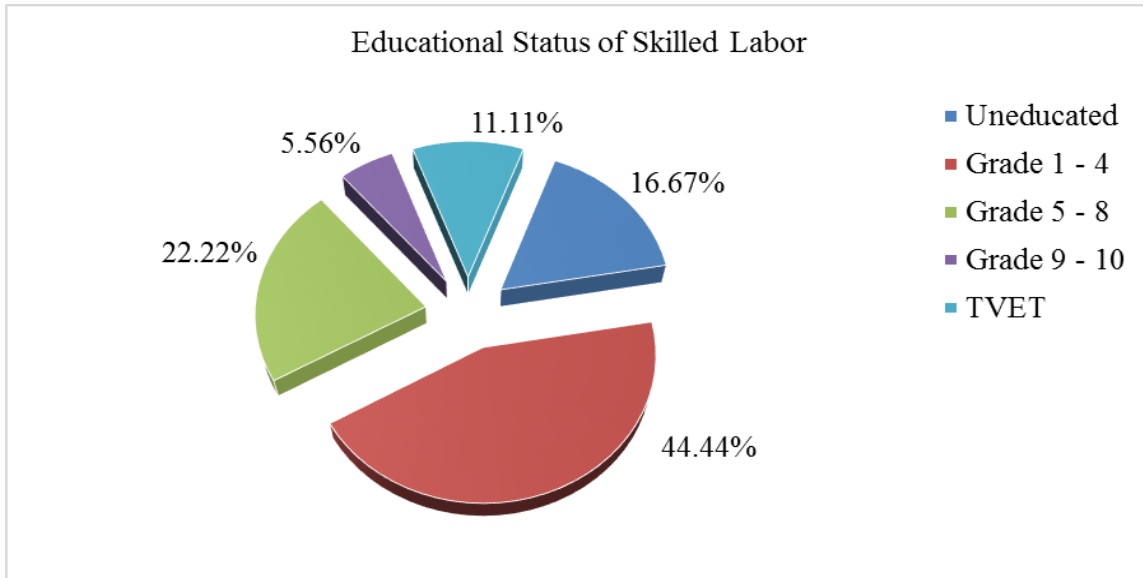


Figure 4.8: Distribution of Skilled Labor Educational Status for In-situ Solid Slab Work

Figure 4.9 depicts that, practically the talented workforces are all prepared on-site gaining from their seniors, and just 11.11% of them are formally prepared in conventional exchange school (TVET). This affirms the restricted consideration paid by Addis Ababa City construction authority for a legitimate expertise based education and training. It would likewise appear to be that contractors are not inspired by any conventional ability prepared workforce on their sites.

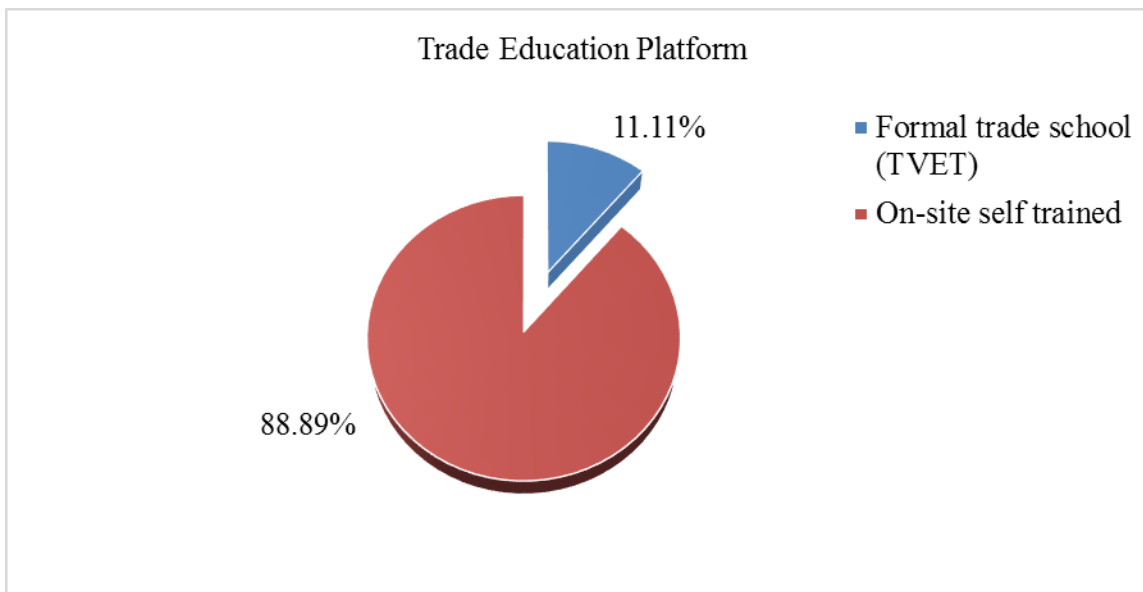


Figure 4.9: Distribution of Skilled Labor Trade Education Platform for In-situ Solid Slab Work

4.5.1.2 Distribution of In-situ Solid Slab Concrete Casting Working Time

Strong slab concrete/substantial projecting work activity was isolated into three groups of activities: productive activities, contributory or semi-productive activities and, ineffective activities. Productive activities incorporate "pouring cement", "substantial spreading (scoop)", "substantial compaction (vibrating)", and "substantial getting done (pack, scoop, wrapping up)". Contributory activities incorporate "substantial blending", "substantial transportation", "providing or getting request", "crane/winch activity", "substantial relieving", "planning workspace", "substantial covering", "substantial testing", and "cleaning workspace". Third gathering, useless activities which incorporate "inactive time (sitting, watching, smoking, drinking and disinfection)", "eliminating and supplanting previously finished work because of administrator issue or the board shortcoming", and "postponement because of climate".

That's what tables 4-15 shows; talented works invest more energy on useful work (78.40%) from his/her functioning time. Then again, this group spends just 11.53% of his/her functioning time on semi-productive (contributory) work, while talented work burn through 10.07% of his/her functioning time on non-productive/non-useful (inactive) work. This demonstrates that skilled labor invests the allocated energy principally in productive activities.

Table 4-15: Statistics of In-situ Solid Slab Concrete Casting Working Time

Work categories	Statistics	Skilled labor (%)
Productive work time	Mean (%)	78.40
	SD (standard deviation)	3.97
Semi-productive (contributory) work time	Mean (%)	11.53
	SD (standard deviation)	1.26
Non-productive work time	Mean (%)	10.07
	SD (standard deviation)	1.42

The discoveries so far reveal that the main action done by skilled labor is concrete/substantial completing which requires some investment (Table 4-16). The second significant movement done by skilled labor is "substantial spreading and substantial compaction which takes 21.39% and 20.56% of skilled labor working time; separately". The outcomes are OK as the fundamental

occupation of a skilled labor is substantial compaction and substantial finishing.

Work categories	Statistics	Skilled labor (%)
Productive activities	Pouring concrete	8.00
	Concrete spreading	21.39
	Concrete compaction	20.56
	Concrete finishing	28.45
Semi-productive (contributory) activities	Giving or receiving order	4.67
	Prepare working area	4.15
	Cleaning working area	2.70
Non-productive activities	Idle time	10.07

Source: Field Study, 2025

Table 4-16: Distribution of In-situ Solid Slab Concrete Casting Work Activities

4.5.1.3 Skilled Worker Efficiency in In-situ Solid Slab Concrete Casting Work

The hourly result of skilled labors is taken during the movement examining study. 81 proportions of hourly work efficiency were produced using nine active sites and the normal of those actions is recorded as a normal hourly result. Accordingly, the finding shows that the typical efficiency of talented worker in projecting strong slab concrete is 2.89 m² each hour. The detail result is in Appendix-4.

4.5.2 Empty Substantial Blocks (ESB) Laying Work Labor Efficiency

Empty substantial blocks (ESB) are created from cement and aggregates. These substantial blocks are delivered with centers to decrease weight and to further develop protection. Empty substantial block have various sizes, the most widely recognized sizes are (40cm*20cm*20cm), (40cm*20cm*15cm) and (40cm*20cm*10cm). These empty substantial blocks are utilized for different purposes; like partition and load bearing walls. In this work, bricklayer (mason) and everyday worker are the fundamental human-power required.

4.5.2.1 Study of Sample Characteristics

Figure 4.10 delineates that, 88.24% of the samples are male and 11.76% of the samples are female. This demonstrates that female has association in block work trade; which is considerable support for ladies to contribute their ability and information past taking care of family activities (cooking, cleaning, washing, and so on) and ladies are showing the amount they can do construction works like block work.

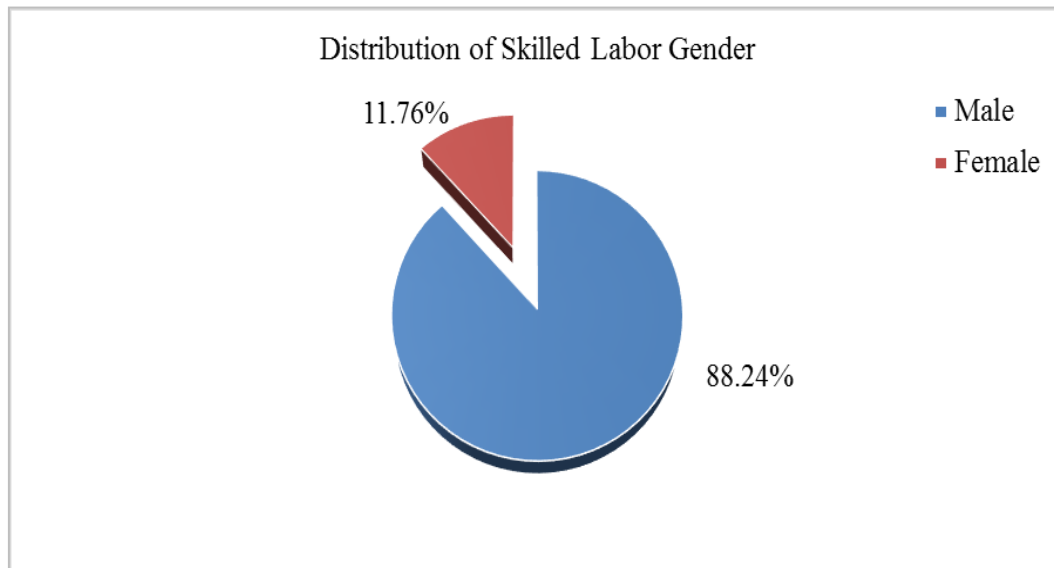
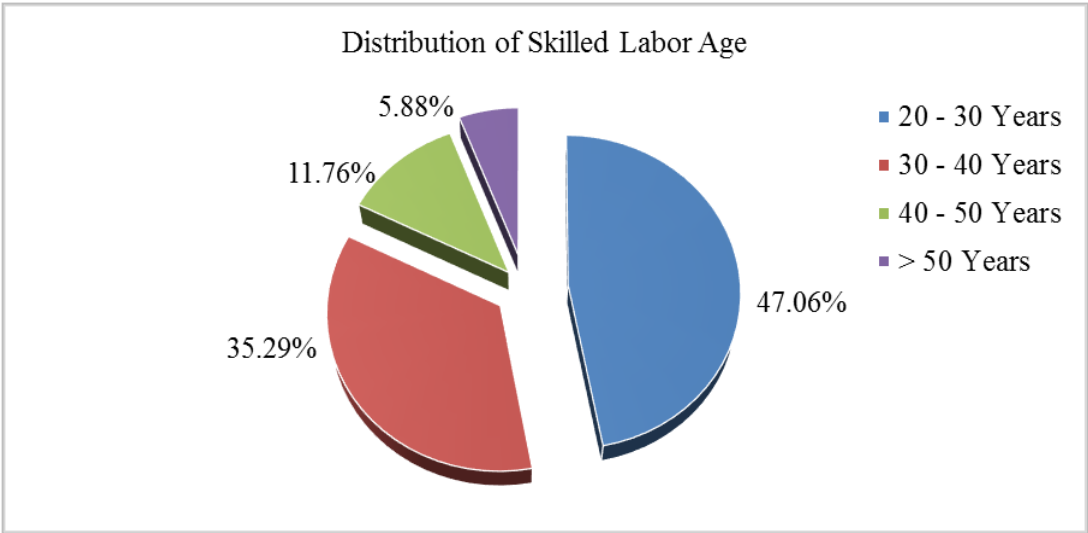


Figure 4.10: Distribution of Skilled Labor Gender for ESB Laying Work

Source: Field Study, 2025

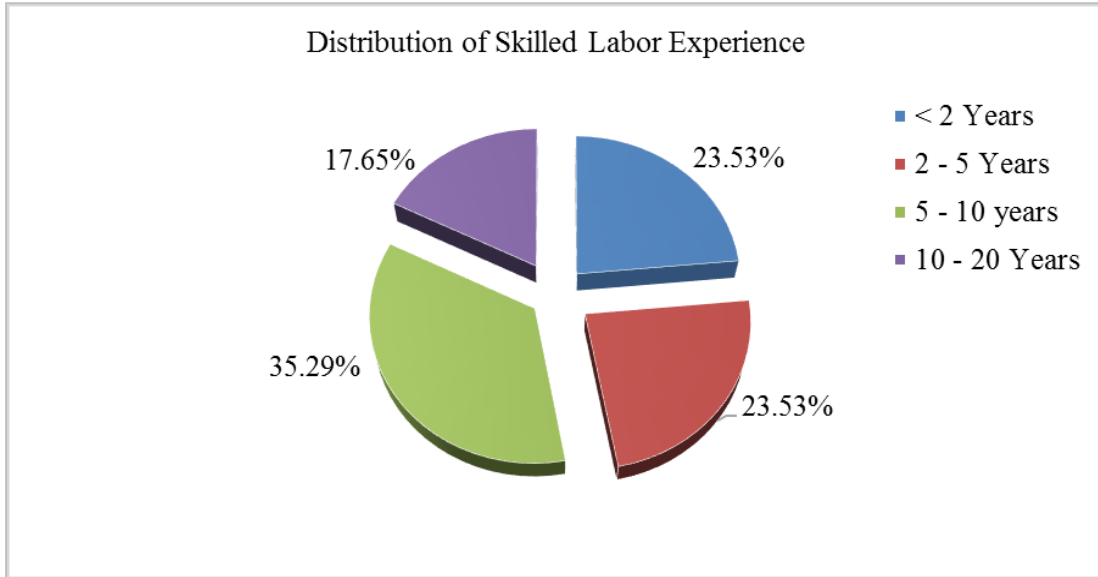
Figure 4.11 shows that, close to half of the samples (47.06%) are matured somewhere in the range of 20 and 30 years, 33% of the sample (35.29%) are matured somewhere in the range of 30 and 40 years, 11.76% of the samples are somewhere in the range of 40 and 50 years of age and 5.88% of the samples are matured over 50 years. This shows that block work is youthful people groups' trade and this high inclusion of youngsters is admirable for high work efficiency since they are fierier than matured people groups normally.



Source: Field Study, 2025

Figure 4.11: Distribution of Skilled Labor Age for ESB Laying Work

As displayed in Figure 4.12, more than 33% of the sample (35.29%) has experience somewhere in the range of 5 and 10 years, 23.53% of the sample has experience under 2 years and somewhere in the range of 2 and 5 years similarly, and 17.65% of the sample has experience over 10 years. The discoveries demonstrate that the majority of the skilled workforce has over 2 years of experience.

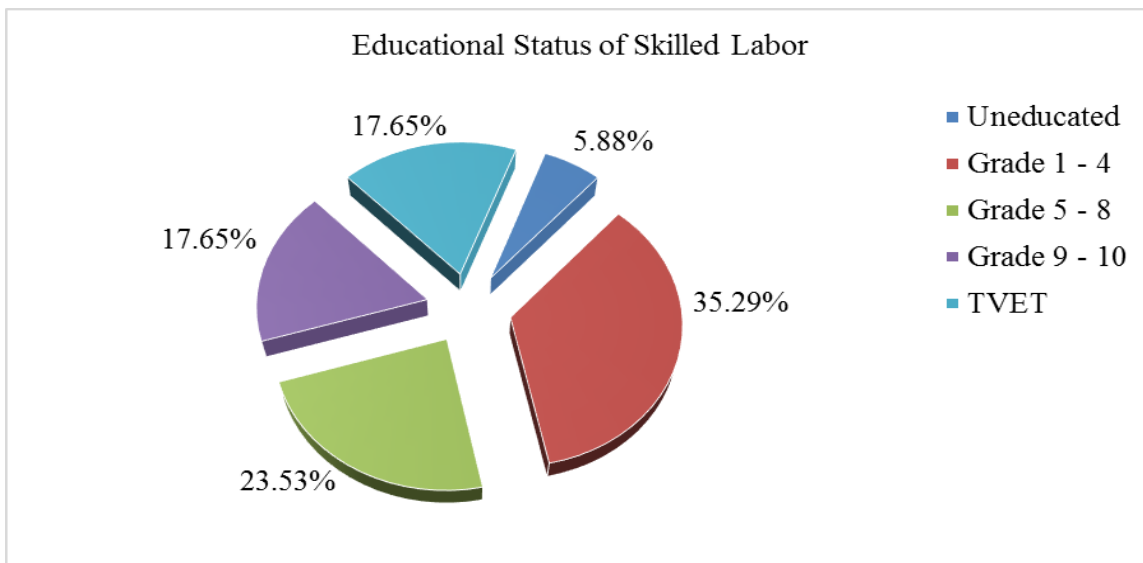


Source: Field Study, 2025

Figure 4.12: Distribution of Skilled Labor Experience for ESB Laying Work

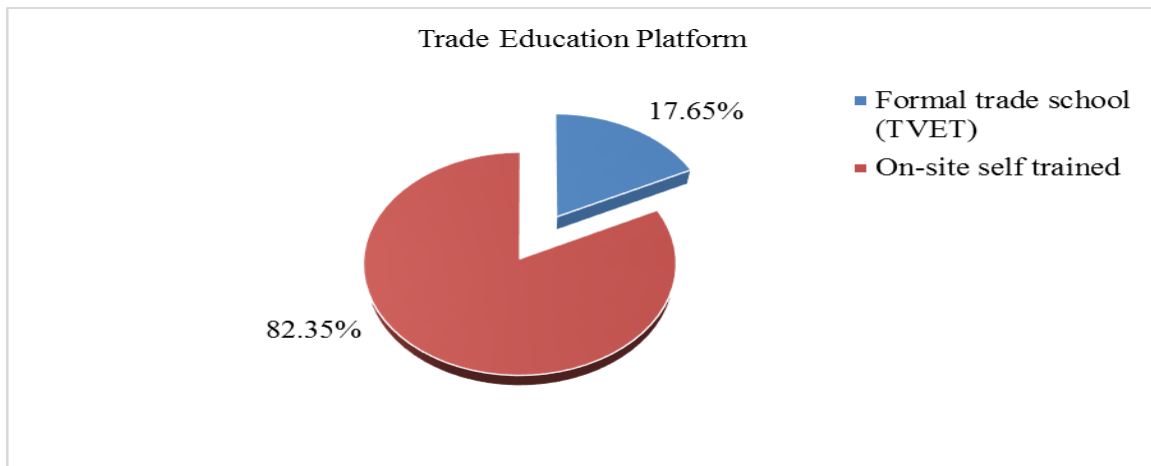
Figure 4.13 outlines that, more than 33% of the sample (35.29%) is taught up to grade four, 23.53% of the samples are concentrated on up to grade eight, 17.65% of the samples are finished grade ten, 17.65% of the samples have TVET certification, and 5.88% of the samples are uneducated. This outcome shows that the vast majority of the block work trade works have primary school education as it were. Training is crucial for everyone to foster information, correspondence expertise, to know the mechanical progression, to increment critical thinking skill and so on.

Figure 4.13: Distribution of Skilled Labor Educational Status for HCB Laying Work



Source: Field Study, 2025

Practically the talented works are all prepared on-site informally gaining from their seniors and just 17.65% of the sample are formally prepared in proper trade schools (Figure 4.14). Despite the fact that efficiency examination of officially prepared works and formally prepared works isn't finished in this review; helping an expertise through trade school preparing is better compared to helping an expertise through informal on location preparing from their seniors. Officially prepared works would have great communication skill, which is created through schooling; they can undoubtedly figure out orders from foreman/bosses and can take care of issues.



Source: Field Study, 2025

Figure 4.14: Distribution of Skilled Labor Trade Education Platform for ESB Laying Work

4.5.2.2 Distribution of ESB Laying Working Time

ESB laying work activity is partitioned into three groups of activities: productive activities, contributory or semi-useful activities and, ineffective exercises. Productive activities incorporate "spreading mortar on the wall in anticipation of laying blocks", "slicing blocks to required size", "situating and squeezing the block on the course", and "setting mortar into vertical holes among blocks and eliminating overabundance mortar". Contributory exercises incorporate "planning mortar and filling it in containers", "auxiliary work, for example, fixing points, checking vertical arrangement utilizing plumb sway, checking even arrangement utilizing hand level, actually looking at spaces in accordance with drawings, taking guidance from bosses", "dispersion of mortar and blocks to spots near talented work", "transportation of materials" and "cleaning workspace". Third gathering, useless exercises which incorporates "inactive time (sitting, watching, smoking, drinking and sterilization)", "eliminating and supplanting previously finished work because of administrator shortcoming or the executives issue", and "deferral because of climate".

That's what table 4-17 portrays; the skilled workforces spend multiple fourth (77.14%) of his/her functioning time in useful work. In the meantime, skilled works spend just 14.01% of his/her functioning time in contributory (semi-useful) work. This demonstrates that skilled labor working time is primarily on productive activities. Ineffective season of talented works is 8.86% of the everyday dispensed working time.

Table 4-17: Statistics of ESB Laying Work Activities

Work categories	Statistics	Skilled labor
Productive work time	Mean (%)	77.14
	SD (standard deviation)	2.76
Semi-productive (contributory) work time	Mean (%)	14.01
	SD (standard deviation)	1.51
Non-productive work time	Mean (%)	8.86
	SD (standard deviation)	1.37

That's what table 4-18 depicts; the main movement done by skilled workforce is laying blocks which had required some investment. The second significant action done is raking and pointing which had taken 28.84% of talented workforce working time. This outcome is OK as the principal occupation of gifted work is laying blocks. Likewise talented works invest 11.53% of their energy in auxiliary work and 8.86% of their time is useless/unproductive.

Work categories	Statistics	Skilled labor (%)
Productive activities	Spreading mortar	13.29
	Cutting blocks	1.65
	Laying blocks	33.37

	Raking	28.84
Semi-productive (contributory) activities	Ancillary work	11.53
	Cleaning working area	2.47
Non-productive activities	Idle time	8.86

Table 4-18: Distribution of ESB Laying Work Activities

4.5.2.3 Skilled Worker Efficiency in ESB Laying Work

The hourly result of skilled workforces is taken during the action examining study. 72 proportions of hourly work efficiency were produced using nine active sites and the normal of those actions is archived as a normal hourly result. In this manner, the finding shows that the typical efficiency of talented work in laying 20 cm thick empty substantial block is 1.31 m² each hour. The detail result is in Appendix- 5.

4.5.3 Stone Workmanship Work Labor Efficiency

Stone workmanship for sub-structures is produced using generally dressed stone laid by stacking each other with mortar. This stone workmanship (masonry) safeguards the solidness of compacted refill soil and grade pillar. Generally this stone work is built beneath the normal ground level. In this work, bricklayer and day to day worker are the essential human-power required. Stone brick work for super-structure is equivalent to sub-structure stone workmanship; it is developed after sub-structure stone workmanship is finished. This stone work structure is additionally fortified and prepped by pointing.

4.5.3.1 Study of Sample Characteristics

Figure 4.15 shows that, the greater part of the samples (55%) are matured somewhere in the range of 30 and 40 years, one-fourth of the sample (25%) are matured somewhere in the range of 20 and 30 years, and one-fifth of the sample (20%) are somewhere in the range of 40 and 50 years of age. This demonstrates that stone brick work is basically grown-up people's exchange. Since stone work is energy concentrated trade, it is great to do with youthful or grown-up works to be more productive.

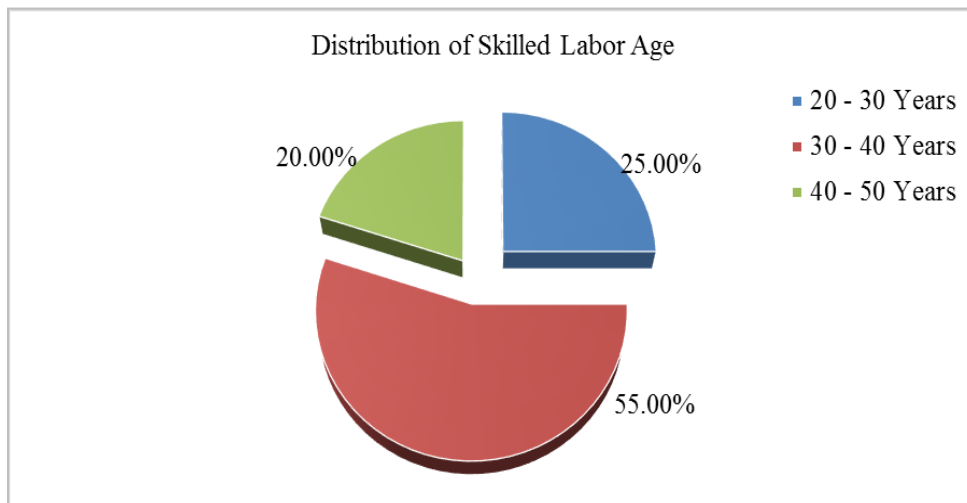


Figure 4.15: Distribution of Skilled Labor Age for Stone Workmanship Work

Figure 4.16 clarify that, more than 33% of the sample (35%) has experience somewhere in the range of 2 and 5 years and somewhere in the range of 5 and 10 years similarly, 20% of the sample has experience under 2 years, and 10% of the sample has experience over 10 years. This outcome demonstrates that the greater part of the skilled workforce has experience somewhere in the range of 2 and 10 years. Obviously when works have more experience, he/she can accomplish more work inside a brief timeframe effectively than inexperienced labor.

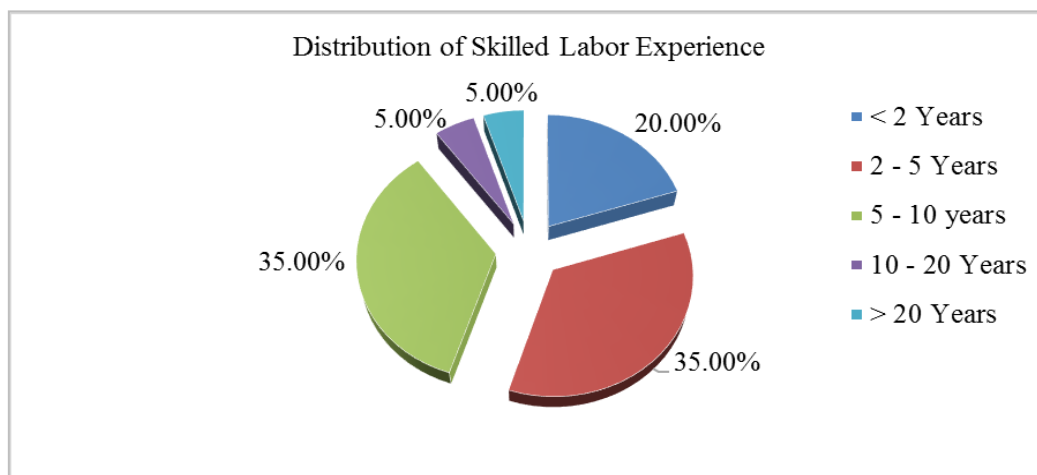
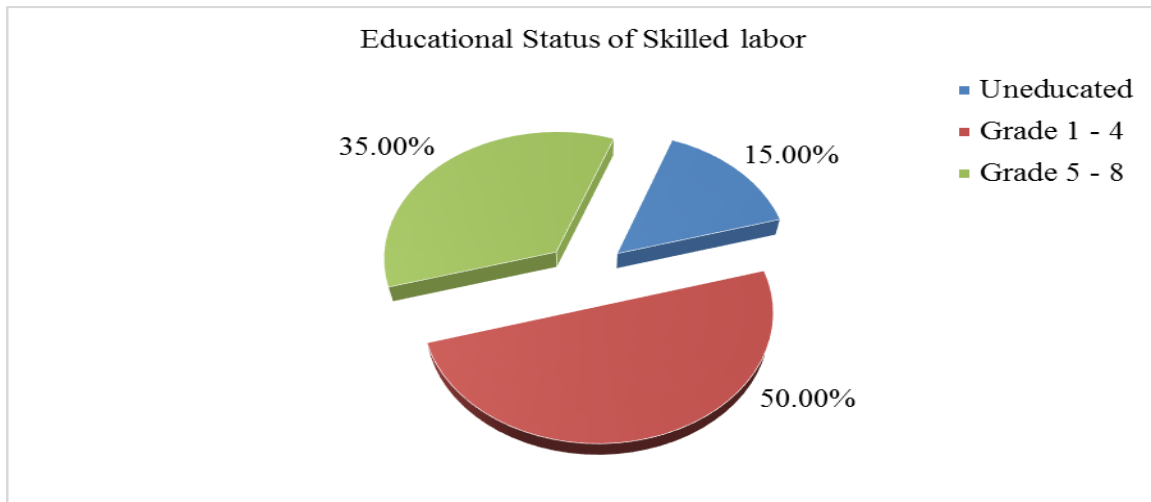


Figure 4.16: Distribution of Skilled Labor Experience for Stone Workmanship Work

Figure 4.17 shows that, a big part of the sample (50%) have concentrated on up to grade four, a larger number of than 33% of the samples (35%) have concentrated on up to grade eight, and 15% of the samples are uneducated. That's what these outcomes show; nobody of stone brick work trade work is from grade nine or more.

Figure 4.17: Distribution of Skilled Labor Educational Status for Stone Workmanship Work



That's what results show, skilled workforce are all trained nearby informally gaining from their seniors, and not a solitary one of them are officially prepared in conventional exchange schools (TVET).

4.5.3.2 Distributions of Stone Workmanship Working Time

Brick work activity is partitioned into three groups of activities: productive activities, contributory or semi-productive activities and, non-productive/inefficient activities. Productive activities incorporate "spreading mortar beneath or over the course", "slicing stones to required size", "situating and squeezing the stones on the course", and "setting mortar into vertical in the middle among stones and eliminating abundance mortar". Contributory activities incorporate "planning mortar and filling it in the container", "auxiliary work, for example, fixing points, checking vertical arrangement utilizing plumb sway, checking even arrangement utilizing hand level, actually looking at spaces in accordance with the drawing, taking guidance from managers", "circulation of mortar and stones to spots near talented work", "transportation of materials" and "cleaning workspace". Third group is ineffective/non-productive activities which incorporate "inactive time (sitting, watching, smoking, drinking and disinfection)", "eliminating and supplanting previously finished work because of administrator shortcoming or the board shortcoming", and "postponement because of climate".

That's what table 4-19 portrays, skilled labor spend more than three-fourth (80.74%) of the day to day working time in productive/useful work; while spending the excess 10.45% just on contributory (semi-productive) work. This shows that talented work spends his/her day to day working time in productive activities. Useless (inactive) season of skilled labor was 8.81% of the day to day working time.

Table 4-19: Statistics of Stone Workmanship Work Activities

Work categories	Statistics	Skilled labor
Productive work time	Mean (%)	80.74
	SD (standard deviation)	4.36
Semi-productive (contributory) work time	Mean (%)	10.45
	SD (standard deviation)	1.50
Non-productive work time	Mean (%)	8.81
	SD (standard deviation)	1.26

That's what table 4-20 shows, the main movement done by gifted workforce is laying stone which had taken 27.97% of a skilled labor daily working time. The second important activity done by skilled labor is “shaping stone and raking and pointing which had taken 19.89% and 19.07% of a skilled labor working time; respectively”. This result is acceptable as the main job of a skilled labor is shaping and laying stones. Also skilled labor spent 0.36% of time in ancillary work, 8.08% of working time spend in distributing shaped stones, 2% of their time by cleaning working area, and the unproductivetime of skilled labor is 8.81%.

Table 4-20: Distribution of Stone Workmanship Work Activities

Work categories	Statistics	Skilled labor (%)
Productive activities	Spreading mortar	13.81
	Shaping (dressing) stones	19.89
	Laying stones	27.97
	Raking	19.07

Semi-productive (contributory) activities	Ancillary work	0.36
	Distributing stones	8.08
	Cleaning working area	2
Non-productive activities	Idle time	8.81

4.5.3.3 Skilled Worker Efficiency in Stone Workmanship Work

The hourly result of talented works was taken during the action inspecting study. Ninety proportions of hourly work efficiency were produced using ten active sites and the normal of those actions is recorded as a normal hourly result. Hence, the finding shows that the typical efficiency of skilled workforces in laying sub-structure stone workmanship is 0.69 m³ each hour. The detail result is in Appendix-6.

4.5.4 Wall Plastering/Putting Work Labor Efficiency

Plastering/putting is a course of covering walls and roofs with smooth wrap up by a putting materials, for example, concrete mortar to prepare for painting. There are three phases of putting, which are first coat, second coat, and third (fine) coat putting. In this work, plasterer and everyday works are the essential human-power required. On account of time requirement, this study is disturbing around second coat putting as it were.

4.5.4.1 Study of Sample Characteristics

Figure 4.18 shows that, close to three-fourth of the sample (73.68%) are male and more than one-fourth of the sample (26.32%) are female. This outcome demonstrates that female has critical association in wall plastering/putting work; which is apparent cooperation for ladies to contribute their ability and information past dealing with family activities (cooking, cleaning, washing, and so on) and ladies are showing the amount they can do construction works like plastering/putting additionally notwithstanding block work.

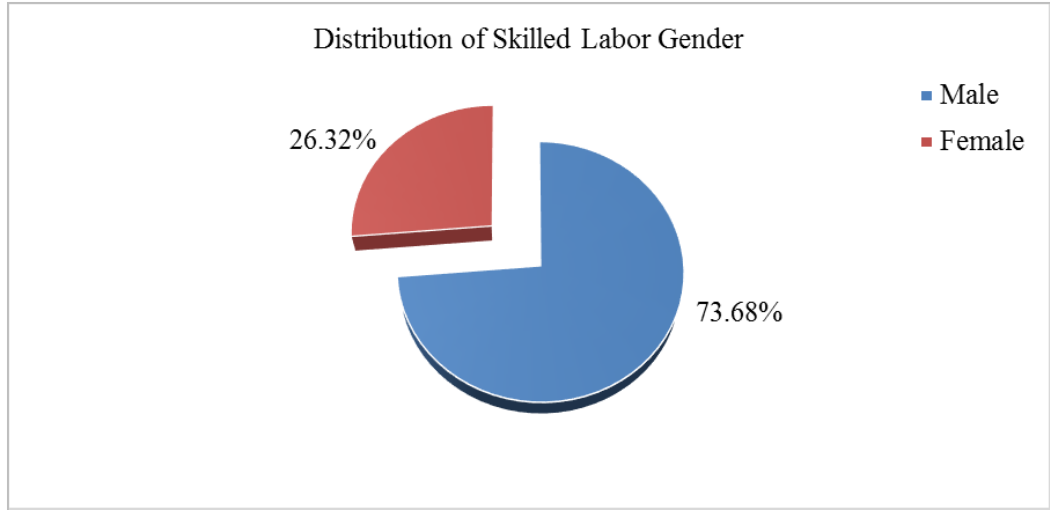


Figure 4.18: Distribution of Skilled Labor Gender for Wall Plastering/putting Work

Figure 4.19 shows that, the greater part of the samples (52.63%) are matured somewhere in the range of 30 and 40 years, more than 33% of the examples (36.84%) are matured somewhere in the range of 20 and 30 years, and 10.53% of the samples are matured somewhere in the range of 40 and 50 years. This outcome demonstrates that wall plastering/putting work is adults' people trade.

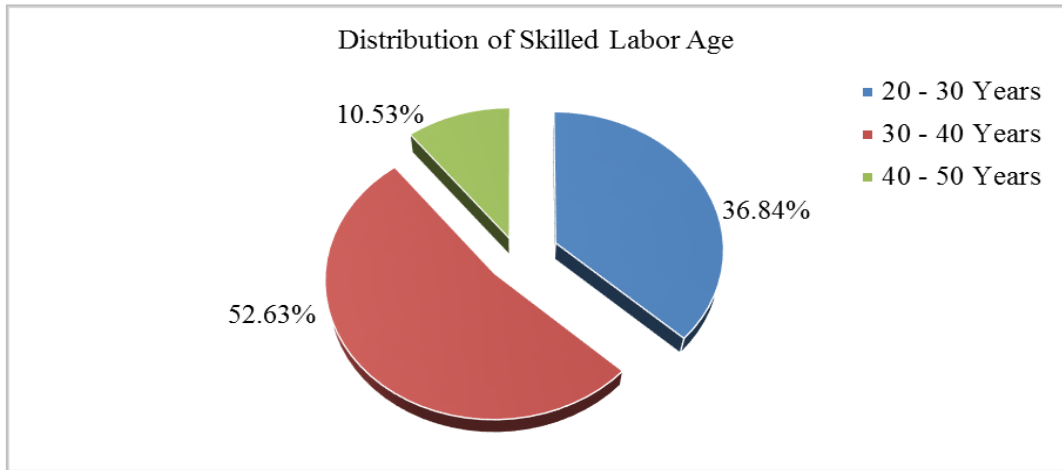


Figure 4.19: Distribution of Skilled Labor Age for Wall Plastering/putting Work

Figure 4.20 depicts that, the greater part of the sample (52.63%) has experience somewhere in the range of 2 and 5 years, and 15.79% of the sample has experience less than 2 years, somewhere in the range of 5 and 10 years, or more 10 years similarly. This outcome demonstrates that the greater part of the skilled workforces have experience somewhere in the range of 2 and 5 years

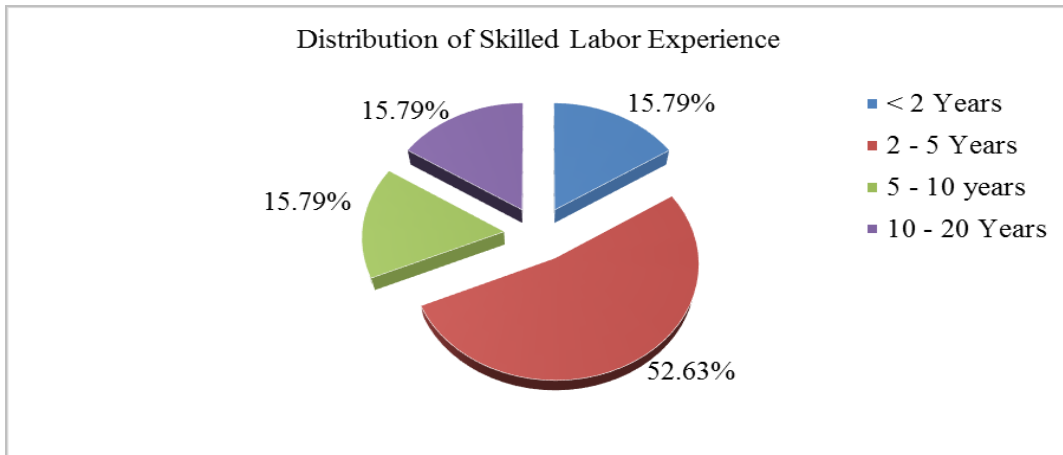


Figure 4.20: Distribution of Skilled Labor Experience for Wall Plastering/Putting Work

Figure 4.21 shows that, 42.11% of the samples are concentrated on up to grade eight, a bigger number of than one-fourth of the samples (26.32%) are concentrated on up to grade four, 15.79% of the samples are concentrated on up to grade ten, and 15.79% of the samples are uninformed. Rely upon the seeing as a large portion of the wall plastering/putting work works are concentrated on just elementary school study.

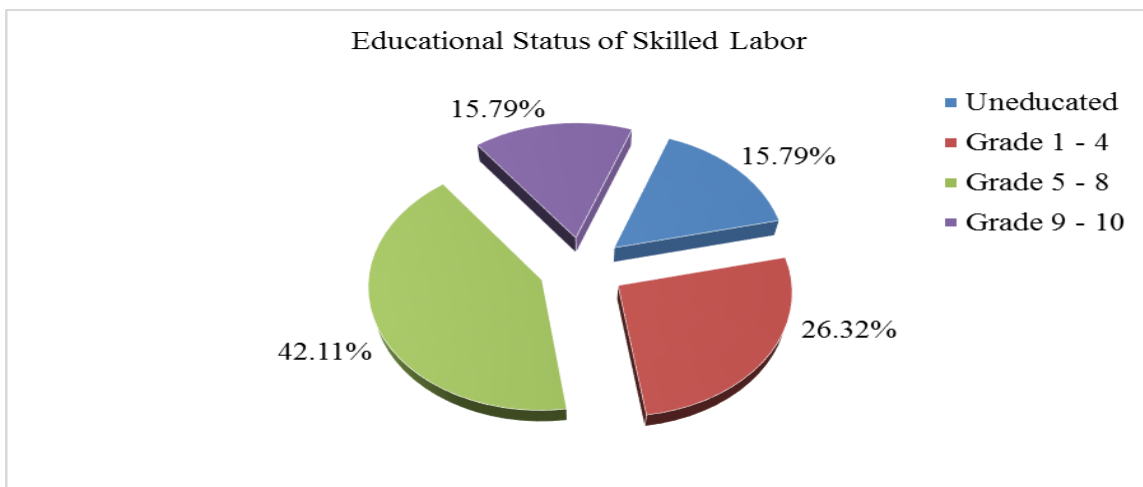


Figure 4.21: Distribution of Skilled Labor Educational Status for Wall Plastering/Putting Work

That's what results show, skilled workforces are all prepared nearby informally learning from their seniors, and nobody of the gifted workforces are officially prepared in proper trade schools (TVET).

4.5.4.2 Distribution of Wall Plastering/Putting Working Time

Wall plastering/putting work activity is separated into three groups of activities: productive activities, contributory or semi-productive activities and, non-productive (inactive) activities. Productive activities incorporate "scoop a measure of mortar utilizing scoop which could be hold by the falcon", "applying the mortar on the wall (strokes with the scoop and compress the mortar onto the wall)", and "scratching (eliminating the abundance mortar)". Contributory activities incorporate "guaranteeing the wall surface is spotless and liberated from dust", "sprinkle water over the surface to guarantee better staying of the mortar", "planning mortar", "transportation of materials", and "cleaning workspace". Non-productive activities which incorporate "inactive time (sitting, watching, smoking, drinking and disinfection)", "adjust (eliminating and supplanting previously finished work because of administrator shortcoming or the board issue)", and "deferral because of climate".

That's what table 4-21 outlines, talented work spend more than three-fourth (79.16%) of their functioning time in productive work. In the meantime, skilled works spend just 8.60% of the everyday working time in contributory (semi-productive work. This demonstrates that gifted works invest more energy in productive work activities. Non-productive (inactive) season of gifted work is 12.24% of the everyday working time.

Table 4-21: Statistics of Wall Plastering/Putting Working Time

Work categories	Statistics	Skilled labor
Productive work time	Mean (%)	79.16
	SD (standard deviation)	3.82
Semi-productive (contributory) work time	Mean (%)	8.60
	SD (standard deviation)	1.30
Non-productive work time	Mean (%)	12.24
	SD (standard deviation)	1.59

That's what table 4-22 portrays; the main action done by skilled works is applying the mortar onto the wall (strokes with the scoop and compress the mortar onto the wall) which had taken 41.68% of working time. The second significant movement done by skilled works is "scratching (eliminating the overabundance mortar) and scoop a measure of mortar utilizing scoop which had taken 19.16% and 18.32% of skilled work working time; individually". This outcome is satisfactory as the primary occupation of a skilled work is applying the mortar onto the wall and scratching overabundance mortar. Notwithstanding that skilled work invest 0.37% of their energy in sprinkle water over the outer layer of the wall, 2.06% of skilled work working time in planning mortar and 6.17% of their time by cleaning working region. Unproductive season of skilled works is 12.24% of the everyday working time.

Table 4-22: Distribution of Wall Plastering/Putting Work Activities

Work categories	Statistics	Skilled labor (%)
Productive activities	Using trowel, scoop an amount of mortar	18.32
	Applying the mortar on the wall	41.68
	Scratching (removing the excess mortar)	19.16
Semi-productive (contributory) activities	Sprinkle water over the surface of the wall	0.37
	Preparing mortar	2.06
	Cleaning	6.17
Non-productive activities	Idle time	12.24

4.5.4.3 Skilled Worker Efficiency in Wall Plastering Work

The hourly result of skilled works is taken during action testing review. Eighty proportions of hourly work efficiency were produced using eight active sites and the normal of those actions is recorded as a normal hourly result. Thusly, the finding demonstrates that the typical efficiency of skilled works in second coat wall putting is 1.49 m² each hour. The detail result is in Appendix-7.

4.5.5 Slab Formwork Work Labor Efficiency

Formwork is an temporary or long-lasting mold into which new cement is poured. Formwork is based nearby out of wood, steel boards and compressed wood or dampness safe board. Floor slabs formwork and lowered radiates in pieces, are made solidly. In floor slab formwork the labor included are carpenter, help craftsman, and everyday workers.

4.5.5.1 Study of Sample Characteristics

Figure 4.22 outlines that, a big part of the sample (50%) are matured somewhere in the range of 30 and 40 years, 33% of the sample (33.33%) are matured somewhere in the range of 20 and 30 years, and 16.67% of the sample are matured somewhere in the range of 40 and 50 years. Depending upon the finding section formwork is adult men trade.

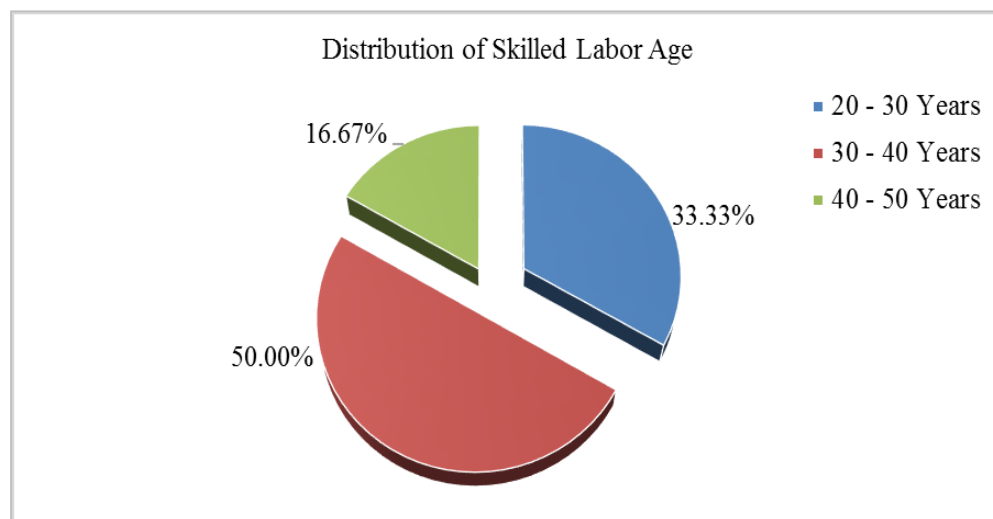


Figure 4.22: Distribution of Skilled Labor Age for Floor Slab Formwork Work

Figure 4.23 depicts that, 44.44% of the sample has experience somewhere in the range of 5 and 10 years, and 38.89% of the sample has experience somewhere in the range of 2 and 5 years, and 16.67% of the sample has experience somewhere in the range of 10 and 20 years. This outcome demonstrates that the greater part of the slab formwork skilled labors have over 5 years of experience.

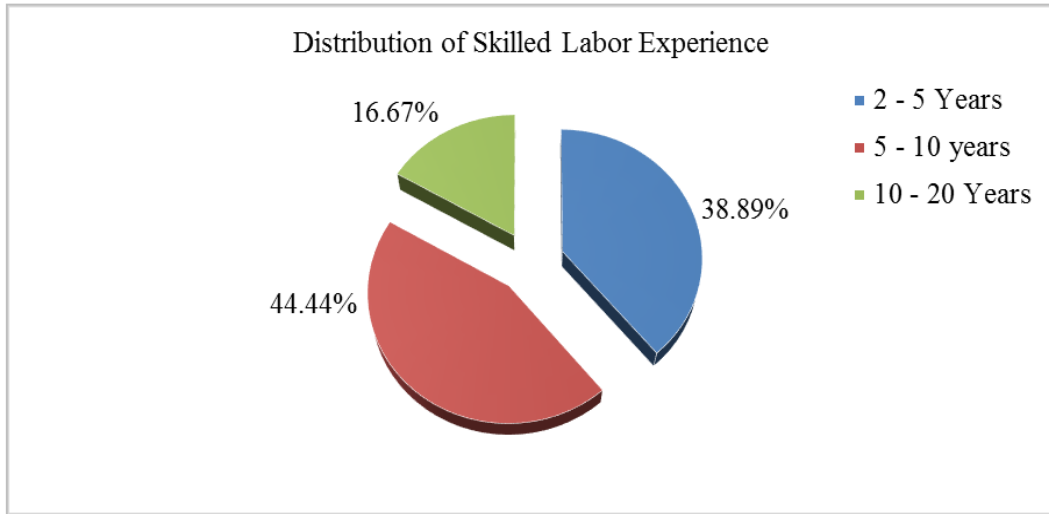
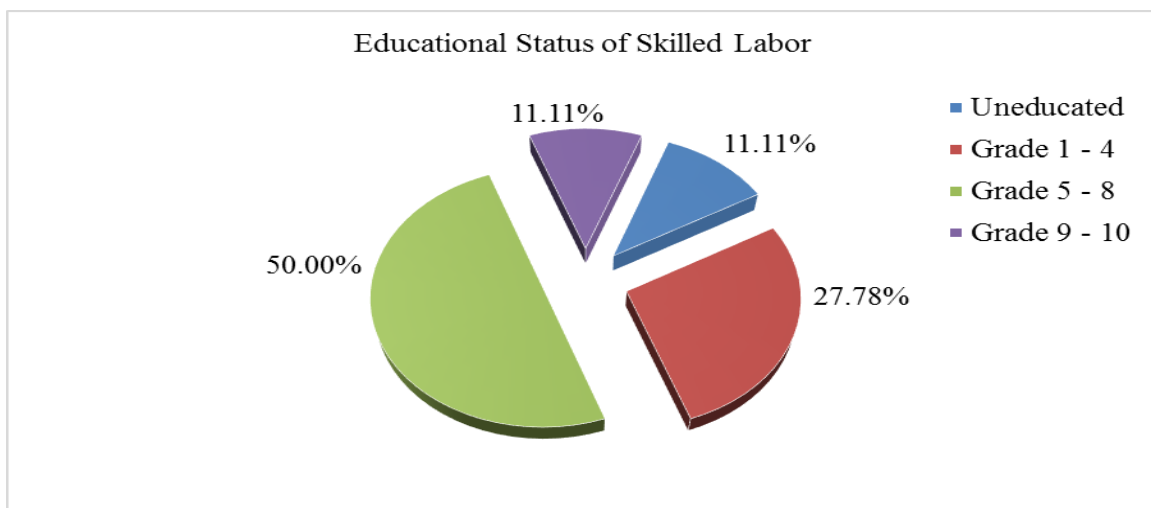


Figure 4.23: Distribution of Skilled Labor Experience for Floor Slab Formwork Work

Figure 4.24 shows that, a big part of the samples (50%) are concentrated on up to grade eight, a larger number of than one-fourth of the samples (27.78%) are concentrated on up to grade four, 11.11% of the samples are concentrated on up to grade ten, and 11.11% of the samples are uneducated. This outcome shows that the greater parts of the carpenters are concentrated on just grade school study.

Figure 4.24: Distribution of Skilled Labor Educational Status for Floor Slab Formwork Work

That's what results show, the skilled workforces are all trained on-site informal gaining from their seniors, and nobody of talented works are officially trained in conventional trade schools (TVET).



4.5.5.2 Distribution of Slab Formwork Working Time

Slab formwork activity is separated into three groups of activities: productive activities, contributory or semi-productive activities and, non-productive (inactive) activities. Productive activities incorporate "collect and attach materials to make system or props utilizing; hand apparatuses, wood screws, nails, dowel, pins, or paste ", "measure and imprint cutting lines on materials utilizing; ruler, pencil, chalk, and stamping check ", and "shape or slice materials to determined estimations, utilizing hand instruments, machines, or power saw ". Contributory activities incorporate "check genuineness of design utilizing; plumb sway, hand level and string", "erect platform and stepping stools for gathering structures over the ground level ", "take guidance from managers ", "cleaning work are ", and "transportation of materials". Non-productive activities which included "inactive time (sitting, watching, smoking, drinking and sterilization)", "revamp (eliminating and supplanting previously finished work because of administrator shortcoming or the executives issue)", and "postponement because of climate".

That's what table 4-23 portrays; skilled labor spend under three-fourth (72.33%) of working time in productive work. Meanwhile, skilled works invest 20.71% of working energy in contributory (semi-productive) work. This demonstrates that skilled works burn through the majority of the day to day working time on productive activities. Non-productive season of skilled labor is 6.97% of the everyday working time.

Table 4-23: Statistics of Floor Slab Formwork Working Time

Work categories	Statistics	Skilled labor
Productive work time	Mean (%)	72.33
	SD (standard deviation)	3.13
Semi-productive (contributory) work time	Mean (%)	20.71
	SD (standard deviation)	1.59
Non-productive work time	Mean (%)	6.97
	SD (standard deviation)	1.08

As can be seen from Table 4-24 the main action done by skilled labors is collect and attach materials to make system or props utilizing; hand devices, wood screws, nails, dowel, pins, or paste which had taken 36.26% of skilled labors working time. The second significant action done by

skilled labors is "measure and imprint cutting lines utilizing; ruler, pencil, chalk, and stamping check and shape or slice materials to indicated estimations which had taken 17.84% and 18.23% of the everyday working time; individually".

Table 4-24: Distribution of Floor Slab Formwork Work Activities

Work categories	Statistics	Skilled labor (%)
Productive activities	Assemble and fasten materials to make framework or props	36.26
	Measure and mark cutting lines	17.84
	Shape or cut materials to specified measurements	18.23
Semi-productive (contributory) activities	Verify trueness of structure, using plumb bob, hand level and string	9.73
	Take instruction from supervisors	4.10
	Cleaning work area	4.87
	Transportation of materials	2
Non-productive activities	Idle time	6.97

This outcome is satisfactory as the fundamental occupation of carpenter is gather and attach materials to make system or props, measure and imprint cutting lines, and shape or slice materials to determined estimations.

4.5.5.3 Skilled Worker Efficiency in Floor Slab Formwork Work

The hourly result of skilled Labors is taken during movement testing review. Eighty proportions of hourly work efficiency were produced using ten active sites and the normal of those actions is reported as a normal hourly result. In this way, the finding demonstrates that the typical efficiency of skilled labors to do floor slab formwork is 0.23 m2 each hour. The detail result is in Appendix-8.

4.5.6 Comparison of Efficiency Rate Measured on Site with the Ministry of Works and Urban Development Efficiency Rate

Table 4-25: Comparison of On-site Measured Productivity Rate with Ministry of Works and Urban Development Efficiency Rate

Activity	Man-power assignment	Ministry of Works and Urban Development rate	On-site measured efficiency
In-situ solid slab concrete casting	1 Workmanship(Mason) + 6 Daily labors	10 m ² /day	23.12 m ² /day
20cm thick ESB laying	1 Mason + 2 Daily labors	10 m ² /day	10.48 m ² /day
2nd coat wall plastering	1 Plasterer + 2 Daily labors	10 m ² /day	11.88 m ² /day
Stone masonry (sub-structure)	1 Mason + 3 Daily labors	5 m ³ /day	5.52 m ³ /day
Floor slab formwork	1 Carpenter + 1 Ass. Carpenter + 2 Daily labors	0.5 m ² /day	1.8 m ² /day

As represented in Table 4-25, the similar examination of the discoveries show a critical augmentation of result in this viewing as contrasted and the Ministry of Works and Urban Development yield in-situ strong section substantial projecting, wall putting and floor piece formwork. Then again, the finding is practically a similar in 20 cm thick ESB work and stone brick work (sub-structure) work with a slight augmentation. This huge addition of result would be a result of the construction strategy, and materials and equipment utilized. Presently, contractors began to involve steel in mix with wooden props, adjust wooden props by giving metal shoes in which the props are embedded and lumber bar floor formwork (wooden I-shaft) for slab construction. Steel structures are likewise being used in mix with wood. Steel is areas of strength for extremely can be changed and fixed inside a brief time frame absent a lot of harm done to the shaping. Compressed

wood is utilized as sheeting that contacts cement and it can save shaping time, since it comes in enormous sizes.

Beforehand, just lumber basically eucalyptus tree props were utilized. Lumber sheets as well as steel boards are utilized as sheeting material. This framework isn't conservative concerning work concentrated nature of works; since it prompts material waste.

At present, contractors began to utilize winch and crane generally for in-situ floor slab substantial work over the ground floor. This technique for substantial transportation will save time and increment efficiency exceptionally. Routinely, contractors were utilizing human ability to ship concrete from ground to higher floors over hazardous wooden stages.

4.5.7 Work Efficiency Index

Utilizing equation 2.6, the file of efficiency for the chose trade of works is introduced in Table 4-26 underneath. The base year efficiency is MoWUD, 1998 rate which is the main record utilized as a norm in our country.

Table 4-26: Efficiency Index of On-site Measured Efficiency Rate with respect to MoWUD Rate

Activity	Ministry of Works and Urban Development rate (efficiency @ period t0)	On-site measured efficiency (efficiency @ period t1)	Efficiency Index
In-situ solid slab concrete casting	10 m ² /day	23.12 m ² /day	2.312
20cm thick ESB laying	10 m ² /day	10.48 m ² /day	1.048
2nd coat wall plastering/putting	10 m ² /day	11.88 m ² /day	1.188
Stone masonry	5 m ³ /day	5.52 m ³ /day	1.104
Floor slab formwork	0.5 m ² /day	1.8 m ² /day	3.6

As displayed in Table 4-26, this proportion mirrors the amounts change from base period to now. The record shows a critical addition of result right now as contrasted and the Ministry of Works and Urban Development yield list in-situ strong piece substantial projecting, and floor section

formwork. On the other hand, the finding is practically something very similar in ESB work, wall putting work and stone workmanship work with a slight augmentation. This critical addition of result would be a direct result of the construction strategy, and materials and equipment utilized. Presently, contractors began to involve steel in blend with wooden props, adjust wooden props by giving metal shoes in which the props are embedded and timber pillar floor formwork (wooden I-bar) for slab construction. Steel structures are likewise being used in mix with wood. Steel is serious areas of strength for extremely can be changed and fixed inside a brief time frame absent a lot of harm done to the shaping. Compressed wood is utilized as sheeting that contacts cement and it can saves framing time, since it comes in huge sizes.

Presently a day, contractors began to utilize winch and crane broadly for in-situ floor slab substantial work for over the ground floors. This technique for substantial transportation will save time and increment efficiency profoundly. Ordinarily, contractors were utilized human ability to ship concrete from ground floor to higher floors over hazardous wooden stages.

Therefore, to quantify the change in work efficiency over time, a work efficiency index was calculated using the MoWUD standards as the baseline. The index revealed substantial improvements in efficiency for in-situ solid slab concrete casting and floor slab formwork, potentially attributed to advancements in technology and construction practices.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1 Major Findings

Major Findings from the Assessment of Work Efficiency in Building Construction Projects in Addis Ababa

The study aimed to assess work efficiency on building construction sites in Addis Ababa, Ethiopia, identifying factors that influence productivity and comparing on-site measurements with the standards set by the Ministry of Works and Urban Development (MoWUD). Here are the major findings:

● **Key Factors Influencing Work Efficiency:**

- ✓ **Material shortage** emerged as the most significant factor hindering work efficiency, with a Relative Importance Index (RII) of 91.20%. This highlights the critical need for contractors to ensure timely procurement and availability of materials.
- ✓ **Payment delays**, both from clients and to laborers, were also identified as major obstacles, with RII values of 88.20% and 90.60%, respectively. This emphasizes the importance of timely payments to maintain workforce morale and motivation.
- ✓ **Tool and equipment shortages**, with an RII of 88.20%, further underscored the need for adequate resource allocation.
- ✓ **Labor-related issues**, including absenteeism (RII 85.80%) and lack of experience (RII 78.20%), significantly impacted productivity, highlighting the need for skilled and reliable workforce.
- ✓ **Construction methods** employed also played a role, with an RII of 86.40%, suggesting that a shift towards more efficient techniques is necessary.

● **Work Efficiency Measurement:**

- ✓ The study employed the activity sampling method to analyze the time distribution and hourly output of skilled labor across five common construction tasks.
- ✓ Findings revealed that skilled labor dedicates the majority of their working time to productive activities, with stone masonry (80.74%) and floor slab formwork (72.33%) exhibiting the highest proportion of productive time.
- ✓ The average hourly output for each trade was measured as follows: in-situ solid slab concrete casting (2.89 m²), 20 cm thick Empty Substantial Block (ESB) laying (1.31

m²), stone masonry (0.69 m³), second coat wall plastering (1.49 m²), and floor slab formwork (0.23 m²).

● **Comparison with MoWUD Standards:**

- ✓ The study revealed a substantial increase in output compared to the efficiency rates set by the MoWUD, particularly in in-situ solid slab concrete casting, wall plastering, and floor slab formwork.
- ✓ This discrepancy can be attributed to advancements in construction techniques, materials, and equipment used by contractors in Addis Ababa. For example, the use of steel props in conjunction with wooden props and the adoption of timber beam floor formwork have led to improved efficiency.

The research highlights the importance of addressing key factors that negatively influence work efficiency, such as material shortages, payment delays, and labor-related challenges, to enhance efficiency in the construction industry in Addis Ababa. Furthermore, the study emphasizes the need for updated efficiency standards that reflect current practices and technological advancements in the industry.

5.1.2 Summary of Findings

The results of analysis of (49) factors were viewed as in the questionnaires filled by delegate tests of contracting organizations. Among those factors the best ten factors adversely influencing work efficiency were: lack of material, payment delay/compensation deferral, tools and equipment shortages, payment delay from client side, poor wage, construction method, labor absenteeism, absence of clear and everyday undertaking task, absence of work close observation and absence of work progress follow up. Among the ten factors lack of material scored RII worth of 91.20% and absence of work progress follow up scored RII worth of 81.80% the leftover in the middle of between the two limits.

This exploration uncovered the disseminations of skilled labor time and hourly efficiency during the everyday working time frame. The aftereffects of skilled labor observation utilizing action examining method on five work things showed their useful time, semi-productive (contributory) time and non-productive time. The discoveries show that skilled labors work essentially useful activities as they invest a greater amount of their functioning energy in efficiency activities. With respect to time among the five trades of works stone workmanship (sub-structure) trade works

invest 80.74% of their energy and floor slab formwork trade works invest 72.33% of their time in productive works the remainder actually in the middle of between these two. Furthermore, along with movement testing concentrate on their hourly efficiency result of the skilled works is: in floor slab concrete (2.89 m²), in 20 cm thick Empty Substantial Block (ESB) (1.31 m²), stone workmanship (sub-structure) (0.69 m³), second coat wall plastering/putting (1.49 m²) and floor slab formwork (0.23 m²).

To sum up, this chapter analyzed factors affecting work efficiency and quantified actual hourly output for common construction activities in Addis Ababa. The findings revealed a diverse range of factors impacting work efficiency, emphasizing the need for targeted interventions by construction companies and policymakers. The study provides valuable insights into the current state of work efficiency in the construction industry and highlights areas for improvement. Future research could expand upon these findings by investigating other construction activities, comparing the efficiency of formally and informally trained workers, and establishing a comprehensive database of work efficiency rates based on on-site measurements.

5.2 Conclusion

This study examined factors influencing work efficiency and measured the actual output for common construction activities in Addis Ababa, revealing key areas for improvement and highlighting the dynamic nature of the industry.

Key Factors Impacting Efficiency:

- **Material shortages:** Consistently ranked as the most significant factor affecting work efficiency across various studies.
- **Payment delays:** From both clients and contractors, directly impacting worker morale and motivation, ultimately leading to decreased productivity.
- **Lack of experience and training:** A recurring challenge, emphasizing the need for investment in workforce development and training programs.
- **Construction methods and site conditions:** The choice of construction methods and the availability of adequate facilities, such as water and power, play a crucial role in worker efficiency.

Work Efficiency Measurement and Comparison with Standards:

The activity sampling method, coupled with actual output measurements, allowed for the quantification of work efficiency for five common construction activities. The findings revealed that:

- Skilled laborers dedicate a majority of their time to productive activities, but variations exist across trades, highlighting the need for trade-specific efficiency improvement strategies.
- The average hourly output for certain activities, such as in-situ solid slab concrete casting and floor slab formwork, significantly exceeded the standards set by the Ministry of Works and Urban Development (MoWUD). This difference suggests advancements in construction techniques and technology.

Recommendations for Improvement:

- **Addressing material shortages:** Implement robust material management systems, including accurate forecasting, timely procurement, and efficient on-site storage.
- **Ensuring timely payments:** Prioritize prompt payments to contractors and workers to maintain morale and motivation.
- **Investing in training and development:** Enhance worker skills and knowledge through formal training programs and apprenticeship opportunities, focusing on both technical skills and best practices for efficiency.
- **Optimizing construction methods and site conditions:** Carefully select appropriate construction methods based on project requirements and ensure adequate facilities, such as water and power supply, to create a conducive working environment.

Future Research Directions:

- Expand the scope of work efficiency measurements to include other construction activities.
- Conduct comparative studies on the efficiency of formally and informally trained workers to assess the impact of training programs.
- Develop a comprehensive database of work efficiency rates based on on-site measurements for various construction activities.

By implementing these recommendations and pursuing further research, the construction industry in Addis Ababa can move towards higher levels of work efficiency, improving project outcomes and contributing to the overall development of the sector.

5.3 Recommendations

- Incredible consideration ought to be given to materials/tools/equipment related factors, since it is positioned first among the nine variables or factors gatherings. It is undeniably challenging and difficult to do any building construction projects without the accessibility of materials/apparatuses/hardware. Accordingly, workers for hire ought to convey any essential materials/tools/equipment or ensure their accessibility prior to beginning their work.

- The contractors working in Addis Ababa ought to work on their strategy for construction.
- Since every one of the main ten variables or factors significance level is at high (RII \geq 80.00 %); unique consideration ought to be given to the main ten factors referenced such a long ways in the review.
- Client ought to impact the payment to contractors on time to limit the effect of payment defer on work efficiency.
- Managers on building construction sites ought to act considering the highest level factors to increment works efficiency by planning month to month, week after week, and day to day work plan and consistently observing the advancement of the work according to the timetable.
- It is smarter to work with and train talented works broadly in conventional exchange schools (TVET), which centers around showing construction exchanges, for example, block work, stone work, carpentry work, substantial work, completing works (painting, putting, coating and such), plumbing and so on to work on the capacities and efficiency of specialties force working in construction projects.
- It is suggested to utilize current formworks than customary wood structures and eucalyptus tree props to increment efficiency. As steel prop is areas of strength for extremely can be changed at more extensive space inside a brief time frame than eucalyptus tree prop. To involve pressed wood than timber as sheeting to save shaping time, since it comes in enormous sizes. Also, it is smarter to utilize crane or winch to fill in-situ strong section substantial projecting work for over the ground floor slabs.
- As a business sign for a proficient financial investor who is prepared to put resources into association with tools and equipment lack, it is smarter to begin tools and equipment rental shop in Addis Ababa City for common advantage of the investor to get benefit and to the contractors to save time and increment efficiency.
- As a healing measure, construction organizations need to lead efficiency learn at functional level like concentrating on factors influencing work efficiency and work efficiency estimation to portray the detailed projects performed for a movement by individual or gathering to figure out the pain points and propose ways of further developing work efficiency. It is fitting to keep authentic information of efficiency rate in completed undertakings to work on the viability and precision of cost assessment, and length for future tasks.

Coming up next is suggested for future examinations;

- ❖ A review focusing on other exchange of works, (for example, bar twisting and setting work, tile work, painting work, plumbing work, electrical work, and so on.)
- ❖ To concentrate on efficiency status of officially prepared works in exchange training school (TVET) and formally prepared works (nearby from their seniors) independently.
- ❖ There is a requirement for additional examinations on work efficiency in Addis Ababa construction industry to set a work efficiency normal result in view of genuine site estimation.

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APPENDIX 1: Questionnaire

Dear Respondents,

First and by and large, I might want to introduce my appreciation and because of you for dedicating your valuable time and the work you will make to finish this questionnaire.

This questionnaire plans to concentrate on work efficiency in building construction projects. This is essential for fractional satisfaction of the prerequisites for level of Master of Project Management.

It would be appreciative if you would finish the connected questionnaire. Obviously, the data furnished will be treated with severe classification and individual projects or organizations won't be recognized. All data in the questionnaire will be utilized exclusively for the research reason.

In the event that you have questions connected with the concentrate kindly go ahead and me through the under noted address:

Much thanks to you for your joint effort

Phone no: +251 913277450

Email:

I. Company and Personal Profile

1. Grade of the organization:

GC 1 GC 2 GC 3 below GC 4

BC 1 BC 2 BC 3 below BC 4

2. What is your position in the organization?

Projects Manger Office Engineer Site Engineer Foreman

3. Years of your experience in the construction industry:

Below 2 years 2-5 years 5-10 years above 10 years

4. How much is the contract amount of the project (in Birr)?

<20 Million 20-50 Million 50-100 Million >100 Million

5 The contract duration of the project (in Months)?

< 6 months 6-12 Months 12-18 months > 18 Months

II. Factors Influencing Efficiency

1. Rating of the effect of factors on Efficiency

In the table below there are quantities of factors adversely influencing work efficiency in building projects. Kindly characterize the level of significance of these factors in influencing work efficiency thinking about the under referenced table. Symbol Meaning

1. Influences with little degree
2. Influences somehow
3. Influences with normal degree
4. Influences with enormous degree
5. Influences with extremely huge degree

No.	Groups	Factors influencing work efficiency	Degree of significance				
			1	2	3	4	5
1	Labor related Factors	Labor absenteeism					
		Increment of labor age					
		Absence of work experiences					
		Labor personal problems (e.g. use of Alcohol, Drugs...)					
		Labor disloyalty					
		Misconception among worker					
		Absence of competition					
2	Leadership and Management related Factors	Misunderstanding between labor and administrators					
		Absence of work close observation					
		Absence of clear and everyday undertaking task					
		Absence of monetary inspiration system (incentive, intermittent reward)					
		Absence of work progress follow up					
		Non-providing of transportation means					
		Absence of place for eating and relaxation					
		Payment delay					
		Poor wage					
		Stay at work longer than required					
		Working for 7 days of week without holiday					
		Increasing No. of labor in order to increase work efficiency					
		Misuse of time schedule					
Method of employment							

3	Materials / Tools/ Equipment related Factors	Lack of Materials					
		Unacceptability of materials stockpiling area					
		Tool and equipment shortages					
		Interruption of power and water supply					
		Out of date tools and equipment					
4	Supervision related Factors	Delay in decision making					
		Supervisors non-attendance					
		Investigation delay					
		Drawings and details change					
		Inadequate and inaccurate drawings					
5	Project related Factors	Size & Complexity of the project					
		Construction method					
		Incomplete facilities (water, power					
		Working in bound space					
6	Health and safety related Factors	Violation of wellbeing insurances					
		Un employment of safety officer in construction site					
		Absence of safety tools					
		Accident during construction					
		Bad health of labors					
7	Quality related Factors	Low quality of raw materials					
		High quality of required work					
		Inefficiency of equipment					
8	Stake Holders Related Factors	Payment delay from client side					
		Owner Interference					
		Absence of communication between parties					

9	External Factors	Bad atmospheric condition (rain, wind, high/low temperature, etc.)					
		Holidays/ Holy days					
		Political situations					
	Others (please specify)						

APPENDIX 2: Interview

General Information

1. What is your trade profession? -----

2. Gender:

Male

Female

2. What is the status of your employer in this project?

Main contractor

Sub-contractor

3. For how long have you been with the current employer?

0 up to 2 years

2 up to 5 years

5 up to 10 years

10 up to 20 years

Greater than 20 years

4. For how long have you been with this project (in month)?

0 up to 3 months

3 up to 6 months

6 up to 12 months

Greater than 12 months

5. How old are you?

15 up to 20 years

20 up to 30 years

30 up to 40 year

40 up to 50 years

Greater than 50 years

6. How many years of experience do you have with this industry?

0 up to 2 years

2 up to 5 years

5 up to 10 years

10 up to 20 years

Greater than 20 years

7. In which of the following ways have you attended your profession?

Apprenticeship

Formal trade schools (TVET)

On-site trained

Government workshop

8. What is your educational status?

Uneducated

Grade 1-4

Grade 4-8

Grade 9-10

Grade 11-12

TVET completed

Higher education completed

APPENDIX 3: Cronbach's Alpha Value of all the Factors

Item no.	Items	Cronbach's Alpha of the Item
1	Labor absenteeism	.858
2	Increment of labor age	.848
3	Absence of work experiences	.850
4	Labor personal problems	.854
5	Labor disloyalty	.845
6	Misconception among worker	.845
7	Absence of competition	.842
8	Misunderstanding between labor and administrators	.850
9	Absence labor close observation(surveillance)	.848
10	Absence of clear and everyday undertaking task	.847
11	Lack of monetary inspiration system(incentive, intermittent)	.853
12	Absence of work progress followup	.851
13	Non-providing of transportation means	.853
14	Absence of place for eating and relaxation	.847
15	Payment delay	.850
16	Poor wage	.853
17	Stay at work longer than required	.848
18	Working for 7 days of week without holiday	.849
19	Increasing No. of labor in order to work efficiency	.853
20	Misuse of time schedule	.850
21	Method of employment	.847
22	Lack of Materials	.853
23	Unacceptability of materials stockpiling area	.849
24	Tool and equipment shortages	.852
25	Interruption of power and water supply	.854

26	Out of date tools and equipment	.857
27	Delay in decision making	.862
28	Supervisors non-attendance	.862
29	Investigation delay	.855
30	Drawings and details change	.855
31	Inadequate and inaccuratedrawings	.857
32	Size & Complexity of the project	.850
33	Construction method	.848
34	Incomplete facilities (water, power supply, sanitary)	.852
35	Working in bound space	.845
36	Violation of wellbeing insurances	.856
37	Un employment of safety officer in construction site	.855
38	Absence of safety tools	.852
39	Accident during construction	.847
40	Bad health of labors	.856
41	Low quality of raw materials	.848
42	High quality of required work	.846
43	Inefficiency of equipment	.855
44	Payment delay from client side	.849
45	Owner Interference	.846
46	Absence of communication between parties (Owner, Consultant and Contractor)	.849
47	Bad atmospheric condition (rain, wind, high/low temperature,etc.)	.854
48	Holidays/ Holy days	.856
49	Political situation	.851

APPENDIX 4: On- site Measured Output for In-situ Solid Slab Concrete Casting

Report

Output per hour

Measures	Mean	Std. Deviation	Sum	Minimum	Maximum
M1	2.5500		2.55	2.55	2.55
M2	3.0200		3.02	3.02	3.02
M3	2.6500		2.65	2.65	2.65
M4	2.8300		2.83	2.83	2.83
M5	2.6800		2.68	2.68	2.68
M6	3.0100		3.01	3.01	3.01
M7	3.0900		3.09	3.09	3.09
M8	2.9400		2.94	2.94	2.94
M9	3.0700		3.07	3.07	3.07
M10	2.8600		2.86	2.86	2.86
M11	2.9100		2.91	2.91	2.91
M12	2.9100		2.91	2.91	2.91
M13	2.7700		2.77	2.77	2.77
M14	3.2300		3.23	3.23	3.23
M15	3.0300		3.03	3.03	3.03
M16	2.8700		2.87	2.87	2.87
M17	3.1600		3.16	3.16	3.16
M18	2.6900		2.69	2.69	2.69
M19	3.0900		3.09	3.09	3.09
M20	2.6700		2.67	2.67	2.67
M21	3.0400		3.04	3.04	3.04
M22	3.1200		3.12	3.12	3.12
M23	2.7200		2.72	2.72	2.72
M24	2.8300		2.83	2.83	2.83
M25	2.9100		2.91	2.91	2.91
M26	3.0300		3.03	3.03	3.03
M27	3.1100		3.11	3.11	3.11
M28	2.9300		2.93	2.93	2.93
M29	2.8400		2.84	2.84	2.84
M30	2.9600		2.96	2.96	2.96
M31	2.5900		2.59	2.59	2.59
M32	2.7600		2.76	2.76	2.76
M33	3.0200		3.02	3.02	3.02
M34	2.8800		2.88	2.88	2.88
M35	2.9500		2.95	2.95	2.95
M36	2.9700		2.97	2.97	2.97
M37	3.1700		3.17	3.17	3.17
M38	3.2500		3.25	3.25	3.25
M39	2.9600		2.96	2.96	2.96
M40	2.9400		2.94	2.94	2.94
M41	3.1200		3.12	3.12	3.12

M42	2.9300		2.93	2.93	2.93
M43	3.1600		3.16	3.16	3.16
M44	3.2200		3.22	3.22	3.22
M45	2.9200		2.92	2.92	2.92
M46	2.8300		2.83	2.83	2.83
M47	3.2100		3.21	3.21	3.21
M48	3.0600		3.06	3.06	3.06
M49	2.7900		2.79	2.79	2.79
M50	2.8600		2.86	2.86	2.86
M51	2.7300		2.73	2.73	2.73
M52	2.8500		2.85	2.85	2.85
M53	2.8400		2.84	2.84	2.84
M54	3.0800		3.08	3.08	3.08
M55	2.6600		2.66	2.66	2.66
M56	3.0400		3.04	3.04	3.04
M57	2.7300		2.73	2.73	2.73
M58	2.5900		2.59	2.59	2.59
M59	2.8800		2.88	2.88	2.88
M60	2.9700		2.97	2.97	2.97
M61	2.6600		2.66	2.66	2.66
M62	2.7300		2.73	2.73	2.73
M63	2.9100		2.91	2.91	2.91
M64	2.7600		2.76	2.76	2.76
M65	2.5200		2.52	2.52	2.52
M66	3.0400		3.04	3.04	3.04
M67	2.6800		2.68	2.68	2.68
M68	2.7900		2.79	2.79	2.79
M69	2.6500		2.65	2.65	2.65
M70	3.1300		3.13	3.13	3.13
M71	2.7100		2.71	2.71	2.71
M72	2.8000		2.80	2.80	2.80
M73	2.5300		2.53	2.53	2.53
M74	2.8100		2.81	2.81	2.81
M75	2.6700		2.67	2.67	2.67
M76	3.1600		3.16	3.16	3.16
M77	2.8300		2.83	2.83	2.83
M78	3.0800		3.08	3.08	3.08
M79	2.7200		2.72	2.72	2.72
M80	2.9100		2.91	2.91	2.91
M81	2.7900		2.79	2.79	2.79
Total	2.8933	.18239	234.36	2.52	3.25

APPENDIX 5: On- site Measured Output for ESB

Report

Output per hour (M²/hr.)

Measures	Mean	Std. Deviation	Sum	Minimum	Maximum
M1	1.1900		1.19	1.19	1.19
M2	1.2300		1.23	1.23	1.23
M3	1.2800		1.28	1.28	1.28
M4	1.2600		1.26	1.26	1.26
M5	1.3700		1.37	1.37	1.37
M6	1.2200		1.22	1.22	1.22
M7	1.3400		1.34	1.34	1.34
M8	1.3600		1.36	1.36	1.36
M9	1.2700		1.27	1.27	1.27
M10	1.4100		1.41	1.41	1.41
M11	1.3400		1.34	1.34	1.34
M12	1.2600		1.26	1.26	1.26
M13	1.1900		1.19	1.19	1.19
M14	1.2800		1.28	1.28	1.28
M15	1.3300		1.33	1.33	1.33
M16	1.3200		1.32	1.32	1.32
M17	1.3500		1.35	1.35	1.35
M18	1.1700		1.17	1.17	1.17
M19	1.2800		1.28	1.28	1.28
M20	1.2100		1.21	1.21	1.21
M21	1.2900		1.29	1.29	1.29
M22	1.3600		1.36	1.36	1.36
M23	1.3700		1.37	1.37	1.37
M24	1.2700		1.27	1.27	1.27
M25	1.2900		1.29	1.29	1.29
M26	1.3900		1.39	1.39	1.39
M27	1.4100		1.41	1.41	1.41
M28	1.3500		1.35	1.35	1.35
M29	1.3200		1.32	1.32	1.32
M30	1.3700		1.37	1.37	1.37
M31	1.2900		1.29	1.29	1.29
M32	1.2500		1.25	1.25	1.25
M33	1.3100		1.31	1.31	1.31
M34	1.2900		1.29	1.29	1.29
M35	1.3800		1.38	1.38	1.38
M36	1.2300		1.23	1.23	1.23
M37	1.1900		1.19	1.19	1.19
M38	1.3500		1.35	1.35	1.35
M39	1.2800		1.28	1.28	1.28
M40	1.3400		1.34	1.34	1.34
M41	1.2900		1.29	1.29	1.29

M42	1.3300		1.33	1.33	1.33
M43	1.3800		1.38	1.38	1.38
M44	1.3600		1.36	1.36	1.36
M45	1.2800		1.28	1.28	1.28
M46	1.2800		1.28	1.28	1.28
M47	1.4200		1.42	1.42	1.42
M48	1.3400		1.34	1.34	1.34
M49	1.2600		1.26	1.26	1.26
M50	1.3300		1.33	1.33	1.33
M51	1.3700		1.37	1.37	1.37
M52	1.2900		1.29	1.29	1.29
M53	1.2600		1.26	1.26	1.26
M54	1.3400		1.34	1.34	1.34
M55	1.2900		1.29	1.29	1.29
M56	1.3300		1.33	1.33	1.33
M57	1.3700		1.37	1.37	1.37
M58	1.4200		1.42	1.42	1.42
M59	1.3600		1.36	1.36	1.36
M60	1.2800		1.28	1.28	1.28
M61	1.2500		1.25	1.25	1.25
M62	1.3100		1.31	1.31	1.31
M63	1.3800		1.38	1.38	1.38
M64	1.3500		1.35	1.35	1.35
M65	1.2900		1.29	1.29	1.29
M66	1.3200		1.32	1.32	1.32
M67	1.2500		1.25	1.25	1.25
M68	1.2700		1.27	1.27	1.27
M69	1.3300		1.33	1.33	1.33
M70	1.3600		1.36	1.36	1.36
M71	1.3500		1.35	1.35	1.35
M72	1.3900		1.39	1.39	1.39
Total	1.3114	.05882	94.42	1.17	1.42

APPENDIX 6: On- site Measured Output for Stone Workmanship

Report

Output per hour (M³/hr.)

Measures	Mean	Std. Deviation	Sum	Minimum	Maximum
M1	.7100		.71	.71	.71
M2	.7100		.71	.71	.71
M3	.6100		.61	.61	.61
M4	.6700		.67	.67	.67
M5	.5800		.58	.58	.58
M6	.6300		.63	.63	.63
M7	.7200		.72	.72	.72
M8	.6800		.68	.68	.68
M9	.7500		.75	.75	.75
M10	.7100		.71	.71	.71
M11	.6600		.66	.66	.66
M12	.6500		.65	.65	.65
M13	.7300		.73	.73	.73
M14	.7600		.76	.76	.76
M15	.7100		.71	.71	.71
M16	.6500		.65	.65	.65
M17	.6900		.69	.69	.69
M18	.7200		.72	.72	.72
M19	.6700		.67	.67	.67
M20	.7300		.73	.73	.73
M21	.6800		.68	.68	.68
M22	.7400		.74	.74	.74
M23	.6600		.66	.66	.66
M24	.7300		.73	.73	.73
M25	.7400		.74	.74	.74
M26	.7200		.72	.72	.72
M27	.6900		.69	.69	.69
M28	.6800		.68	.68	.68
M29	.7600		.76	.76	.76
M30	.6800		.68	.68	.68
M31	.7500		.75	.75	.75
M32	.7100		.71	.71	.71
M33	.7300		.73	.73	.73
M34	.6800		.68	.68	.68
M35	.6900		.69	.69	.69
M36	.6800		.68	.68	.68
M37	.7600		.76	.76	.76
M38	.6500		.65	.65	.65
M39	.7100		.71	.71	.71
M40	.7400		.74	.74	.74
M41	.6600		.66	.66	.66

M42	.7200	.72	.72	.72
M43	.7500	.75	.75	.75
M44	.6700	.67	.67	.67
M45	.6400	.64	.64	.64
M46	.7300	.73	.73	.73
M47	.7100	.71	.71	.71
M48	.7700	.77	.77	.77
M49	.6900	.69	.69	.69
M50	.5900	.59	.59	.59
M51	.6200	.62	.62	.62
M52	.7200	.72	.72	.72
M53	.6800	.68	.68	.68
M54	.7000	.70	.70	.70
M55	.6500	.65	.65	.65
M56	.7300	.73	.73	.73
M57	.7400	.74	.74	.74
M58	.7300	.73	.73	.73
M59	.7500	.75	.75	.75
M60	.6500	.65	.65	.65
M61	.6700	.67	.67	.67
M62	.7400	.74	.74	.74
M63	.7600	.76	.76	.76
M64	.6600	.66	.66	.66
M65	.7300	.73	.73	.73
M66	.7100	.71	.71	.71
M67	.6600	.66	.66	.66
M68	.7200	.72	.72	.72
M69	.6700	.67	.67	.67
M70	.7300	.73	.73	.73
M71	.6800	.68	.68	.68
M72	.6500	.65	.65	.65
M73	.7000	.70	.70	.70
M74	.7300	.73	.73	.73
M75	.7600	.76	.76	.76
M76	.6900	.69	.69	.69
M77	.7300	.73	.73	.73
M78	.6100	.61	.61	.61
M79	.6600	.66	.66	.66
M80	.7200	.72	.72	.72
M81	.6800	.68	.68	.68
M82	.6900	.69	.69	.69
M83	.6800	.68	.68	.68
M84	.6100	.61	.61	.61
M85	.7200	.72	.72	.72
M86	.6900	.69	.69	.69
M87	.7100	.71	.71	.71
M88	.6500	.65	.65	.65

| M89 | .5800 | | .58 | .58 | .58 |

M90	.6300		.63	.63	.63
Total	.6938	.04405	62.44	.58	.77

APPENDIX 7: On- site Measured Output for Wall Plastering/Putting

Report

Output per hour (M²/hr.)

Measures	Mean	Std. Deviation	Sum	Minimum	Maximum
M1	1.4600		1.46	1.46	1.46
M2	1.5300		1.53	1.53	1.53
M3	1.4900		1.49	1.49	1.49
M4	1.5900		1.59	1.59	1.59
M5	1.4400		1.44	1.44	1.44
M6	1.5200		1.52	1.52	1.52
M7	1.4600		1.46	1.46	1.46
M8	1.5700		1.57	1.57	1.57
M9	1.4900		1.49	1.49	1.49
M10	1.5100		1.51	1.51	1.51
M11	1.5500		1.55	1.55	1.55
M12	1.5100		1.51	1.51	1.51
M13	1.4700		1.47	1.47	1.47
M14	1.4800		1.48	1.48	1.48
M15	1.5300		1.53	1.53	1.53
M16	1.4500		1.45	1.45	1.45
M17	1.5700		1.57	1.57	1.57
M18	1.4600		1.46	1.46	1.46
M19	1.4300		1.43	1.43	1.43
M20	1.4700		1.47	1.47	1.47
M21	1.5100		1.51	1.51	1.51
M22	1.4400		1.44	1.44	1.44
M23	1.4900		1.49	1.49	1.49
M24	1.4200		1.42	1.42	1.42
M25	1.5600		1.56	1.56	1.56
M26	1.5100		1.51	1.51	1.51
M27	1.4700		1.47	1.47	1.47
M28	1.5500		1.55	1.55	1.55
M29	1.4700		1.47	1.47	1.47
M30	1.4800		1.48	1.48	1.48
M31	1.5100		1.51	1.51	1.51
M32	1.5800		1.58	1.58	1.58
M33	1.5200		1.52	1.52	1.52
M34	1.5500		1.55	1.55	1.55
M35	1.4500		1.45	1.45	1.45
M36	1.4500		1.45	1.45	1.45
M37	1.5200		1.52	1.52	1.52

M38	1.4900		1.49	1.49	1.49
M39	1.4600		1.46	1.46	1.46
M40	1.4100		1.41	1.41	1.41
M41	1.5300		1.53	1.53	1.53
M42	1.5800		1.58	1.58	1.58
M43	1.4700		1.47	1.47	1.47
M44	1.5500		1.55	1.55	1.55
M45	1.4300		1.43	1.43	1.43
M46	1.4400		1.44	1.44	1.44
M47	1.5300		1.53	1.53	1.53
M48	1.5900		1.59	1.59	1.59
M49	1.4800		1.48	1.48	1.48
M50	1.5200		1.52	1.52	1.52
M51	1.4600		1.46	1.46	1.46
M52	1.5500		1.55	1.55	1.55
M53	1.5100		1.51	1.51	1.51
M54	1.4700		1.47	1.47	1.47
M55	1.4500		1.45	1.45	1.45
M56	1.5600		1.56	1.56	1.56
M57	1.4600		1.46	1.46	1.46
M58	1.4300		1.43	1.43	1.43
M59	1.5000		1.50	1.50	1.50
M60	1.4400		1.44	1.44	1.44
M61	1.5300		1.53	1.53	1.53
M62	1.4200		1.42	1.42	1.42
M63	1.4600		1.46	1.46	1.46
M64	1.4700		1.47	1.47	1.47
M65	1.5200		1.52	1.52	1.52
M66	1.4300		1.43	1.43	1.43
M67	1.6100		1.61	1.61	1.61
M68	1.5200		1.52	1.52	1.52
M69	1.5400		1.54	1.54	1.54
M70	1.5200		1.52	1.52	1.52
M71	1.4500		1.45	1.45	1.45
M72	1.5100		1.51	1.51	1.51
M73	1.4400		1.44	1.44	1.44
M74	1.4600		1.46	1.46	1.46
M75	1.3900		1.39	1.39	1.39
M76	1.4700		1.47	1.47	1.47
M77	1.5300		1.53	1.53	1.53
M78	1.5200		1.52	1.52	1.52
M79	1.4300		1.43	1.43	1.43
M80	1.4700		1.47	1.47	1.47
Total	1.4933	.04883	119.46	1.39	1.61

APPENDIX 8: On- site Measured Output for Slab Formwork

Report

Output per hour (M²/hr.)

Measures	Mean	Std. Deviation	Sum	Minimum	Maximum
M1	.2600		.26	.26	.26
M2	.2800		.28	.28	.28
M3	.2400		.24	.24	.24
M4	.2500		.25	.25	.25
M5	.2600		.26	.26	.26
M6	.2700		.27	.27	.27
M7	.2100		.21	.21	.21
M8	.2300		.23	.23	.23
M9	.1800		.18	.18	.18
M10	.2300		.23	.23	.23
M11	.2600		.26	.26	.26
M12	.2100		.21	.21	.21
M13	.2100		.21	.21	.21
M14	.2900		.29	.29	.29
M15	.2000		.20	.20	.20
M16	.2400		.24	.24	.24
M17	.2200		.22	.22	.22
M18	.2000		.20	.20	.20
M19	.1900		.19	.19	.19
M20	.2200		.22	.22	.22
M21	.2400		.24	.24	.24
M22	.2100		.21	.21	.21
M23	.2500		.25	.25	.25
M24	.2600		.26	.26	.26
M25	.2900		.29	.29	.29
M26	.2100		.21	.21	.21
M27	.2400		.24	.24	.24
M28	.2600		.26	.26	.26
M29	.1900		.19	.19	.19
M30	.2200		.22	.22	.22
M31	.2700		.27	.27	.27
M32	.2900		.29	.29	.29
M33	.2500		.25	.25	.25
M34	.2200		.22	.22	.22
M35	.2800		.28	.28	.28
M36	.2100		.21	.21	.21
M37	.2500		.25	.25	.25
M38	.2900		.29	.29	.29
M39	.2300		.23	.23	.23
M40	.2500		.25	.25	.25

| M41 | | .2400 | | .24 | | .24 | | .24 |

M42	.2200		.22	.22	.22
M43	.2600		.26	.26	.26
M44	.1900		.19	.19	.19
M45	.2000		.20	.20	.20
M46	.2200		.22	.22	.22
M47	.2800		.28	.28	.28
M48	.2400		.24	.24	.24
M49	.2800		.28	.28	.28
M50	.2300		.23	.23	.23
M51	.2100		.21	.21	.21
M52	.2700		.27	.27	.27
M53	.2800		.28	.28	.28
M54	.2100		.21	.21	.21
M55	.2400		.24	.24	.24
M56	.1800		.18	.18	.18
M57	.2300		.23	.23	.23
M58	.2700		.27	.27	.27
M59	.2500		.25	.25	.25
M60	.1900		.19	.19	.19
M61	.2200		.22	.22	.22
M62	.2300		.23	.23	.23
M63	.1900		.19	.19	.19
M64	.2100		.21	.21	.21
M65	.1700		.17	.17	.17
M66	.2500		.25	.25	.25
M67	.2400		.24	.24	.24
M68	.2200		.22	.22	.22
M69	.3000		.30	.30	.30
M70	.2300		.23	.23	.23
M71	.2100		.21	.21	.21
M72	.2600		.26	.26	.26
M73	.2500		.25	.25	.25
M74	.2200		.22	.22	.22
M75	.2400		.24	.24	.24
M76	.2700		.27	.27	.27
M77	.1800		.18	.18	.18
M78	.1900		.19	.19	.19
M79	.2000		.20	.20	.20
M80	.2200		.22	.22	.22
Total	.2344	.03142	18.75	.17	.30