Development of a Performance Evaluation Tool for the Implementation of Construction Site Layout Planning in the Case of Hawassa City Building Projects

Junedin Yassin Yimam

A Thesis Submitted to the Department of Civil Engineering

School of Civil Engineering and Architecture

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

Office of Graduate Studies

Adama Science and Technology University

July, 2023

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Advisor: Meseret Getinet (Ph.D.)

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DECLARATION

I hereby declare that this Master Thesis entitled **"Development of a Performance Evaluation Tool for the Implementation of Construction Site Layout Planning in the Case of Hawassa City Building Projects''** is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

Junedin Yassin Yimam	____________	____________
Name of the student	Signature	Date

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I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled **"Development of a Performance Evaluation Tool for the Implementation of Construction Site Layout Planning in the Case of Hawassa City Building Projects''** prepared under my guidance by Junedin Yassin Yimam submitted in partial fulfilment of the requirements for the degree of Masters of Science in Civil Engineering (Specialization in Construction Engineering and Management). Therefore, I recommend the submission of revised version of the thesis to the department following the applicable procedures.

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Major advisor	Signature	Date

APPROVAL SHEET

I, the advisor of the thesis entitled **"Development of a Performance Evaluation Tool for the Implementation of Construction Site Layout Planning in the Case of Hawassa City Building Projects''** and developed by Junedin Yassin Yimam, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Meseret Getinet (Ph.D.)	_______________	______________
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We, the undersigned, members of the Board of Examiners of the thesis by Junedin Yassin Yimam have read and evaluated the thesis **"Development of a Performance Evaluation Tool for the Implementation of Construction Site Layout Planning in the Case of Hawassa City Building Projects''** and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfilment of the requirement of the degree of Masters of Civil Engineering (Specialization in Construction Engineering and Management).

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ABBREVIATIONS & ACRONYMS

TFs	Temporary facilities
GDP	Gross domestic product
BIM	Building Information Modeling
GIS	Geographic Information System
VR	Virtual reality
2D	two dimension
3D	three dimensions
CSUP	Construction site utilization plan
SUP	site utilization plan
OSHA	Occupational Safety and Health Administration
Km	Kilo meters
AHP	Analytical Hierarchy Process method
CSLP	Construction site layout planning
CR	Consistency ratio
NBCR	Non-Building Coverage Ratio

ABSTRACT

Site layout planning is one of the most critical and important tasks of construction site-based management. which has an impact on every area of works on a building site, including construction techniques and schedule as well as productivity, cost, and safety. previous studies in the Ethiopian construction industry showed that, there is a limitation of performance evaluation tool regarding on the implementation of construction site layout planning in building construction projects. based on this, the study aims to develop a performance evaluation tool for the implementation of Construction Site Layout Planning in the case of Hawassa city building projects. In order to achieve this objective both quantitative and qualitative approaches of descriptive and exploratory nature of research types were used. Both primary and secondary data were used as inputs for the study. 49 variables under five main categories were extracted from the literature review as barrier (9 leaning and management and 11 technical indicator variables) and success factors (12 site layout element, 9 material management, and 8 safety management variables) for construction site layout. After conducting a Pilot study, a total of 40 variables were finally identified and selected as relevant for the study. 16 of them were as a barriers and categorized under two group (8 variables from learning and managing, and 8 variables from technical categories), and the remains of 24 variables were as a success factors and categorized under three group (10 variables from site layout elements, 6 variables from material management, and 8 variables from safety management). Primary data were collected in the form of closed-ended questionnaires (Analytical Hierarchy Process and Likert scale method). Purposive sampling method was used to collect information from experts in the construction industry who were staff members of the contractors, consultants, local authority experts, and also academicians. The collected data were analyzed by the Analytical Hierarchy Process technique using Microsoft Excel 2016, the analysis results were presented in the form of tables. based on the data analysis result, Lack of experienced experts on the site and the Location of the site was founded to be the dominant barriers for the implantation of construction site layout planning under the category of learning and Management, and technical respectively. on other hand, provisions of site layout element, Safety Management, and Material Management were found to be the top three main categories of success factors for the implementation of construction site layout planning respectively. provision of site material storage space, providing a sufficient budget for safety management, and Provision of adequate material storage facilities founded as the major success factors respectively under each main category. By using the analytical hierarchy process analysis result for the success factors as an input, the construction site layout planning performance evaluation checklist was developed as an assessment tool. Then after case study was applied to evaluate the current building projects performance, the case study result showed that the performance of the selected building projects in Hawassa city was found in fair or moderate performance. Therefore, the study provides a significant contribution for the implementation of construction site layout planning and also stakeholders in the building construction industry can use this tool as an input to control, monitor, and to improve the implementation of construction site layout planning.

Keywords: site layout, planning, construction, performance, checklist, tool,

CHAPTER ONE

1. INTRODUCTION

1.1 Background of The Study

Construction industry is an important sector in Ethiopia's economy which, involved in planning, executing, and monitoring various civil works such as buildings, infrastructure, water supply, and sewerage systems. It plays a vital role in the country's economic, social, and political development, in developed countries the construction industry incorporates the GDP growth of 7-10%, whereas in under developed countries the percentage is only 3-6 % of GDP growth (Sana and Muqeem 2012). (Arnaud, 2019) supported this, its contribution was up to 6% of the country’s GDP. In addition, the Ethiopian construction industry is expected to grow by 8.3% of annual average growth per year between 2022 and 2025 (Metropolitan Real Estate, 2021).

From many different categories of construction industry building consternation is the major one, which plays a vital role in the country's economic development by creating job opportunities and helping to the growth of many other sectors such as tourism, real estate, and infrastructure. But despite of its great contribution to the country economy, it has been facing many challenges during construction phase; Labour health and safety, Labour productivity, material management are the major challenges which are mostly observed in the building construction sites. it can be seen that, those listed challenges were mostly related to managerial factors rather than technical. studies in the construction industry also agreed to that, managerial factors account a great contribution for most construction sites to run into trouble (Elbeltagi et al, 2004).

So in order to make the building industries profitable, need to work focusing on the issues related to site based management during construction phases. Because site-based management can make significant improvements in the cost and time savings. also it has a direct influence on the issues like: Labour performance, Labour health and safety, and material management of the building construction projects. Among the most significant aspects of building site management is site layout planning and, it has been recognized as a critical step in construction planning. the basic function of the process is to find the most suitable arrangement for the positioning of temporary facilities (Emad Elbeltagi., 2008). extensive material loss, safety problems, productivity losses, longer duration, higher cost, and space shortages were resulted due to poor implementation of CSLP (He & Wu, 2012; Razavialavi, Abourizk, & Alanjari, 2014).

Different studies in elsewhere showed that, the practice of construction site layout planning in the developed countries was evolved in to advanced way by adopting different technologies to the construction industry. Varity of software and tools were used to improve the layout planning and administration of construction sites. advanced construction site layout planning may use a variety of technologies, for instance: Building Information Modeling (BIM), drone technology, geographic information systems (GIS), and virtual reality (VR). However, in African studies showed that, the practice of site layout planning was the most neglected aspect and also it has poor implementation (Salih, Oztas, Dewary, & Ahmed, 2019). as well as in Ethiopia, previous researches works showed that, the practice of site layout planning was poor (Belyu Bogale., 2020; Birhanu, 2019; Bruk, 2019). and supported that it has major effect on issues like: Labour productivity, material management, health and safety management.

site organization problems like; safety issues, material handling and productivity issue were the most frequently observed problems in Hawassa city building construction projects. also this was confirmed in the case of Hawassa city, by having interview with experts in the construction industry and these experts agreed that the site organization problem was mostly caused due to poor performance of building construction projects regarding on the implementation of construction site layout planning. in addition to this, experts working in the local construction affairs regulatory authority office agreed on that, poor implementation of construction site layout planning was observed in the city building construction projects. and suggested that, stockholders especially local construction regulatory bodies need to give special attentions for construction site layout planning practice. therefore, the study was conducted to improve site layout panning practice by developing a performance evaluation tool or checklist for site layout planning.

1.2 Statement of The Problem

Construction industry being one of the economic sector which is highly affected by issues of productivity, delay, material management issues and, health & safety issues. it is generally agreed that, Planning and implementing an effective construction site layout planning is essential for the successful implementation of construction projects (Ganiyu Otukogbe 2021). Also it has a significantly impact the productivity, cost and, safety on the construction site.

In many developed countries studies were been devoted to the ways of optimizations of site layout planning for the productivity, cos t and safety related issues (Khalid & Publications, 2017; Said & El-Rayes, 2013). However, in Africa studies showed that the implementation of construction site layout planning in the building construction industry is poor (Salih et al., 2019) (AbdulAzeez. et al., 2016).

Also, this was confirmed in Ethiopia by different previous research works, such as (Belyu Bogale., 2020; Birhanu, 2019; Michael, 2021) in Bahir Dar city, and also (Bruk, 2019) in Addis Ababa, shows that the practice of construction site layout planning is poor. Since, there is no significant difference between Ethiopian cities regarding on the adaptation and execution of construction works, it is a common and generally known problem which is observed in Ethiopian construction industry.

Poor implementation of construction site layout planning is also a day to day problem which is observed in hawassa city building projects. this was proven by conducting interviews with ten experts in the building construction industry who were working in Hawassa city, and almost all of them agreed that the practice and implementation of construction site layout planning is poor in Hawassa city. Also the local construction regulator authority experts working in the Hawassa city municipal office, revealed that there is a limitation of guidelines, checklists, or assessment tool for the implementation of construction site layout planning. And due to this projects supervision works in hawassa city become very difficult. Previous related studies in Ethiopian, also agreed and recommended that, the practice of site layout planning can be improved by developing performance evaluation tool for the implementation of construction site layout planning.

Therefore, in order to improve the construction site layout planning practice and to fill the gap regarding on the implementation of construction site layout planning, the study intended to develop a performance evaluation checklist for the implementation of construction site layout planning.

1.3 Objectives of the Study

The objectives of the study discussed as general objective and specific objectives below:

1.3.1 General Objective of the Study

The general objective of the study was to develop a performance evaluation tool for the implementation of Construction Site Layout Planning in the case of Hawassa city building projects.

1.3.2 Specific Objectives of the Study

- To weight and prioritize barriers for the effective implementation of construction site layout planning practice in the case of Hawassa city.
- To identify success factors that ensure the implementation of construction site layout planning in the Case of Hawassa city.
- To develop a performance evaluation checklist for the effective implementation of construction site layout planning.
- To evaluate the current performances of building construction projects in hawassa city by conducting a case study through the application of the developed checklist.

1.4 Significance of the Study

The study investigates the major barriers of construction site layout planning practice which leads the practice to be poor. And also provide performance evaluation checklist for the implementation of the construction site layout planning in building projects by weighting and prioritizing success factors for the effective implementations of construction site layout planning in the case of Hawassa city building projects. Stakeholders in the construction industry can improve the practice of construction site layout planning in hawassa city by using the findings of the study as an assessment tool for the implementation of the construction site layout planning. Contractors can use the findings of the study for evaluate the performances of their construction site work. Consultants can use the study finding for the supervision and evaluation of construction site works, and also the local authority body can use this tool as input to authorize construction permission as well as to control and track building projects in relation to the execution of construction site layout planning. The study adds knowledge to existing research works by advancing the view perspective on the concept of construction site layout planning and used as a reference for other future study.

1.5 Scopes of the Study

The scope of this study was subjected to identifying barriers and success factors for the implementation of construction site layout planning in the case of Hawassa city building projects. The study was conducted by identifying 16 barriers under two categories (leaning and management factors and, technical factors) and 24 success factors Under three categories (site layout element, material management issues and, safety management issues) for the implementation of construction site layout planning in the case of Hawassa city building projects. The study was conducted mainly focused on Non-confined building project types (NBCR > 0.6). See about confine site on (appendix VIII).

1.6 Limitations of the study

Lack of active, ongoing building construction projects in Hawassa city was one of the limitation to evaluate the performance of building construction projects regarding on the implementation of construction site layout planning.

CHAPTER TWO

2. LITERATURE REVIEW

This chapter of the study deals with reviews of related literatures which includes theoretical reviews and, empirical literature. The literature review was framed around subject area of construction site layout planning in the building construction industry. the results were imported from pieces of literatures; including books, journals, scientific papers, conference papers and different web pages.

2.1 Nature of Construction Industry

Construction industry is an industry, which involved in planning, execution and monitoring of all various types of civil works. physical infrastructures such as buildings, communications & energy related construction works, water supply and sewerage works and, others are some of the major projects (programs) in the construction industry.

The construction industry is a key contributor to Ethiopia's GDP growth rate and it is also expected to continue to play a vital role in the country's economic development. Also the government has been investing heavily in the sector as part of its efforts to achieve sustainable economic growth and development. For instance, the Ethiopian Government had allocated an average of 58.2% of its annual capital budget for Public Construction Projects between 1996/97 and 2001/02 (Wubishet, 2004). The industry has been growing rapidly in recent years, driven by a surge in infrastructure development projects such as roads, airports, and dams, as well as commercial and residential building construction.

Building consternation industry is known as one of the major category in the construction industry, and it involves design, planning, and constructions of buildings such as houses, offices, schools, hospitals, and other structures. The industry encompasses a wide range of activities, including architectural design, engineering, project management, and construction. It also plays a vital role in the country's economic development, providing employment opportunities and contributing to the growth of various sectors such as tourism, real estate, and infrastructure.

2.2 Construction Site Management

Project management is defined as the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. Project management needs the application of knowledge's, skills, equipments and different methods in order to fulfill or exceed stakeholder's demands and expectations. It is the art of managing and arranging both material and personnel resources during the course of a project in order to fulfill project objectives within established constraints. The culture of Project management in the construction industry is different than in the other sectors. (Yimam, 2011) stated that the main differences emerged from the nature and characteristics of construction projects. Such as required capital intensive, complex & require significant management skills, involvement, and coordination of a wide range of experts in various fields.

In a construction company, the general organization consists of people in the head office and people on the construction site. the on-site structure within an organization is influenced by the size, type, and complexity of a project (Birhanu, 2019). On large project, the builder will appoint project manager, assistant project manager, site engineer, foremen, first aid person, and so on.

The project manager would be an organization employee who would be in charge of the overall operation on the site and any other related issues. Whose involved in the management in terms of: budgeted costs, specified quality and contracted time.

2.3 Definitions and Terms of Construction Site Layout

Site layout plans are an essential part of construction management because sites can be extremely complex places requiring the coordination and movement of large quantities of materials as well as high-value products, plants, and people. Laying out a site effectively and precisely can help ensure that the work is completed efficiently and safely (Belyu Bogale., 2020).

Site layout planning can be defined as the accommodation of supporting temporary facilities at an appropriate location within the available space on site (Abune'Meh, 2017). It is also one of the most important planning activities in a building project, with a significant impact on efficiency and safety. Construction site planning include determining, sizing, and locating temporary facilities within the boundary of the construction site. These temporary facilities include everything from basic laydown spaces to warehouses, fabrication shops, maintenance shops, batch plants, and residential facilities. Many factors, including project type, size, design, geographical location, and the organizations of work flow on the site determine the temporary facilities required on the site. (Emad Elbeltagi., 2008).

Site layout planning encompasses a range of construction management activities including spatial layout distribution and general site management structures and processes.

The process of identifying the required types of temporary facilities which used supports the construction works, determining their size and design, and also arranging them with in the available space on the construction site is known as site layout planning. Thus, site layout deals with the relative placements of the facility to be built, office space, plant, storage facilities, and other amenities. Site organization refers to the organizational structure that guides site management and also referred as the processes of planning and controlling construction operations. The construction manager is usually responsible for the layout and management with in the site (Anumba & Bishop, 1997).

2.3.1 Site Layout Plan for Construction

Laying out a site effectively and properly can help to ensure the job is done efficiently and safely (Harbour. R. S., 2019). The basic goal of construction site layout is to create a safe and productive working environment. Laying out of a construction site deals with the placing and timing of temporary facilities which is used to carry out a construction project. It is important to virtually plan any construction project and be able to see one step ahead since it can significantly affect the cost of the project (Abdelrazig, 2015). Proper sizing and placement of temporary facilities can help to decrease travel times, congestion, waiting times and also help to make a more effective workplace (Harbour. R. S., 2019).

2.3.2 Importance of Site Layout Planning

The site layout planning illustrates the proposed location's and relationship of facilities with its surroundings in terms of communication, accesses, and existing facilities. Improvements like safety, construction cost, time of construction operations, and worker productivity all benefit from proper design of the site layout. Also enable workers be able to move easily and quickly within the site which result, minimizing travel time, increase productivity, improving worker morale by demonstrating a better and safer working environment.

However, in the lack of effective construction site layout, major projects may have significant time and cost overruns. Material loss, safety issues, productivity losses, higher expense, and space shortages are other consequences (He & Wu, 2012; Razavialavi et al., 2014). Here some advantages of good site layout discussed below as follow;

Utilization of Available Space

Planning a layout will assist you in covering every corner of the property and so capture the most valuable area first. Location and services are helpful to perform multiple functions at the available site area. The development of updated work areas and operator job assignments for full utilization of the labor force will help to cover every inch of the area (Anna Barton and Stephen Robinson., 2017).

Minimizing the production delays

It will help to reduce delays in-between construction. It will always help to track schedules while having construction on a site. An ideal layout planning will reduce the causes of delays and improves work quality (Anna Barton and Stephen Robinson., 2017).

Improves quality control

A well-planned layout will significantly improve quality control. Regular inspection at various phases of construction is required for higher quality. It will help in the timely execution of tasks during on-site construction (Anna Barton and Stephen Robinson., 2017).

Proper utilization of labor

Layout planning is always productive in the utilization of time and labor. It helps to keep the flow of material handling in such a way that the time of each worker should not extend the time limit. Planning for the layout of a site is beneficial in a way that it always provides quality construction and work, meeting the requirement with all safety measures (Anna Barton and Stephen Robinson., 2017).

2.3.3 Site Layout Problem

Arranging a given set of facilities into an acceptable location while satisfying a set of layout constraints is a tough challenge due to the large number of viable possibilities. Site layout issues can be broadly categorized into two categories: facility assignment methods and layout planning procedures.

Method of facility assignment

With regard to the method of facility assignment, or in other words, how temporary facilities are assigned on-site, two distinct methods are commonly encountered. These methods are: the optimal arrangement of facilities to reduce transportation costs is known as facility assignment, also known as location analysis and temporary facilities are placed in the designated place (R. R. Kumar & Singh, 2007).

Layout planning techniques

About layout planning, two distinct techniques are commonly encountered. The two techniques are: Mathematical planning; is representing objects with their actual shape in 2D or 3D allows for a more realistic representation of the site space availability and the location. An accurate interpretations of site layout elements are important for construction sites. Also Knowledge-based planning is required, in this method the real form and size of an object is interpreted approximately by a basic 2D or 3D geometric construct (such as rectangle or cylinder) that avoid actual geometry of the object.

2.4 Construction Site Layout Planning from Decision Making Perspective

Design a construction sites layout has been identified as a time-consuming process in construction planning. Site layout planning is considered as a decision-making process, which involves the identification of problems associated with construction site layout design and also developing the solutions to those problems by choosing the best alternative and implementing the selected objective (Ning Xin et al., 2011).

2.4.1 Construction Spatial Requirement

Each construction activity on the construction site requires a space to conduct. According to (Bansal V.K., 2014) workers, equipment, materials, temporary facilities, and the components of the structure which was under construction were compute for the available space on a jobsite during its execution. (Akinci et al, 2002) identified six spaces, required by different construction activities. These are described as follow; Building component space: physical space occupied by building component to be installed; Labour crew space: space used by labour crew installing components; Equipment space: space used by equipment supporting labour crew or component during installation; Hazard space: space generated when activity creates hazardous situation; Protected space: space required to protect component from possible damage for certain period of time; Temporary structure space: physical space occupied by temporary structures, such as scaffolding and shoring. Temporary structures are modelled like permanent building components.

A little modification was made by (Marx et al, 2010) where he divided construction site spatial requirement into three; resource, topology and process space (See table 2.1). Resource spaces are spaces required for both human and material resource on the construction site. They include labour, equipment and material. The topology space contains the area of building under construction, the walk way or road for movement, storage space and space for temporary structures on site. While processing space is the space needed to carry out the necessary site procedures.

Table 2.1 Construction Site Elements And Construction Spatial Requirement (Marx et al, 2010).

Resource Space	Work Resource Space	Crew Space
		Equipment Space
	Material Resource Space	Building Component Space
		Material Space
Topology Space	Building Structure	Building Space
	Construction Site	Storage Space
		Temporary Structure Space
		Road Space
		Emergency Space
	Environment	External Constraint Space
Process Space	Working Space	
	Hazard Space	
	Protected Space	
	Post-Processing Space	

2.4.2 Construction Site Utilization Planning

Construction Site Utilization Planning (CSUP) is a decision-making procedure for deciding on a location for temporary facilities around the construction site's boundaries. It is the process of identifying spatial relationships and developing the best alternative solutions, so that the efficiency of the construction process is improved over the project life cycle (Whitman, 2014).

The required number, kind and size of temporary facilities for the project were determined based on the scale, design and construction execution strategies of the project. Basically, CSUP is a tradeoff problem in which decisions must be made based on project attributes (e.g., cost and safety) without sacrificing site plan quality (Ning Xin et al., 2011). Optimum SUP reduces the labor involvement in material movement, and allowing workers to spend the majority of their time on productive construction tasks.

2.4.3 Best Practices of Construction Site Utilization Planning:

The technique was created to act as a reference guide for creating customized site planning strategies. This will allow companies to customize the process to suit their specific requirements. The following sections outline the best practices within the industry and the site planning procedure.

Table 2.2 Best Practices of Construction Site Utilization Planning (Whitman, 2014).

No.	Best Practices of Construction site utilization planning
1	Prior to developing a Site Utilization Plan (SUP), conduct an on-site examination of the location.
2	Begin SUP development earlier as soon as possible.
3	Involve stakeholders (e.g., owner, subcontractor, project manager, superintendent, management personnel) throughout the SUP development.
4	Consider the effects of adverse weather and safety laws when designing a SUP.
5	Communicate and distribute the SUP to all parties.
6	Ascertain that all stakeholders support the SUP.
7	Communicate clearly the SUP enforcement policies to all subcontractors on the job site.
8	Implement and enforce the SUP from the beginning day of construction.
9	Monitor the SUP effectiveness regularly.

10	Throughout the project, remain flexible on-site space allocation.
11	Update/modify the SUP as needed, and communicate the changes to all stakeholders.
12	Lessons learnt should be documented and shared with others in the organization.
13	If available, use BIM technology for SUP development.

2.5 Success Factors to be Consider in Planning a Site Layout

To achieve an effective and efficient site layout, certain success factors has to be considered in the planning and implementation of a site layout plan. This aid in the smooth running of any construction process. From the literature review some of the factors that should be considered are: preparation of site layout designs before the start of site work; provision of on-site offices for clients, contractors, and consultants; building a fence around the construction site; ensuring a good positioning system for temporary facilities; first aid centers for workers' emergency responses; safety and safety equipment; information signs and signals; public convenience for on-site workers; fabrication and maintenance shop; fire prevention and suppression; security checkpoints (AbdulAzeez. et al., 2016).

Construction Site Facilities

The primary roles of temporary facilities are to support construction operations. These facilities can be classified into three categories storage facilities, processing facilities, and residence facilities.(S. S. Kumar & Cheng, 2015)

Table 2.3 Categories of Construction Site Facilities

Storage facilities	are used to temporarily store materials that will be used for construction. Steel storage place, precast panel storage place, cement warehouses, and other are examples of these. To safeguard materials from damage caused by the sun, wind, or rain, sufficient material storage facilities must be provided.
Processing facilities	are utilized to prepare raw materials on a construction site. Fabrication shops, rebar cutting shops, steel bending yards, and so on are examples of these. Because to the high level of humans and equipment in

	processing facilities, adequate space is required to conduct the required activities in a safe and efficient manner.
Residence facilities	provide shelter and cater to the requirements of personnel involved in the construction project. Common examples of residence facilities include site offices, pantries, toilets, etc. Residence facilities with adequate space should be provided for workers to be efficient. Thus, the size of a storage facility is governed by the quantity of material to be stored in it, whereas the size of processing and residence facilities depends on the number of machines and humans, respectively.

Site Accessibility

Good planning is needed to link the site roads to a major highway nearby. Roads within the site are needed to allow work to flow easily. Spaces for parking vehicles are to be provided. Where space does not exist this facility must be planned and provided somewhere convenient. The easy movement will keep the morale of the equipment and vehicle drivers high, thus minimizing the chance of accidents (Lin et al., 2013; Salih et al., 2019). It will also save time when entering and exiting the building site (Elbeltagi, Hegazy, & Eldosouky, 2004).

Information signs and signage

Information signs as a form of communication should be of utmost consideration during the site layout planning. It should be visible and in clear plain language that is easy to comprehend, indicating what to do and what not to do on-site, to avoid unnecessary hits and falls resulting in accidents and injuries. Construction site information signs like: site map, traffic regulation signs, Display of labor relations' policy and safety rules, Emergency routes and exits.

Table 2.4 Description of Information Signs and Signals on Construction Site

Site map	Project-related information must be included on the site map and should be exhibited in the office of the site manager or project manager, as well as posted at the site entrance gate.
Traffic regulatory signs	For huge projects, traffic regulating signs aid in directing traffic and reducing accidents. should be placed to direct traffic on the site in order to avoid accidents as much as feasible (Elbeltagi et al., 2004).

Labor relationship policy display	which is used to control over construction crew and avoiding any disputes among labors and management (Cleland, 2007).
Emergency routes and exits	As the building grows, it is critical to highlight the emergency escape routes on each story.

Security

The security of the site should be a primary consideration to the site planner. If the project should end successfully there must be provided proper guard entrance on the site. Also should provide Lighting and Fencing (El-Rayes & Khalafallah, 2005; Elbeltagi et al., 2004).

Entrance

It is vital to have an appropriate guard access to the site given by a booth. Also, all visitors to the project must be tracked, and the general public is not permitted to enter.

Lighting

Planning a construction site lighting includes determining the necessary level of lighting in various areas of the site, selection and location of lighting equipment (type, individual output), calculation of the required power output, and planning of the mains lines. It is also necessary to have and install a standby generator to maintain site lighting.

Fencing

All the boundary around the project should be fenced for security to prevent theft or vandalism of construction equipment, materials or the work in progress, however, it can also be to protect people from getting hurt while construction is underway (Salih et al., 2019). According to (Sutt, Lill, & Müürsepp, 2013) construction site fencing is divided into three categories based on their use: protective & guard fencing, safety fencing and, signal fencing.

Table 2.5 Categories of Construction Site Fencing

protective and guard fencing,	which is to prevent outsiders from gaining access to the construction site and any areas that present risk, and to prevent theft of materials;

safety fencing,	which prevents access to a particular task area for those unconnected with that task, and which prevents risk associated with objects falling from above. safety fencing is generally made from inventory units (plates, handrails, protective screen components, etc.). Plates can be made of light or dense boarding or as framed web fence units mounted on special concrete legs.
signal fencing,	which marks the boundaries of areas with risk factors.

Accommodation and craft change-houses

On-site accommodation should be readily available for all types of people working in the project, especially if the project is large. On a small or restricted site, accommodation for only the site engineer and the security man should be considered and arrangements should be made for others nearby. Craft change-houses should be provided for workers to change, keep clothes, bath and relax during breaks. This space should have toilet facilities for their convenience (Elbeltagi et al., 2004).

Site Offices

for efficient and effective monitoring of the project site offices should be provided. All the offices should be close together, away from the noisy zone and, located in the safe area. They are to be properly equipped to meet the needs of the project (Elbeltagi et al., 2004). The site offices may include job office, general contractor office, and sub-contractors and consultants' offices.

Construction site Utilities

all the necessary utilities available should be harnessed to the advantage of the project. In areas where water is a problem, arrangements can be made for tanker services or a borehole can be sunk to provide water. In areas with no power supply, a generator plant can be installed to provide electricity. All of these should be strategically located so as not to impede operations of the construction (Elbeltagi et al., 2004). Also it requires to provide water supply and toilet facilities in the accessible place to serve the work force (OSHA, 2011).

Handling of Materials

(Elbeltagi et al., 2004) Material handling is estimated to account around one third of all construction projects. The use of proper equipment for material handling and planning will minimize multiple handling which will result which reduces loss, reduce wastage, save time, and improve project performance.

Material Storages

It is vital to plan and allocate storage places for items in order to avoid multiple material handling. Reserved areas for long-term or short-term storage of large materials and equipment should be clearly defined. Warehousing should be provided when there is the need to store materials and equipment for a relatively long period.

Site cleaning

It is important to have a designated area to dispose of waste and debris on site (El-Rayes & Khalafallah, 2005; Elbeltagi et al., 2004). Also it is critical to have a cleaning program for the construction site that all debris, scraps, wastage of materials must be removed regularly during construction or repair process. All work area, stairs, passageways, and the road must be routinely cleaned (Muiruri & Mulinge, 2014; Salih et al., 2019).

Laydown areas

It is for delivering and storage of large equipment and material, such as tracks and shovels and other big machines; it can be used for long-term or short-term.

Workshops

Workshops should be provided, if possible, for all workers working on the project. Workshops are used to fabricated materials and equipment on site. They include plumbing, electrical, carpentry, mechanical, and steelworks. If possible there need be a laboratory for testing with all the essential equipment and qualified personnel to be in charge of it (El-Rayes & Khalafallah, 2005; Elbeltagi et al., 2004).

Plot size and shape

The plot shape and size should be assessed during the planning of the site layout. Since the size of the plot will determine what can be accommodated on the site, construction sites with limited space need proper planning thereby more necessary facilities should be located on-site (Elbeltagi et al., 2004).

Batch plant and workshops

In case of a large quantity of concrete, having batch plants on site which it is more cost-effective to produce concrete on-site rather than buy ready-mix. Therefore, provisions of Adequate and accessible place needed to install batching plants on the construction sites.

2.6 Site Layout Object

Site layout objects are those that takes space on the construction site for a long period of time. Temporary facilities, access roads, machineries, and materials are some examples of site layout objects. Some characteristics of these objects are, such as typology (the object's nature and function), object boundary (the object's shape and size), and mobility (The capability of a site object to move). The most typically addressed property in the case of site layout is the object border (Sadeghpour & Andayesh, 2015, p. 7).

Object Typology

Common sorts of items in a typical construction work include temporary facilities, laydown or placement and storage areas, construction equipment, material, access roads and paths, workspace, and site elements. object typology during the site layout is critical because it has a direct influences on the required space for operation (e.g., equipment operation), handling (e.g., material handling), safety (e.g., access roads), or a combination of these (Sadeghpour & Andayesh, 2015).

Object boundary

Besides of object typology, determining the optimum site layout requires to determine the shapes and sizes of the objects, in order to determine space required to accommodate objects and also to mitigates objects space conflicts. This process is generally known as object boundaries, which is directly related to size and shape of the object (Sadeghpour & Andayesh, 2015).

There are three approaches on identifying the optimal locations of an object. the first is dimensionless objects concept in this case, the shape and size of objects have no bearing on determining the optimal location of an object, the second one is approximate geometry concept which says, the shape of an object is determined approximated by applying a basic 2D or 3D geometric design, and lastly actual object shape in this case, objects are represented by their true actual shape in the form of 2D or 3D.

Object mobility

The mobility of objects on construction sites varies based on their natures, Certain objects are immobile and cannot be switched or relocated, other objects can be moved and relocated if necessary, and also other objects perform their functions by moving to the construction site (Sadeghpour & Andayesh, 2015). Such as stationary objects which perform their tasks staying on a fixed position until a period of task completion (e.g. tower cranes and batch plants), movable objects are objects that can be moved but operate in a fixed position and also can be moved around if required (e.g. concrete testing laboratory), and moving objects such as trucks and earthmoving equipment which perform their task by moving on the construction sites.

2.7 Material Management Issues on the Construction Sites

Effective construction materials management process is a key to success of a construction project. The costs of materials management may range from 30-80% of the total construction costs depending on the type of construction (Patel, Pitroda, & Bhavsar, 2015). However, the total cost accounted 50-60% of construction projects is for construction materials and equipment. Construction materials are major components on any project with value 50-60% (Kasim et al, 2013). Since material costs attributes high percentages from the total cost of the project, effective management is required to ensure projects profitability’s.

Many factors might contribute to project delays; inadequate materials management can have a significant impact on site activity. As a result, good material management in building projects is required. This is due to the fact that inadequate material management will have an impact on the total building time, quality, and budget. It is also affects Labour productivity and, health and safety. Therefore, an effective materials management system is required in order to avoid problems, such as delays in a construction project (Kasim et al, 2013; Thomas & Ellis Jr, 2017).

According to the Materials Handling Industry of America (MHIA), material handling is "the transportation, storage, control, and protection of material, goods, and products throughout the process of manufacturing, distribution, consumption, and disposal. Material storage issues, wrong materials delivery, subsequent design revisions, materials surplus, materials damage/loss and, improper materials handling are all the most frequently raised issues related to materials management. Hence, to implement efficient materials management, construction sites will always require space to facilitate the movement, handling, storage and, assembly of materials within a complex environment, when storage space is insufficient, resulting in further negative results in productivity and materials management. Efficient space utilization is fundamental to the management of materials (Chau KW et al., 2004).

(Thomas, Riley, Messner, & management, 2005) agreed that with the ever increasingly complex designs and countless materials required to construct these often intricate structures, endless quantities of materials are required at various times and in various locations, in order to complete the project. Those activities have their own effect on material management related with the site layout. And larger sites that pose the biggest problems due to the long distances for which materials must be transported, coupled with the additional burden of monitoring materials.

(Ermias Birke, 2019) outlines that the significance of a well-designed site plan and its effects on material management. It is necessary to place material storage spaces close to off-loading zones while also keeping them close to the work area. (Gulghane, 2015) stated that, there is problem in material management due to improper planning, poor logistics management, improper supervision, double handling of materials, and due to improper site layout.

Also there is different wastes are there which has effects on the safety of Labour. The construction sector produces huge waste leading to environmental contamination and CO_2 emissions. If material waste is not correctly handled and controlled on the site, it will cause financial problems and also have a detrimental influence on the community and on the environment (Ajayi et al., 2015). On the other hand, proper waste reduction and management on the construction sites reduces disposal and transportation costs, enhances profitability, saves time, protects the environment, and promotes clean and safe work environments (Eze, Seghosime, Eyong, Loya, & Science, 2017). The generation of construction waste is caused by improper management of building materials in construction projects(Hassan, Ahzahar, Fauzi, Eman, & Sciences, 2012).

2.7.1 Material Management Strategies On the Construction Sites

The effective management of materials both prior to and when delivered to site (i.e: delivery, off-loading, storage, handling, on-site transportation and on-site utilization of materials) is fundamental to the overall success of any construction work.

Space Scheduling

Space scheduling helps to manage materials and the available space on the construction site. (Elbeltagi et al, 2004) outlines that space scheduling optimizes the site layout by giving a particular attention to the interrelationship of the other facilities on-site. Resulting from this, on-site storage is critically accessed and located accordingly, to benefit the end user on-site, thereby, reducing travel distances, reducing improper/inadequate storage and incorrectly located storage facilities. (Elbeltagi et al, 2004) continues by stating that while excellent space scheduling and materials management will incur an initial cost, it will always result in larger immediate cost and time savings throughout the project period. (Winch & North, 2006) furthers outlines the importance of space scheduling and materials management by indicating that materials management is one of the core task execution requiring attention in construction project planning.

Providing Adequate Storage for Materials on-Site

Provisions of adequate on-site materials storage is essential to facilitate productivity of personnel on the construction site. Inadequate storage leads to congested workspaces (Thomas et al., 2006). To overcome such issues, management must ensure that adequate storage space is assigned for the various material requirements. Providing sufficient storage arrangements coincide directly with the design site layout, once materials are successfully delivered to site, they must be accommodated within the bounds of the site or storied appropriately. The overall site layout is critical to the success of aspects of material management. (Harris F. and Mc Caffer, 2013) outlines the importance of material management on-site, including the importance of correct material storage.

(Ermias Birke, 2019) outlines that the significance of a well-designed site plan and its effects on material management. It is critical to place material storage spaces close to off-loading zones while also keeping them close to the work area. Material flow from the site entrance to the workplace is the fundamental and important practice which requires on-site management input on an ongoing basis.

Waste material management

Another area within the field of materials management is waste management. (Joro, 2015) gives brief but concise insight for construction material management and its effect on the resulting waste management.

This topic is critical due to the limited space on-site; therefore, any excess material or waste material is occupying space that could be better allocated to tasks requiring the allotted space. Those writing on waste (Sanad Haytham M. et al, 2008; Thomas et al., 2006) highlight the importance of site layout and many attributes it to one of the leading factors of waste on building sites today.

According to (Poon et al, 2004) there are numerous variables that contribute to waste formation; these include both human and mechanical activities. When it comes to material waste, many personnel's fail to consider the importance of construction site planning, under such headings as; lack of adequate materials storage space, poor handling and inefficient logistics in the construction damage occurring due to poor material management, and materials become buried on-site.

2.8 Source of Barriers and Success Factors for CSLP

Barriers refer to obstacles or challenges for the effective implantation of construction site layout planning. On the other hand, success factors are referred as a factors that has a positive contribution for the overall effective implementation of the construction site layout planning.

Table 2.6 Different Barriers and Success Factors with Reference Sources

(A). Barriers factors for the effective implementation of construction site layout planning		
No.	**learning and Managing Indicators**	**Source**
1	poor Leadership skills of top managers	(bin Mamat & bin Mohamad Zin, 2014)
2	Poor organizational structures of the companies/contractors	(Belyu Bogale., 2020), (Andy & Price, 2010)
3	Lake of experienced experts on the site	(bin Mamat & bin Mohamad Zin, 2014), (Michael, 2021), (Andy & Price, 2010)
4	Frequent change of personnel	(Belyu Bogale., 2020)
5	Poor Stakeholder Involvement	(Whitman, 2014);
6	Absence of common acceptable procedures, standards, and technical guidelines in the context of Ethiopia.	(bin Mamat & bin Mohamad Zin, 2014), (Michael, 2021), (Belyu Bogale., 2020)
7	poor implementation and inspection of the available procedures, standards, and technical guidelines.	(bin Mamat & bin Mohamad Zin, 2014), (Michael, 2021), (Belyu Bogale., 2020);
8	Preparation of temporary works before the commencement of site works	(AbdulAzeez, Usman, Osuji, & Yusuf, 2016) (Adeagbo, Dakas, & Izam, 2019);
9	Poor understanding of construction site layout	(Michael, 2021);
No.	**Technical Indicators**	
1	Insufficient technical support from the head office	(Belyu Bogale., 2020), (Andy & Price, 2010);
2	Contract condition (special agreement issues, if needed)	(Belyu Bogale., 2020), (Emad Elbeltagi., 2008)

3	Location of the site (down towns, confined areas urban)	(Jaafar, Elbarkouky, & Kennedy, 2021), (Michael, 2021), (Belyu Bogale., 2020)
4	improper utilization of Available Site Space (Area)	(Jaafar, Elbarkouky, & Kennedy, 2021), (Belyu Bogale., 2020)
5	Available construction site boundaries and adjacent areas (Existing trees, buildings, and foundations)	(Sutt et al., 2013)
6	Poor facility type identification and selection	(Jaafar, Elbarkouky, & Kennedy, 2021), (Michael, 2021)
7	improper determining the size of the facility	(Jaafar, Elbarkouky, & Kennedy, 2021), (Michael, 2021)
8	choosing the position and location of the temporary facility	(bin Mamat & bin Mohamad Zin, 2014), (Jaafar, Elbarkouky, & Kennedy, 2021), (Michael, 2021), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016)
9	distance between different facilities (office, process plants, equipment, and machinery)	(bin Mamat & bin Mohamad Zin, 2014)
10	availability and movement of construction equipments (Plant, Vehicle, and machinery)	(Jusoh & Kasim, 2017);
11	availability and position of equipment (Plant, Vehicle, and machinery)	(Jusoh & Kasim, 2017);
(B). Success factors for the implementation of construction site layout planning		
No.	**Site layout element Indicators**	
1	Provision of access roads for trucks and lightweight vehicles.	(dhanjode, 2010), (Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), (Sutt et al., 2013);
2	Provision of site offices (clients, contractors, and consultants)	(dhanjode, 2010), (Whitman, 2014), (Small & Baqer, 2016), (Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), (Kim, Ryu, & Kim, 2021), (Sutt et al., 2013)

3	Provision of Accommodation	(dhanjode, 2010), (Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016);
4	Provision of Processing facilities	(Michael, 2021), (Kim, Ryu, & Kim, 2021);
5	Provision of site material storage space/yards	(dhanjode, 2010), (Whitman, 2014), (Small & Baqer, 2016), (Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), (Kim, Ryu, & Kim, 2021), (Emad Elbeltagi., 2008), (Sutt et al., 2013);
6	provision of parking lots	(Whitman, 2014), (Kim, Ryu, & Kim, 2021), (Emad Elbeltagi., 2008);
7	availability of material damp area (stones, aggregate, sand)	(Whitman, 2014), (Salih et al., 2019), (Kim, Ryu, & Kim, 2021);
8	Availability of utilities on site (electricity, water, telecommunication,)	(Small & Baqer, 2016), (Michael, 2021), (Kim, Ryu, & Kim, 2021), (Sutt et al., 2013);
9	Provision of welfare facilities (sanitary, drinking water, site toilet)	(dhanjode, 2010), (Whitman, 2014), (Small & Baqer, 2016), (Salih et al., 2019), ("Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations," 2015), (Kim, Ryu, & Kim, 2021), (Emad Elbeltagi., 2008);
10	Provision of information signs and signals (site map, safety rules, traffic regulatory signs)	(dhanjode, 2010), (Whitman, 2014), (Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), (Emad Elbeltagi., 2008);
11	Provision of security (Entrance gate, Fencing the boundary, security checkpoints, Gard house, Lighting)	(dhanjode, 2010), (Whitman, 2014), (Small & Baqer, 2016), (Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), ("Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations," 2015), (Kim, Ryu, & Kim, 2021), (Emad Elbeltagi., 2008), (Sutt et al., 2013);
12	provision of Cranes, hoisting, lift	(Whitman, 2014), (Small & Baqer, 2016), (Kim, Ryu, & Kim, 2021), (Sutt et al., 2013);

No.	Material Management Indicators/factors	
1	Properly use of Materials	(Jusoh & Kasim, 2017), (Zewdu, 2019);
2	Provision of adequate material storage facilities	(Zewdu, 2019), (Tafesse, 2021);
3	Deliver required quantity of material based on schedule & specification	(Oseghale, Adetooto, & Oseghale, 2021), (Tafesse, 2021), (Albert, Shakantu, & Ibrahim, 2021);
4	material management awareness	(Jusoh & Kasim, 2017);
5	Unsuitable materials storage places	(Oseghale, Adetooto, & Oseghale, 2021);
6	availability of waste storage on the construction site	(Sutt et al., 2013), (Albert, Shakantu, & Ibrahim, 2021);
7	provision of appropriate location for material storage	(dhanjode, 2010), (Oseghale, Adetooto, & Oseghale, 2021), (Tafesse, 2021), (Zewdu, 2019), (Albert, Shakantu, & Ibrahim, 2021);
8	Purchasing excess materials before they are required	(Oseghale, Adetooto, & Oseghale, 2021), (Albert, Shakantu, & Ibrahim, 2021);
9	Lack of material storage & stack place	(Oseghale, Adetooto, & Oseghale, 2021);
No.	**Safety Management Indicators**	
1	Provide sufficient budget for safety management	(Michael, 2021), (Buniya et al., 2021), (Mohammadi, Tavakolan, & Khosravi, 2018), (Mohammadfam et al., 2016);
2	sufficient emergency plan and procedures	(Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), ("Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations," 2015), (Yap & Lee, 2020), ("Work Health and Safety Regulation 2011," 2011);
3	Provision of safe & safety equipment (personal protective equipments (PPE), safety fence line)	(Michael, 2021), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), (Adeagbo, Dakas, & Izam, 2019), (Yap & Lee, 2020),

		(Mohammadi, Tavakolan, & Khosravi, 2018), (Mustapha, 2019), (Sutt et al., 2013), ("Work Health and Safety Regulation 2011," 2011);
4	on site Availability of safety Officer (safety supervisor)	("Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations," 2015), (Buniya et al., 2021), (Mohammadi, Tavakolan, & Khosravi, 2018), (Nawi, Ibrahim, Affandi, Rosli, & Basri, 2016), ("Work Health and Safety Regulation 2011," 2011);
5	Provision of first aid centers for worker's emergency responses	(dhanjode, 2010), (Whitman, 2014), (Salih et al., 2019), (AbdulAzeez, Usman, Osuji, & Yusuf, 2016), (Adeagbo, Dakas, & Izam, 2019), (Yap & Lee, 2020), ("Work Health and Safety Regulation 2011," 2011);
6	Safety awareness of the company top managers	(Adeagbo, Dakas, & Izam, 2019), (Buniya et al., 2021), (Mohammadi, Tavakolan, & Khosravi, 2018), (Wang, Zou, & Li, 2016);
7	provision of safety training	(Adeagbo, Dakas, & Izam, 2019), ("Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations," 2015), (Buniya et al., 2021), (Yap & Lee, 2020), (Mohammadi, Tavakolan, & Khosravi, 2018), (Nawi, Ibrahim, Affandi, Rosli, & Basri, 2016), (Wang, Zou, & Li, 2016), ("Work Health and Safety Regulation 2011," 2011);
8	provision of safety rule and regulation	("Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations," 2015), (Buniya et al., 2021), (Mohammadi, Tavakolan, & Khosravi, 2018), (Wang, Zou, & Li, 2016);

2.9 Summary of Literature

The literature review of the study was conducted in two basic sections, those are theoretical review and empirical review. The first section concentrated on introduction to the knowledge area of Construction site layout planning practice and it explains what should be considered and elements of Construction site layout planning. The second section is about empirical review focused on identifying barriers and success factors for the implementation of construction site layout planning. And the literature review was summarized below.

physical aspects of a site have a direct bearing upon the construction method and sequence adopted as well as has influence on productivity, health and safety, and also on materials handling practice. The construction site layout planning practice is considered as the important managerial practice which Facilitate the efficient performance of the construction site and it is used to improve Labour productivity, health and safety related issues, site material management. On the other hand, inadequate Construction site layout planning practice also has its own effect on the construction project performance, Labour productivity and as well as on the Labour safety.

Therefore, the study focuses on assessing the current construction site layout planning practice by Providing a construction site layout planning performance evaluation tool, which was developed by considering the success factors (i.e. material management practices, site layout element, and safety management.) identified from the literature review for the effective implementation of CSLP.

2.10 Research Gap

Much research in the construction industry has been conducted related to site layout planning and site organization. This indicates that there is good awareness of the advantages and importance of site layout planning practice in the construction industry. In many cases, Studies in developed countries concerted on site layout planning and also on site organization were devoted to the ways of optimizing site layout planning practices for productivity, safety, and cost-related issues (Khalid & Publications, 2017; Said & El-Rayes, 2013). Also in Ethiopia, different research works have been conducted focused on the assessment of site layout and organization practice, assessment of causes for poor site layout planning, and, investigation of its impact on Labour productivity, Labour safety, and on material handling and management practice (Belyu Bogale., 2020) (Birhanu, 2019). And also there were other studies focused on the practices of construction site layout planning in the case of confined construction sites (Bruk, 2019) & (Michael, 2021). It can be seen from the above that Ethiopian researchers mainly focused on assessing the construction site layout planning and site organization practice. However, so far there are a limitation of research works on developing an assessment tool or performance evaluation tool for the implementation of construction site layout planning. This shows the research gap in the provision of assessment tools. And also those previous studies in Ethiopia agreed and indicated that the implementation of construction site layout planning in Ethiopia was poor. And it can be improved by providing a performance evaluation tool. Based on this, the study was conducted to overcome the gap that existed in the construction industry.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals about, research methodologies and elaborates the methods and procedures undertaken during the study. It includes: descriptions of study area, research type, research design flow chart, discussion on pilot study, populations of the study, sampling method, data collection method, method of data analysis, and finally ethical considerations for the study.

3.2 Description of Study Area

Hawassa is a city in the Sidama Regional State, located on the shores of Lake Hawassa. It is located in the Great Rift Valley region; 275 km south of Addis Ababa via DebreZeit and 1125 km north of Nairobi. The city is the capital of the Sidama Regional State with a total area of 157.2 sq.km. Geographically it lays between 7°03'43.4"N latitude North and 38°28'34.9"E longitude East (Hawassa city administration, 2019).

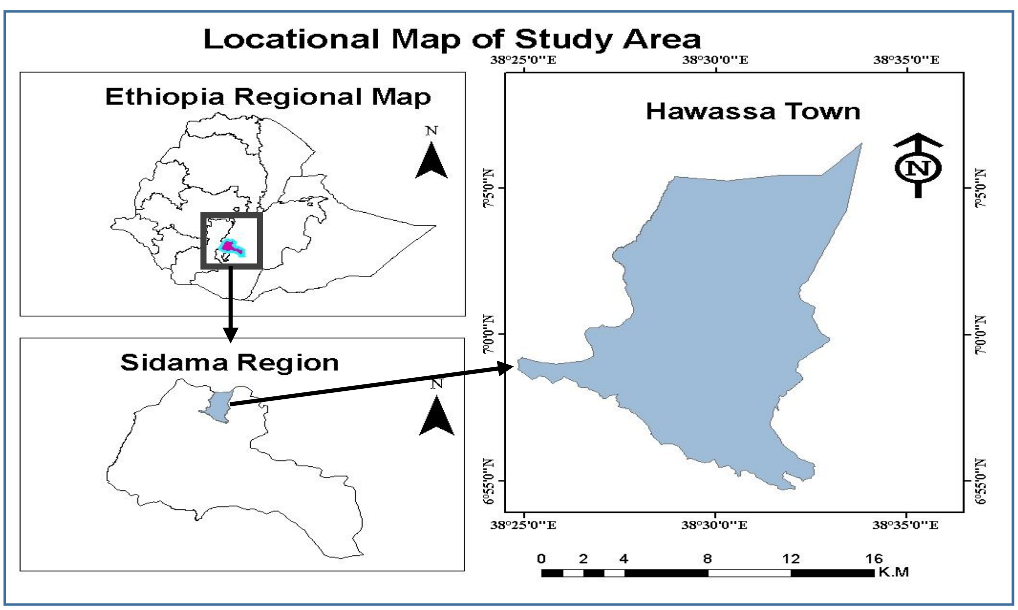

Figure 3.1 Location of Hawassa City

3.3 Research Type

To achieve the study's objectives, both quantitative and qualitative approaches of descriptive and exploratory nature of research were used, focusing on comparative judgment. The research is deceptive as it attempts to answer the question of what are the barriers/challenges for the effective implementation of construction site layout planning and, also to assess the current performance of building construction projects in hawassa city. To prioritize the success indicator factors and to develop performance evaluation checklist exploratory type was used. Exploratory research is used to conduct & support exploratory research, even if there is no prior information available on the problem from the past research, or undertaken to explore an area where little is known. It is carried out in order to gain a better understanding of the current problem. This can be done by using both qualitative and quantitative source of data.

3.4 Research Design

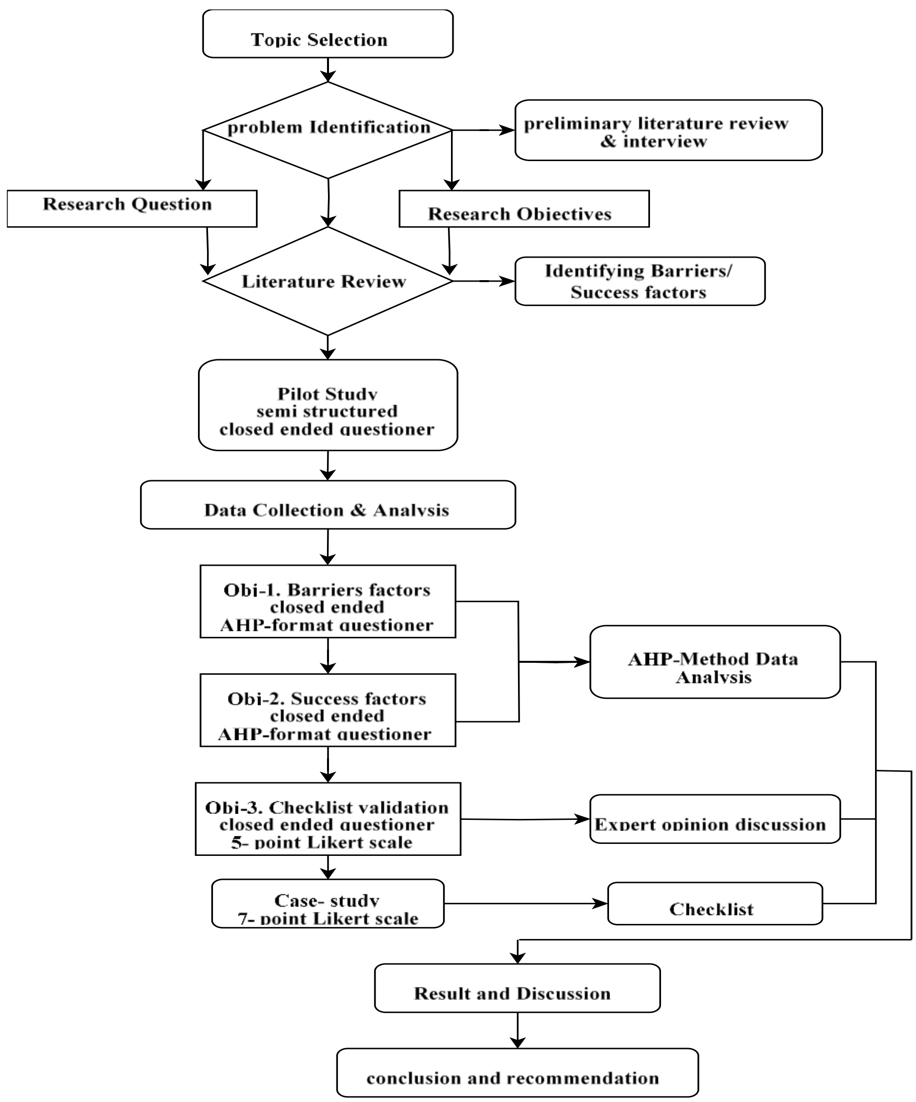

Figure 3.2 Research Design Flow Chart

3.5 Pilot Survey and Questionnaire Revision

Based on the Literature Review; the study identified and extracted 49 variables for the effective implementation of construction site layout planning. The pilot study was carried out to assess the feasibility of the questionnaire's contents for AHP-format data collection. And also conducted to ratify relevant variables to the context of hawassa city. The pilot survey questionnaire was organized under two main sub sections, barriers factors and success factors to be ratified, the pilot survey questionnaire had also a space for comment and recommendations, as well as writing space if there any related barriers or success factors for the implementation of construction site layout planning missed in the questionnaire (refer appendix II).

The pilot questionnaires were distributed by hard copies for 16 experts in Hawassa city construction industry. those were Academician, consultants, project managers, site engineers, office engineers, experts working in local construction regulatory authority (Hawassa city municipal office). Those experts were chosen based on criteria such as: participants should have a minimum of 5-year of working experience and also should have a minimum of highest education level qualification in masters of science degree related to construction field.

After collecting the pilot questionnaire and analyzed it, experts/respondents were put some factors to be included in the study and some factors to be excluded, and also recommended that some factors to be merged together. Then after analyzing and discussed on the pilot study data some similar variables were merged together, some irrelevant variables were excluded and also some new factors were added. after pilot study, the total of 40 variables were emerged under two main sections, barriers section and success factors section.

The overall decision and comments from the experts during the pilot study was discussed below as follow:

3.5.1 Decision and Revision on Barriers for Construction Site Layout Planning

A. Discussion during pilot study on learning and Managing category

A total 9 factors were proposed as barriers for site layout planning under the category of learning and Managing for the pilot study. during pilot study, 2 factors were merged together as one, 2 factors were excluded from the category, and also 2 factors also added as a new barrier from expert's suggestions. Finally, a total of 8 factors were refined as relevance or validate under learning and management category.

Based on the comments of professionals; the absence of common acceptable procedures, standards, and technical guidelines in the context of Ethiopia, and poor implementation and inspection of the available procedures, standards, and technical guidelines; were merged together as the absence & poor implementation of common acceptable procedures, standards, and technical guidelines in the context of Ethiopia. On the other hand, planning of temporary works before the commencement of site works and poor understanding of construction site layout were the two excluded barriers from the learning and managing category. and also tight schedules & overlapping activities, and lack of budget consideration & upon a time relies of budget for CSLP were the two factors that were added as a new barrier based on the expert's comment.

B. Discussion during a pilot study on Technical Factors Category

A total of 11 factors were proposed as barriers for site layout planning under the category of technical barriers for the pilot study. during the pilot study, 2 factors were merged together as one, and 3 factors were excluded from the category, and also 1 factor was added as new barrier from the expert's suggestions. Finally, a total of 8 factors were refined as relevance for the study after the expert's responses and comments on the pilot study.

Based on the comments of the expert's poor facility type identification and selection, and improper determining the size of the facility were merged together and renamed as; improper identification and determining the size of facilities. On the other hand, the distance between different facilities (office, process plants, equipment, and machinery), availability and movement of construction equipment (plant, vehicle, and machinery), availability and position of equipment (plant, vehicle, and machinery), were excluded as not relevance from the category. And also poor identification and selection of contactor and subcontractors was added as a new barrier under this category.

3.5.2 Decision and Revision on Success Factors for Construction Site Layout Planning

A. Discussion during pilot study on Site layout element Category

A total of 12 variables were proposed as site layout planning success factors under site layout element category for the pilot study. during pilot study, one variable provision of crafts changing room was added as a new indicator for expert's comments, and merged with Provision of welfare facilities under this category. On the other hand, 2 variables, provision of accommodation (rest room) and provision of cranes, hoisting, lifts were excluded from the category. Finally, a total of 10 variables were refining as relevance for the study after expert's responses and comments on the pilot study.

B. Discussion during pilot study on Material Management Category

A total of 9 variables were proposed as site layout planning success factors under material management category for the pilot study. During pilot study, based on expert's comments, 6 variables were refined as relevance variable. the remaining 3 variables; existence of unnecessary materials on site, unsuitable materials storage places and, lack of material storage & stack place were excluded during pilot study. Finally, a total of 6 variables were refining as relevance for the study after expert's responses and comments during pilot study.

C. Discussion during pilot study on Safety Management Category

A total of 8 variables were proposed as site layout planning success factors under Safety management category for the pilot study. During pilot study, based on the experts comment on the category of safety management some variables were added as a new, and merged and summarized with the other variable: availability of accident record keeping and reporting system and, Provision of fire prevention and firefighting equipment were summarized under the item of sufficient emergency plan and procedures. Finally, a total of 8 summarized variables were presented under this category.

3.5.3 All Relevant and Validated Variables After Conducting Pilot Study

Based on the expert's comments and evaluation the contents of the AHP-format questionnaire were revised and the questioner was organized well. The main work done here was relevant variables were ratified. after completing the first round pilot study, the second round validation test where ahead conducted.

During second round, the experts were evaluated the outcomes of first round and check whether all comments given by them were taken in to account or not, finally as result the experts were confirmed that, the contents of the work was valid to their perspective and agreed that, the content was valid for the next study.

Information obtained during pilot study, which were taken as an input for the work form participants were discussion as follows: the questionnaire should have start with the personal information, the questionnaire should also contain introduction part, the title of the study, objectives of the study, causes repeated with similar meaning should be removed, during analytical hierarchy process (AHP) for easy understanding and to facilitate the data collection process and data analysis, all relevant variables under each category should be summarized and listed with their respective Acronyms.

All relevant variables which were used as an input to for the Analytic Hierarchy Process (AHP) were presented with their acronyms below on table 3.1.

Table 3.1 Barriers & Success Factors with Their Respective Acronyms for CSLP

Barriers for Construction Site Layout Planning		
No.	**Learning And Managing Indicators Category**	**LMI**
1.	poor Leadership skills of top managers	LMI-1
2.	Poor organizational structures of the companies/contractors	LMI-2
3.	Lake of experienced experts on the site	LMI-3
4.	Frequent change of personnel	LMI-4
5.	Tight schedule & overlapping activities.	LMI-5
6.	Lack of budget consideration & upon a time relies of budget for CSLP	LMI-6
7.	Poor Stakeholder Involvement.	LMI-7
8.	the Absence & poor implementation of common acceptable standards and guidelines.	LMI-8
No.	**Technical Indicators Category**	**TI**
1.	Insufficient technical support from the head office	TI-1
2.	Poor identification and selection of contactor and subcontractors	TI-2
3.	Contract condition (special agreement issues, if needed)	TI-3
4.	Location of the site (down towns, confined areas urban)	TI-4
5.	Improper utilization of Available Site Space	TI-5
6.	Available construction site boundaries and adjacent areas (Existing trees, buildings, and foundations)	TI-6
7.	Improper identification and determining the size of facilities	TI-7
8.	Choosing the position and location of the temporary facility	TI-8
Success Factors for Construction Site Layout Planning		
No.	**Site Layout Element Indicators**	**SLE**
1.	Provision of access roads for trucks and lightweight vehicles.	SLE-1
2.	Provision of site offices	SLE-2
3.	Provision of Processing facilities	SLE-3
4.	Provision of site material storage space/yards (cement, steel)	SLE-4
5.	provision of parking lots	SLE-5

6.	Availability of material damp area (stones, aggregate, sand)	SLE-6
7.	Availability of utilities on site	SLE-7
8.	Provision of welfare facilities	SLE-8
9.	Provision of information signs and signals	SLE-9
10.	Provision of security	SLE-10
No.	**Material Management Indicators Category**	**MMI**
1.	Properly use of Materials	MM-1
2.	Provision of adequate material storage facilities	MM-2
3.	Deliver required quantity of material based on schedule & specification	MM-3
4.	Material management awareness	MM-4
5.	Availability of waste storage on the construction site	MM-5
6.	provision of appropriate location for material storage	MM-6
No.	**Safety Management Indicators Category**	**SMI**
1.	Provide sufficient budget for safety management	SMI-1
2.	Sufficient emergency plan and procedures	SMI-2
3.	Provision of safety equipment	SMI-3
4.	On site Availability of safety Officer (safety supervisor)	SMI-4
5.	Provision of first aid centers for worker's emergency responses	SMI-5
6.	Safety awareness of the company top managers	SMI-6
7.	provision of safety training	SMI-7
8.	provision of safety rule and regulation	SMI-8

After review the pilot survey better and accurate (AHP- format) questionnaire related to the topic was prepared. The study title, objective, personal information parts were written in pleasant-looking. Also Respondents were informed about the confidentiality of their response at any time. The questionnaire used for survey of data collection was with complete information and supportive letter (appendix III).

3.6 Populations of The Study

The populations of the study were Non- confined site type Building construction projects in Hawassa city. The population is an entire group of individuals, objectives, or events which finally the conclusion where made for, while a sample is a small portion of individuals, objects, or events which represent the domain population and also used as a source of data to analyze the situations to reach on the final conclusions.

3.7 Sampling Methods

The purposive sampling technique was used as a sampling method to selection the participants for the study. data was collected using purposive sampling techniques from construction industry professionals. purposive sampling is one of the most common non-probability sampling technique where the researcher selects individuals or groups to be included in a study based on specific per-selection criteria or characteristics (Mohajan, 2018).

The purpose of this sampling method is to select participants who have the information or experience that the researcher is interested in studying. The goal is to include people in the sample who can provide a significant information for the study question or issue. Since, the main concern of the study was on exploring major barriers and key successes factors for the effective implementation of construction site layout planning, and also to developing a checklist or an assessment tool for the effective implementation of construction site layout planning. for this researcher believed that participants on the study, needs to be experts who can provide sufficient and full information.

After conducting a pilot study, in order to address the first and the second objectives AHP format questionnaire was organized and distributed. This was achieved by selecting 60 professionals, who were working in hawassa city building construction industry. Those participants were selected Purposively to collect the data by distributing AHP format questionnaires. A total of 60 AHP format questionnaires were distributed for purposively selected professionals, who were stakeholders on building construction industry in hawassa city. Those are local construction regulatory authority experts who were working in hawassa city municipality, academicians in hawassa city who were familiar to Hawassa city building construction works, consultants who were working in hawassa city, site engineer, office engineers and, project (head) managers (PMs) who were currently working in hawassa city building projects. The selection was based on the criteria of experience years of experts, and also highest education level qualification.

After achieving objective two, a performance evaluation checklist was developed. This was conducted by using the criteria weights generated during prioritizations of success factors under each category (i.e, site layout element, material management and, safety management categories) and also the criteria weights of the categories, and by collaborating with 7- point Likert scale as an input for the performance evaluation process.

The applicability and appropriateness of the developed checklist was evaluated and validated by experts. This was conducted by selecting eight professionals purposively, based on criteria’s such as: participants should have a minimum of 5-year of working experience and also should have a minimum of highest education level qualification in masters of science degree related to construction field. Those experts were academia, local authority experts, consultants, project (head) managers, site engineers.

A performance evaluation for the implementation of CSLP was conducted by applying a case study, for this purpose four project sites were selected, the selection was based on the criteria's such as; the site should be more than ground plus four and also the site should be active, ongoing building construction projects in hawassa city. A total of 14 experts were participated during the performance evaluations of building construction project regarding on the implementations of construction site layout planning. During the study three experts were participated separately from each project one and project three, and Four experts were participated separately from each project two and project four. Participants were project manager, office engineers and, site engineers in the construction projects.

The overall summaries of the sample size used during conducting the study was discussed and presented in the table 3.2 below:

Table 3.2 The Overall Summaries of the Sample Size for the Study

Sampling Based On Specific Objectives	
For Pilot Study	16 – Expects More than 5-years of experience Minimum of MSc. degree in building construction related field
For- Weight & Prioritize	60 - Experts Minimum of BSc. degree in building construction related field
For- Checklist Validation	8 - Experts More than 5-years of experience Minimum of MSc. degree in building construction related field
Current Performance Evaluation (Case Study)	14 – Experts Minimum of BSc. degree in building construction related field

3.8 Source of Data and Collection Methods

The data collection methods used for this study was both qualitative and quantitative method in the form of open ended and close ended structured questionnaires. Both Primary and secondary source of data were used for the study.

Primary source of data was collected from the professionals in the construction industry through open ended and closed ended semi-structured questionnaires and also by conducting a semi-structured interviews with the professionals. The questionnaires were constructed in the form Analytic Hierarchy Process (AHP) format, 5- point Likert scale and, 7- point Likert scale, and also case study. On the other hand, secondary sources of data were used during the study, variables for the implementation of construction site layout planning were identified and archived from various related literatures such as books, journals, different thesis & dissertation and, internet source.

To address the first and the second specific objectives of the study, Analytic Hierarchy Process (AHP) method was used to collect data from respondents, as Structured quantitative questionnaire. The Analytic Hierarchy Process (AHP) is a mathematical decision-making technique provides an effective means to deal with complex decision-making, developed by Thomas Saaty in 1980. AHP allows for the examination of both qualitative and quantitative components of decisions; it can simplify difficult judgments by assisting with the identification and weighting of selection criteria., analyzing the data collected for the criteria and expediting the decision-making process. According to (Vaidya & Kumar, 2006), AHP is one of the most extensively used tools for making multiple criteria decisions. AHP can be used in planning, selecting the best choice, allocating resources, and optimizing (Saaty, 2008).

For the easy of reference, barriers and Successes factors for construction site layout planning were written with their corresponding acronyms. The respondents of the questionnaire survey were required to carry out pair-wise comparison between barriers and also between Successes factors, and rate them according to their importance. According (Saaty, 2008; Temiz & Calis, 2017) to make comparisons, a numerical scale is required to indicate how important or dominant an element is over another concerning the criterion for which they were compared. The matrix was arranged and a score range of 1 to 9 was selected and allocated, comparing scale points were specified below on table 3.3.

Table 3.3 Fundamental Scale of Absolute Numbers (Temiz & Calis, 2017; Wong & Li, 2008).

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgement moderately favor one activity over another
5	Essential or Strong importance	Experience and judgement strongly favor one activity over another
7	Very Strong importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme importance	An activity is extremely favored and its dominance demonstrated in practice
2,4,6,8	Intermediate values between the two adjacent judgments	
Reciprocals	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.	

where a maximum score implies that the row is more important than the column. The diagonal of the matrix was allocated at a score of 1. Going on column wise, the value in the corresponding column just below the diagonal is reciprocal of the scores in the corresponding row. This is based on the reasonable assumption that if the attribute A is extremely important than attribute B and it is rated at 9, then B must be less important than A and it is valued at 1/9. The matrix was established by making rows and columns having the same parameters.

After developing a proposed check list as a performance evaluation tool for the implementation of construction site layout planning, the checklist was validated to find out its applicability and its appropriateness to influence and contribution on the implementation of construction site layout planning in the case of hawassa city building projects. Validation was conducted based on professional's responses. During evaluation, respondents were asked to give their level of agreement and comments on the applicability and appropriateness of the proposed check list. Closed ended structured questionnaire in the form of 5- points agree-disagree Likert scale questionnaire format was used for a checklist validation survey (refer Appendix V). The participant need to give their response based on the provided scale as: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree.

After confirming the developed checklist is applicability and appropriate to use as an assessment tool, case study was applied, to address the specific objective four “current performance evaluations of building construction projects in hawassa city regarding on the implementation of construction site layout planning” by using the developing checklist as a data collection tool with the collaborations of 7- point Likert scale as inputs for the data collection, the Likert scale was in the form of poor- out standing. 7- point Likert scales were used as a data collection method for the developed checklists. (1 = very poor, 2 = poor, 3 = satisfactory, 4= good, 5 = very good, 6 = excellent, 7 = outstanding) (refer Appendix VI).

3.9 Data Analysis Methods

Data analysis were started after the data collection was completed. For the first and the second objectives Analytic Hierarchy Process (AHP) was applied, under specific objective three the proposed checklist was validated and analyzed based on the expert’s level of agreement, also their response was discussed based on the 5- point Likert scale (Agree-Disagree) response. Finally, the developed checklist was used to analyze the current performances evaluate of the selected building projects during conducting the case study in hawassa city by Appling 7- point Likert scale rating system. Microsoft Excel 2016 was used as a data analysis tool.

3.9.1 AHP-Method Data Analysis

16 factors were identified and selected as a barrier for the implementation of construction site layout planning and grouped under two categories for objective one, on the other hand, 24 variables were identified and selected as a success factors for the implementation of construction site layout planning and grouped under three categories for objective two. A total of 40 variables were organized under five categories, and distributed in the form of analytical hierarchy process (AHP) format questionnaires to weigh and prioritize variables.

The collected data were analyzed and prioritization by AHP-data analysis method based on the comparative judgments of the construction professionals. According to (Wong & Li, 2008), the following AHP- data analysis steps were followed; defining the problem and objective, development of the hierarchy, pair-wise comparison, Normalization calculation and consistency calculation. According to Saaty's rule of thumb, only judgment matrices with a consistency ratio of less than one is acceptable (CR) < 0.1 (Deng & Hu, 2014).

Step -1. Defining the problem and objective

The overall goals of decision-making are brought hierarchically into a scene of the related decision elements. In this study construction site layout planning take the ultimate goal of the work. In the AHP model method, the problem modelling as well as pairwise comparison concerning its structure can be represented by the hierarchical structure of AHP (Saaty & Vargas, 2012).

Step -2. Development of the Hierarchy

Hierarchical construction is top to down process and it contains main domain, several categories under the main domain, and also sub-criteria's or variables under each category. The study used two categories to investigate barriers/challenges for CSLP under these two categories 8 sub-criteria/variables were grouped, and also the study organized 24 sub-criteria/variables under three categories as a success factors for the implementation of CSLP. Construction site layout planning practice (CSLP) takes the first level, the second level contains all the three main success indicator categories (site layout elements, material management, and safety management) and also contains the two main barriers/challenge categories for the implementation of construction site layout planning. Finally, the third level contains all sub-criteria under each category. Elements in the hierarchical levels are controlled in such a manner that they are on the same scale and extent as well as they must be associated with other relevant factors of structure, according to (Waris et al., 2019).

Step -3. Sum up the column of Pair-wise comparisons matrix

After obtaining the pairwise judgments of all respondents, form the distributed AHP-format questionnaire. The following steps were conducted:

Step1. Insert the average responses rates of the respondents in to the provided pair-wise compassion matrix.

The average score values of respondents were given by the professionals was used as an input score value in to the Pair-wise comparisons matrix during AHP- data analysis. This was conducted by finding the total sun of the compassion responses of participants and dividing by the total number of participants. The average score values were Inserted for the entities found on the top of the diagonals. The diagonal entities of the matrix indicate that, there is equal importance comparison between the variable itself, as the result of this the score value was 1.

For the column entities found under the diagonals were equals to the reciprocal of the scores in the corresponding row which found on the top of the diagonals

Step 2. Pair-wise comparison

Vertical sum up of the insisted values given by the respondents during pair-wise comparisons between the given variables with in the matrix.

$$\mathrm{Cij} = \sum_{i=1}^{n} \mathrm{Cij} \; \dots \dots \dots \dots \dots \dots \dots \dots \dots (eq. 3.1)$$

Likewise, all the columns were calculated and added to arrive at the total.

Step 4. Normalize the comparison

Normalizing of each column to a total sum of 1.0 or 100%, were done by dividing each entry of pair-wise comparison matrices by the respective column total sum of each pair-wise comparison matrix.

$$\mathrm{C}ij = \frac{\mathrm{Cij}}{\sum_{i=1}^{n} \mathrm{Cij}} \begin{Bmatrix} \mathrm{W11} & \mathrm{W12} & \mathrm{W13} \\ \mathrm{W21} & \mathrm{W22} & \mathrm{W23} \\ \mathrm{W31} & \mathrm{W32} & \mathrm{W33} \end{Bmatrix} \dots . . \dots \dots (eq. 3.2)$$

After completing Normalization process of each entities of the matrix, computation for criteria weights (CW) were followed.

Criteria weight (CW) is generated by dividing the total sun of each rows of normalized matrix to the numbers of variables or indicators (n) used in the category.

$$CW = \frac{Totl\ SUM\ of\ each\ normalized\ row}{\text{number of variables in the category}}, \dots \dots . \dots (eq. 3.3)$$

After computing criteria weights for all variables founded under the same categories, the percentage criteria weights were calculated for each variable, by multiplying the generated criteria weight of each variable by 100.

$$\%CW = (\mathrm{CW} * 100) \dots \dots \dots \dots \dots . \dots \dots \dots \dots . \dots \dots (eq. 3.4)$$

Step 5. Consistency calculation

To accept the criteria weight generated from the above Normalization step, the consistency of the data needs to be checked. Consistency is related to the internal coherence of the decisionmaker when the judgment is considered in the pairwise comparison matrix. It is the most important measurement for the results which generated from the pairwise comparison.

Lambda Max (λmax) is the maximum eigenvalue of the matrix and it is needed to calculate the consistency index. λmax was calculated as the average values of the ratios which generated by dividing weighted sum values of variable in each row to the respective criteria weighted of each variable.

The consistency ratio (CR) determines that the compassion matrix is consistence and reliable to use the criteria weight for rating. Further, Saaty's rule of thumb can be used to accept only judgment matrices with the consistency ratio must be less than 0.1 or CR < 0.1 (Deng & Hu, 2014). This consistency ratio value is generated by using a Randomized Index (RI) and the average consistency index (CI) for randomly filled matrices (Goepel, 2013). The random consistency index (RI) values for the number of indicators were taken for the table 3.4 below.

Table 3.4 Random Consistency Index Values (Saaty & Sodenkamp, 2010)

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI.	0.00	0.00	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49	1.52	1.54	1.56	1.58	1.59

To determine the consistency ratio (CR) of for randomly filled matrices about three steps required to be followed;

Step 1: the column entities of the pair-wise comparison matrix were multiplied by corresponding criteria weights to obtain the eigenvector. After completing multiplication process, column named weighted sum value sum (WSV) was generated, which is obtained by Calculating the total sum of each row of consistency matrix. Then after, column (WSV/CW) was generated by calculating the ratio between weighted sum value (WSV) and criteria weight (CW) obtained during normalization.

Step 2: λ max is calculated using the equation 3.5 presented below. λ max is the average value of the column sum of WSV/CW.

$$\lambda\, max\ = \frac{\sum\left(\frac{\mathrm{WSV}}{\mathrm{CW}}\right)}{n} \dots\dots.\dots\dots\dots\dots\dots..\dots(eq. 3.5)$$

Step 3: CI and CR were calculated as per the Equation (3.6) and (3.7), respectively:

$$CI = \frac{\lambda\, max - n}{n - 1} \ldots \ldots . \ldots \ldots \ldots \ldots \ldots . . \ldots (eq. 3.6)$$

$$CR = \frac{CI}{RI} \ldots \ldots . \ldots \ldots \ldots . . \ldots \ldots \ldots \ldots . \ldots (eq. 3.7)$$

where, (n) represents for number of variables under the category, and RI represents the random consistency index valve which directly depends on the number of variables on the category, which is taken from table 3.5.

For the value of consistency ratio less than 0.1 indicates that, the comparison matrix is consistence and reliable to use the criteria weight for rating. For the value of CR < 0.1, it is valid.

The proposed check list was evaluated and validated based on level of agreements of experts on the applicability and appropriateness of the checklist. For this the responses of experts were analyzed by discussion of their level of agreement on the given eight questions for validation.

After the checklist was validated, the current performances of building construction projects regarding on the implementation of construction site layout planning was analyzed by using the checklist as a data analysis tool. This will be elaborated in chapter 4 (refer section 4.3)

3.10 Ethical Consideration

Ethical considerations are expected to be involved in any kind of research study. Ethics are standards of behavior that guide the moral choices about our behavior and our relationship with others. All parties in research should observe ethical behavior. The study will be in line with the organization’s policy in relation to any intellectual property rights of the organization. Regarding privacy of the respondents, their responses are strictly confidential and only used for academic purposes and concerning references, all the materials and sources are properly acknowledged.

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the data analysis and discussions of the collected data though questionnaires and case studies. the main findings of the study were summarized and discussed below based on the specific objectives.

4.2 Demographic Characteristics of the Sample

4.2.1 Response Rate

This sub section presents the rate of respondents during the questioner survey. Rates of respondents who were participated during the study to achieve specific objectives one and two discussed and summarized below in table 4.1.

Table 4.1 Questionnaires Survey Respondent Rates for Objective One & Two

Title	distributed	not retuned	retuned response	In-complete response	Net
Architecture	10	2	8	1	7
Civil Engineer	26	2	24	2	22
Construction engineer (COTM)	24	4	20	1	19
Total	60	8	52	4	48
Rate (%)	100	13.33	86.67	6.67	80

Table 4.1 in the above showed that, 52 AHP-format questionnaires were collected from the total of 60 questionnaires which were distributed to the experts and only 48 of them were founded as adequate and completed responses for the study. And the remained 4 questionnaires from the retuned were founded not completed response and managed not to be included on the study.

4.2.2 General Background Profiles of Respondents

Here the backgrounds of all 48 participants who were return full and complete responses during AHP- data collection were summarized under the followings table 4.2.

Table 4.2 Respondents Background Profile for Objective One AHP-Format Questionnaire

categories			
Discipline of higher degree			
	Education level	**frequency**	Rate (%)
	Ph.D.	1	2.08
	MSc	25	52.08
	BSc	22	45.83
	Total	48	100
Years of experience			
	years	frequency	Rate (%)
	< 3 years	6	12.5
	3 - 5 years	17	35.42
	5 - 10 years	19	39.58
	> 10 years	6	12.5
	total	48	100

The above table 4.2 showed that, Backgrounds of the respondents participated to conduct the first and the second objectives, about 52% of Experts were with education level of MSc degree, 45% of the total respondents have BSc degrees and, the remained 2% were have Ph.D. from the total respondents of the study, around 39% of the respondents have 5 - 10 years of experience, 35% with 3 - 5 years of experience and, about 12% of respondents have both less than three years of experience and more than ten years of experience.

Here in table 4.3 below, the responses rates of all eight respondents who were participated during checklist validation was summarize and discussed based on their respective background of Job Positions and filed of highest degree qualification.

Table 4.3 Backgrounds of Respondents for Check List Validation

	Filed of highest degree qualification			
Job position	Architecture	Civil Engineer	Construction engineer (COTM)	Total
Academician		1	1	2
Consultants	2			2
Local regulatory authority expertise		2		2
Project head (managers)		2		2
			total	8

4.3 AHP Data Analysis

A total of 40 variables, i.e. 16 barriers and 24 success factors were identified and selected as a relevant after conducting pilot study from the proposed total 49 variables for the implementation of construction site layout planning, as it was presented in chapter three (refer section 3.3.2 Table 3.1. In order to make comparative judgements and prioritization, variables were organized into five categories and distributed in the form of AHP questionnaires to the building industry professionals. the acquired data were examined and prioritized through AHP-data analysis method. the Data- analysis was conducted by the following steps, for each category; Pair-wise comparison, Normalized comparison pairwise matrix and weighted matrix and, Consistency calculation. as it was presented in chapter 3 (refer section 3.8.1).

4.3.1 Hierarchy Development

Indicating the hierarchical relationships between the main domain and sub-categories under the main domain. and also, shows that, the variables/indicators under each sub categories. this was conducted by taking all the relevant variables from the pilot study analysis, and re-writing them with representative acronyms. The hierarchical arrangement for the study was presents in figure below under two section barriers/challenges and success indicator factors foe construction site layout planning.

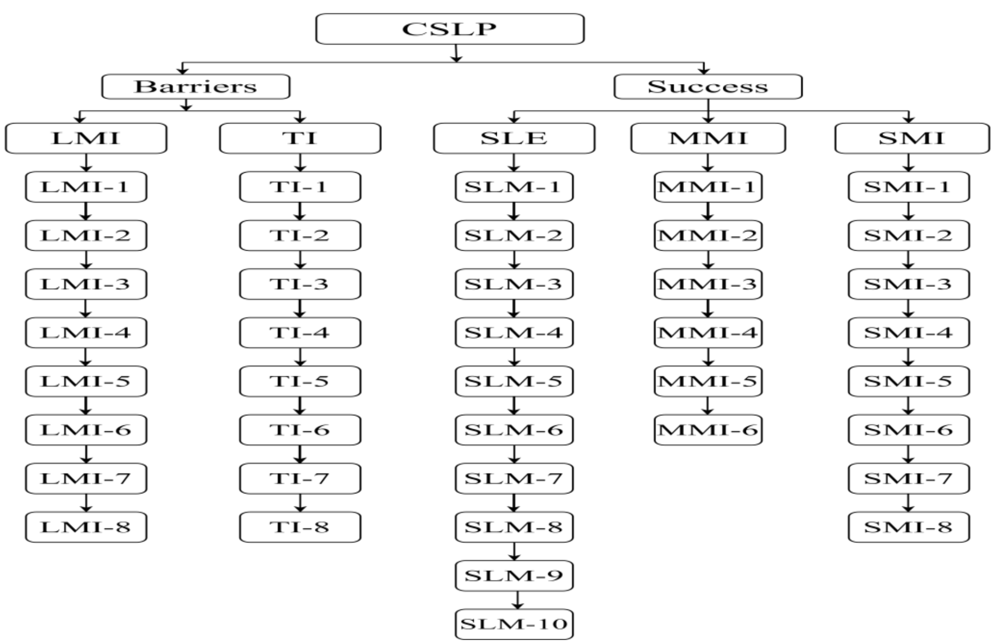

Figure 4.1 Hierarchy Structure for Proposed Construction Site Layout Planning

4.3.2 AHP-Data Analysis of Barriers for Construction Site Layout Planning

4.3.2.1 AHP- Data Analysis for Leaning and Management Category

After obtaining the average pairwise judgments of participants on the importance of the variable under learning and management category, the next step was computation of a vector of priorities or weighting of elements in the matrix.

Step-1. Sum up the column of Pair-wise comparisons matrix

Insert the average score values of responses, which was given by respondents to the Pair-wise comparisons matrix. and find out the total sum of each column of Pair-wise comparisons matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.1). this is illustrated by taking the first and the second column of Pair-wise comparisons matrix as example;

column- 1: (1 + 3.1210 + 3.4100 + 0.1460 + 0.1600 + 0.2924 + 0.1675 + 0.2884 = 8.5853)

column- 2: (0.3204 + 1 + 3.2100 + 0.1349 + 0.1433 + 0.2924 + 0.1504 + 0.1553= 5.4066)

Likewise, all the columns were calculated and added to arrive at the total sum.

Table 4.4 Pair-Wise Comparisons Matrix – Learning and Managing

LMI	LMI-1	LMI-2	LMI-3	LMI-4	LMI-5	LMI-6	LMI-7	LMI-8
LMI-1	1	0.3204	0.2933	6.8500	6.2500	3.4200	5.9700	3.4670
LMI-2	3.1210	1	0.3115	7.4120	6.9800	3.4200	6.6500	6.4400
LMI-3	3.4100	3.2100	1	7.6430	7.2100	3.8000	6.8800	6.6600
LMI-4	0.1460	0.1349	0.1308	1	0.3541	0.2273	0.2778	0.2941
LMI-5	0.1600	0.1433	0.1387	2.8240	1	0.2732	0.3125	0.2941
LMI-6	0.2924	0.2924	0.2632	4.4000	3.6600	1	3.4200	3.2100
LMI-7	0.1675	0.1504	0.1453	3.6000	3.2000	0.2924	1	0.3495
LMI-8	0.2884	0.1553	0.1502	3.4000	3.4000	0.3115	2.8610	1
Sum	8.5853	5.4066	2.4330	37.1290	32.0541	12.7444	27.3713	21.7148

Step 2. Normalize the comparison

To normalize each columns of Pair-wise comparisons matrix to a total sum of 1.0 or 100%, each elements of the column was divided by the total sum of respective column. as it was presented in chapter 3 (refer section 3.8.1, equation 3.2).

For instances; normalization process, for the first entity of first column, and also for the first entity of the second column by dividing to their respective column total sum was illustrated below as example;

Column-1 first entity: (1/8.5853 = 0.1165)

Column-2 first entity: (0.3204/5.4066 = 0.0593), Likewise, all columns were normalized.

also the horizontal total sum of normalized entities in each rows were divided to the number of variables (n) to generate a criteria weighted matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.3). for instance, criteria weight (CW) calculation for the first row was shown as follow: (0.1165 + 0.0593+ 0.1205+ 0.1845+ 0.1950+ 0.2684+ 0.2181+ 0.1597) / 8 = 0.1652.

Table 4.5 Normalized Pairwise Matrix and Weighted Matrix – Learning and Managing

LMI	LM-1	LM-2	LM-3	LM-4	LM-5	LM-6	LM-7	LM-8	SUM	criteria weight (CW)	criteria weight (%CW)
LM-1	0.1165	0.0593	0.1205	0.1845	0.1950	0.2684	0.2181	0.1597	1.3219	0.1652	16.5234
LM-2	0.3635	0.1850	0.1280	0.1996	0.2178	0.2684	0.2430	0.2966	1.9018	0.2377	23.7724
LM-3	0.3972	0.5937	0.4110	0.2058	0.2249	0.2982	0.2514	0.3067	2.6889	0.3361	33.6117
LM-4	0.0170	0.0250	0.0538	0.0269	0.0110	0.0178	0.0101	0.0135	0.1752	0.0219	2.1905
LM-5	0.0186	0.0265	0.0570	0.0761	0.0312	0.0214	0.0114	0.0135	0.2558	0.0320	3.1975
LM-6	0.0341	0.0541	0.1082	0.1185	0.1142	0.0785	0.1249	0.1478	0.7802	0.0975	9.7529
LM-7	0.0195	0.0278	0.0597	0.0970	0.0998	0.0229	0.0365	0.0161	0.3794	0.0474	4.7429
LM-8	0.0336	0.0287	0.0617	0.0916	0.1061	0.0244	0.1045	0.0461	0.4967	0.0621	6.2087
	1	1	1	1	1	1	1	1	sum	1	100
										n=	8

The vertical sum of each normalized column must give a result of one. This is illustrated below by taking first column: 0.1165 + 0.3635 + 0.3972 + 0.0170 + 0.0186 + 0.0341 + 0.0195 + 0.0336 = 1

Step 3. Consistency calculation

After the normalization takes place, consistency of the data needs to be checked. as it was presented in chapter 3 (refer section 3.8.1).

Step 1. Multiply each entity of pair-wise comparison matrix with the corresponding criteria weight. this is elaborated by taking first two entities of column one and column two as follow;

to find consistency of column one; elements in the first column of pair-wise comparison matrix were multiplied by the first criteria weight. For instance, the first two entities explained below.

For the first entity of column one: (1 * 0.1652 = 0.1652),

For the second entity of column one: (3.1210 * 0.1652 = 0.5157),
to find consistency of column two; elements in the second column of pair-wise comparison matrix were multiplied by the second criteria weight. For instance, the first two entities explained below.

For the first entity of column one: (0.3204 * 0.2377 = 0.0762),

For the second entity of column one: (1 * 0.2377 = 0.2377), Likewise, all the rest columns in the consistency matrix were calculated.

Step 2. After the entire consistency matrix was calculated and filled, weighted sum value (WSV) generate by applying total horizontal sum of all entities in each row. This is elaborated by taking first rows of consistency matrix.

weighted sum value of first row (WSV_1) = 0.1652 + 0.0762 + 0.0986 + 0.1501 + 0.1998 + 0.3335 + 0.2831 + 0.2153 = 1.5218,

The ratio (WSV/ CW) was generated by dividing the total sum of weighted sum value with criteria weighted (CW) from normalization. this is also elaborated by taking the first row of consistency matrix.:

Ratio of first row (WSV/CW) = 1.5218 / 0.1652 = 9.2101

Table 4.6 Consistency Calculation – Learning and Managing

LMI	LM-1	LM-2	LM-3	LM-4	LM-5	LM-6	LM-7	LM-8	weighted sum value sum (wsv)	criteria weighted (CW)	WSV/ CW
LM-1	0.1652	0.0762	0.0986	0.1501	0.1998	0.3335	0.2831	0.2153	1.5218	0.1652	9.2101
LM-2	0.5157	0.2377	0.1047	0.1624	0.2232	0.3335	0.3154	0.3998	2.2925	0.2377	9.6434
LM-3	0.5634	0.7631	0.3361	0.1674	0.2305	0.3706	0.3263	0.4135	3.1710	0.3361	9.4343
LM-4	0.0241	0.0321	0.0440	0.0219	0.0113	0.0222	0.0132	0.0183	0.1870	0.0219	8.5368
LM-5	0.0264	0.0341	0.0466	0.0619	0.0320	0.0266	0.0148	0.0183	0.2607	0.0320	8.1526
LM-6	0.0483	0.0695	0.0885	0.0964	0.1170	0.0975	0.1622	0.1993	0.8787	0.0975	9.0099
LM-7	0.0277	0.0357	0.0489	0.0789	0.1023	0.0285	0.0474	0.0217	0.3911	0.0474	8.2462
LM-8	0.0477	0.0369	0.0505	0.0745	0.1087	0.0304	0.1357	0.0621	0.5464	0.0621	8.8005
										sum	71.0337

Step 3: λ max is the average value of the column values of (WSV/CW). λ max was calculated by using the following equation. as it was presented in chapter 3 (refer section 3.8.1, equation 3.5)

$$\lambda\, max \ = \frac{\sum\left(\frac{\text{WSV}}{\text{CW}}\right)}{n}$$

$$\lambda\, max = \left(\frac{71.0337}{8}\right) = 8.8792 \qquad when, \sum\left(\frac{\text{WSV}}{\text{CW}}\right) = \ 71.0337\ \&\ \ \text{n} = 8$$

After λ max was calculated, the Consistency index CI was generated by applying the next equation. as it was presented in chapter 3 (refer section 3.8.1, equation 3.6).

$$CI = \frac{\lambda\, max - n}{n - 1}$$

$$CI = \frac{8.8792 - 8}{8 - 1} = 0.1256$$

After consistency index was calculated, calculation for consistency ratio was followed by taking the equation presented in chapter 3 (refer section 3.8.1, equation 3.7).

$$CR = \frac{CI}{RI}$$

$$CR = \frac{0.1256}{1.40} = 0.0897 = OK! \ \ for\ n = 8\ use\ the\ RI\ values\ of\ 1.40$$

As a result of AHP- Data analysis, consistency ratio of 0.0897 was found, which is acceptable as it is less than 0.10. Based on this, table 4.10 blow present all eight barriers for the implementations of construction site layout planning under learning and managing, which were compared with each other under leaning and management category based on their criteria weight.

Likewise, the same all steps and procedures were followed to Analyze other remaining categories.

Table 4.7 Criteria Weight – Learning and Managing

learning and Managing factors	LMI	criteria weighted (CW)	Rank
Lake of experienced experts on the site	LMI-3	33.61	1
Poor organizational structures of the companies/contractors	LMI-2	23.77	2
poor leadership skills of top managers	LMI-1	16.52	3
Lack of budget consideration & upon a time relies of budget for CSLP	LMI-6	9.75	4
the Absence & poor implementation of common acceptable standards and guidelines.	LMI-8	6.21	5
Poor Stakeholder Involvement.	LMI-7	4.74	6
Tight schedule & overlapping activities.	LMI-5	3.20	7
Frequent changes of personnel	LMI-4	2.19	8

Based on the expert's computation result: Lake of experienced experts on the site, Poor organizational structures of the companies and, poor leadership skills of top managers in order was prioritized to be the top three barrier for the implementation of construction site layout planning under the category of learning and management.

Lake of experienced experts on the site was found to be the most dominant barrier for the implementation of CSLP with a 33.61% of priority rate under learning and management category. It was also found to be a major factor in different previous works by different researchers, elsewhere, (bin Mamat & bin Mohamad Zin, 2014) stated that efficient implementation of CSLP requires knowledge and experience, availability of too inexperienced staff to coordinate the site work were ranked as the 3rd major problem of site coordination (Andy & Price, 2010). This was also supported by local works in Ethiopia, (Belyu Bogale., 2020) availability of too inexperience staff on site was stated as the second major cause of poor site layout planning. (Michael, 2021) supported that, the absence of experts to prepare a site layout plan was the Challenges of Construction site organization in case of Congested Construction Sites.

Poor Organizational structure of the companies was ranked as the second major barrier with a given rate of 23.77% compared to the other factors. According to (Andy & Price, 2010) Unclear job duties resulted from not well defined duties with in the key staff members of the company ranked to be the first-cause for site coordination problem under the category of management system.

Poor leadership skills of top manager were put third based on the professional's computation result with a 16.52% of priority rate. It was also found to be a major problem for Construction site layout planning in different previous works by different researchers, according to (Andy & Price, 2010) too inexperienced staff to coordinate the technical administration work and ranked as the first-problem for site coordination under the categories of staffing, Also it was confirmed in Ethiopia to be the third-causes of poor site layout planning (Belyu Bogale., 2020).

4.3.2.2 AHP-Data Analysis for Technical Category

Step-1. Sum up the column of Pair-wise comparisons matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.1).

Table 4.8 Pair-Wise Comparisons Matrix - Technical Factors

TI	TI-1	TI-2	TI-3	TI-4	TI-5	TI-6	TI-7	TI-8
TI-1	1	3.3500	3.4900	0.2033	0.2062	3.2400	0.2674	0.3077
TI-2	0.2985	1	3.2100	0.1558	0.1721	0.3333	0.2075	0.2227
TI-3	0.2865	0.3115	1	0.1468	0.1631	0.3333	0.1923	0.2381
TI-4	4.9200	6.4200	6.8100	1	3.2300	4.2100	3.4100	3.5100
TI-5	4.8500	5.8100	6.1300	0.3096	1	3.8100	3.2000	3.3100
TI-6	0.3086	3.0000	3.0000	0.2375	0.2625	1	0.2890	0.2959
TI-7	3.7400	4.8200	5.2000	0.2933	0.3125	3.4600	1	3.2300
TI-8	3.2500	4.4900	4.2000	0.2849	0.3021	3.3800	0.3096	1
sum	18.6537	29.2015	33.0400	2.6311	5.6485	19.7667	8.8758	12.1144

Step 2. Normalize the comparison. as it was presented in chapter 3 (refer section 3.8.1, equation 3.2).

Table 4.9 Normalized Pairwise Matrix and Weighted Matrix - Technical Factors

TI	TI-1	TI-2	TI-3	TI-4	TI-5	TI-6	TI-7	TI-8	SUM	criteria weight (CW)	criteria weight (%CW)
TI-1	0.0536	0.1147	0.1056	0.0772	0.0365	0.1639	0.0301	0.0254	0.6071	0.0759	7.5893
TI-2	0.0160	0.0342	0.0972	0.0592	0.0305	0.0169	0.0234	0.0184	0.2957	0.0370	3.6962
TI-3	0.0154	0.0107	0.0303	0.0558	0.0289	0.0169	0.0217	0.0197	0.1992	0.0249	2.4896
TI-4	0.2638	0.2199	0.2061	0.3801	0.5718	0.2130	0.3842	0.2897	2.5285	0.3161	31.6066
TI-5	0.2600	0.1990	0.1855	0.1177	0.1770	0.1927	0.3605	0.2732	1.7657	0.2207	22.0714
TI-6	0.0165	0.1027	0.0908	0.0903	0.0465	0.0506	0.0326	0.0244	0.4544	0.0568	5.6800
TI-7	0.2005	0.1651	0.1574	0.1115	0.0553	0.1750	0.1127	0.2666	1.2441	0.1555	15.5507
TI-8	0.1742	0.1538	0.1271	0.1083	0.0535	0.1710	0.0349	0.0825	0.9053	0.1132	11.3162
	1	1	1	1	1	1	1	1	sum	1	100
										n=	8

Step 3. Consistency calculation. as it was presented in chapter 3 (refer section 3.8.1)

Table 4.10 Consistency Calculation Ratio Calculation - Technical Factors

TI	TI-1	TI-2	TI-3	TI-4	TI-5	TI-6	TI-7	TI-8	weighted sum value sum (wsv)	criteria weighted (CW)	WSV/ CW
TI-1	0.0759	0.1238	0.0869	0.0642	0.0455	0.1840	0.0416	0.0348	0.6568	0.0759	8.6540
TI-2	0.0227	0.0370	0.0799	0.0492	0.0380	0.0189	0.0323	0.0252	0.3032	0.0370	8.2017
TI-3	0.0217	0.0115	0.0249	0.0464	0.0360	0.0189	0.0299	0.0269	0.2164	0.0249	8.6903
TI-4	0.3734	0.2373	0.1695	0.3161	0.7129	0.2391	0.5303	0.3972	2.9758	0.3161	9.4151
TI-5	0.3681	0.2147	0.1526	0.0979	0.2207	0.2164	0.4976	0.3746	2.1426	0.2207	9.7076
TI-6	0.0234	0.1109	0.0747	0.0751	0.0579	0.0568	0.0449	0.0335	0.4772	0.0568	8.4019
TI-7	0.2838	0.1782	0.1295	0.0927	0.0690	0.1965	0.1555	0.3655	1.4707	0.1555	9.4572
TI-8	0.2467	0.1660	0.1046	0.0900	0.0667	0.1920	0.0481	0.1132	1.0272	0.1132	9.0772
										sum	71.6052

Step 2: λ max is calculated by using the equation presented in chapter 3 (refer section 3.8.1, equation 3.5).

$$\lambda\, max = \left(\frac{71.6052}{8}\right) = 8.9507 \qquad when, \sum\left(\frac{\mathrm{WSV}}{\mathrm{CW}}\right) = \ 71.6052\ \&\ \ \mathrm{n} = 8$$

After λ max was calculated, the Consistency index CI was generated by applying the equation presented in chapter 3 (refer section 3.8.1, equation 3.6)

$$CI = \frac{8.9507 - 8}{8 - 1} = \ 0.1358$$

After consistency index was calculated, calculation for consistency ratio was followed by taking the equation presented in chapter 3 (refer section 3.8.1, equation 3.7).

$$CR = \frac{0.1358}{1.40} = 0.0970 = OK! \qquad for\ n\ =\ 8\ use\ the\ RI\ values\ of\ 1.40$$

consistency ratio of 0.0970 was found, which is acceptable as it is less than 0.10. Based on this, table 4.28 blow presents that, the eight barriers for the implementations of construction site layout planning which were compared with each other under the technical category and their rating accordingly.

Table 4.11 Criteria Weight - Technical Factors

Technical factors	TI	criteria weighted (CW)	Rank
Location of the site (down towns, confined areas urban)	TI-4	31.61	1
improper utilization of Available Site Space	TI-5	22.07	2
improper identification and determining the size of facilities	TI-7	15.55	3
Poor positioning and locating of the temporary facility	TI-8	11.32	4
insufficient technical support from the head office	TI-1	7.59	5
Available construction site boundaries and adjacent areas (Existing trees, buildings, and foundations)	TI-6	5.68	6
Poor identification and selection of contactor and subcontractors	TI-2	3.70	7
Contract condition (special agreement issues, if needed)	TI-3	2.49	8

Based on the expert's computation result: Location of the site, improper utilization of Available Site Space and, improper identifying the type & determining the size of facilities in order was ranked as the top three barriers for the implementation of construction site layout planning respectively under the technical category.

Location of the site was found to be the most dominant barrier for the implementation of CSLP with a 31.61% of priority rate under technical category. It was also Stated in different pervious words, the location where the project found has an impact on the site layout planning, project located in uninhabited regions or in place where skilled labour is scared requires additional facilities for eating and living. also project located far from industrial centers, requires long term storage area (Emad Elbeltagi., 2008). availability of working space in construction projects are highly affected by the location of the site. this is supported by Local works in Ethiopia, Location of the sites was stated as the second significant factor which is accountable for congestion on site (Michael, 2021). However, in (Belyu Bogale., 2020) work location of sites were stated as has a least effect on the implementation of CSLP, as Michael discussed, this controversy occurred due to the reason that, the main focus of the study by Belyu was on public building projects, most of which are located out of urban settings restriction.

improper utilization of Available Site Space was ranked as the second major barrier with a rate of 22.07% compared with other barriers under this category. the construction site space is a significant resource that has influences on another resource like time, money, material, labor and equipment (Belyu Bogale., 2020). If it is not managed efficiently it will result insufficient space on the construction site. planning a construction site layout depends on the available site apace (AbdulAzeez et al., 2016).

improper identification of the type & determining the size of facilities was ranked as the third barrier with a rate of 15.55% compared to the other factors under the category. identifying the site facilities that will be required and determining their size and other constraints of those facilities is the fist key steps during site layout planning processes. But also it is a very difficult task during site organization or site layout planning, which requires consideration of project condition and local regulations (AbdulAzeez et al., 2016; Elbeltagi et al., 2004).

4.3.3 AHP-Data Analysis of Successes Factors for Construction Site Layout Planning

4.3.3.1 AHP- Data Analysis for The Main Three Categories

After obtaining the average pairwise judgments of participants on the importance of main three categories of site layout performance indicators, the next step was computation of a vector of priorities or weighting of elements in the matrix.

Step-1. Sum up the column of Pair-wise comparisons matrix

Insert the average score values of responses given by respondents to the Pair-wise comparisons matrix. and find out the total sum of each column of Pair-wise comparisons matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.1). this is illustrated by taking the first and the second column of Pair-wise comparisons matrix as example;

Column- 1: (1 + 0.2268 + 0.3125 = 1.5393), Likewise, all the columns were calculated and added to arrive at the total sum.

Table 4.12 Pair-Wise Comparisons Matrix Three Main Indicator Categories

CSLPi	SLE	MMI	SMI
SLE	1	4.4100	3.2000
MMI	0.2268	1	0.3125
SMI	0.3125	3.2000	1
sum	1.5393	8.6100	4.5125

Step 2. Normalize the comparison

To normalize each columns of Pair-wise comparisons matrix to a total sum of 1.0 or 100%, each elements of the column was divided by the total sum of respective column. as it was presented in chapter 3 (refer section 3.8.1, equation 3.2).

Table 4.13 Normalized Pairwise Matrix and Weighted Matrix of Three Main Indicator Categories

CSLPt	SLE	MMI	SMI	SUM	criteria weight (CW)	criteria weight (%CW)
SLE	0.6497	0.5122	0.7091	1.8710	0.6237	62.37
MMI	0.1473	0.1161	0.0693	0.3327	0.1109	11.09
SMI	0.2030	0.3717	0.2216	0.7963	0.2654	26.54
	1	1	1	sum	1	100.00
					n=	3

The vertical sum of the normalized column gives result of one. This is illustrated as follow by taking first column; (0.6497 + 0.1473 + 0.2030 = 1).

Step 3. Consistency calculation.

After the normalization takes place, consistency of the data needs to be checked. as it was presented in chapter 3 (refer section 3.8.1, equation 3.3).

Step 1. Multiply each entity of pair-wise comparison matrix with the corresponding criteria weight. this is elaborated by taking first two entities of column one and column two as follow;

to find consistency of column one; elements in the first column of pair-wise comparison matrix were multiplied by the first criteria weight. For instance, the first entity of column one: (1* 0.6237= 0.6237). and to find consistency of column two; elements in the second column of pair-wise comparison matrix were multiplied by the second criteria weight. For instance, the first entity of column one: (4.4100 * 0.1109 = 0.4891), Likewise, all the rest columns in the consistency matrix were calculated.

Step 2. After the entire consistency matrix was calculated and filled, weighted sum value (WSV) generate by applying total horizontal sum of all entities in each row. This is elaborated by taking first rows of consistency matrix.

weighted sum value sum (wsv) = 0.6237 + 0.4891 + 0.8494 = 1.9621 and the ratio of WSV/CW = 1.9621 / 0.6237 = 3.1461.

`Table 4.14 Consistency Calculation of Three Main Indicator Categories

CSLPt	SLE	MMI	SMI	weighted sum value sum (wsv)	criteria weighted (CW)	WSV/CW
SLE	0.6237	0.4891	0.8494	1.9621	0.6237	3.1461
MMI	0.1414	0.1109	0.0829	0.3353	0.1109	3.0231
SMI	0.1949	0.3549	0.2654	0.8152	0.2654	3.0713
					sum	9.2405

Step 3: λ max was calculated by using the following equation. as it was presented in chapter 3 (refer section 3.8.1, equation 3.5)

$$\lambda\, max = \left(\frac{9.2405}{3}\right) = 3.0802 \qquad when, \sum\left(\frac{\mathrm{WSV}}{\mathrm{CW}}\right) = 9.2405 \ \& \ \mathrm{n} = 3$$

After λ max was calculated, the Consistency index CI was generated by applying the equation presented in chapter 3 (refer section 3.8.1, equation 3.6)

$$CI = \frac{3.0802 - 3}{3\ - 1} = 0.0401$$

After consistency index was calculated, calculation for consistency ratio was followed by taking the equation presented in chapter 3 (refer section 3.8.1, equation 3.7).

$$CR = \frac{0.0401}{0.52} = 0.0771 = OK! \qquad for\ n = 3\ use\ the\ RI\ values\ of\ 0.52$$

consistency ratio of 0.0771 was found, which is acceptable as it is less than 0.10. Based on this, table 4.20 below presents that, the main three categories which were compared with each other and their rating accordingly.

Table 4.15 Criteria Weight of Three Main Indicator Categories

construction site layout planning indicators	**CSLPi**	criteria weight (CW)	Rank
Site layout element Indicators	SLE	62.37	1
Safety Management Indicators	SMI	26.54	2
Material Management Indicators	MMI	11.09	3

Based on the expert's computation result: Site layout element Indicators, Safety Management Indicators and, Material Management Indicators in order were ranked as the top three main indicators for the implementation of CSLP when compared with each other with a priority rate of 62.37%, 26.54% and, 11.09% respectively.

4.3.3.2 AHP-Data Analysis for Site Layout Element Category

Step-1. Sum up the column of Pair-wise comparisons matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.1).

Table 4.16 Pair-Wise Comparisons Matrix – Site Layout Element

SLE	SLE-1	SLE-2	SLE-3	SLE-4	SLE-5	SLE-6	SLE-7	SLE-8	SLE-9	SLE-10
SLE-1	1	0.2933	0.2770	0.1976	3.6100	0.2262	0.3125	3.2100	3.3400	0.2941
SLE-2	3.4100	1	0.3125	0.2890	5.6800	0.2933	3.4200	5.2600	5.0800	3.2400
SLE-3	3.6100	3.2000	1	0.2994	6.1420	0.3815	3.8000	6.0160	5.8620	3.6200
SLE-4	5.0600	3.4600	3.3400	1	6.8400	2.8400	4.4200	6.4200	6.2180	4.2000
SLE-5	0.2770	0.1761	0.1628	0.1462	1	0.1502	0.2381	0.3067	0.2933	0.2273
SLE-6	4.4200	3.4100	2.6210	0.3521	6.6600	1	4.6800	6.2890	6.1200	4.3200
SLE-7	3.2000	0.2924	0.2632	0.2262	4.2000	0.2137	1	3.5800	3.4600	0.3086
SLE-8	0.3115	0.1901	0.1662	0.1558	3.2600	0.1590	0.2793	1	0.3546	0.2591
SLE-9	0.2994	0.1969	0.1706	0.1608	3.4100	0.1634	0.2890	2.8200	1	0.2762
SLE-10	3.4000	0.3086	0.2762	0.2381	4.4000	0.2315	3.2400	3.8600	3.6200	1
sum	24.9879	12.5273	8.5895	3.0653	45.2020	5.6587	21.6789	38.7617	35.3479	17.7453

Step 2. Normalize the comparison. as it was presented in chapter 3 (refer section 3.8.1, equation 3.2).

Table 4.17 Normalized Pairwise Matrix and Weighted Matrix – Site Layout Element

SLE	SE-1	SE-2	SE-3	SE-4	SE-5	SE-6	SE-7	SE-8	SE-9	SE-10	SUM	criteria weight (CW)	criteria weight (%CW)
SE-1	0.0400	0.0234	0.0322	0.0645	0.0799	0.0400	0.0144	0.0828	0.0945	0.0166	0.4883	0.0488	4.8829
SE-2	0.1365	0.0798	0.0364	0.0943	0.1257	0.0518	0.1578	0.1357	0.1437	0.1826	1.1442	0.1144	11.4420
SE-3	0.1445	0.2554	0.1164	0.0977	0.1359	0.0674	0.1753	0.1552	0.1658	0.2040	1.5176	0.1518	15.1763
SE-4	0.2025	0.2762	0.3888	0.3262	0.1513	0.5019	0.2039	0.1656	0.1759	0.2367	2.6291	0.2629	26.2907
SE-5	0.0111	0.0141	0.0190	0.0477	0.0221	0.0265	0.0110	0.0079	0.0083	0.0128	0.1804	0.0180	1.8045

SE-6	0.1769	0.2722	0.3051	0.1149	0.1473	0.1767	0.2159	0.1622	0.1731	0.2434	1.9879	0.1988	19.8786
SE-7	0.1281	0.0233	0.0306	0.0738	0.0929	0.0378	0.0461	0.0924	0.0979	0.0174	0.6403	0.0640	6.4029
SE-8	0.0125	0.0152	0.0194	0.0508	0.0721	0.0281	0.0129	0.0258	0.0100	0.0146	0.2613	0.0261	2.6134
SE-9	0.0120	0.0157	0.0199	0.0525	0.0754	0.0289	0.0133	0.0728	0.0283	0.0156	0.3343	0.0334	3.3428
SE-10	0.1361	0.0246	0.0322	0.0777	0.0973	0.0409	0.1495	0.0996	0.1024	0.0564	0.8166	0.0817	8.1659
	1	1	1	1	1	1	1	1	1	1	sum	1	100.00
												n=	10

Step 3. Consistency calculation.as it was presented in chapter 3 (refer section 3.8.1)

Table 4.18 Consistency Calculation – Site Layout Element

SLE	SE-1	SE-2	SE-3	SE-4	SE-5	SE-6	SE-7	SE-8	SE-9	SE-10	weighted sum value sum (wsv)	criteria weigh ted (CW)	WSV/CW
SE-1	0.0488	0.0336	0.0420	0.0520	0.0651	0.0450	0.0200	0.0839	0.1116	0.0240	0.5261	0.0488	10.7736
SE-2	0.1665	0.1144	0.0474	0.0760	0.1025	0.0583	0.2190	0.1375	0.1698	0.2646	1.3560	0.1144	11.8507
SE-3	0.1763	0.3661	0.1518	0.0787	0.1108	0.0758	0.2433	0.1572	0.1960	0.2956	1.8517	0.1518	12.2010
SE-4	0.2471	0.3959	0.5069	0.2629	0.1234	0.5646	0.2830	0.1678	0.2079	0.3430	3.1024	0.2629	11.8002
SE-5	0.0135	0.0201	0.0247	0.0384	0.0180	0.0298	0.0152	0.0080	0.0098	0.0186	0.1963	0.0180	10.8803
SE-6	0.2158	0.3902	0.3978	0.0926	0.1202	0.1988	0.2997	0.1644	0.2046	0.3528	2.4367	0.1988	12.2577
SE-7	0.1563	0.0335	0.0399	0.0595	0.0758	0.0425	0.0640	0.0936	0.1157	0.0252	0.7058	0.0640	11.0238
SE-8	0.0152	0.0218	0.0252	0.0410	0.0588	0.0316	0.0179	0.0261	0.0119	0.0212	0.2706	0.0261	10.3543
SE-9	0.0146	0.0225	0.0259	0.0423	0.0615	0.0325	0.0185	0.0737	0.0334	0.0226	0.3475	0.0334	10.3961
SE-10	0.1660	0.0353	0.0419	0.0626	0.0794	0.0460	0.2075	0.1009	0.1210	0.0817	0.9423	0.0817	11.5391
												sum	113.0768

Step 2: λ max is calculated by using the equation presented in chapter 3 (refer section 3.8.1, equation 3.5).

$$\lambda\, max = \left(\frac{113.0768}{10}\right) = 11.3077 \qquad when, \sum\left(\frac{\mathrm{WSV}}{\mathrm{CW}}\right) = 113.0768\ \&\ \mathrm{n} = 10$$

After λ max was calculated, the Consistency index CI was generated by applying the equation presented in chapter 3 (refer section 3.8.1, equation 3.6)

$$CI = \frac{11.3077 - 10}{10 - 1} = 0.1453$$

After consistency index was calculated, calculation for consistency ratio was followed by taking the equation presented in chapter 3 (refer section 3.8.1, equation 3.7).

$$CR = \frac{0.1453}{1.49} = 0.0975 = OK! \qquad for\ n = 10\ use\ the\ RI\ values\ of\ 1.49$$

consistency ratio of 0.0975 was found, which is acceptable as it is less than 0.10. Based on this, table 4.32 blow presents that, the ten indicators which were compared with each other under the site layout elements category and their rating accordingly

Table 4.19 Criteria Weight – Site Layout Element

Site layout element Indicators	**SLE**	criteria weighted (CW)	Rank
Provision of site material storage space/yards (cement, steel)	SLE-4	26.29	1
availability of material damp area (stones, aggregate, sand)	SLE-6	19.88	2
Provision of Processing facilities	SLE-3	15.18	3
Provision of site offices	SLE-2	11.44	4
Provision of security	SLE-10	8.17	5
Availability of utilities on site	SLE-7	6.40	6
Provision of access roads for trucks and lightweight vehicles.	SLE-1	4.88	7
Provision of information signs and signals	SLE-9	3.34	8
Provision of welfare facilities	SLE-8	2.61	9
provision of parking lots	SLE-5	1.80	10

Site layout element Indicators category was ranked as the first out of the three Indicator categories with a 62.37% of priority rate compared with the other three indicator categories, which contains indicators for the implementation of construction site layout planning.

Based on the expert's computation result, Provision of on-site material storage, material damp area, Processing facilities, site offices, and Provision of security were the top three indicators for the implementation of CSLP respectively, under the category of Site layout elements that should be available on the building construction site. (Kim et al., 2021) Conducted a literature review and identify that, Site office, material storage, work area, laydown areas, and gate(security) were the top five most frequently used temporary facilities as CSLP elements on research papers published between 1995 & 2019.

Provision of on-site material storages was found to be the first dominant indicator for the implementation of CSLP with a 26.29% of priority rate under Site layout element category. It was also found to be a major indicator in different previous works by different researchers, elsewhere, Provision of site material storage was the most applicable element in the construction site layout practices (AbdulAzeez et al., 2016) (Small & Baqer, 2016). It is vital to plan and prepare storage locations for materials, which helps in avoiding multiple martial movements (dhanjode, 2010)**.**

material damp area was ranked as the second indicator for the implementation of CSLP with a 19.88% of priority rate, for the implementation of construction site layout planning under the category of Site layout element Indicators.

provision of Processing facilities was ranked as the third indicator for the implementation of CSLP with a 15.18% of priority rate for the implementation of construction site layout planning under the category of Site layout element Indicators.

On the other hand, Provision of information signs and signals, Provision of welfare facilities and, provision of parking lots in order were ranked as the least three indicators for the implementation of CSLP under the category of site layout elements with a priority rate of 3.34%, 2.61% and, 1.80% respectively. this result indicates that the awareness for the Provisions of those elements on the construction sites were poor in hawassa context, this also supported by different previous works by different researchers, elsewhere, (Salih et al., 2019) revealed that by conducting the performance evaluations on construction sites, the provision and the presence of water supply & sanitation, Information signs and, site map were very poor on the sites. Therefore, need to give special attention.

4.3.3.3 AHP-Data Analysis for Material Management Category

Step-1. Sum up the column of Pair-wise comparisons matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.1).

Table 4.20 Pair-Wise Comparisons Matrix – Material Management

MMI	MM-1	MM-2	MM-3	MM-4	MM-5	MM-6
MM-1	1	0.1508	0.1589	0.3088	0.2909	0.2253
MM-2	6.6300	1	2.8211	4.0100	3.6500	3.2600
MM-3	6.2930	0.3545	1	5.4300	3.6800	3.4300
MM-4	3.2380	0.2494	0.1842	1	0.3115	0.2933
MM-5	3.4380	0.2740	0.2717	3.2100	1	0.3333
MM-6	4.4380	0.3067	0.2915	3.4100	3.0000	1
sum	25.0370	2.3354	4.7275	17.3688	11.9324	8.5419

Step 2. Normalize the comparison. as it was presented in chapter 3 (refer section 3.8.1, equation 3.2).

Table 4.21 Normalized Pairwise Matrix and Weighted Matrix – Material Management

MMI	MM-1	MM-2	MM-3	MM-4	MM-5	MM-6	SUM	criteria weight (CW)	criteria weight (%CW)
MM-1	0.0399	0.0646	0.0336	0.0178	0.0244	0.0264	0.2067	0.0344	3.4446
MM-2	0.2648	0.4282	0.5967	0.2309	0.3059	0.3816	2.2082	0.3680	36.8027
MM-3	0.2513	0.1518	0.2115	0.3126	0.3084	0.4015	1.6372	0.2729	27.2874
MM-4	0.1293	0.1068	0.0390	0.0576	0.0261	0.0343	0.3931	0.0655	6.5513
MM-5	0.1373	0.1173	0.0575	0.1848	0.0838	0.0390	0.6198	0.1033	10.3292
MM-6	0.1773	0.1313	0.0617	0.1963	0.2514	0.1171	0.9351	0.1558	15.5848
	1	1	1	1	1	1	sum	1	100
								n=	6

Step 3. Consistency calculation. as it was presented in chapter 3 (refer section 3.8.1)

Table 4.22 Consistency Calculation – Material Management

MMI	MMI-1	MMI-2	MMI-3	MMI-4	MMI-5	MMI-6	Weighted sum value sum (wsv)	criteria weighted (CW)	WSV/CW
MMI-1	0.0344	0.0555	0.0434	0.0202	0.0300	0.0351	0.2187	0.0344	6.3494
MMI-2	0.2284	0.3680	0.7698	0.2627	0.3770	0.5081	2.5140	0.3680	6.8310
MMI-3	0.2168	0.1305	0.2729	0.3557	0.3801	0.5346	1.8905	0.2729	6.9281
MMI-4	0.1115	0.0918	0.0503	0.0655	0.0322	0.0457	0.3970	0.0655	6.0592
MMI-5	0.1184	0.1008	0.0742	0.2103	0.1033	0.0519	0.6589	0.1033	6.3794
MMI-6	0.1529	0.1129	0.0796	0.2234	0.3099	0.1558	1.0344	0.1558	6.6375
								sum	39.1847

Step 2: λ max is calculated by using the equation presented in chapter 3 (refer section 3.8.1, equation 3.5).

$$\lambda\, max = \left(\frac{39.1847}{6}\right) = 6.5308 \qquad when, \sum\left(\frac{\mathrm{WSV}}{\mathrm{CW}}\right) = 39.1847 \;\&\; \mathrm{n} = 6$$

After λ max was calculated, the Consistency index CI was generated by applying the equation presented in chapter 3 (refer section 3.8.1, equation 3.6)

$$CI = \frac{6.5308 - 6}{6 - 1} = 0.1062$$

After consistency index was calculated, calculation for consistency ratio was followed by taking the equation presented in chapter 3 (refer section 3.8.1, equation 3.7).

$$CR = \frac{0.1062}{1.25} = 0.0849 = OK! \qquad for\ n = 6\ use\ the\ RI\ values\ of\ 1.25$$

consistency ratio of 0.0849 was found, which is acceptable as it is less than 0.10. Based on this, table 4.36 blow presents that, the six indicators which were compared with each other under the material management category and their rating accordingly.

Table 4.23 Criteria Weight – Material Management

Material Management Indicators	MMI	criteria weighted (CW)	Rank
Provision of adequate material storage facilities	MM-2	36.80	1
Deliver required quantity of material based on schedule & specification	MM-3	27.29	2
provision of appropriate location for material storage	MM-6	15.58	3
availability of waste storage on the construction site	MM-5	10.33	4
material management awareness	MM-4	6.55	5
Properly use of Materials	MM-1	3.44	6

Material Management Indicators category was ranked as the third major category with a 11.09% of priority rate compared with the other three main categories which contains indicators for the implementation of construction site layout planning.

Based on the expert's computation result: provision of adequate material storage facilities, Deliver required quantity of material based on schedule & specification and, provision of appropriate location for material storage in order was ranked as the top three indicators for the implementation of construction site layout planning respectively under the category of Material Management.

Provision of adequate material storage facilities was found to be the most dominant indicator for the implementation of CSLP with a 36.80% of priority rate under Material Management category. It was also found to be a major indicator in different previous works by different researchers, elsewhere, (Arijeloye & Akinradewo, 2016; Oseghale et al., 2021) were stated that insufficient storage spaces on site were mostly affects the material management practice. Also this is supported by local works in Ethiopia, (Zewdu, 2019) confirmed that, Insufficient storage space was the second key problem related with storage of material.

Deliver required quantity of material based on schedule & specification was ranked as the second with a rate of 27.29% compared to the other factors. Also this is supported by different previous works related to material management, According to (Oseghale et al., 2021) Material not delivered as per schedules was ranked as third major factor that affecting material management practice. And also overstocking of materials on sites were ranked as the sixth major material management related factor that influence cost overrun in building construction projects. Also this is confirmed to Ethiopia by local works, (Zewdu, 2019) stated that late delivery of ordered material was ranked as the second key problem related with material procurement. (Tafesse, 2021) confirmed that, Deliver required quantity of material based on schedule used as a technique to minimize the wastes generated on the construction sites.

provision of appropriate location for material storage was ranked as third based on the computation result of professional’s response with a 15.58% of priority rate. It was also supported by different previous works of different researchers, elsewhere, (dhanjode, 2010) stated that, material stacks wrongly located and inadequate material storages is the main problem that occurs due to the absence of efficient site layout planning. also (Arijeloye & Akinradewo, 2016; Osmani et al., 2008) supported that, Improper material storing, location of material far away from the point of application were causes for the construction waste. This is also supported by local workers in Ethiopia, inappropriate storage of material was a key problem related with material management (Zewdu, 2019).

4.3.3.4 AHP-Data Analysis for Safety Management Category

Step-1. Sum up the column of Pair-wise comparisons matrix. as it was presented in chapter 3 (refer section 3.8.1, equation 3.1).

Table 4.24 Pair-Wise Comparisons Matrix - Safety Management

SMI	SMI-1	SMI-2	SMI-3	SMI-4	SMI-5	SMI-6	SMI-7	SMI-8
SMI-1	1	6.2320	2.8210	3.4310	4.2200	7.4200	7.0840	6.6200
SMI-2	0.1605	1	0.2941	0.2762	0.2924	3.2400	3.2300	2.8220
SMI-3	0.3545	3.4000	1	3.2000	3.6300	7.9820	6.6200	3.5230
SMI-4	0.3584	3.6210	0.3125	1	3.2462	5.6420	3.2400	3.4200
SMI-5	0.2370	3.4200	0.2755	0.3081	1	5.6720	3.4610	3.3210
SMI-6	0.1348	0.3086	0.1253	0.1772	0.1763	1	0.2924	0.2762
SMI-7	0.1412	0.3096	0.1511	0.3086	0.2889	3.4200	1	0.3269
SMI-8	0.1511	0.3544	0.2838	0.2924	0.3011	3.6200	3.0590	1
Sum	2.5373	18.6456	5.2633	8.9935	13.1550	37.9960	27.9864	21.3091

Step 2. Normalize the comparison. as it was presented in chapter 3 (refer section 3.8.1, equation 3.2).

Table 4.25 Normalized Pairwise Matrix and Weighted Matrix - Safety Management

SMI	SMI-1	SMI-2	SMI-3	SMI-4	SMI-5	SMI-6	SMI-7	SMI-8	SUM	criteria weight (CW)	criteria weight (%CW)
SMI-1	0.3941	0.3342	0.5360	0.3815	0.3208	0.1953	0.2531	0.3107	2.7257	0.3407	34.0711
SMI-2	0.0632	0.0536	0.0559	0.0307	0.0222	0.0853	0.1154	0.1324	0.5588	0.0699	6.9851
SMI-3	0.1397	0.1823	0.1900	0.3558	0.2759	0.2101	0.2365	0.1653	1.7558	0.2195	21.9469
SMI-4	0.1413	0.1942	0.0594	0.1112	0.2468	0.1485	0.1158	0.1605	1.1775	0.1472	14.7193
SMI-5	0.0934	0.1834	0.0523	0.0343	0.0760	0.1493	0.1237	0.1558	0.8682	0.1085	10.8527
SMI-6	0.0531	0.0166	0.0238	0.0197	0.0134	0.0263	0.0104	0.0130	0.1763	0.0220	2.2039
SMI-7	0.0556	0.0166	0.0287	0.0343	0.0220	0.0900	0.0357	0.0153	0.2983	0.0373	3.7288
SMI-8	0.0595	0.0190	0.0539	0.0325	0.0229	0.0953	0.1093	0.0469	0.4394	0.0549	5.4922
	1	1	1	1	1	1	1	1	sum	1	100
									n=	8	

Step 3. Consistency calculation. as it was presented in chapter 3 (refer section 3.8.1)

Table 4.26 Consistency Calculation - Safety Management

SMI	SMI-1	SMI-2	SMI-3	SMI-4	SMI-5	SMI-6	SMI-7	SMI-8	weighted sum value sum (wsv)	criteria weigh ted (CW)	WSV/ CW
SMI-1	0.3407	0.4353	0.6191	0.5050	0.4580	0.1635	0.2641	0.3636	3.1494	0.3407	9.2436
SMI-2	0.0547	0.0699	0.0645	0.0406	0.0317	0.0714	0.1204	0.1550	0.6083	0.0699	8.7084
SMI-3	0.1208	0.2375	0.2195	0.4710	0.3940	0.1759	0.2468	0.1935	2.0590	0.2195	9.3816
SMI-4	0.1221	0.2529	0.0686	0.1472	0.3523	0.1243	0.1208	0.1878	1.3761	0.1472	9.3490
SMI-5	0.0807	0.2389	0.0605	0.0453	0.1085	0.1250	0.1291	0.1824	0.9704	0.1085	8.9416
SMI-6	0.0459	0.0216	0.0275	0.0261	0.0191	0.0220	0.0109	0.0152	0.1883	0.0220	8.5444
SMI-7	0.0481	0.0216	0.0332	0.0454	0.0314	0.0754	0.0373	0.0180	0.3103	0.0373	8.3211
SMI-8	0.0515	0.0248	0.0623	0.0430	0.0327	0.0798	0.1141	0.0549	0.4630	0.0549	8.4301
										sum	70.9199

Step 2: λ max is calculated by using the equation presented in chapter 3 (refer section 3.8.1, equation 3.5).

$$\lambda\, max = \left(\frac{70.9199}{8}\right) = 8.8650 \qquad when, \sum\left(\frac{\text{WSV}}{\text{CW}}\right) = 70.9199\ \&\ \text{n} = 8$$

After λ max was calculated, the Consistency index CI was generated by applying the equation presented in chapter 3 (refer section 3.8.1, equation 3.6)

$$CI = \frac{8.8650 - 8}{8 - 1} = 0.1236$$

After consistency index was calculated, calculation for consistency ratio was followed by taking the equation presented in chapter 3 (refer section 3.8.1, equation 3.7).

$$CR = \frac{0.1236}{1.40} = 0.0883 = OK! \qquad for\ n = 8\ use\ the\ RI\ values\ of\ 1.40$$

consistency ratio of 0.0883 was found, which is acceptable as it is less than 0.10. Based on this, table 4.40 blow presents that, the eight indicators which were compared with each other under the safety management category and their rating accordingly.

Table 4.27 Criteria Weight - Safety Management

Safety Management Indicators	SMI	criteria weighted (CW)	Rank
Provide sufficient budget for safety management	SMI-1	34.07	1
Provision of safety equipment	SMI-3	21.95	2
on site Availability of safety Officer (safety supervisor)	SMI-4	14.72	3
Provision of first aid centers for worker's emergency responses	SMI-5	10.85	4
sufficient emergency plan and procedures	SMI-2	6.99	5
provision of safety rule and regulation	SMI-8	5.49	6
provision of safety training	SMI-7	3.73	7
Safety awareness of the company top managers	SMI-6	2.20	8

Safety Management Indicator category was ranked as the second major category with a 26.54% of priority rate compared with the other three main categories which contains indicators for the implementation of construction site layout planning.

Based on the expert's computation result: Provide sufficient budget for safety management, Provision of safety equipments and, on site Availability of safety Officer or safety supervisor was ranked as the top three indicators for the implementation of construction site layout planning respectively under the category of Safety Management.

Provide sufficient budget for safety management was found to be the fires most dominant indicator for the implementation of CSLP with a 34.07% of priority rate under Safety Management category. It was also found to be a major indicator in different previous works by different researchers, elsewhere, according to (Buniya et al., 2021) insufficient resources (i.e. budget, personnel, tools & others) were stated as a major barrier for the implementation of safety program which leads to a low commitment to organizational safety and health by the management staff. (Mohammadfam et al., 2016) indicated that allocation of financial resources were the most influential factors to be considered to improve organizational health and safety.

Provision of safety equipments was also ranked as the second indicator with a 21.95% of priority rate compared with the other factors. It was also found to be a major indicator in different previous works by different researchers, elsewhere, (Yap & Lee, 2020) personal protective equipment (PPE) was ranked as the first leading factor that affect safety performance. Also (Wang et al., 2016) confirmed that provision of safety protection equipment was the second critical factors that affects workers' safety risk tolerance. Likewise (Nawi et al., 2016) also stated that PPE as a crucial factor influencing safety performance in a construction site. (Mustapha, 2019) recommended that, provision of sufficient PPE was required to improve construction site safety performance.

on site Availability of safety Officer or safety supervisor was ranked as the third indicator with a 14.72% of priority rate under the category of safety management for the implementation of CSLP. It was also supported by different pervious works related with safety management: According to (Nawi et al., 2016) absence of safety & health committees and, failed to nominate safety officer in order were the first two leading factors that affecting safety performance. also studies in Ethiopia showed that, lack of safety professionals assigned on the construction site was ranked as the second major factor that has an impact on the Labour performance (Birhanu, 2019).

After weighting and prioritizing the variables/performance indicators for the implementations of construction site layout planning under objectives two, the study provides a check list which is used as a performance evaluation tool for the implementation of construction site layout planning practice, as an objective three. and also conducted a case study analysis for the performance evaluations of building project sites in hawassa city based on the developed checklists.

4.4 Checklist Development for The Implementation of CSLP

The checklist was developed by using the criteria weights as an inputs, which was generated during prioritizations of success factors on the specific objective two. The checklist contains; indicators of construction site layout planning, percentage contributions of indicators by weights (criteria weight of indicators), Likert scale evaluation scoring section, calculation section for Result of each Indicators, Total result of Indicators, Total Result of the category and, Total performance of the site, see the sample checklist which was presented on (Appendix IV). each section of the check list and also how to conduct calculation of the section discussed below.

Likert scale Evaluation Scoring section: column which is filled by the score point value which is given by the experts during performance evaluations of the sites. the scoring process conducted by using 7- point Likert scaling tools (1 for Very poor, 2 for poor, 3 for Fair, 4 for Good, 5 for Very Good, 6 for Excellent, 7 for Outstanding) which is easy to use during evaluation,

Criteria weight of indicators [CW_I]: the criteria weights of each variable/indicators from each category was generate from AHP- Data analysis, Normalization section. This indicates that the percentage contributions of indicators for the category. The total sum of indicators contribution was gives us the total performance of the category.

Result of Indicators [RI]: which show that the contributions of the indicators to the category. It is calculated by multiplying the evaluation score which is given by the expert by the criteria weights of the indicators.

$$\text{Result of Indicators } [\text{RI} = [\text{Es}] \, * \, [\text{CWI}]$$

Total result of Indicators [TRI]: the total sum of all indicators contribution result to the category, which they were found under.

$$\text{Total result of Indicators [TRI]} = \sum_{n=1}^{n} (\text{RI})$$

Criteria weight of the category [CW_C]: indicates that the total weights of the category which contributes to the main domain or for the assessment tool. Which is directly derived from the eigenvalues/ categories weights, generated during poetization AHP- Data analysis, Normalization section.

Total Result of the category [TR_C]: indicates that, total performance score of the category. Which is calculated by multiplying the total sum of indicators results under the same category with its Criteria weight of the category [CW_C].

$$\text{Total Result of the category [TRC]} = \text{[TRI]} * \text{[CWC]}$$

Total performance of the site [TPs]: indicates that, the total performance of the site, which is generated by calculating a total sum of all categories total Results together such as **(**Category-1 + Category-2 + Category-3).

$$[\text{TPs}] = [\text{TWC} - 1] + [\text{TWC} - 2] + [\text{TWC} - 3]$$

4.4.1 Performance Evaluations Rating System

A 7-point Likert scale is a commonly used rating scale in performance evaluation methods. It allows individuals to provide their subjective opinions or judgments about the performance of a person or entity on a continuum ranging from Very poor - Strongly disagree and outstanding - extremely agree. Here's on table 4.31 a breakdown of how the scale can be interpreted:

Table 4.28 Description of 7-Point Likert Scale Scoring Tool with Response Options

7-point Likert scales	**Description**
Very poor - 1	• This response option indicates a very negative the performance of CSLP. • It is typically used to indicate strong disagreement or a very negative Performance of CSLP. • The Performance is significantly below expectations, lacking in quality, and in need of improvement.

Poor – 2	• This response option indicates a negative view or opinion, but not as strong as "very poor." • It is typically used to indicate disagreement or a negative Performance of CSLP • The performance is below average and falls short of meeting expectations. Improvement is needed in multiple areas to reach satisfactory levels.
Fair - 3	• It is typically used to indicate a moderate or middle ground Performance of CSLP. • The CSLP- Performance meets basic expectations but does not stand out in any significant way. It demonstrates competence but lacks exceptional qualities.
Good - 4	• This response option indicates a positive view or opinion, but not as strong as "very good" or "excellent." • It is typically used to indicate agreement or a positive Performance of CSLP. • The CSLP- Performance is slightly above average or moderate, and exceeds basic expectations. There are some notable strengths, but further development is still needed.
Very good - 5	• This response option indicates a very positive view or opinion, but not as strong as "excellent" or "outstanding." • It is typically used to indicate strong agreement or a very positive Performance of CSLP • The CSLP- Performance is good and generally meets or slightly exceeds expectations.
Excellent - 6	• This response option indicates a very positive view or opinion. • It is typically used to indicate strong agreement or a very positive Performance of CSLP. • The CSLP- Performance is very good and consistently exceeds expectations.
Outstanding- 7	• This response option indicates an extremely positive view or opinion. • It is typically used to indicate the highest level of agreement or a very positive Performance of CSLP. • The CSLP- Performance is exceptional and significantly exceeds expectations.

a 7-point Likert scale is a response options which help to differentiate between respondents who may have similar but slightly different views on a topic. A 7-point scale can also provide more detailed information, which can be useful in situations where a more fine-grained understanding of attitudes or opinions is needed.

Table 4.29 Description of Scales for Performance Evaluation

7-point Likert scale Items	Scale of Performance Evaluation out of 7- point	
	lower limit	upper limit
1 = Very Poor	1.00 - 1.86	
2 = Poor	1.87 - 2.71	
3 = Fair	2.72 - 3.57	
4 = Good	3.58 - 4.43	
5 = Very Good	4.44 - 5.29	
6 = Excellent	5.30 - 6.14	
7 = Outstanding	6.15 - 7.00	

4.4.2 Check List Evaluation and Validation Analysis

the proposed check list was evaluated based on the professional’s responses. respondents were asked to indicate their level of agreement with the findings of the research, the level of agreement of the respondents during check list evaluation were presented and discussed on table 4.41 below.

Table 4.30 Summary of Check List Evaluation Analysis Result

No	Questions	Strongly disagree [1]	Disagree [2]	Neutral [3]	Agree [4]	Strongly agree [5]
1	Does the proposed check list is clear and easy to understand			1	3	4
2	Does the variables/ indicators used for the check list was clearly described organized well			1	5	2
3	Does the methodology used to develop the check list was appropriate to achieve the research objectives				5	3
4	the check list contains all the Categories or major issues that should be included as indicators for the implementation of construction site layout planning.		1	1	6	

5	Does the developed check list contain key indicators or variables which are appropriate enough representatives for implementation of site layout planning.			2	4	2
6	Does the prioritization or weight values which is given for the variables or indicators in the check list represents the actual existing problems and helps to mitigate the existing problems in the Hawassa city construction industry.			1	5	2
7	Does the check list is relevant and has contribution for the implementation of construction site layout planning practice in hawassa city?		1	1	5	1
8	Does the developed check list can be workable and applicability in the construction sector?		1	1	5	1

Based on the above table 4.33 the expert's response was discussed as follow: four experts were agreed, in addition to these also four experts were strongly agreed that, the proposed check list was clear and easy to understand. While one expert was disagreed on the with that of check list clarity and understandable.

Two experts were strongly agreed and also five others were supported and agreed to that the check list was described clearly and organized well. while, one expert responded that neutral respond that means nether agreed or disagree.

Five experts were agreed to that, the methodology used to develop the check list was appropriate to achieve the objectives of the study and three expects were also strongly agreed with that appropriate methodologies were used.

six experts agreed that, the check list contains all the Categories and major issues were also included as indicators for the implementation of construction site layout planning. on the other hand, one expert dis-agreed with the content category and with the major issues raised. Only one expert was nether agreed or disagreed on the question.

Four experts were agreed and also two experts strongly agreed that the developed check list contains key indicators or variables which are appropriate representatives for the implementation of site layout planning. on the other hand, two expects responded neutral (i.e. neither agree nor disagree) with the representativeness of variables for site layout planning.

Table 4.33shows that, five experts were agreed and also two experts were strongly agreed that, the indicators or variables used in the proposed check list was representatives of the existing problem in hawassa city and help to mitigation the existing problem. While one expects respond neutral (neither agree nor disagree).

only one expert responded strongly agree and also five experts were agreed on that, the proposed check list is relevant and has its own contribution for the implementation of site layout planning. while one in addition to this one expert were responded neutral (nether agree nor disagree). On the other hand, one expert disagreed with relevance and contributions of the proposed check list.

Five experts were agreed that the proposed check list can be workable and applicable in the construction sector, also one expert was supported this and rated strongly agree. on the other hand, one expert was disagreed on the workable and Applicability. while one expert responds that nether agreed or disagree on its applicability.

As table 4.33 indicated, the overall agreement level of experts on the proposed checklist was almost more than 25% of experts were scored Agree & Strongly agree for the questions raised to validate the checklist.

4.5 Case Study

After developing and validating the performance evaluation checklist for the implementation of construction site layout planning, the developed checklist was applied and used as an assessment tool to evaluate the current performances of building projects in hawassa city as an objective four, this was conducted by selecting four active, ongoing building construction projects in hawassa city as a case study.

Here the section presents an analysis of quantitative data obtained during case study, which was conducted to evaluate the performance of construction projects regarding on the implementation of construction site layout planning.

4.5.1 Backgrounds of the Selected Building Construction Projects

The backgrounds of the selected four active, ongoing building construction projects in hawassa city were presented and discussed in table 4.31 below.

Table 4.31 Case-Study Sites Background Descriptions

No.	Project Name	Total Overall Site Area (m^2)	Total Building Area (m^2)	Total Non-building Area (m^2)	NBCR	Building sites-type
1	Hilton Hawassa Resort Hotel 2B+G+9	80000	28800	51200	0.640	Non-confined
2	B+G+M+8+T Mixed Use Building	6750	2496	4254	0.630	Non-confined
3	Federal Defense Army Dormitory G+9	39006	6025	32981	0.846	Non-confined
4	Affini Sidama Cultural Hall 2B+G+4	30500	3320	27180	0.891	Non-confined

A total of 14 experts were participated during the performance evaluations of building construction project regarding on the implementations of construction site layout planning. During the study three experts participated separately from project one and project three, and Four experts participated separately from project two and project four. Those expects were project managers, site engineers, and office engineers.

an average of all expert's responses in each project was uses as an input score for performance evaluation of individual construction site, this was applied because the evaluation was post-occupancy, which means based on subjective judgment, knowledge and, other subjective perspective of the expert. the participant's responses during the case study and the average performance evaluation responses of experts on each projects were presented on (Appendix VII).

Table 4.32 Average Evaluation Scores for The Projects

Success factors under their categories		**Proj - 1**	**Proj - 2**	**Proj - 3**	**Proj - 4**
No.	**Site layout element category**	**Average response**	**Average response**	**Average response**	**Average response**
1	Provision of site material storage space/yards (cement, steel)	4.00	2.25	4.67	4.50
2	availability of material damp area (stones, aggregate, sand)	4.00	2.75	5.00	4.75

3	Provision of Processing facilities	4.33	2.25	4.00	4.50
4	Provision of site offices	4.67	4.25	3.00	5.00
5	Provision of security	4.67	3.25	4.00	3.25
6	Availability of utilities on site	3.67	3.50	3.00	5.00
7	Provision of access roads for trucks and lightweight vehicles.	4.00	2.50	4.67	5.00
8	Provision of information signs and signals	1.67	3.50	1.00	1.00
9	Provision of welfare facilities	2.67	3.75	2.67	3.75
10	provision of parking lots	2.67	1.75	2.67	4.25
No.	**Material Management category**				
1	provision of sufficient material storage spaces	3.67	1.75	3.67	3.75
2	Deliver required quantity of material based on schedule & specification	3.67	3.25	3.67	4.50
3	provision of appropriate location for material storage	3.00	2.00	4.00	4.25
4	availability of waste storage on the construction site	1.67	1.25	1.00	1.25
5	material management awareness	4.00	2.25	3.67	4.25
6	Properly use of Materials	3.67	2.00	3.00	4.25
No.	**Safety Management category**				
1	Provision of adequate material storage facilities	3.33	4.00	1.33	1.50
2	Provision of safety equipment	3.00	4.25	2.00	2.50
3	on site Availability of safety Officer (safety supervisor)	1.33	5.00	1.00	1.00
4	Provision of first aid centers for worker's emergency responses	3.00	5.00	1.33	1.00
5	sufficient emergency plan and procedures	2.67	4.00	1.67	1.00
6	provision of safety rule and regulation	3.33	4.50	1.67	1.00
7	provision of safety training	2.67	2.75	2.33	1.25
8	Safety awareness of the company top managers	3.33	5.00	2.00	2.25

Performance evaluations of the four projects by using the developed checklist as an assessment tool for the implementation of construction site layout planning was discussed as follow. the analysis was based on the developed checklist.

4.5.2 Case Study Analysis and Discussions

Case Study – 1

Table 4.33 Case Study Analysis of Project – 1

Construction site layout planning performance evaluation checklist				
Project: Hilton Hawassa Resort Hotel 2B+G+9 **Contractor: Sunshine construction plc** **Location: Hawassa** **Site Area: 80000 m2** **Building Coverage Area: 28800 m2** **NBCR: 0.640**				
Site layout element category				
Criteria weight of the category [CW_C] = 62.37%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of site material storage space/yards (cement, steel)	4.00	0.2629	1.0516
2	availability of material damp area (stones, aggregate, sand)	4.00	0.1988	0.7952
3	Provision of Processing facilities	4.33	0.1518	0.6578
4	Provision of site offices	4.67	0.1144	0.5339
5	Provision of security	4.67	0.0817	0.3813
6	Availability of utilities on site	3.67	0.064	0.2347
7	Provision of access roads for trucks and lightweight vehicles.	4.00	0.0488	0.1952
8	Provision of information signs and signals	1.67	0.0334	0.0557
9	Provision of welfare facilities	2.67	0.0261	0.0696
10	provision of parking lots	2.67	0.018	0.0480
			Total Result of Indicators[TR_I] =	**4.0229**
		Criteria weight of the category [CW_C] =	0.62367	
			Total Result of the category [TR_C] = [TR_I] * [CW_C] =	2.5089
Material Management category				
Criteria weight of the category [CW_C] = 11.09%				
No.	Indicators	7- point Likert scale Evaluation	Criteria weights of	Result of Indicators [RI]

		score (Metropolitan Real Estate)	indicators that [CWI]	
1	Provision of adequate material storage facilities	3.67	0.368	1.3493
2	Deliver required quantity of material based on schedule & specification	3.67	0.2729	1.0006
3	provision of appropriate location for material storage	3.00	0.1558	0.4674
4	availability of waste storage on the construction site	1.67	0.1033	0.1722
5	material management awareness	4.00	0.0655	0.2620
6	Properly use of Materials	3.67	0.0344	0.1261
Total Result of Indicators[TR_I] =				**3.3777**
Criteria weight of the category [CW_C] =			0.1109	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.3746
Safety Management category				
Criteria weight of the category [CW_C] = 26.54%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provide sufficient budget for safety management	3.33	0.3407	1.1357
2	Provision of safety equipment	3.00	0.2195	0.6585
3	on site Availability of safety Officer (safety supervisor)	1.33	0.1472	0.1963
4	Provision of first aid centers for worker's emergency responses	3.00	0.1085	0.3255
5	sufficient emergency plan and procedures	2.67	0.0699	0.1864
6	provision of safety rule and regulation	3.33	0.0549	0.1830
7	provision of safety training	2.67	0.0373	0.0995
8	Safety awareness of the company top managers	3.33	0.022	0.0733
Total Result of Indicators[TR_I] =				**2.8581**
Criteria weight of the category [CW_C] =			0.26543	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.7586
Total CSLP performance of the site [TPs] = [TR_{C-1}] + [TR_{C-2}] + [TR_{C-3}] =				**3.6422**
Descriptions of the total CSLP Performance of the Project:				**Good !**

The case study analysis showed that, the total performance evaluation result of project- 1 regarding on the implementation of construction site layout planning was in a good performance, with the total score of 3.6422. when we see each category performance separately;

The total Result of performance Indicators under Site layout elements category was found 4.0229, which indicates that the project performance on this category was good. However, the average response score showed that, Provision of information signs and signals, Provision of welfare facilities and, provision of parking lots was in poor performance.

The total sum of performance Indicators under material management category was scored a result of 3.3777, which indicates fair which means neutral or moderate performance of the project on this category. But the average responses of experts showed that, the availability of waste storage on the construction site was found in very poor performance.

and also the assessment results on Safety Management category showed that, the total result of performance indicators under this category was 2.8581, which indicates the project Performance on regarding on this category was fair which means neutral or moderate. But the average evaluation score values given by the experts on this category indicates that, on site availability of safety officer was in very poor performance and also availability of sufficient emergency plan and procedures and, provision of safety training on the construction site was found in poor performance.

Case Study – 2

Table 4.34 Case Study Analysis of Project – 2

Construction site layout planning performance evaluation checklist				
Project: B+G+M+8+T Mixed Use Building **Contractor: Birhanu Abebe Building Construction** **Location: Hawassa** **Site Area: 6750 m2** **Building Coverage Area: 2496 m2** **NBCR: 0.630**				
Site layout element category				
Criteria weight of the category [CW_C] = 62.37%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]

1	Provision of site material storage space/yards (cement, steel)	2.25	0.2629	0.5915
2	availability of material damp area (stones, aggregate, sand)	2.75	0.1988	0.5467
3	Provision of Processing facilities	2.25	0.1518	0.3416
4	Provision of site offices	4.25	0.1144	0.4862
5	Provision of security	3.25	0.0817	0.2655
6	Availability of utilities on site	3.5	0.064	0.2240
7	Provision of access roads for trucks and lightweight vehicles.	2.5	0.0488	0.1220
8	Provision of information signs and signals	3.5	0.0334	0.1169
9	Provision of welfare facilities	3.75	0.0261	0.0979
10	provision of parking lots	1.75	0.018	0.0315
Total Result of Indicators[TR_I] =				**2.8238**
Criteria weight of the category [CW_C] =			0.62367	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				1.7611
Material Management category				
Criteria weight of the category [CW_C] = 11.09%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of adequate material storage facilities	1.75	0.368	0.6440
2	Deliver required quantity of material based on schedule & specification	3.25	0.2729	0.8869
3	provision of appropriate location for material storage	2.00	0.1558	0.3116
4	availability of waste storage on the construction site	1.25	0.1033	0.1291
5	material management awareness	2.25	0.0655	0.1474
6	Properly use of Materials	2.00	0.0344	0.0688
Total Result of Indicators[TR_I] =				**2.1878**
Criteria weight of the category [CW_C] =			0.1109	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.2426
Safety Management category				
Criteria weight of the category [CW_C] = 26.54%				

No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provide sufficient budget for safety management	4.00	0.3407	1.3628
2	Provision of safety equipment	4.25	0.2195	0.9329
3	on site Availability of safety Officer (safety supervisor)	5.00	0.1472	0.7360
4	Provision of first aid centers for worker's emergency responses	5.00	0.1085	0.5425
5	sufficient emergency plan and procedures	4.00	0.0699	0.2796
6	provision of safety rule and regulation	4.50	0.0549	0.2471
7	provision of safety training	2.75	0.0373	0.1026
8	Safety awareness of the company top managers	5.00	0.022	0.1100
Total Result of Indicators [TR_I] =				**4.3134**
Criteria weight of the category [CW_C] =			0.26543	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				1.1449
Total CSLP performance of the site [TPs] = [TR_{C-1}] + [TR_{C-2}] + [TR_{C-3}] =				**3.1486**
Descriptions of the total CSLP Performance of the Project:				**Fair !**

The case study analysis showed that, the total performance evaluation result of project- 2 regarding on the implementation of construction site layout planning was Fair, with the score rate of 3.1486. this indicates a neutral or moderate performance of the project. Also the performance of the project was also elaborated by taking each category performance separately as follow;

The total Result of performance Indicators under Site layout elements category for this project was found 2.8238, which indicates that the project performance on this category was also fair. also experts average response score showed that, the provision of parking lots was found in vary poor performance, and Provision of site material storage space was found in poor performances. On other the hand, Provision of welfare facilities and site offices were found in good performance

the total sum of performance Indicators under material management category was scored a result of 2.1878, which indicates poor performance of the project on material management category. also expert's response during the case study assessment showed that, the availability of waste storage on the construction site and provision of sufficient material storage spaces were founded in very poor performance. and almost all the rest indicators under this category was founded in poor performance

and also the assessment results on Safety Management category showed that, the total sum results of performance indicators under this category was scored 4.3134, which indicates the project was founded performing in a good way regarding safety management category. Also the expert's response elaborates the condition of the project regarding on safety management as follow; on site Availability of safety Officer (safety supervisor), Provision of first aid centers for worker's emergency responses, provision of safety rule and regulation, and Safety awareness of the company top managers all were founded in very good performances. On the other hand, provision of safety training which was founded in fair performance.

Case Study – 3

Table 4.35 Case Study Analysis of Project – 3

Construction site layout planning performance evaluation checklist				
Project: Federal Defense Army Dormitory G+9 **Contractor: Dessalegn Asrade Construction Company B.C-1** **Location: Hawassa** **Site Area: 39006 m2** **Building Coverage Area: 6025 m2** **NBCR: 0.846**				
Site layout element category				
Criteria weight of the category [CW_C] = 62.37%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of site material storage space/yards (cement, steel)	4.67	0.2629	1.2269
2	availability of material damp area (stones, aggregate, sand)	5.00	0.1988	0.9940
3	Provision of Processing facilities	4.00	0.1518	0.6072
4	Provision of site offices	3.00	0.1144	0.3432
5	Provision of security	4.00	0.0817	0.3268

6	Availability of utilities on site	3.00	0.064	0.1920
7	Provision of access roads for trucks and lightweight vehicles.	4.67	0.0488	0.2277
8	Provision of information signs and signals	1.00	0.0334	0.0334
9	Provision of welfare facilities	2.67	0.0261	0.0696
10	provision of parking lots	2.67	0.018	0.0480
Total Result of Indicators[TR_I] =				**4.0688**
Criteria weight of the category [CW_C] =			0.62367	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				2.538
Material Management category				
Criteria weight of the category [CW_C] = 11.09%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of adequate material storage facilities	3.67	0.368	1.3493
2	Deliver required quantity of material based on schedule & specification	3.67	0.2729	1.0006
3	provision of appropriate location for material storage	4.00	0.1558	0.6232
4	availability of waste storage on the construction site	1.00	0.1033	0.1033
5	material management awareness	3.67	0.0655	0.2402
6	Properly use of Materials	3.00	0.0344	0.1032
Total Result of Indicators[TR_I] =				**3.4198**
Criteria weight of the category [CW_C] =			0.1109	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.379
Safety Management category				
Criteria weight of the category [CW_C] = 26.54%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provide sufficient budget for safety management	1.33	0.3407	0.4543
2	Provision of safety equipment	2.00	0.2195	0.4390

3	on site Availability of safety Officer (safety supervisor)	1.00	0.1472	0.1472
4	Provision of first aid centers for worker's emergency responses	1.33	0.1085	0.1447
5	sufficient emergency plan and procedures	1.67	0.0699	0.1165
6	provision of safety rule and regulation	1.67	0.0549	0.0915
7	provision of safety training	2.33	0.0373	0.0870
8	Safety awareness of the company top managers	2.00	0.022	0.0440
Total Result of Indicators[TR_I] =				**1.5242**
Criteria weight of the category [CW_C] =			0.26543	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.405
Total CSLP performance of the site [TPs] = [TR_{C-1}] + [TR_{C-2}] + [TR_{C-3}] =				**3.321**
Descriptions of the total CSLP Performance of the Project:				**Fair !**

The case study analysis showed that, the total performance evaluation result of project- 3 regarding on the implementation of construction site layout planning was Fair, with the score rate of 3.321 which indicates a neutral or moderate performance of the project. Also the performance of the project was also elaborated by taking each category performance separately as follow;

Indicators under the site layout element category were scored a total result of 4.0688, which indicates that the project regarding on this category was founded in good performance. also the evaluation scores which was given by the experts for the indicators under site layout elements category showed that; provision of information signs and signals was founded in very poor performance. and also provision of welfare facilities and provision of parking lots on the construction site was founded in poor performance.

the total sum of performance Indicators under material management category was scored a total result of 3.4198, which indicates fair performance of the project on material management category. also expert's response during the case study assessment showed that, the availability of waste storage on the construction site was gat evaluation score of very poor in this project.

and also the assessment results on Safety Management category showed that, the total sum results of performance indicators under this category was scored 1.5242, which indicates the project was founded performing very poorly regarding on safety management category. Also the expert's responses were founded below score value of 2, which indicates the project safety management practices was founded in poor and very poor performance.

Case Study – 4

Table 4.36 Case Study Analysis of Project – 4

Construction site layout planning performance evaluation checklist				
Project: Affini Sidama Cultural Hall 2B+G+4 **Contractor: Yirgalem Construction PLC** **Location: Hawassa** **Site Area: 30500 m2** **Building Coverage Area: 3320 m2** **NBCR: 0.891**				
Site layout element category				
Criteria weight of the category [CW$_C$] = 62.37%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of site material storage space/yards (cement, steel)	4.50	0.2629	1.1831
2	availability of material damp area (stones, aggregate, sand)	4.75	0.1988	0.9443
3	Provision of Processing facilities	4.50	0.1518	0.6831
4	Provision of site offices	5.00	0.1144	0.5720
5	Provision of security	3.25	0.0817	0.2655
6	Availability of utilities on site	5.00	0.064	0.3200
7	Provision of access roads for trucks and lightweight vehicles.	5.00	0.0488	0.2440
8	Provision of information signs and signals	1.00	0.0334	0.0334
9	Provision of welfare facilities	3.75	0.0261	0.0979
10	provision of parking lots	4.25	0.018	0.0765
Total Result of Indicators[TR$_I$] =				**4.4198**
Criteria weight of the category [CW$_C$] =			0.62367	
Total Result of the category [TR$_C$] = [TR$_I$] * [CW$_C$] =				2.7565
Material Management category				
Criteria weight of the category [CW$_C$] = 11.09%				

No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of adequate material storage facilities	3.75	0.368	1.3800
2	Deliver required quantity of material based on schedule & specification	4.50	0.2729	1.2281
3	provision of appropriate location for material storage	4.25	0.1558	0.6622
4	availability of waste storage on the construction site	1.25	0.1033	0.1291
5	material management awareness	4.25	0.0655	0.2784
6	Properly use of Materials	4.25	0.0344	0.1462
Total Result of Indicators[TR_I] =				**3.8239**
Criteria weight of the category [CW_C] =			0.1109	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.4241
Safety Management category				
Criteria weight of the category [CW_C] = 26.54%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provide sufficient budget for safety management	1.50	0.3407	0.5111
2	Provision of safety equipment	2.50	0.2195	0.5488
3	on site Availability of safety Officer (safety supervisor)	1.00	0.1472	0.1472
4	Provision of first aid centers for worker's emergency responses	1.00	0.1085	0.1085
5	sufficient emergency plan and procedures	1.00	0.0699	0.0699
6	provision of safety rule and regulation	1.00	0.0549	0.0549
7	provision of safety training	1.25	0.0373	0.0466
8	Safety awareness of the company top managers	2.25	0.022	0.0495
Total Result of Indicators[TR_I] =				**1.5364**
Criteria weight of the category [CW_C] =			0.26543	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				0.4078

Total CSLP performance of the site [TPs] = [TR_{C-1}] + [TR_{C-2}] + [TR_{C-3}] =	**3.5883**
Descriptions of the total CSLP Performance of the Project:	**Good !**

The case study analysis showed that, the total performance evaluation result of project- 3 regarding on the implementation of construction site layout planning was Fair, with the score rate of 3.588, which indicates the project was founded in good performance. the performance of the project was also elaborated by taking each category performance separately as follow;

Indicators under the site layout element category were scored a total result of 4.4198, which indicates that the project regarding on this category was founded in good performance. also the evaluation scores which was given by the experts for the indicators under site layout elements category showed that; the site was almost in good performance under this category. but Provision of information signs and signals on the construction site was founded in very poor performance. also regarding on material management practice the project was almost in good performance. 3.8239 was scored as the computational result of total sum of performance Indicators under material management category, this indicates that the project was founded in a good performance on material management category. But the expert's response during the case study assessment showed that, the availability of waste storage on the construction site was founded in very poor performance in this project. However, the total sum results of performance indicators for this category was 1.5364, which indicates the project was founded in very poor performance regarding on safety management category. Also expert's respond reviled that on site Availability of safety Officer, Provision of first aid centers for worker's, sufficient emergency plan and procedures, provision of safety rule and regulation on this project was founded in very poor performance.

The overall discussion on the case study analysis of the selected four building projects was summarized as follow;

The total indicators result of site layout elements category which obtained from the four projects were discussed by calculation the average performance evaluation scores of the four projects, which is found 3.834 this indicates the performance was found in good. The total indicators result of material management category which obtained from the four projects were discussed by calculation the average performance evaluation scores of the four projects, which is found

3.202 this indicates the performance was found in fair. The total indicators result of safety management category which obtained from the four projects were discussed by calculation the average performance evaluation scores of the four projects which is found 2.56 this indicates the performance was found in poor.

The overall average performances evaluation analysis of the case study was found 3.43, this indicates that the implantation of construction site layout planning was found in fair performance or in moderate performance.

CHAPTER FIVE

5. CONCUSSIONS AND RECOMMENDATIONS

This chapter contains conclusions and recommendations of the study which were achieved based on the objectives of this study, investigates challenges and prioritizes success factors for the implementation of construction site layout planning in Hawassa City building projects.

5.1 Conclusion

Based on the results and findings of the study the following conclusions were drawn.

- Lake of experienced experts on the site, poor organizational structures of the companies and, poor leadership skills of top managers were the top three barriers of for construction site layout planning under leaning and Management category. and also Location of the site, improper utilization of Available Site Space and, improper identification and determining the size of facilities were the top three barriers for the construction site layout planning under the category of technical.
- provisions of site layout elements, Safety Management, and Material Management were in order founded as the main top three Success factors categories for the implementation of construction site layout planning. provision of site material storage space, availability of material damp area, and Provision of Processing facilities on the project site were founded as the top three dominant Success factors under the category of site layout element. Provide sufficient budget for safety management, Provision of safety equipment, and on site availability of safety officer were founded as the top three dominant Success Factors under the Category of Safety Management. And also Provision of adequate material storage facilities, deliver required quantity of material based on schedule & specification, and provision of appropriate location for material storage, were founded as the top three dominant Success factors under the category of material management for the implementation of construction sites layout planning.

5.2 Recommendation

Based on the conclusions presented, the following recommendations were suggested

5.2.1 Recommendation for Construction Stockholders

- Stockholders in the building construction industry (i.e, consultants, contractors, local construction regulatory body) should use this tool as an input to control, monitor, and to improve the implementation of construction site layout planning in the case of hawassa city building construction projects.
- contactors should implement construction site layout planning which can improve labour health and safety management, material management and also need to focused providing appropriate site layout elements.
- Consultants must participate on the implementation of construction site layout planning and need to monitor the performance of the site regarding on construction sites layout planning.
- local construction regulatory body need to give attention to improve the implementation of site layout planning practice in hawassa city building projects. for this, guidelines, rules and regulations should be provided, which enforces stockholders in the construction industry to implement construction site layout planning proper.
- Local construction regulatory office should provide trainings which improves knowledge's and experience of the experts working in the office.

5.2.3 Recommendations for Future Work

- additional works should be conducted to improve construction site layout planning practices; such as; developing a guideline which can improve the practice of construction site layout planning in the case of Ethiopia.
- The assessment of the current performance of building construction projects on the implementation of construction site layout planning should be studied by increasing the sample size of active, ongoing building construction projects in Hawassa City.

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REFERENCE

Abdelrazig, Y. (2015). Dynamic Construction Site Layout Using Ant Colony Optimization. *International Journal of Civil and Environmental Engineering, Vol:9, No:5,, 623.*

Abdul-Rashid, I., Bassioni, H., & Bawazeer, F. (2007). *Factors affecting safety performance in large construction contractors in Egypt.* Paper presented at the Proceedings of 23rd Annual ARCOM Conference.

AbdulAzeez, A., Usman, M., Osuji, E., & Yusuf, Y. (2016). AN ASSESSMENT OF SITE LAYOUT PRACTICES OF CONSTRUCTION PROJECTS IN NIGERIA. *NZAAR SCIENTIFIC COMMITTEE*, 1.

AbdulAzeez. et al., A. U., M Osuji, EC Yusuf,. (2016). An assessment of site layout practices of construction projects in Nigeria. *NZAAR SCIENTIFIC COMMITTEE*, 1.

Abune'Meh, M. (2017). *Construction Site Layout Optimization, Considering Risk of Natural or Technological Hazard Utilizing GIS Optimisation* Université Paris-Est, Retrieved from https://theses.hal.science/tel-01631400 (2017PESC1012)

Adeagbo, D. O., Dakas, A. I. I., & Izam, Y. D. (2019). Safety practices on building construction sites for sustainable development in Nigeria. *Journal of Sustainable Development in Africa, 21*(4), 111-120.

Ajayi, S. O., Oyedele, L. O., Bilal, M., Akinade, O. O., Alaka, H. A., Owolabi, H. A., . . . Recycling. (2015). Waste effectiveness of the construction industry: Understanding the impediments and requisites for improvements. *102*, 101-112.

Akinci et al, B. F., Martin Levitt, Raymond Carlson, Robert,. (2002). Formalization and automation of time-space conflict analysis. *Journal of Computing in Civil Engineering, 16*(2), 124-134.

Albert, I., Shakantu, W., & Ibrahim, S. (2021). The effect of poor materials management in the construction industry: a case study of Abuja, Nigeria. *Acta Structilia, 28*(1), 142-167.

Andy, K., & Price, D. (2010). Causes leading to poor site coordination in building projects. *Organization, technology & management in construction: an international journal, 2*(2), 167-172.

Anna Barton and Stephen Robinson. (2017). Significance of Layout Planning in Site Construction.

Anumba, C., & Bishop, G. J. C. J. o. C. E. (1997). Importance of safety considerations in site layout and organization. *24*(2), 229-236.

Arijeloye, B. T., & Akinradewo, F. O. (2016). Assessment of materials management on building projects in Ondo State, Nigeria. *World Scientific News*(55), 168-185.

Arnaud, K. (2019). *A Factor model to predict the construction labour productivity for building construction: A Case study of Meles Zenawi leadership academy construction project.* Addis Ababa University,

Bansal V.K. (2014). *Identification and resolution of construction space conflicts using Geographic Information Systems*. Paper presented at the Proc. of 7th International Conference on Engineering Mechanics, Structures, and Engineering Geology (EMESEG ‘14), Salerno, Italy.

Belyu Bogale., M. (2020). Investigation on the Current Practice of Local Contractor on Site Layout Planning In Bahir Dar City Public Buildings. *Downloaded from DSpace Repository, DSpace Institution's institutional repository.*

bin Mamat, M. Z., & bin Mohamad Zin, R. (2014). Site Layout Design That Ensures the Efficiency at Construction Site. In: Malaysia.

Birhanu, D. A. (2019). THE IMPACT ASSESSMENT OF CONSTRUCTION SITE ORGANIZATION ON LABOR PERFORMANCE IN PUBLIC BUILDING CONSTRUCTION PROJECTS IN BAHIR DAR. *Downloaded from DSpace Repository, DSpace Institution's institutional repository*. Retrieved from http://hdl.handle.net/123456789/10983

Bruk, S. E. (2019). INVESTIGATING FACTORS AFFECTING THE EFFICIENCY OF CONFINED CONSTRUCTION SITES: THE CASE OF SELECTED SITES IN ADDIS ABABA.

Buniya, M. K., Othman, I., Sunindijo, R. Y., Kineber, A. F., Mussi, E., & Ahmad, H. (2021). Barriers to safety program implementation in the construction industry. *Ain Shams Engineering Journal, 12*(1), 65-72.

Chau KW et al., A., M Zhang, JP. (2004). Four-dimensional visualization of construction scheduling and site utilization. *Journal of construction engineering management*, *130*(4), 598-606.

Cleland, D. I. (2007). *Project management: strategic design and implementation*: McGraw-Hill Education.

Deng, X. e. a., & Hu, Y. D., Yong Mahadevan, Sankaran. (2014). Supplier selection using AHP methodology extended by D numbers. *Expert Systems with Applications, 41*(1), 156-167.

dhanjode, C. (2010). CONSTRUCTION SITE LAYOUT PLANNING. *K.D.K. COLLEGE OF ENGINEEING, NAGPUR*(CONSTRUCTION MANAGEMENT & LAW). Retrieved from https://www.kdkce.edu.in/pdf/Site%20Planning.pdf

El-Rayes, K., & Khalafallah, A. (2005). Trade-off between safety and cost in planning construction site layouts. *Journal of construction engineering and management, 131*(11), 1186-1195.

Elbeltagi, E., Hegazy, T., & Eldosouky, A. (2004). Dynamic layout of construction temporary facilities considering safety. *Journal of construction engineering and management, 130*(4), 534-541.

Elbeltagi et al, E. H., Tarek Eldosouky, Adel. (2004). Dynamic layout of construction temporary facilities considering safety. *Journal of construction engineering and management*, *130*(4), 534-541.

Emad Elbeltagi. (2008). Site Layout Planning.

Ermias Birke. (2019). Construction Material Management Practices and Its impact on Project Delivery: The Case of Public Building Projects in Addis Ababa. *ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY*.

Eze, E., Seghosime, R., Eyong, O., Loya, O. J. T. I. J. o. E., & Science. (2017). Assessment of materials waste in the construction industry: A view of Construction Operatives, Tradesmen and Artisans in Nigeria. *6*(4), 32-47.

Goepel, K. (2013). Implementing the Analytic Hierarchy Process as a Standard Method for Multi-Criteria Decision Making in Corporate Enterprises – a New AHP Excel Template with Multiple Inputs. . *10.13033/isahp.y2013.047.*

Gulghane, A. A. K., P. V. (2015). Management for Construction and Control of Construction Waste in Construction Industry: A Review. . *International Journal of Engineering Research and Application, Vol 5*, 59-64.

Harbour. R. S. (2019). Site layout plan for construction. Brazill.

Harris F. and Mc Caffer, R. (2013). Modern Construction Management, 7th Edition. *John Willey and Sons*, 243-249.

Hassan, S. H., Ahzahar, N., Fauzi, M. A., Eman, J. J. P.-S., & Sciences, B. (2012). Waste management issues in the northern region of Malaysia. *42*, 175-181.

Hawassa city administration, e. p. a. f. d. o. (2019). PROJECT PROPOSAL ON ENVIRONMENTAL PROTECTION and FOREST DEVELOPMENT AROUND HAWASSA CITY AND THE LAKE. Retrieved from http://www.czechaid.cz/wp-content/uploads/2019/04/P%C5%99%C3%ADloha_2_Project-proposal_Cityhall.pdf

He, K.-Y., & Wu, I.-C. (2012). *Dynamic simulation and visualization for site layout planning.* Paper presented at the ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction.

Jaafar, K., Elbarkouky, R., & Kennedy, J. (2021). Construction site layout optimization model considering cost and safety in a dynamic environment. *Asian Journal of Civil Engineering, 22*(2), 297-312.

Joro, A. S. (2015). *A Thesis Submitted to School of Graduate Studies in Partial fulfillment of.* ADDIS ABABA UNIVERSITY,

Jusoh, Z. M., & Kasim, N. (2017). Influential factors affecting materials management in construction projects. *Management and production engineering review, 8*.

Kasim et al, N. L., Aryani Ahmad Fathi, Mohamad Syazli. (2013). RFID Technology for materials management in construction projects–A Review. *International Journal of Construction Engineering and Management, 2*(4A), 7-12.

Khalid, F. J. I. J. M.-K. E. C. J. F. E., & Publications, S. (2017). The impact of poor planning and management on the duration of construction projects: a review. *2*, 161-181.

Kim, M., Ryu, H.-G., & Kim, T. W. (2021). A typology model of temporary facility constraints for automated construction site layout planning. *Applied Sciences, 11*(3), 1027.

Kumar, R. R., & Singh, A. K. (2007). *A CAD-based site layout for irregular facilities using ACO.* Paper presented at the 24th International Symposium l on Automation & Robotics in construction (ISARC 2007), IIT Madras, India.

Kumar, S. S., & Cheng, J. C. (2015). A BIM-based automated site layout planning framework for congested construction sites. *Automation in Construction, 59*, 24-37.

Lin et al., J. J.-C., Chi-En Hung, Wei-Han Kang, Shih-Chung. (2013). Accessibility evaluation system for site layout planning–a tractor trailer example. *Visualization in engineering, 1*(1), 1-11.

Managing health and safety in construction, Construction (Design and Management Regulations 2015, Guidance on Regulations. (2015). Retrieved from https://www.hse.gov.uk/pubns/priced/l153.pdf

Marx et al, A. E., Kai König, Markus. (2010). *Simulation of construction processes considering spatial constraints of crane operations.* Paper presented at the Proceedings of the XIIIth international conference on computing in civil and building engineering.

Metropolitan Real Estate. (2021). Ethiopian Construction Industry – Key Trends And Opportunities To 2025. Retrieved from https://metropolitanaddis.com/2021/07/27/ethiopian-construction-industry-key-trends-and-opportunities-to-2025/#:~:text=The%20Ethiopian%20construction%20industry%20expects%20to%20register%20an,transport%2C%20electricity%2C%20tourism%2C%20manufacturing%2C%20and%20industrial%20park%20projects.

Metropolitan Real Estate. (July 27, 2021). Ethiopian Construction Industry – Key Trends And Opportunities To 2025. Retrieved from https://metropolitanaddis.com/2021/07/27/ethiopian-construction-industry-key-trends-and-opportunities-to-2025/#:~:text=The%20Ethiopian%20construction%20industry%20expects%20to%20register

%20an,transport%2C%20electricity%2C%20tourism%2C%20manufacturing%2C%20and%20industrial%20park%20projects.

Michael, G. N. (2021). INVESTIGATION ON SITE ORGANIZATION PRACTICE IN CONGESTED BUILDING CONSTRUCTION SITES WITHIN BUSINESS DISTRICTS OF BAHIR DAR CITY. *Downloaded from DSpace Repository, DSpace Institution's institutional repository*. Retrieved from http://ir.bdu.edu.et/handle/123456789/12596

Misron et al, N. F. K., Muhamad Azry Hamzah, Noraini. (2019). Index of site congestion for effective material storage at construction site. *International Journal of Engineering and Advanced Technology, 8*(6S3), 1739-1747.

Mohajan, H. K. (2018). Qualitative research methodology in social sciences and related subjects. *Journal of economic development, environment and people, 7*(1), 23-48.

Mohammadfam, I., Kamalinia, M., Momeni, M., Golmohammadi, R., Hamidi, Y., & Soltanian, A. (2016). Developing an integrated decision making approach to assess and promote the effectiveness of occupational health and safety management systems. *Journal of Cleaner Production, 127*, 119-133.

Mohammadi, A., Tavakolan, M., & Khosravi, Y. (2018). Factors influencing safety performance on construction projects: A review. *Safety science, 109*, 382-397.

Mortaheb MM. et al, R., JY Dehghan, R Khoramshahi, F. (2007). *Major factors influencing construction productivity in industrial congested sites.* Paper presented at the Proceedings of the Annual Conference of the Canadian Society for Civil Engineering, Yellowknife.

Muiruri, G., & Mulinge, C. (2014). Health and safety management on construction project sites in Kenya. *A case study of construction projects in Nairobi County, Engaging the challenges–enhancing their relevance*, 16-21.

Mustapha, Z. (2019). Contractor's perception towards safety and its consequences on construction workers in cape coast metropolis. *MOJ Civil Eng, 5*(4), 102-105.

Nawi, M. N. M., Ibrahim, S. H., Affandi, R., Rosli, N. A., & Basri, F. M. (2016). Factor affecting safety performance construction industry. *International Review of Management and Marketing, 6*(8), 280-285.

Ning Xin et al., a. L., Ka-Chi and Lam, Mike. (2011). A decision-making system for construction site layout planning. *Automation in Construction - AUTOM CONSTR, 20*, 459-473. doi:10.1016/j.autcon.2010.11.014

Oseghale, G. E., Adetooto, J. D., & Oseghale, B. (2021). Evaluation of Material Management Methods in Selected Building Construction Sites in Abuja and Lagos State, Nigeria. *American Journal of Mechanical and Materials Engineering, 5*(1), 11-17.

OSHA, U. S., Department of labour, Occupational Safety and Health Administration. (2011). Retrieved from https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.141

Osmani, M., Glass, J., & Price, A. D. (2008). Architects' perspectives on construction waste reduction by design. *Waste management, 28*(7), 1147-1158.

Patel, H., Pitroda, J., & Bhavsar, J. (2015). *Analysis of factors affecting material management and inventory management: Survey of construction firms using Rii method.* Paper presented at the International Conference on Engineering: Issues, opportunities and challenges for development. ISBN: 978-81-929339-1-7 ANALYSIS.

Poon et al, C. S. Y., Ann Tit Wan Wong, Sze Wai Cheung, Esther. (2004). Management of construction waste in public housing projects in Hong Kong. *Construction Management & Economics, 22*(7), 675-689.

Razavialavi, S., Abourizk, S., & Alanjari, P. (2014). *Estimating the size of temporary facilities in construction site layout planning using simulation.* Paper presented at the Construction Research Congress 2014: Construction in a Global Network.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International journal of services sciences, 1*(1), 83-98.

Saaty, T. L., & Sodenkamp, M. (2010). The Analytic Hierarchy and Analytic Network Measurement Processes: The measurement of intangibles: Decision making under benefits, opportunities, costs and risks. In *Handbook of multicriteria analysis* (pp. 91-166): Springer.

Saaty, T. L., & Vargas, L. G. (2012). Models, methods. *Concepts & Applications of the Analytic Hierarchy Process, 14,* 346.

Sadeghpour, F., & Andayesh, M. J. C. j. o. c. e. (2015). The constructs of site layout modeling: an overview. *42*(3), 199-212.

Said, H., & El-Rayes, K. J. A. i. C. (2013). Performance of global optimization models for dynamic site layout planning of construction projects. *36*, 71-78.

Salih, H. M., Oztas, A., Dewary, O., & Ahmed, A. A. (2019). Performance Evaluation of Construction Project in Erbil City by adopting Site Layout planning. *Polytechnic Journal, 9*(2), 76-79.

Sanad Haytham M. et al, A., Mohammad A Ibrahim, Moheeb E. (2008). Optimal construction site layout considering safety and environmental aspects. *Journal of construction engineering and management, 134*(7), 536-544.

Small, E. P., & Baqer, M. (2016). Examination of job-site layout approaches and their impact on construction job-site productivity. *Procedia engineering, 164*, 383-388.

Spillane et al, J. P. F., Michael Oyedele, Lukumon O von Meding, Jason K Konanahalli, Ashwini (2013). *Urban high-density construction sites and their surrounding community: Issues encountered and strategies adopted by contractors.* Paper presented at the Proceedings of the 29th Annual Association of Researchers in Construction Management Conference (ARCOM 2013), Reading, UK.

Sutt, J., Lill, I., & Müürsepp, O. (2013). *The Engineer's Manual of Construction Site Planning*: John Wiley & Sons.

Tafesse, S. (2021). Material waste minimization techniques in building construction projects. *Ethiopian Journal of Science and Technology, 14*(1), 1-19.

Temiz, I., & Calis, G. (2017). Selection of construction equipment by using multi-criteria decision making methods. *Procedia Engineering, 196*, 286-293.

Thomas et al., H. R. R., David R Sinha, Sunil K,. (2006). Fundamental principles for avoiding congested work areas—A case study. *Practice Periodical on Structural Design and Construction, 11*(4), 197-205.

Thomas, H. R., & Ellis Jr, R. D. (2017). *Construction site management and labor productivity improvement: How to improve the bottom line and shorten the project schedule*.

Thomas, H. R., Riley, D. R., Messner, J. I. J. J. o. c. e., & management. (2005). Fundamental principles of site material management. *131*(7), 808-815.

Vaidya, O. S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. *European Journal of operational research, 169*(1), 1-29.

Wang, J., Zou, P. X., & Li, P. P. (2016). Critical factors and paths influencing construction workers' safety risk tolerances. *Accident Analysis & Prevention, 93*, 267-279.

Waris, M., Panigrahi, S., Mengal, A., Soomro, M. I., Mirjat, N. H., Ullah, M., . . . Khan, A. (2019). An application of analytic hierarchy process (AHP) for sustainable procurement of construction equipment: Multicriteria-based decision framework for Malaysia. *Mathematical Problems in Engineering, 2019*, 1-20.

Whitman, J. B. (2014). *Construction site utilization planning best practices.* Auburn University,

Winch, G. M., & North, S. (2006). Critical space analysis. *Journal of construction engineering and management, 132*(5), 473-481.

Wong, J. K., & Li, H. (2008). Application of the analytic hierarchy process (AHP) in multi-criteria analysis of the selection of intelligent building systems. *Building and environment, 43*(1), 108-125.

Work Health and Safety Regulation 2011. (2011).

Wubishet, J. M. (2004). Performance for Public Construction Projects in Developing Countries, Federal Road and Educational Building Projects in Ethiopia. *Norwegian University of Science & Technology, Norway*.

Yap, J. B. H., & Lee, W. K. (2020). Analysing the underlying factors affecting safety performance in building construction. *Production Planning & Control, 31*(13), 1061-1076.

Yimam, A. H. (2011). *Project management maturity in the construction industry of developing countries (the case of Ethiopian contractors)*: University of Maryland, College Park.

Zewdu, N. (2019). *Study On Practice And Challenges Of Material Management In Building Construction Projects Of Hawassa City*.

APPENDIX

Appendix- I: Descriptions of Variables for (Barriers & Success Factors)

(A) Barriers for construction site layout planning		
No	**learning and Managing Indicators category**	**Descriptions**
1.	Poor Leadership skills of top managers	refer to the abilities and qualities that enable them to effectively lead and guide their organizations towards achieving their goals. These skills include (Communication, Ethics and integrity, Decision-making, experience and educated level, Team management, Cooperation and coordination)
2.	Poor organizational structures of the companies/contractors	Organizational structures of the companies/contractors dose the company top positions where organized by having professionals on construction. Does the organizational structure of the company often divided according to function, such as finance, human resources, marketing, and operations.
3.	Lake of experienced experts on the site	the availability of educated and experienced experts on the construction site in Ethiopia can vary depending on the specific project and location. However, there are many highly skilled professionals in the construction industry in Ethiopia, including architects, civil engineers, project managers, site engineer, office engineer and other technical experts like Forman.
4.	Frequent change of personnel	Overall, frequent changes in personnel on construction sites can have a negative impact on site layout planning, potentially leading to reduced efficiency, increased errors, safety concerns, increased costs, and communication issues.
5.	Tight schedule & overlapping activities.	refer to when construction projects are under tight schedules, it can be challenging to manage the overlapping activities that are required to complete the project on time. as a result of this; workers may need to work in close proximity to each other or with heavy equipment, which can affect the flow and organization of the construction site. Also can have negative effects, such as increased risk of errors, safety concerns, and increased costs.
6.	Lack of budget consideration & upon a time relies of budget for CSLP	refers to the situation where the financial constraints or limitations were not taken into account during planning phase and un wiling to upon a time relies on a budget for construction site layout planning.
7.	Poor Stakeholder Involvement.	Participation of all construction parties (e.g., owner, consultant, sub-contractors, main constructor, regulatory body, etc.)
8.	the Absence & poor implementation of common	refers to the lack of established and well-implemented regulations and principles for organizing and arranging construction sites. It implies that there is a lack of universally accepted rules or guidelines to follow when planning the layout of a construction site.

	acceptable standards and guidelines.	
No	**Technical Indicators category**	**Descriptions**
1.	sufficient technical support from the head office	refers to having access to a team or department within the company that can provide expertise, guidance, and assistance on various technical aspects of construction projects. This support may include professionals such as engineers, architects, or specialized technicians and others
2.	Identification and selection of contactor and subcontractors	refer to the process of finding and choosing the right individuals or companies to work on a construction project.
3.	The applied contract condition (special agreement issues, if needed)	refers to a specific requirement or provision included in a contract that governs the rights, obligations, and responsibilities of the parties involved in a construction project. and if there is any special issues on agreement.
4.	Location of the site (down towns, confined areas urban)	refers to the physical positioning or geographical address of a construction project. It is where the actual construction work is taking place (down towns, confined areas urban).
5.	Proper utilization of Available Site Space	refers to maximizing the use of the available land and resources on a construction site. It involves efficient planning, organization, and management of the physical space to ensure optimal productivity and safety.
6.	construction site boundaries and adjacent areas	refer to the defined limits of a construction site and the areas surrounding it. These boundaries are established to ensure safety, security, and regulatory compliance during the construction process (Existing trees, buildings, and foundations).
7.	Proper identification and determining the size of facilities	refers to the process of accurately recognizing and assessing the physical infrastructure requirements for a construction project. This includes identifying the necessary spaces, buildings, and structures needed to carry out the construction activities efficiently.
8.	choosing the position and location of the temporary facility	refers to the process of determining where to set up temporary structures or facilities on a construction site. These temporary facilities can include offices, storage units, break areas, restrooms, and other structures necessary for the construction project.
(B) Success factors for construction site layout planning		
No	**Site layout element Indicators category**	**Descriptions**
1.	Provision of access roads for trucks and lightweight vehicles.	refers to the process of creating temporary roads or pathways that allow vehicles, machinery, and personnel to access the construction site. These roads are typically constructed to provide safe and convenient transportation of construction materials, equipment, and workers to and from the site.

2.	Provision of site offices	refers to the construction and establishment of office spaces or temporary buildings that are specifically designed to accommodate administrative personnel, project managers, engineers, and other staff members involved in the construction project.
3.	Provision of Processing facilities	refers to the setup and availability of various equipment and infrastructure necessary for carrying out specific tasks or processing materials directly at the construction location. (fabrication shops, rebar cutting shops, steel bending yards)
4.	Provision of site material storage space/yards (cement, steel)	refers to the availability and management of designated physical spaces or areas where construction materials are stored on-site during a construction project.
5.	provision of parking lots	refers to the inclusion or allocation of designated parking spaces within construction sites or areas where construction activities are taking place.
6.	availability of material damp area or material lay down area (stones, aggregate, sand)	refers to a designated space or location on a construction site where construction materials and equipment are stored temporarily.
7.	Availability of utilities on site	refers to the presence and accessibility of essential services and infrastructure needed for construction activities. These utilities may include (water supply, electricity, gas, telecommunications, sewerage systems, and other necessary services).
8.	Provision of welfare facilities	refers to the provision of necessary amenities and services to ensure the health, safety, and well-being of workers while they are on construction sites, (sanitary, drinking water, crafts changing room, site toilet).
9.	Provision of information signs and signals	refers to the placement and display of various signs and signals to communicate important information, instructions, and warnings to workers, visitors, and the public (site map, safety rules, traffic regulatory signs)
10.	Provision of security	refers to measures taken to ensure the safety and protection of people, equipment, and property within the construction area (Entrance gate, Fencing the boundary, security checkpoints, Gard house, Lighting)
No	**Material Management Indicators category**	**Descriptions**
1.	Properly use of Materials	refers to Proper utilization of building materials during construction. can compromise structural integrity, safety, and reduce project durability.
2.	Provision of adequate material storage facilities	refers to ensuring the availability of suitable and adequate spaces or infrastructure for storing or keeping items or resources. It involves determining the right amount of storage space required to accommodate materials, considering factors such as quantity, size, and special handling requirements.

3.	Deliver required quantity of material based on schedule & specification	refers to the process of ensuring that the correct amount and type of materials are delivered to a construction site according to an agreed-upon schedule and specific requirements or specifications.
4.	material management awareness	refers to the understanding and implementation of effective practices related to the procurement, storage, transportation, and utilization of materials in construction projects.
5.	availability of waste storage on the construction site	refers to the presence and capacity of designated areas or containers to safely store and manage construction waste.
6.	provision of appropriate location for material storage	refers to identifying and setting up suitable areas to store construction materials on a job site.
No	**Safety Management Indicators category**	**Descriptions**
1.	Provide sufficient budget for safety management	refers to allocating adequate financial resources to ensure effective safety measures
2.	sufficient emergency plan and procedures	refer to a set of guidelines, actions, and precautions put in place to effectively respond to emergency situations during construction activities. (accident record keeping & reporting system, training, instructions, fire prevention & firefighting equipment)
3.	Provision of safety equipment	refers to ensuring that workers have access to and are equipped with appropriate protective gear and tools to minimize the risk of injury or accidents (personal protective equipments (PPE), safety fence line).
4.	on site Availability of safety Officer (safety supervisor)	refers to having a safety professional present at the construction site at all times, to ensure compliance with safety regulations and promote a safe working environment.
5.	Provision of first aid centers for worker's emergency responses	refers to the establishment of designated spaces or areas within construction sites where immediate medical assistance can be provided to workers in case of injuries or emergencies.
6.	Safety awareness of the company top managers	refers to company top managers understanding, knowledge, and commitment to ensuring a safe working environment for the workers and the public.
7.	provision of safety training	refers to the process of educating and equipping workers with the necessary knowledge and skills to identify and mitigate potential hazards or risks in their work environment.
8.	provision of safety rule and regulation	refers to the establishment and enforcement of guidelines and protocols to ensure the safety and well-being of workers, contractors, and the public involved in construction projects, aim to prevent accidents, injuries, and potential hazards that may arise during the construction process.

Appendix- II: Pilot Questionnaire

Pilot Questionnaire

Questionnaire interview on “developing a performance evaluation tool for the implementation of site layout planning”, it is for pilot test of the questionnaire. I would like to request you that if I missed significant factors which can adversely affect construction productivity please put on the prepared blank space at the bottom.

Objectives of the study

- To weight and prioritize barriers for the effective implementation of construction site layout planning practice in the case of Hawassa city.
- To identify success factors that ensure the implementation of construction site layout planning in the Case of Hawassa city.
- To develop a performance evaluation checklist for the effective implementation of construction site layout planning.
- To evaluate the current performances of building construction projects in hawassa city by conducting a case study through the application of the developed checklist.

Dear Sir/Madam

I am currently undertaking masters of science degree in construction engineering and management at Adama ASTU University. In fulfillment of this thesis I am required to research a topic area and produce a thesis. The topic I have chosen is “developing a performance evaluation tool for the implementation of site layout planning in building project in the case of Hawassa city.” And I am investigating the following issues.

All data’s and information are strictly confidential and will not be disclosed. It is only for the purposes of Academicals study only.

Instructions

- Please tick a right sign on the provided place, for the relevance’s or not relevance’s of the variables/ indicators for the implementation of construction site layout planning in the case of Hawassa city.

Section One: Barrier for The Implementation of Construction Site Layout Planning in Building Projects, In Hawassa City.

Categories with their variables/ indicators		Relevant Variables	Not-Relevant Variables
No.	**learning and Managing Indicators**		
1	poor Leadership skills of top managers (experience and educated level, Team management, Cooperation and coordination)		
2	Poor organizational structures of the companies/contractors		
3	Lake of experienced experts on the site (PM, site engineer, Forman)		
4	Preparation/planning of temporary works before the commencement of site works		
5	Frequent change of personnel		
6	Poor understanding of construction site layout		
7	Poor stakeholder Involvement: All parties (e.g., owner, subcontractors, management, etc.)		
8	Absence of common acceptable procedures, standards, and technical guidelines in the context of Ethiopia.		
9	poor implementation and inspection of the available procedures, standards, and technical guidelines.		
Do you consider any other variables under this category to be indicators for the implementations of construction site layout planning? If yes, please mention. And also please mention if there are anycommentsonimprovement.?____			
No.	**Technical Indicators**		
1	distance between different facilities (office, process plants, equipment, and machinery)		
2	insufficient technical support from the head office		
3	Contract condition (special agreement issues, if needed)		
4	availability and movement of construction equipments (Plant, Vehicle, and machinery)		
5	availability and position of equipment (Plant, Vehicle, and machinery)		
6	Location of the site (down towns, confined areas urban)		
7	improper utilization of Available Site Space		

8	Available construction site boundaries and adjacent areas (Existing trees, buildings, and foundations)		
9	poor facility type identification and selection		
10	improper determining the size of the facility		
11	choosing the position and location of the temporary facility		
Do you consider any other variables under this category to be indicators for the implementations of construction site layout planning? If yes, please mention. And also please mention if there are anycommentsonimprovement.?____			

Section Two: Variables/Indicators That Indicates the Implementation of Construction Site Layout Planning in Building Projects.

No.	Site layout element Indicators		
1	Provision of access roads for trucks and lightweight vehicles.		
2	Provision of site offices (clients, contractors, and consultants)		
3	provision of accommodation, rest room		
4	Provision of Processing facilities (rebar cutting shops, steel bending yards, fabrication shops,)		
5	Provision of site material storage space/yards (cement storage, steel storage, casting panels, scaffoldings yards, and other materials)		
6	provision of Cranes, hoisting, lift		
7	provision of parking lots		
8	availability of material damp area (stones, aggregate, sand)		
9	Availability of utilities on site (electricity, water, telecommunication,)		
10	Provision of welfare facilities (sanitary, drinking water, site toilet)		
11	Provision of information signs and signals (site map, safety rules, traffic regulatory signs)		
12	Provision of security office/ security checkpoints		
Do you consider any other variables under this category to be indicators for the implementations of construction site layout planning? If yes, please mention. And also please mention if there are anycommentsonimprovement.?____			

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No.	Material Management Indicators		
1	properly use of Materials		
2	Provision of adequate material storage facilities		
3	Existence of unnecessary materials on site		
4	Deliver required quantity of material based on schedule & specification		
5	material management awareness		
6	Unsuitable materials storage places		
7	availability of waste storage on the construction site		
8	provision of appropriate location for material storage		
9	Lack of material storage & stack place		

Do you consider any other variables under this category to be indicators for the implementations of construction site layout planning? If yes, please mention. And also please mention if there are anycommentsonimprovement.?____
____
____
____
____
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No.	Safety Management Indicators		
1	Provide sufficient budget for safety management		
2	sufficient emergency plan and procedures		
3	Provision of safe and safety equipment (PPE,)		
4	on site Availability of safety Officer (safety supervisor)		
5	Provision of first aid centers for worker's emergency responses		
6	Sufficient safety awareness of top management		
7	provision of safety training		
8	provision of safety rule and regulation		

Do you consider any other variables under this category to be indicators for the implementations of construction site layout planning? If yes, please mention. And also please mention if there are anycommentsonimprovement.?____
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Appendix- III: AHP-Format Questionnaire

Performance Evaluation for The Implementation of Construction Site Layout Planning in The Case of Hawassa City Building Projects

Dear Sir/Madam,

My name is Junedin Yassin, Master of Science degree student at Adama science and technology university (ASTU) on the field of construction engineering and management. for partial fulfillment of my MSc degree, I am currently undertaking a thesis under the title of "performance evaluation for the implementation of Construction Site Layout Planning in the case of hawassa city building projects". the objectives of the study are:

- To weight and prioritize barriers for the effective implementation of construction site layout planning practice in the case of Hawassa city.
- To identify success factors that ensure the implementation of construction site layout planning in the Case of Hawassa city.
- To develop a performance evaluation checklist for the effective implementation of construction site layout planning.
- To evaluate the current performances of building construction projects in hawassa city by conducting a case study through the application of the developed checklist.

This Analytical hierarchy process (AHP) template contains 5 main category tables of site layout planning with acronyms and total 5 AHP format tables for main category tables of construction site layout planning. I need your judgment on the comparison of each item with itself and with others in provided AHP tables. Your comparison review should be based on the operational definition and relevant terminologies of construction site layout planning. Please be as objective and constructive as possible in your comparison and use the following comparing scale:

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate Importance	Experience and judgement moderately favor one activity over another
5	Essential or Strong Importance	Experience and judgement strongly favor one activity over another
7	Very Strong Importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme Importance	An activity is extremely favored and its dominance demonstrated in practice
2,4,6,8	Intermediate values between the two adjacent judgments	
Reciprocals	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.	

Junedin Yassin	**Phone No: +251984785760**
Advisor: Meseret G. Ph.D.	**E-mail: www.judayassin@gmail.com**

Section -1: Background of Expert

1. Sex

☐ Male ☐ Female

2. level of your highest degree

☐ diplomas ☐ Bachelor's ☐ Master's or Professional ☐ Doctorate

3. discipline of your highest degree

☐Architecture ☐Civil Engineering ☐construction management ☐specify Other, ____________________

4. experience years in the building construction industry

☐ 1-3 years ☐ 3-5 years ☐ 5-10 years ☐ >10 years

Section -2: AHP Format Questionnaire

Objective-1. Barrier for The Implementation of Construction Site Layout Planning in Building Projects, In Hawassa City.

Table 1: learning and Managing variables/ Indicators with their acronyms

No.	learning and Managing Indicators	LMI
1	poor Leadership skills of top managers	LMI-1
2	Poor organizational structures of the companies/contractors	LMI-2
3	Lake of experienced experts on the site	LMI-3
4	Frequent change of personnel	LMI-4
5	Tight schedule & overlapping activities.	LMI-5
6	Lack of budget consideration & upon a time relies of budget for CSLP	LMI-6
7	Poor Stakeholder Involvement.	LMI-7
8	the Absence & poor implementation of common acceptable standards and guidelines.	LMI-8

Table 2: AHP format for learning and Managing variables/ Indicators

LMI	LMI-1	LMI-2	LMI-3	LMI-4	LMI-5	LMI-6	LMI-7	LMI-8
LMI-1	1							
LMI-2		1						
LMI-3			1					
LMI-4				1				
LMI-5					1			
LMI-6						1		
LMI-7							1	
LMI-8								1

Table 3: Technical variables/ Indicators with their acronyms

No.	**Technical Indicators**	**TI**
1	insufficient technical support from the head office	TI-1
2	Poor identification and selection of contactor and subcontractors	TI-2
3	Contract condition (special agreement issues, if needed)	TI-3
4	Location of the site (down towns, confined areas urban)	TI-4
5	improper utilization of Available Site Space	TI-5
6	Available construction site boundaries and adjacent areas (Existing trees, buildings, and foundations)	TI-6
7	improper identification and determining the size of facilities	TI-7
8	choosing the position and location of the temporary facility	TI-8

Table 4: AHP format for Technical variables/ Indicators

TI	TI-1	TI-2	TI-3	TI-4	TI-5	TI-6	TI-7	TI-8
TI-1	1							
TI-2		1						
TI-3			1					
TI-4				1				
TI-5					1			
TI-6						1		
TI-7							1	
TI-8								1

Objective-2. Performance-Indicator Variables for The Implementation of Construction Site Layout Planning in Building Projects.

Table 5: site layout element variables/ Indicators with their acronyms

No.	Site layout element Indicators	SLE
1	Provision of access roads for trucks and lightweight vehicles.	SLE-1
2	Provision of site offices (clients, contractors, and consultants)	SLE-2
3	Provision of Processing facilities (rebar cutting shops, steel bending yards, fabrication shops,)	SLE-3
4	Provision of site material storage space/yards (cement storage, steel storage, casting panels, scaffoldings yards, and other materials)	SLE-4
5	provision of parking lots	SLE-5
6	availability of material damp area (stones, aggregate, sand)	SLE-6
7	Availability of utilities on site (electricity, water, telecommunication,)	SLE-7
8	Provision of welfare facilities (sanitary, drinking water, crafts changing room, site toilet)	SLE-8
9	Provision of information signs and signals (site map, safety rules, traffic regulatory signs)	SLE-9
10	Provision of security (Entrance gate, Fencing the boundary, security checkpoints, Gard house, Lighting)	SLE-10

Table 6: AHP format for site layout element variables/ Indicators

SLE	SLE-1	SLE-2	SLE-3	SLE-4	SLE-5	SLE-6	SLE-7	SLE-8	SLE-9	SLE-10
SLE-1	1									
SLE-2		1								
SLE-3			1							
SLE-4				1						
SLE-5					1					
SLE-6						1				
SLE-7							1			
SLE-8								1		
SLE-9									1	
SLE-10										1

Table 7: Material Management variables/ Indicators with their acronyms

No.	Material Management Indicators	MMI
1	Properly use of Materials	MM-1
2	Provision of adequate material storage facilities	MM-2
3	Deliver required quantity of material based on schedule & specification	MM-3
4	material management awareness	MM-4
5	availability of waste storage on the construction site	MM-5
6	provision of appropriate location for material storage	MM-6

Table 8: AHP format for Material Management variables/ Indicators

MMI	MM-1	MM-2	MM-3	MM-4	MM-5	MM-6
MM-1	1					
MM-2		1				
MM-3			1			
MM-4				1		
MM-5					1	
MM-6						1

Table 9: safety Management variables/ Indicators with their acronyms

No.	Safety Management Indicators	SMI
1	Provide sufficient budget for safety management	SMI-1
2	sufficient emergency plan and procedures (accident record keeping & reporting system, training, instructions, fire prevention & firefighting equipment)	SMI-2
3	Provision of safety equipment (personal protective equipments (PPE), safety fence line)	SMI-3
4	on site Availability of safety Officer (safety supervisor)	SMI-4
5	Provision of first aid centers for worker's emergency responses	SMI-5
6	Safety awareness of the company top managers	SMI-6
7	provision of safety training	SMI-7
8	provision of safety rule and regulation	SMI-8

Table 10: AHP format for safety Management variables/ Indicators

SMI	SMI-1	SMI-2	SMI-3	SMI-4	SMI-5	SMI-6	SMI-7	SMI-8
SMI-1	1							
SMI-2		1						
SMI-3			1					
SMI-4				1				
SMI-5					1			
SMI-6						1		
SMI-7							1	
SMI-8								1

Table 11: Construction site layout planning main indicators categories with their acronyms

No.	construction site layout planning assessment tool	CSLPt
3	Site layout element Indicators	SLE
4	Material Management Indicators	MMI
5	Safety Management Indicators	SMI

Table 12: AHP format for Construction site layout planning main performance indicators categories

CSLPt	SLE	MMI	SMI
SLE	1		
MMI		1	
SMI			1

Appendix- IV: Sample Checklist

Construction site layout planning performance evaluation checklist				
Project: _________________				
Contractor: _________________				
Location: _________________				
Site Area: _________________				
Building Coverage Area: _________________				
NBCR: _________________				
Site layout element category				
Criteria weight of the category [CW_C] = 62.37%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of site material storage space/yards (cement, steel)		0.2629	
2	availability of material damp area (stones, aggregate, sand)		0.1988	
3	Provision of Processing facilities		0.1518	
4	Provision of site offices		0.1144	
5	Provision of security		0.0817	
6	Availability of utilities on site		0.064	
7	Provision of access roads for trucks and lightweight vehicles.		0.0488	
8	Provision of information signs and signals		0.0334	
9	Provision of welfare facilities		0.0261	
10	provision of parking lots		0.018	
Total Result of Indicators[TR_I] =				
Criteria weight of the category [CW_C] =			0.623667	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				
Material Management category				
Criteria weight of the category [CW_C] = 11.09%				

No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provision of adequate material storage facilities		0.368	
2	Deliver required quantity of material based on schedule & specification		0.2729	
3	provision of appropriate location for material storage		0.1558	
4	availability of waste storage on the construction site		0.1033	
5	material management awareness		0.0655	
6	Properly use of Materials		0.0344	
Total Result of Indicators[TR_I] =				
Criteria weight of the category [CW_C] =			0.110904	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =				
Safety Management category				
Criteria weight of the category [CW_C] = 26.54%				
No.	Indicators	7- point Likert scale Evaluation score (Metropolitan Real Estate)	Criteria weights of indicators that [CWI]	Result of Indicators [RI]
1	Provide sufficient budget for safety management		0.3407	
2	Provision of safety equipment		0.2195	
3	on site Availability of safety Officer (safety supervisor)		0.1472	
4	Provision of first aid centers for worker's emergency responses		0.1085	
5	sufficient emergency plan and procedures		0.0699	
6	provision of safety rule and regulation		0.0549	
7	provision of safety training		0.0373	
8	Safety awareness of the company top managers		0.022	

Total Result of Indicators[TR_I] =		
Criteria weight of the category [CW_C] =	0.265429	
Total Result of the category [TR_C] = [TR_I] * [CW_C] =		
Total CSLP performance of the site [TPs] = [TR_{C-1}] + [TR_{C-2}] + [TR_{C-3}] =		
Project Performance Evaluation in Percentage & Statues:	**%**	

Appendix- V: Checklist Validation Questions

Dear Sir/Madam,

My name is Junedin Yassin, Master of Science degree student at Adama science and technology university (ASTU) on the field of construction engineering and management. for the partial fulfillment of my MSc degree, I am currently undertaking a thesis under the title of '**Performance Evaluation for the Implementation of Construction Site Layout Planning: In the Case of Hawassa City Building Projects''**

- To weight and prioritize barriers for the effective implementation of construction site layout planning practice in the case of Hawassa city.
- To identify success factors that ensure the implementation of construction site layout planning in the Case of Hawassa city.
- To develop a performance evaluation checklist for the effective implementation of construction site layout planning.
- To evaluate the current performances of building construction projects in hawassa city by conducting a case study through the application of the developed checklist.

here is the proposed checklist based on the analysis result obtained from AHP- Data Analysis (comparison and prioritization). I need your expert judgment in connection with the rationale and usefulness of the proposed Checklist for the implementation of construction site layout planning in Hawassa city, a number of questions were asked below. Kindly provide us with your view on the proposed Checklist by ticking on provided tables. Please be as objective and constructive as possible in your review and use the following rating scale:

5-point Likert scale (Agree-disagree scales)
[1] = strongly disagree [2] = disagree [3] = neither agree nor disagree (Neutral) [4] = agree [5] = strongly agree

Junedin Yassin Yimam

Phone No: +251984785760

E-mail: www.judayassin@gmail.com

Advisor: Meseret G. (Ph.D.)

Section -1: Background of Expert

1. Sex

☐ Male ☐ Female

2. level of your highest degree

☐ diploma's ☐ Bachelor's ☐ Master's or Professional ☐ Doctorate

3. discipline of your highest degree

☐Architecture ☐Civil Engineering ☐construction management ☐specify Other,

____

4. experience years in the building construction industry

☐ 1-3 years ☐ 3-5 years ☐ 5-10 years ☐ >10 years

**Section -2: Checklist Validation Questions **

No.	Questions	Strongly-disagree [1]	Disagree [2]	Neutral [3]	Agree [4]	Strongly-agree [5]
1	Does the proposed Checklist is clear and easy to understand					
2	Does the variables/ indicators used for the Checklist was clearly described organized well					
3	Does the methodology used to develop the Checklist was appropriate to achieve the research objectives					
4	the Checklist contains all the Categories or major issues that should be included as indicators for the implementation of construction site layout planning.					
5	Does the developed Checklist contain key indicators or variables which are appropriate enough representatives for implementation of site layout planning.					
6	Does the prioritization or weight values which is given for the variables or indicators in the Checklist represents the actual existing problems and helps to mitigate the existing problems in the Hawassa city construction industry.					

7	Does the Checklist is relevant and has contribution for the implementation of construction site layout planning practice in hawassa city.					
8	Does the developed Checklist can be workable and applicability in the construction sector?					

Appendix- VI: Current Project Performance Evaluation Questioner

Performance Evaluation for The Implementation of Construction Site Layout Planning in The Case of Hawassa City Building Projects

Dear Sir/Madam,

My name is Junedin Yassin, Master of Science degree student at Adama science and technology university (ASTU) on the field of construction engineering and management. for the partial fulfillment of my MSc degree, I am currently undertaking a thesis under the title of **"performance evaluation for the implementation of Construction Site Layout Planning in the case of hawassa city building projects"**

The objectives of the study are:

- To weight and prioritize barriers for the effective implementation of construction site layout planning practice in the case of Hawassa city.
- To identify success factors that ensure the implementation of construction site layout planning in the Case of Hawassa city.
- To develop a performance evaluation checklist for the effective implementation of construction site layout planning.
- To evaluate the current performances of building construction projects in hawassa city by conducting a case study through the application of the developed checklist.

This questionnaire was organized under 3 main categories and with a total of 24 variables, which is indicators for the implementations of construction site layout planning. I need your expert agreement on the degree of availabilities of these 24 variables on your construction sites by ticking on provided tables. all data's and information are strictly confidential and will not be disclosed. It is only for the purposes of Academicals study only. Please be as objective and constructive as possible in your review and use the following 7- point Likert scale rating provided on the table below.

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tank you in advance!

#. Instructions

- Please tick a right sign on one of the 7- point Likert scale scoring points for the question provided on the table below, based on your construction site performance.

7-point Likert scales	Description
Very poor - 1	• This response option indicates a very negative the performance of CSLP. • It is typically used to indicate strong disagreement or a very negative Performance of CSLP. • The Performance is significantly below expectations, lacking in quality, and in need of improvement.
Poor – 2	• This response option indicates a negative view or opinion, but not as strong as "very poor." • It is typically used to indicate disagreement or a negative Performance of CSLP • The performance is below average and falls short of meeting expectations. Improvement is needed in multiple areas to reach satisfactory levels.
Fair - 3	• It is typically used to indicate a moderate or middle ground Performance of CSLP. • The CSLP- Performance meets basic expectations but does not stand out in any significant way. It demonstrates competence but lacks exceptional qualities.
Good - 4	• This response option indicates a positive view or opinion, but not as strong as "very good" or "excellent." • It is typically used to indicate agreement or a positive Performance of CSLP. • The CSLP- Performance is slightly above average or moderate, and exceeds basic expectations. There are some notable strengths, but further development is still needed.
Very good - 5	• This response option indicates a very positive view or opinion, but not as strong as "excellent" or "outstanding." • It is typically used to indicate strong agreement or a very positive Performance of CSLP • The CSLP- Performance is good and generally meets or slightly exceeds expectations.
Excellent - 6	• This response option indicates a very positive view or opinion. • It is typically used to indicate strong agreement or a very positive Performance of CSLP.

	• The CSLP- Performance is very good and consistently exceeds expectations.
Outstanding - 7	• This response option indicates an extremely positive view or opinion. • It is typically used to indicate the highest level of agreement or a very positive Performance of CSLP. • The CSLP- Performance is exceptional and significantly exceeds expectations.

Section -1: Background of Expert

5. Sex

☐ Male ☐ Female

6. level of your highest degree qualification

☐ diploma's ☐ Bachelor's ☐ Master's or Professional ☐ Doctorate

7. filed of your highest degree

☐Architecture ☐Civil Engineering ☐construction management ☐specify Other, ___________________

8. experience years in the building construction industry

☐ 1-3 years ☐ 3-5 years ☐ 5-10 years ☐ >10 years

Section -2: Performance Evaluation for The Availabilities of Construction Site Layout Planning Variables/Indicators in Building Construction Projects.

Variables/ indicators under their categories		Agreement Score						
No.	**Site layout element category**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Provision of site material storage space/yards (cement, steel)							
2	availability of material damp area (stones, aggregate, sand)							
3	Provision of Processing facilities							

4	Provision of site offices							
5	Provision of security							
6	Availability of utilities on site							
7	Provision of access roads for trucks and lightweight vehicles.							
8	Provision of information signs and signals							
9	Provision of welfare facilities							
10	provision of parking lots							
No.	**Material Management category**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Provision of adequate material storage facilities							
2	Deliver required quantity of material based on schedule & specification							
3	provision of appropriate location for material storage							
4	availability of waste storage on the construction site							
5	material management awareness							
6	Properly use of Materials							
No.	**Safety Management category**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Provide sufficient budget for safety management							
2	Provision of safety equipment							
3	on site Availability of safety Officer (safety supervisor)							
4	Provision of first aid centers for worker's emergency responses							
5	sufficient emergency plan and procedures							
6	provision of safety rule and regulation							
7	provision of safety training							
8	Safety awareness of the company top managers							

Appendix- VII: Participant’s Responses During the Case Study

Variables/ indicators under their categories		**Project- 1**				**Project- 2**					**Project- 3**				**Project- 4**				
No.	**Site layout element category**	**Ex-1**	**Ex-2**	**Ex-3**	**Ave**	**Ex-1**	**Ex-2**	**Ex-3**	**Ex-4**	**Ave**	**Ex-1**	**Ex-2**	**Ex-3**	**Ave**	**Ex-1**	**Ex-2**	**Ex-3**	**Ex-4**	**Ave**
1	Provision of site material storage space/yards (cement, steel)	4	4	4	4.00	2	3	2	2	2.25	5	5	4	4.67	4	5	4	5	4.5
2	availability of material damp area (stones, aggregate, sand)	4	4	4	4.00	2	4	3	2	2.75	5	5	5	5.0	4	5	5	5	4.75
3	Provision of Processing facilities	4	4	5	4.33	2	2	2	3	2.25	4	3	5	4.0	5	4	4	5	4.5
4	Provision of site offices	5	4	5	4.67	4	4	4	5	4.25	2	4	3	3.0	5	5	5	5	5
5	Provision of security	5	4	5	4.67	3	3	3	4	3.25	4	4	4	4.0	4	4	3	2	3.25
6	Availability of utilities on site	4	4	3	3.67	3	3	4	4	3.50	2	4	3	3.0	6	4	5	5	5
7	Provision of access roads for trucks and lightweight vehicles.	4	4	4	4.0	2	3	3	2	2.50	6	4	4	4.67	5	5	5	5	5
8	Provision of information signs and signals	2	1	2	1.67	4	4	3	3	3.50	1	1	1	1.0	1	1	1	1	1
9	Provision of welfare facilities	3	2	3	2.67	4	4	3	4	3.75	2	2	4	2.67	4	4	3	4	3.75
10	provision of parking lots	2	3	3	2.67	2	2	1	2	1.75	3	2	3	2.67	5	4	4	4	4.25
No.	**Material Management category**																		
1	Provision of adequate material storage facilities	3	4	4	3.67	2	2	2	1	1.75	4	4	3	3.67	4	4	3	4	3.75
2	Deliver required quantity of material based on schedule & specification	4	4	3	3.67	4	2	4	3	3.25	5	3	3	3.67	5	4	5	4	4.5
3	provision of appropriate location for material storage	4	2	3	3.0	2	2	3	1	2.0	4	4	4	4.00	5	4	4	4	4.25
4	availability of waste storage on the construction site	1	2	2	1.67	1	1	1	2	1.25	1	1	1	1.0	2	1	1	1	1.25

5	material management awareness	4	4	4	4.00	2	2	3	2	2.25	4	3	4	3.67	5	4	4	4	4.25
6	properly use of Materials	3	4	4	3.67	3	2	1	2	2.0	4	2	3	3.0	5	4	5	3	4.25
No.	**Safety Management category**																		
1	Provide sufficient budget for safety management	3	4	3	3.33	4	4	4	4	4.0	2	1	1	1.33	2	1	1	2	1.5
2	Provision of safety equipment	2	4	3	3.0	4	4	5	4	4.25	1	3	2	2.0	3	2	3	2	2.5
3	on site Availability of safety Officer (safety supervisor)	1	2	1	1.33	6	5	5	4	5.0	1	1	1	1.0	1	1	1	1	1
4	Provision of first aid centers for worker’s emergency responses	2	3	4	3.0	5	5	4	6	5.0	1	2	1	1.33	1	1	1	1	1
5	sufficient emergency plan and procedures	3	2	3	2.67	4	4	4	4	4.0	2	2	1	1.67	1	1	1	1	1
6	provision of safety rule and regulation	3	3	4	3.33	5	4	5	4	4.50	2	2	1	1.67	1	1	1	1	1
7	provision of safety training	3	2	3	2.67	3	3	2	3	2.75	2	2	3	2.33	1	2	1	1	1.25
8	Safety awareness of the company top managers	2	4	4	3.33	6	5	4	5	5.00	2	2	2	2.0	2	3	2	2	2.25

Appendix- VIII: Technical Definitions of Congestion (Contested Construction Sites)

Limited working area or space, restricted access ways, and small clearance among a piece of equipment are some of the indications towards the level of congestion at a construction site (Mortaheb MM. et al, 2007). also (Spillane et al, 2013) defined a limited space construction site as a site with a building area of more than 90% of the whole construction site area within the boundaries of the site. (Misron et al, 2019) has also generated a site congestion index by calculating non-building coverage ratio (NBCR) using building site measurement data which are buildings site area (built-up) area and projects site area (gross area), by integrating with the concept of relative importance index as an inputs to generate a site congestion index.

The hypothesis is developed Based on the results of the calculations. According to (Misron et al, 2019), the initial hypothesis was that low NBCR values showed high congestion whereas high NBCR values were low congestion. Further, (Misron et al, 2019) classified the level of congestion relaying on NBCR values. Accordingly,

If NBCR index values less than or equal to 0.5 represent high congestion,

If NBCR greater than 0.6 represent low congestion whereas

If NBCR values between 0.5 and 0.6 represent moderate congestion.

(Misron et al, 2019) articulated non-building coverage (NBCR) by the formula.

$$\text{NBCR} = \frac{\text{ANB}}{\text{AT}}$$

$$\text{ANB} = \text{AT} - \text{AB} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots.\dots. (2.1)$$

Where: NBCR is Non-Building Coverage Ratio

A_{NB} is the value of a Non-Building Area,

A_T is the Total area of the whole site,

A_B is the value of Area covered by the Building

Appendix- Ix: Interview Question During Problem Identification

#. Interview Question During Problem Identification

No.	Interview Question During Problem Identification
1.	What is your Job discipline and position, role in this organization/ Project?
2.	How many years of experience you have been working in the construction industry?
3.	what do you understand by the concept of site layout planning (site organization planning)?
4.	Does the construction projects exist in the Hawassa city undergoes site organization planning (site layout planning)?
5.	From your experience which major problems usually happen/ occurred in your company with regard to construction site organization practice?
6.	What are the major challenges/ barriers for the adoption and implementations of construction site layout planning (site organization) in hawassa city building construction projects?
7.	What do you suggest as a strategy to mitigate problems encountered due to the implementation of construction sites layout planning in the case of Hawassa city?
8.	Do you have a formal and standard tools/ methods, policy, guidelines or well-defined framework to measure the implementation of construction site layout planning?
9	Do you think the availability of an performance evaluation tool for the implementation of construction site layout planning has its own contribution for the existing problem?