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Measurement of Labour Productivity in Construction Projects

By

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Abstract

The research is about systematic measurement of labour productivity to indicate whether construction labor productivity is low in the case of building projects in Addis Ababa, and if it is; to assess productivity problems and their causes.

A review of other country studies, project reports and consultation with practitioners were made to identify the productivity problem areas and process factors for inclusion into the study instruments. A case study of seven projects on three construction trades, namely concrete, steel reinforcement placing and masonry works, revealed that 11 front line factors are responsible for low productivity; the major ones in the order of their rank are **lack of materials**, **instruction delay**, **rework**, **change of workers**, **lack of tools and less work load** and **congestion**.

The research result showed that nearly all projects (except project 5) have a productivity performance ability ratio (PAR) greater than one indicating that the studied crews' productivity performance was low. In addition opinion survey of foremen on the amount of effective productive time of workers showed that on the average the studied craftsmen spend only 56% of the total paid time.

An open system theory of management was applied to identify the major managerial causes of productivity, which resulted in four factors contributory to low labor productivity; these are: **external precondition factors**, **technical management sub system**, **managerial systems** and **organizational behavior factors**. That is; The causal problems for low productive performance was analyzed and it was found that unfulfilled conditions from project site external bodies, lack of project management systems, poor technical management in areas of developing productivity standards and construction methods, average leadership efficiency and low project culture towards workers satisfaction are responsible for low productivity performance.

Key words: process factors, open system theory, construction trades, performance ability ratio (PAR)

Summary

It is evident that the socioeconomic development of any country is highly dependent on the amount of socioeconomic infrastructure. Construction industry being one of the major sectors contributing for infrastructure development, the Ethiopian government, main investor in developing countries allocates a considerable amount of budget. Besides, the policy of free market economy the country follows makes the private sector to participate in development works, which increases the flow of funds towards construction. Hence, productivity improvement in this sector will undoubtedly generate lots of benefits for all stakeholders of the country which can be considered justification for this study.

Earlier studies by international consultants (SMEC, GTZ) had indicated that the construction sector is low in productive performance. Investigation of a few researches made on the sector revealed that there few studies that are made at macro managerial level but studies at micro level are minimal. This has made the research to focus on micro or project level.

The research title came from the problem statement that there is a need to enhance the construction sector productivity. This in turn was streamlined into construction projects labour productivity measurement because most of the constructions in developing countries are labour intensive. Consequently, three research questions are raised; these are: Is there really low performance in construction labour productivity?; If there is, what are the productivity problems and their causes?; and How can we improve this low labour productivity?

To respond for these questions a case study of seven projects emphasizing on three construction trades, namely, concrete, steel reinforcement placing and masonry works was made. Case study was chosen as a research strategy because the study involves in depth assessment of the construction process with research questions “How?” and an imbedded “What and why?” types; the control over the actual behavioral events are minimal due to lack of data and associated attitudinal and consequential problems with regard to project productivity evaluation and the novice ness of the study area

and my self as a researcher. The selection of the three trades was due to constraint of resources and time to conduct on all trades, their involvement in most construction works and their use of larger proportion of labour.

The study was designed to contribute knowledge on:

Productivity performance management of construction operations; methods and techniques of developing productivity standards, and methods and techniques of viewing the causal productivity factors of construction operations as a system.

The case study was made using questioner, interview, observations and archival documents as instruments.

Accordingly, the conditional research question showed that the productivity performance of selected construction trades in the case study projects was low. That is for nearly all projects (except project 5) the ratio of planned productivity to actual productivity, or performance ability ratio (PAR) was found grater than one. In addition another survey to estimate the productive time of the studied trades show that an average craftsman spends only 56% of the total allotted time of the operation, meaning 44% of the craftsmen time is wasted unproductively. The study has also identified that the major frontline productivity problems are lack of materials, instruction delay, rework, change of workers, lack of tools and less work load and congestion.

The study has also investigated the causes of these frontline productivity problems. Open system theory shows that the productivity of organizations is a function of social, technical and managerial components. This idea was taken to systematically view the cause of low productivity and hence the study classified the major causes of project site productivity as external preconditions, technical system, managerial and organizational behavior.

External Preconditions are factors which the external bodies lack to contribute their share for the project site productivity improvement and the study indicate that the

timeliness and clarity of decisions and responses from the consultant were found to hinder the productivity performance construction crews.

In the managerial subsystem it was found that little project management system exist in the case study projects; in projects where there exist project management software it was found that no data collection system was installed to support the soft wares and the use of the project instruments so produced were found low.

Factors which affect productivity in the technical management subsystem were analyzed and it was found that the case study projects lacks knowledge on the importance of productivity standards. Hence, they were not used for crew productivity management, even they are not known by most crew supervisors and craftsmen. In addition, constructions methods management was left to lower level craftsmen with little support given from the upper supervisory level (Superintendents and Foremen), though lack blue collar training either to pass their knowledge or to control.

In the case of organizational behavior subsystem, the study had investigated factors related to projects leadership and culture. It was found that the construction leadership in the case study projects was only averagely efficient, near to Blake middle of the road leadership and the project culture towards promoting important behavior to productivity was found average except that the project culture to satisfy workers was found low.

We can see from the above the causal factors are a combination of system and human components. Thus the productivity of the construction industry can be improved from the combined improvement of systems and human interventions. That is by appropriately designing construction managerial systems in the area of schedule management, productivity measurement and progress, quality and safety control system, organizational and labour relations and resource management systems. In additions problems encountered in leadership and culture can be improved by training worker on soft and hard skills.

Finally, I believe that this study will contribute a lot for practitioners to observe their management style for new entrants to know the basics of project leadership. It also gives clues for researchers interested to asses the construction industry progressively and for me to further conceptualize the construction projects.

Acknowledgements

Like many other researches, this research required literature review to build up the research conceptual frame work hence selected books and journals related to my field of study were reviewed hence my first thanks and appreciation goes to these authors who built up the knowledge of management. But besides that construction management researches require collaboration from many practitioners in the field to idealize the existing managerial situation of the construction environment hence regards is forwarded for those who lend previous project reports and other construction management related books to my thesis. During the research progress I found out that the study requires social science background, especially concepts of leadership and culture, and I want to pass similar thanks to my friend, Birhanu Bogale, for lending me these books.

I am grateful to my supervisor, Doctor Ingenure Wubishet Jekale, not only in reviewing and clarifying my thoughts and giving constructive comments as ideal supervisor; but also in searching and lending me construction productivity books which are not available in the country. The opportunity that my supervisor gave me to meet him at any time and friendly environment created encourages me to forward any problem that I encounter .The research title being focused towards process management requires in depth study and abstraction coupled with the freshness of me to the research world, forced me to meet my advisor frequently to know more about the research methodology at each stage besides the basic research work.

Especial thanks are also forwarded for those who helped me in facilitating data collection. As most of the respondents were demotivated to react quickly, it required me to create relational network with my friends in facilitating and supporting the data collection process. Finally, thanks pass to the almighty, who gave me the commitment and tolerance to pass various obstacles and come to the accomplishment of this thesis in a situation where shortage of resources, especially finance and books, and unduly restricted study time period, prevail.

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Abbreviations/Acronyms

GDP = Gross domestic product

SMEC = Snowy Mountains Engineering Corporation

GTZ = Abbreviation for German Technical Cooperation

BaTCoDA =Building and Transport Construction and Design Authority

MH = Man hour

PAR = Performance Ability Ratio

Id = Identification

TVET = Technical and Vocational Education Training

MR = Mean Rank

OMR = Overall Mean Rank

EPC = Engineering Procurement and Construction

CM = Construction Management

Cps= Construction Projects

Glossary/Explanations

Traditional management: It is the type of management which emphasize on handling the process of a certain activity/work by observations of the method followed and focusing on low performing workers. It handles the process part only in the input-process-output model of a certain activity

Performance based management: It is the type of management which emphasize on handling the process by integrating information obtained from the output and focusing on best workers for continual learning. It mostly uses quantitative techniques to obtain hard facts from outputs which are then used to investigate the methods followed.

Productivity standards: These are tools developed by measuring the productivity performance of an average worker (often) and used as a benchmark to compare the performance of any worker doing similar work for the purpose of analyzing any differences observed and investigating the underlining cause. It is measured as the output amount produced per unit of time.

Integration: Aligning people and tasks so as to unify and harmonize all activity and effort towards objectives. It uses various instruments such as, schedule, control meeting, reports, etc.

Open system: It is a system that is made up of interdependent elements, as such actions which affect one element must affect others also, and actions of one cause reaction on others. The recognition of such interactions and interdependencies both with in and out side of project is the essence of open system theory.

Process factors: These are factors which affect the process part of any activity in the input-process- output model of any activity. The type of management which handles such factors is called process management. For example the process factors which affect productivity are managerial system, technical and organizational factors.

Part I: The Research Basic Information

Chapter 1.Introduction

Chapter 1.Introduction

1.1. The Study Overview

It is evident that the socio economic development of any country is highly dependent on the amount of economic and social infrastructure, whether it is public or private.
One of the major sectors contributing for infrastructure growth is the construction industry.

The construction industry is also highest recipient of government budget in terms of government development programmes, for example from 1996/97 up to 2001/02 public projects shared an average annual rate of 58.2% of the capital budget [17]. Hence a little improvement in this sector will undoubtedly generate a lot of benefit. Despite this fact, this sector embodies complex problems which made its contribution to the development of itself and support other development works is not as expected.

The major problems that hinder the development of the industry are shortage of capital, lack of conducive working environment and trained manpower especially in construction management, among others [15].Some draft studies indicate that the contribution of the industry to development is lower than sub Saharan countries average of 6% GDP.A study made recently by SMEC international [Cited by17] and German technical cooperation (GTZ) [16] has indicated that the sector is poor in quality and expensive as compared to sub Saharan countries. These rough studies show that thorough studies shall be conducted to increase the productivity of the sector both the macro and micro level of management.

This research focuses on increasing the productivity of the sector at micro, more specifically at project, level. This makes most of the factors to be controllable by the site

management, and hence needs only the competence of the site management and external bodies around it for its intervention.

The factors affecting productivity at the project level are many. Increment of productivity at this level can be enhanced by increasing the productivity of hard factors such as product, equipment, technology, materials and energy; and soft factors such as human and system development [8].
The attention of this study is on increasing the productivity of soft factors, which includes human beings and systems of working; this may be categorized under a generalized topic of labour management.

Labour productivity management is chosen from others because productivity improvement over labour and its working environment can be accomplished in a short period of time and it is easily adaptable to a project site. The other reason is that the desire to increase construction productivity must geared towards better control and management of labour mainly because labour is the one resource that affects all other resources and it is also most susceptible to improvement. Consultants via specifications control material and plant productivity, and profit and overhead are generally controlled by competition, then this leaves labour as one resource open to improvement.

A case study in this area revealed that, in regular building construction works where standard practice is followed labour constitutes 15% to 23% of the total project cost [63]. This dose not include the cost that can be saved by the reduction of operational and technical losses of resources due to the increased in productivity of workers, which I believe is a significant amount if it can be traced by research.

According to studies made in most African countries and Canada, company called Optima Engineers and Constructors, productive labour time accounts only up to half of the total payroll time [52].Hence many man hours are being lost due to poor labour management.

Information on labour productivity is indispensable in the determination of cost and duration of man controlled activities, thus it is important for subjects such as estimating, cost monitoring, scheduling and resource management. But the most important contribution of productivity data of labour is for continuous performance management. Performance management system is the establishment of labour productivity measurement system and benchmarking to guide and improve daily crew performance. By regularly using this information, management will become more competitive.

There are no comprehensive documented studies made on labour productivity in Ethiopia. Studies made by the former BaTCoDA are meant to establish productivity standards only. There are no background studies, which pinpoint problem areas of productivity in the sector. This standard is still being used by the sector despite the fact that the standard methods that were envisaged in the study are now totally changed. There was also a trial by the ministry of infrastructure in setting productivity standards for the sector. However the method that was used for setting is data collection from contractors, and simulating the data to produce the standard. This has limitation in that the methods that are used for the setting of standards did not follow the scientific principles for developing engineered standards. Hence two things are missing; one is the development of standard by appropriate scientific methods and the other is continuous updating of the standard with a change in method of construction and resource capability. These practices have made the Ethiopian contactors devoid of benchmarks to which they can compare their performance. Besides, there are no detailed studies which pinpoint areas of poor labour productivity performance in the context of Ethiopia.

Studies in other African countries indicate many areas of poor labour productivity performance in general and detailed studies on poor productive activities are being taking place. Thus, it is time now for the Ethiopian construction industry to deal with these problems to compete adequately with its neighboring African countries. This study tries to contribute its share on labour productivity improvement on concreting trades by manual methods, wall masonry construction, and reinforcement production and fixing.

Due to the nature of the problem the study uses a case study on selected regular building constructions as its research strategy; and deals with the above mentioned trades. The activities mentioned above are selected because; these activities can represent other trades in terms of problems; most of them are labour intensive, hence important areas for labour productivity management.

The research process involves two steps. The first step is to check whether low performances of these trades exist or not. After this hypothesis is confirmed, the causes for these low performances are investigated qualitatively and improvement interventions will be proposed as recommendations.

Investigation of causal relationships and improvement interventions will involve practical learning and theoretical reviews. Hence, similar studies in other countries and local experience were consulted besides; brainstorming among experienced engineers was made.

Generally, desk studies, field survey to collect qualitative information by questionnaires and work sampling study to collect quantitative labour lost hours and output; using case study as a research strategy is being followed. The study can be categorized under a larger issue of ‘‘performance management in projects’’. This study is therefore made particular emphasis in contributing knowledge with regard to improving the productivity of labour performance for construction projects.

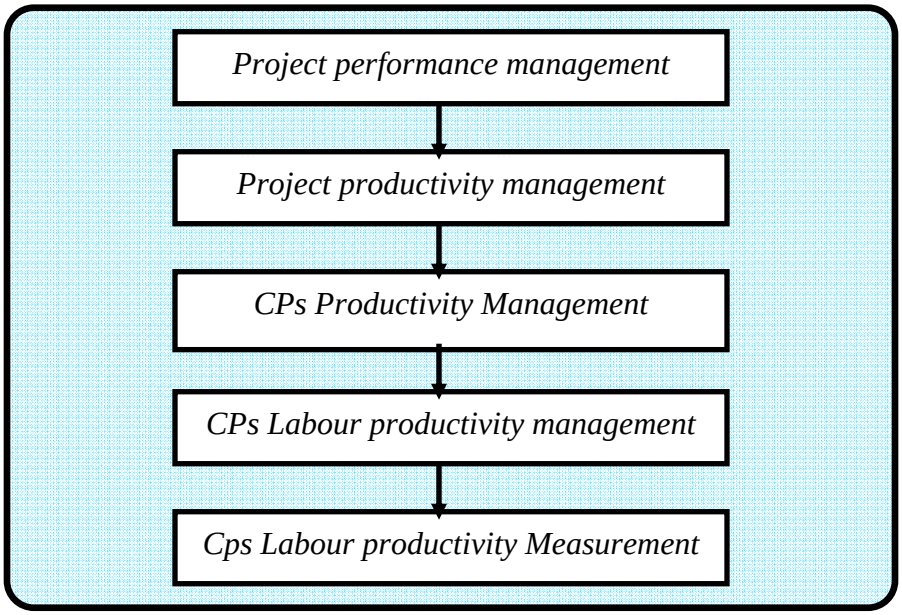
1.2 The Research Motivations

The initiation for the study of this research is largely due to the researcher experience and low performance of the construction projects in terms of both cost and time. These include construction works both by the government and contractors. My first observation is the variance in labor cost planned and actual by contractors and poor labour management practices in construction site. It is common to see poorly laid out projects, demotivated workers on whom work is a burden than elicited from them. Further while I was reading some draft studies about Ethiopian construction industry by some

international consultants stating the problems I was wondering what were the causes and their remedial solutions. These sensations have pushed me to make a research on some part of it.

1.3 The Research Problem, Questions and Objectives

The first and fundamental point in any research is to find the clear definition of the research issue [17]. As it was stated above the research problem of the study comes from my practical observations. Similar studies from internet and has reinforced my motivation. The research problem is focused from the general area of project productivity management (Box 1.1).



Box 1.1. Streamlining the Research Problem

Further, to assess the objectives, beneficiaries and methodology of the research work the final title is diagnosed by question and answer approach.

Question	Answer
Why has the research been established?	Most Cps in this country suffer cost and time overruns.
What dose the research try to achieve?	To contribute knowledge on problems of

	low LP and their causes.
What are the important issues for the research framework?	Methodology and literature review together with the case study of some projects.
Who will benefit from or affected by this research?	Construction industry leaders, project owners, financers, regulatory bodies, consultants and contractors, and my self.
How can the research be done?	Case study on selective trades in building projects and literature survey.

Table 1.1.The Question and Answer Approach

The above questions and answer build confidence in me to pursue on this research title. Finally, the problem statement of the research and its objectives leading to research questions were developed.

The Research Problem

The Need for Measurement and Control of Labour Productivity in CPs

The research objectives	The research Questions
To asses theoretical status of LP concept (Desk study)	1. Is there low LP in Cps? If there is why?
To measure selected groups of selected activities (Work sampling)	What are the causes for these low LP performances?
To prove the existence of low productivity and then identify the causative factors	How do these causes relate with low productivity problems?
To propose interventions for improving LP performance	2. How can we improve LP in construction projects?

Table 1.2. The Research Problem, Its Objectives and Questions

1.4. Overview of the Research Process and Study

The final output of this research is to provide the causes influencing low productivity of labour and the possible intervention mechanisms. Like most researches it has the following broad categories.

Part I: The Research Basic Information

Part II: The Research Methodology

Part III: The Research conceptual Framework

Part IV: The Research Analysis and Discussions

Part V: The Research Conclusions and Recommendations

The total research process can be conceptually modeled by production control system[1].

The function of the control process is to make the system operate true to the objectives which the system was designed to achieve.

1. A production control system is a system that is designed to compare the actual accomplishment with the plan objectives by using deviation analysis and taking corrective measures.

The control function includes measurement of output, the comparison of output with some standard, and the adjustment, if necessary, of the inputs/or conversion process to restore the system to its predetermined plan.

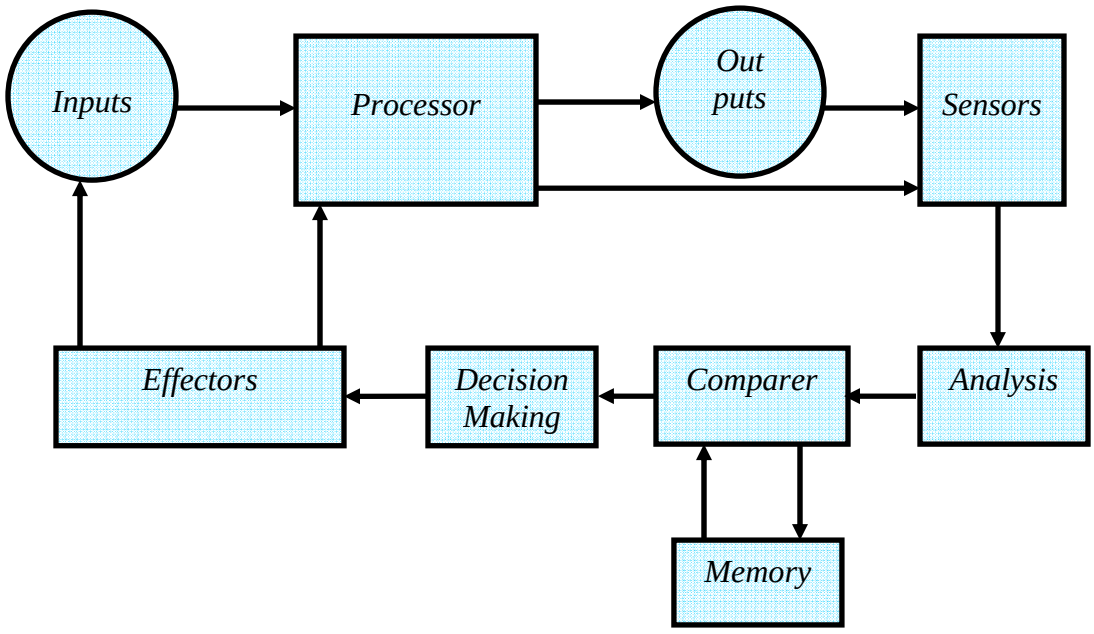


Figure 1.1. The Control Process System Modified by the Researcher [6]

The research can be seen as shown by the above control process model emphasizing labour as an input. The study will measure the construction output and the process quantitatively by activity sampling and qualitatively by questionnaires, observations and archival documents. Theses actions by the researcher are the functions of the sensor as depicted in the above system and then collected actual data is analyzed by appropriate descriptive and inferential stastics to find the actual performance trend and causes of the performance gap. This completes the control functions of analysis.

The development of standard by measuring was also very important for productivity improvement, however for this study historical standard developed earlier by the sector or planned accomplishment rate of the project are used. I believe that historical standards have many limitations and might not be realistic to represent the actual. However they can at least show the performance gaps, even though in some activities they might emphasize the gap. Secondly their limitation will be taken into consideration during the analysis phase. Similarly the standard process of construction of the selected activities is known from the researcher's practical knowledge. The measures of actual output and process trapped by sensing and analyzed as required will be compared with the standard. This completes the function of the researcher as comparer.

The deviation result obtained by comparing the actual performances with memories, which is standard theory and productivity, helps some one to know the deficiency and decide; completing the function of decision making. Finally the whole study and its findings will be sent to different bodies and level of management to act either directly on indirectly by different intervention strategies on the inputs and the process. This completes the function of effectors in the above model.

The analysis of the research questions is not clearly shown in the above model, as the model is of process type. The analysis of each research question can modeled as below [17].

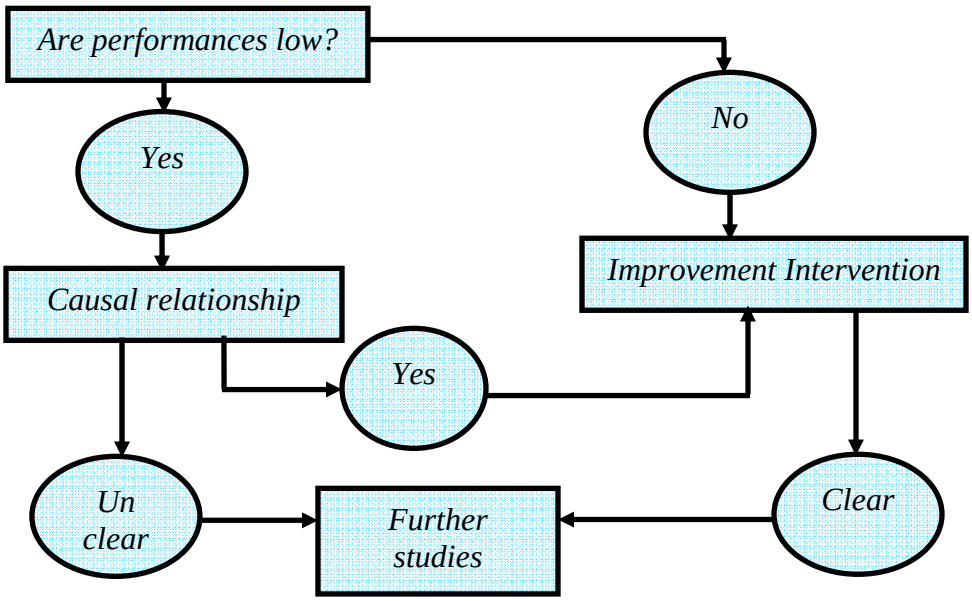


Figure 1.2. Study Model Using Research Questions [17]

Each of the above major categories will contain the following contents as stipulated below.

Part I consists of a single chapter describing the research overview, its initiation and purposes and how the research title is streamlined from the general title. It also

indicates the research problem, objectives and questions and finally how the research process is conducted and the contents of the study dossier.

Part II covers the research methodology as one chapter. The methodological approach consists of the overall research strategy, why case study is chosen as a research strategy; the research design and the analysis of the data and writing of the research paper.

Part III covers the research conceptual framework. It is divided into three chapters containing the concepts of construction performance, productivity, and measurement and approaches of productivity improvement. It also shows how productivity measurement

varies upon the user and managerial level, assumptions and techniques on site for labour productivity measurement, and systematic approach to productivity improvement.

Part IV contains the discussion and analysis part .It is divided into two chapters containing findings on productivity problems and their causal factors and finally;

Part IV containing the research conclusions and recommendations is presented as one chapter. This will serve as an action guideline to different bodies and levels of management.

Part II

The Research methodology

The Research Conceptual Review

Chapter 2. The Research Methodology

2.1 The Study Approach

For the purpose of this thesis, research is defined as a methodological search or inquiry to discover new facts or collate old facts by scientific study for the purpose of developing existing theory or its application in a real problem. Some others define research as a process of collecting, analyzing and interpreting information to provide solutions to questions. This study approaches the problem from two perspectives that are from empiricism (practical) and the rationalism (theoretical) point of views. It tries to search practical productivity problems and integrate it to theoretical models to analyze the problem.

The study has posed the following queries, which latter became research questions.

- How does Cps perform towards labour? How do we determine good and poor labour productivity performance?
- What are the direct problems of low labour productivity?

- What are the causes of low labour productivity?
- How can we improve low labour productivity?

These questions are viewed at trades' operation level only, namely concreting work, masonry work and steel fixing. However, this cannot entirely reveal all possible factors but can intervene with all vertical and horizontal cross teams both internal and external to the projects as an open socio technical system. In addition the effect of external bodies such as designers, construction management consultants and company bosses.

The study being done at project level, the following are used as study populations. These are:

1. Project managers and engineers (Project supervisors, level 1);
2. Project site engineers and superintendents (Project supervisors, level 2);
3. Crew foremen (Project supervisors, level 3); and
4. Craftsmen from the study trades (Project operatives, direct workers).

The study will use case study[1] as a strategy for inquiry but it has used mixed data collection due to the scarcity of data and low perception of the construction workforce to the management world.

The study sought:

- Both hard facts (measurements) of productivity and qualitative causal factors;
- Similar analysis was done both qualitatively and quantitatively,

This makes the research mixed type.

A survey in the form of structured letter questioners and interview guides were prepared for the craftsmen and supervisors respectively to identify causal problems. In parallel with this, activity sampling measurements was done on two project sites to measure the productivity performance of the studied trades. On site observation of the administrative and technical management of the project and the studied work teams was also the part of the study.

The research characteristics and type: The research is a practical problem developed from on site observation of construction projects and the research questions are oriented to investigate management related causal factors from the perspectives of system and human components.

Due to limitation of time and budget the research is limited to three activities, with reinforced concreting activity divided into steel fixing and concrete placing and masonry constructions. The scope of the research was controlled by focusing on the most important process management factors affecting productivity. The research activities were done rigorously and systematically and similar research questions were asked to enhance the validity and reliability of the research.

This research can be categorized as applied, exploratory, descriptive and co relational[2] type.

1. The seven projects investigated are considered as one case study
2. The term co relational refers more to association, relations are not investigated analytically

It is applied and exploratory because the research was initiated from practical problems and finds whether there is low labour productivity performance of the studied trades. It is also descriptive and co relational because it tried to describe the actual labour productivity performance of the surveyed projects and relates the managerial causal problems with labour productivity performance.

2.2 The case study as a research strategy

The research being focused towards process management which involves detailed analysis (raising how type questions) as indicated on the conceptual framework requires a case study to conceptualize the research. In addition the study was designed systematically in such a way to integrate the productivity results with the causative factors necessitating case study. The other important factor which made me to select case study was lack of information concerning the study, which requires multiple evidence approach for data collection. Besides, the novice ness of the study area and my self justifies the study to be done by case study.

2.3 The study scope and limitation

The research problem was initiated from my practical experience and motivation coupled with finding of international consultants about the construction industry in Ethiopia. Accordingly, the study problem is streamlined from the general problem to specific project level problem hence limiting the scope of the study (Box1.1 shows this process).

Moreover, the project scope is delimited by the various models presented in the conceptual framework, the content of the research framework itself and stating the focus of the research after concept explanations of literature. Various definitions are also pinpointed to show the scope of the research.

The limitations of this research are unavailability of adequate documented information in the field of the study, low management perception of the workforce and management to audit their working environment and unwillingness and low education level of the workforce.

2.4 The research design

The research was designed in a way that makes analysis easier. The research detailed questions were grouped under one major factor to ease analysis and interpretation. Besides, on site observations were made to judge there administrative and technical management and counter check their responses to the questioner. It was said that due to limitation of data for this particular study multiple evidences approach was used for data collection. Hence the following table shows the instruments that were used for data collection.

The Research Instruments	
Secondary & primary archival source	**Primary sources**
Monthly Project reports of projects Books on construction productivity Downloadable documents on construction productivity	Structured questioner for 18 craftsmen
	Structured interview for 21 supervisors
	On site observations

Books on organizational management in construction Yearly publication from ILO,BLS and Ethiopian LL CM journals and personal reserves	On site activity sampling measurement Other countries studies

Table 2.1 Data Collection Instruments of the Study

2.5 Data source and collection

The study has used the data sources to produce the following basic documents. These are respondents' documents, observations made on site and archival documents. The respondents' documents were collected using questioners and interview with the project leaders and discussions with some interested practitioners. Observations made on site have helped me to judge the capacity of the respondents to the management world. Besides, it is used to countercheck the reliability of their response. Archival documents were mostly project reports, which are used to identify the recurrent problems in the Ethiopian building construction sector. In addition, they are used to judge the management systems that are traditionally practiced by the industry.

The projects were selected taking the fact that they are conducted by large companies because these are the ones where the introduction of productivity performance management system is beneficial. All the studied projects are made to be constructed by different companies.

Three field works are conducted to 11 project sites in Addis Ababa. These are:
Phase one: I introduced my self to the study population and collected some project documents and reports.
Phase two: It includes data collection from primary sources using structured questioner, interview, and on site observation.
Phase three: It includes data collection for some projects which reacted lately and clarification of responses on some projects.

Item	Research Instrument	Field travel1	Field travel 2	Field travel 3

1	Questionnaire	20%	30%	50%
2	Interview	40%	10%	50%
3	Observations	80%	20%	-
4	Archival documents	60%	40%	-

Table 2.2 Research Instrument Accomplishments in three Field Travels

Data collection and its processes for the three field travels are presented in the above table. Data collection part of the research is the most tire some part of this project. It is true that there is little data in my field of study but the most difficult one is the respondents' reluctance to react as per their promised schedule. The time schedule that was allocated to the research and respondents reluctance not to respond quickly made the research stressful for the period of data collection.

Questioner: out of the total 11 projects only 7 projects respond to the structured questioner and interview which makes the response rate 63.6%.Scrutiny of the filled out questioner revealed that only the 6 projects questioner was properly filled and used in the analysis as the response from one project seems to be filled carelessly. The total number of questioner for one project was 6 which make the total effective respondent number 36.

Interview: Interview was conducted with 5 project managers based on the structured interview guideline and detailed descriptions to support it. The response they provide is appropriately taken down as short notes. However, two of the project managers preferred to give written responses and as such used in the analysis. Hence the responses of the total of 7 projects were taken into consideration to trap information on management systems and technical factors.

Observations and archival documents: Documents which are important for the study such as project reports were referred .Besides, information on the standard productivity use, their team management, their actual performance and communication for the three trades

was observed on site. The researcher also observed the different schedules actually used on site, their material management system and other administrative on site matters.

2.6. Research Processing

Analysis and processing of research involves examining, categorizing, tabulating, testing or otherwise combining mixed evidences to address the initial problem statement. The analysis of the data depends on the specific research problem and question. The research instruments were designed properly to ease examining, categorizing and tabulating the research responses. The research questions are given weightings for the different responses both for interview and letter questioner.

No	Type of Instrument	Weight of the Different Responses			
		Very often	Often	Sometimes	None
1	Letter Questioner	6	4	2	1
2	Structured Interview	6	4	2	1
3	Ranking questioner	Not applicable			
4	Questions on hard facts	Not applicable			

Table 2.3 Weight used for the Different Instruments

Responses for similar questions are aggregated by the following formula considering the above weightings (used in [23]).

$$MS = \frac{6(Vo_n) + 4(O_n) + 2(St_n) + 1(No_n)}{Vo_n + O_n + No_n}$$

Where; MS= Mean score; and Vo_n = Number of respondents selecting very often

O_n = Number of respondents selecting often

St_n = Number of respondents selecting some times

No_n = Number of respondents selecting none

The mean score of responses obtained by the above method is again collected and averaged to get the general opinion of respondents under a part of the questioner. Responses obtained by the above method are again classified based on the following criteria for interpretation.

Average score ranging:	$0 \leq MAS \leq 2$;	Poor performance
	$2 \leq MAS \leq 4$;	Low performance (Unsatisfactory)
	$4 \leq MAS \leq 5$;	Satisfactory performance
	$5 \leq MAS \leq 6$;	Good performance

Where; MAS = Mean score value of the subtitle being analyzed in the discussion report and the numbers are score values.

The following factors were taken while setting the above interpreting criteria.

- *The perception of the construction workforce and management to the management world.*
- *The gap that was observed from the face to face interview, observations, hard facts and the questioners.*
- *The effect that people feel (Hawthorne effect) while judging their site top management.*
- *The feeling by the site management that our reputation will be in danger.*
- *The education and motivation level of the taskforce and the management.*

A simple descriptive stastics was used to show the characteristics of the projects and workers developing the case study context which is included in the discussion part. No inferential stastics was used during the analyses but while interpreting, the correlations (association) of data collected for productivity results, processes and preconditions were observed.

2.7. Writing of the Research

The research contains three main parts. These are the research proposal (RP), the literature review part, and the final research writing. The research proposal writing was already taken place but later it was refined to produce the research basic information. The literature review part took the longest period of the research during this different documents collected were tested against the research objectives and relevant information were taken. Finally all the notes take down are linked down to produce a document; the differences in perceptions between authors being noted down. The final research part was written after analyzing all primary and other support documents to test the actual existing situation of the construction industry towards the research objectives.

The recommendation and conclusion part was written after analyzing the gap between the conceptual framework and the research. The total report being a little bit large, I classified the document into the following parts for final presentation.

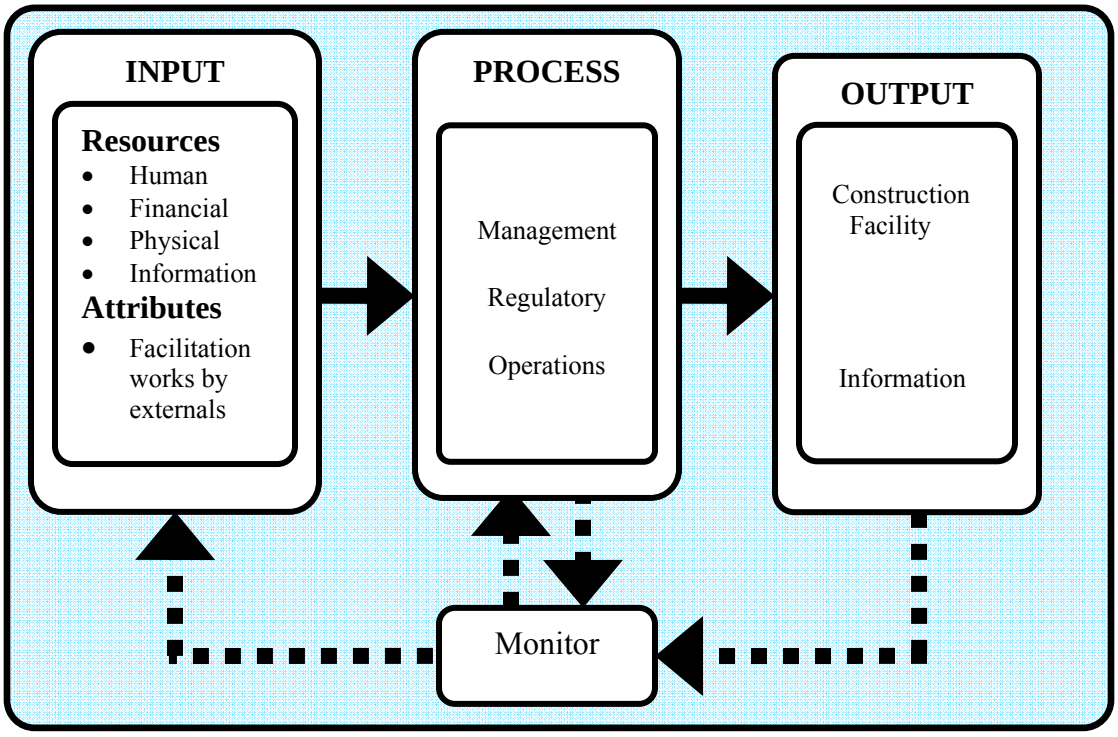
Part I The research basic information containing one introductory chapter
Part II The research methodology containing one chapter
Part III The research conceptual framework containing three chapters
Part IV The research analysis and discussion part containing two chapters
Part V Recommendations and Conclusions containing one chapter

The Research Conceptual Review

Chapter 3. General Description of Performance

3.1 Construction Project Management

Before we directly enter into construction performance, it is better to understand what construction project management mean. Construction management is a discipline that deals with the management of construction projects[1] from their inception to their completion with the aim of achieving projects within budget, time and quality. Besides when the term construction management is used for project delivery system, it represents the owner for managerial decisions related with the project. Construction work, like any other work, involves the systematic integration of various resources such as human, finance, physical resources, information and attributes that are used to achieve transformations of input to output. The key to productive work is appropriate planning for such transformations [2]. The construction work like any other work can be conceptualized using Input – Output model as:



Box 3.1 The Construction Work Model (Modified From [32])

1. Project is some form of human activity that has a beginning, a productive middle phase and an end, created something that has not previously existed [53].

Unlike other works, construction works are often conducted by project shop configurations. Due to a unique[2] nature of such configuration management needs additional competence to improve their productivity. Competent management performance can be engineered just as we have learned to engineer the structures we erect. Every construction project can be improved provided that management knows what to improve and how to improve it [7].

The central concept for competent management is better information. To improve performance, above all other things, contractors need to focus their attention on how they collect, interpret, and act on jobsite information [7]. But good information does not just pop out of a construction job. It requires a systematic effort to collect, analyze and make sense out of it.

As this study deals with one of the dimensions of performance, productivity, it is essential to deal a little deeper by what we mean performance and as related to construction.

2. Projects are introduced wherever they are required, Subject to local conditions and environments, unique design, different managerial style at different phases and usually produce a huge product which makes it unique from industries that produce a large quantity of products having similar design.

3.2 Construction Performance

Performance can be defined as a means to represent accomplishment through subject and object relationships and metaphors [17]. Accordingly construction performance can be defined as a means to represent accomplishment through activity or method relationship and their output.

Others define performance as a concept that is very closely linked a company's competitiveness[3*] [54].

Alfeld (1988) defined construction performance as a ratio of accomplishment measured in terms of their value and methods measured by their cost[3] [7].This definition is similar to the above except that performance is delimited by a qualifying criterion, cost[4]. For the purpose of this thesis the definition given by Alfeld (1988) is modified as:

Construction performance is a ratio of accomplishment measured in terms of their value and methods measured by their cost for a constant price recovery factor[5].

Performance require the integration of methods and their accomplishments; that is, worthy performance can be valued when their cost for methods do not exceed the value of their accomplishments. In managing construction work, we look to maximize the worth of the job. Competent individuals create worth by creating valuable accomplishments while minimizing costly methods. Performance is directly proportional to accomplishment and inversely proportional to the cost of methods; that is, performance is not only dependent up on how much we put into the effort, but also on how much we are able to accomplish.

3*.Note that competitiveness, performance enhancement, can only be created by providing level ground for competitors

3. Alfeld considers performance from the economic side of it only. This is not wrong from the stand point of business management but for public projects performance may be assessed from political, social or technological perspectives.

4. Note that productivity is related with cost. The object of improving productivity is to minimize lost hours which cause overburden cost on the project.

5. Price recovery factor is the ratio of output price to input price.

Therefore there is a need to separate accomplishments from methods in job site performance [7]. Contractors can improve performance either by raising the value of output or reducing the cost of the method with out price recovery.

Performance must not be confused with business strategies[1] and decisions, which are major factors in business success in their own. Performance is the ability of an organization to implement a chosen strategy. However, with in the frame work of business strategy, performance comprises many innovative, process level decisions and choices and is much more extensive concept, thus provides many opportunities for profitability. In summary it can be said that performance is one of the factor that contributes to the profitability of a certain company.

3.2.1 Performance and Its Key Indicators

Monitoring company performance has traditionally been associated with accounting, and the purpose has been to determine a company's financial success. Success has been judged via comparison to previous results using various key indicators such as return on investment, turnover, gross margin and net profit. However, success in projects shall not be measured only by financial performance; others[2] should be considered. This problem leads to creation key performance indicators for organizations and their measurement, hence performance measuring systems [3](PMS).Essentially performance indicators are designed to allow performance to be measured in the areas they cover and to facilitate benchmarking for continual improvement.

Performance indicators may be classified based on areas and are called key performance areas or by their scope from the level of the national economy down to individual [54].

1In this context business strategies means strategies connected with market strategies, which may include Promotion works, pricing policy and others.

2 other areas of performance include product quality, customer satisfaction, employee satisfaction, process performance and others.

3 PMS are often, in practice, group of key indicators that are used to monitor different areas of operations in an organization.

Pickrell et al (1999) had divided the construction key indicators into seven as follows

1. Time	3.Quality	5.Client changes	7.Safety & health
2. Cost	4.Client satisfaction	6.Bussiness performance	

Table 3.1. Construction Key Indicators by Pickrell [54].

Alfeld (1988) has classified performance indicators into three areas of quality, quantity and cost. He further broke down the key factors in to detailed factors (Table 3.2).

No	Key Performance Indicators	Detailed Performance Indicators
1	Quality	Accuracy
		Workmanship[1]
2	Quantity	Productivity[2]
		Schedule
3	Cost	Manpower
		Materials, tools and equipment

Table 3.2 Performance Indicators by Alfeld (1988) [7]

The 2001 report of construction documentation of U.K has identified ten key performance areas (Table 3.3).

Client satisfaction Product	Time predictability
Client satisfaction service	cost predictability
Defects	Profitability
Construction cost	Productivity
Construction time	Safety & Health

Table 3.3 Performance Indicators [54]

The focus of this study is not on the measurement of the total performance of the construction, but on one important dimension of performance, that is, productivity.

1. Workmanship measures the capacity of craftsman to accomplish a task aesthetically
2. Productivity is one of the parameter of performance and it has relations with most performance indicators such as schedule, quality, safety as included in this research instruments.

These key performance provide us strategic areas for identifying detail performance indicators to be measured and managed, hence paves the way to performance management. Performance management is a preferred option for large contractors, who manage a large amount of workforce and complex projects. In such projects management do not have close contact with every job, hence lacks performance information to make decision. This gap is filled by the collection of measured data.

performance management might not benefit contractors having small jobs ,few in number consisting of unique installations (specialty contractors).Yet if the work is repetitive or requires many man hour measurements may well help pin point opportunities for improved performance. The focus of this research is on large contactors managing relatively large construction projects and workforce.

3.2.2 Comparison of performance and Traditional Management

The productivity performance of construction workers can be shown graphically as below where the vertical axis plots number of workers and the horizontal axis plots their performance.

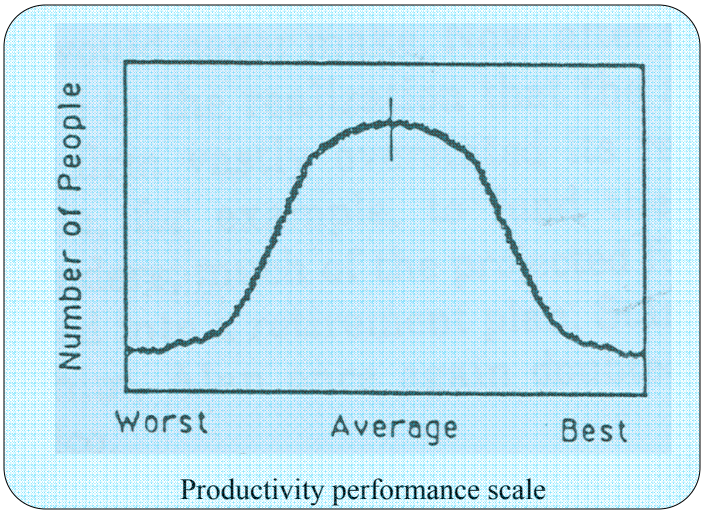


Figure 3.1 Distribution of Productivity Performance of Workers

From the graph in the box it can be seen that some people will be at one end, some at the other, most in the middle. This has led to two management approaches to increase the performance of construction workers [7] .These are:

a) The traditional management approach which focuses on lower productive workers.
b) The performance management approach which focuses on the best workers for benchmarking.

Traditional management approach: It is the usual approach to focus on the worst end of workers in the traditional approach. Foreman often come down hard on workers and crews which they fell to perform well. The effect of this kind of management is to push the few worst end workers to the average hence increasing number of average workers and crews but more average workers are not motivated to the best performers (Figure 3.2).

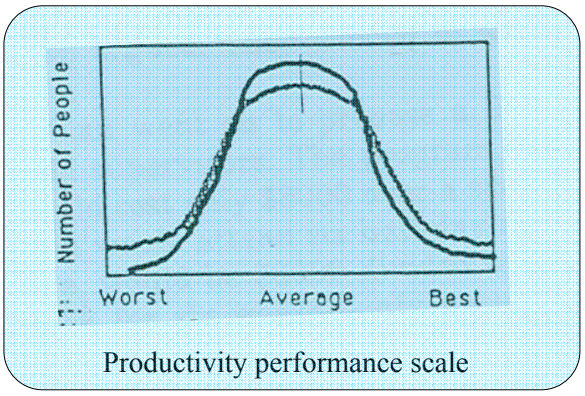


Figure 3.2 Effect of Traditional Management on Productivity Distribution Curve of Workers [7]

The performance management approach: It is a management approach by which the performance of workers is measured and improvement is made by learning working methods from the best workers (Benchmarking).Two things should be done for this approach to be effective .These are accurate work measurement to identify exemplar workers and crews and studying these workers to learn their working methods. The effect of this management approach is to shift the majority average workers to the best, hence producing positively skewed performance distribution curve. It has also the effect of improving poorer performers to the average (Figure 3.3).

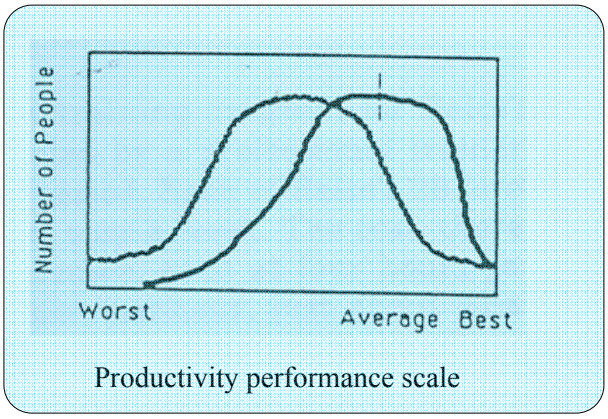


Figure 3.3 Effect of Performance Management on Productivity Distribution Curve of Workers [7]

The overall focus of this study is on the performance management approach which includes performance measurement and benchmarking taking productivity as a parameter to be studied.

Chapter 4. Productivity and Its Measurement

4.1 General

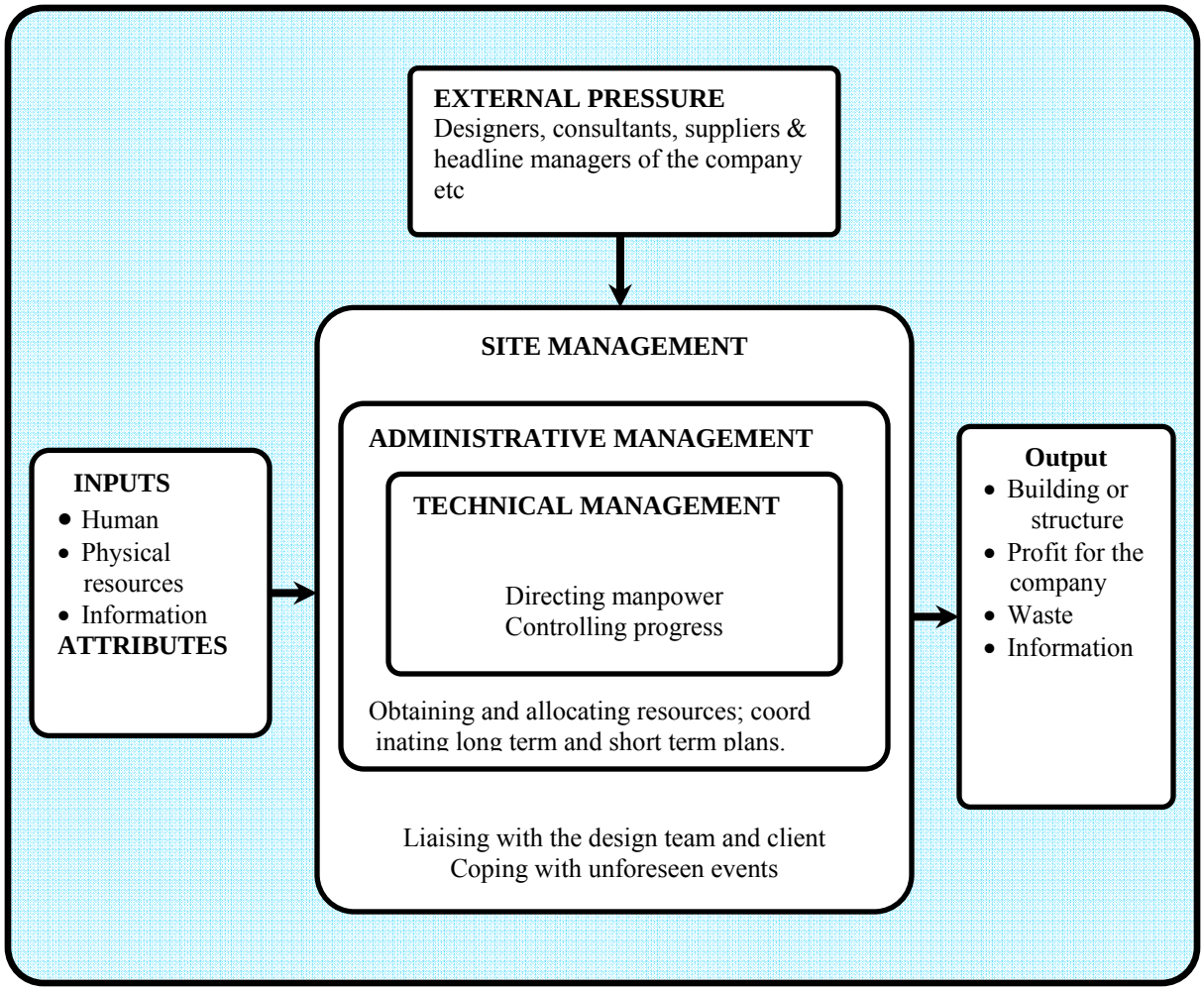
One way of looking at productivity in any business organization including construction firms is to think in terms production model on chapter 3.Essentially, productivity is a performance indicator which measures the efficiency of construction firm to convert input resources (labour, materials, equipment, etc) into outputs. Like performance, productivity can be defined, measured, analyzed and interpreted according to the objectives of the different level management.

At strategic[1] level the criteria for the measurement of productivity are profit margin, market share, reputation, employee satisfaction and etc [32]. This kind of criteria is related with effectiveness. At tactical level productivity is measured by using efficiency as a criteria and hence defined as the ratio of the quantity of goods or services produced and amount of resources employed in turning out these goods and services (Solomon) [Cited by 2]. This kind of measure is developed to measure the efficiency of the whole firm or organization.

At operations level productivity is measured by using efficiency as a criteria. The only difference from the tactical level is that it measures the efficiency of certain operations or activities in the firm.

The above analysis is based on the model on chapter 3 which is developed considering the whole construction work at accompany level. But the focus of this study is on construction project sites; hence another model applicable for this condition is necessary. Fryer [Cited by 61] has developed a model of construction site, which can be used to visualize the different productivity levels in the construction site.

1. The term came about to represent a planned framework for achieving a military mission. It is the art of planning operations in the war, especially movement of armies in to favorable position for fighting. In business it is the technique of fitting organizational objectives to the environment to utilize opportunities and threats in it. It may be strategic fitting or stretching.



Box 4.1.System View of Management of a Construction Site (Fryer, 1990) [61]

The system provides a strong emphasis on the manager's duty to deal with designers, consultants, suppliers, clients and company line managers, which are similar to most organizational behavior function in many system models. Fryer sees the outer environment of the construction site as pressure from consultants, designers, clients, etc, which is more limited than the outer environment of the company.

4.2 Measures of Construction Site Productivity

As the final aim of this study is to improve construction productivity, first we have to know the magnitude and area of the problem existing in the site, this can best be done by measurement. Measurement whether it is qualitative or quantitative reveals important

information for management. In the context of organizations, measurement is a method of knowing where an organization is now, to help it plan where it wants to go and to tell when it has arrived there (Chang & young) [60].

We have said that the value of measurement is to produce information for the management to act upon, hence first we have to know the purpose of the measurement and secondly we have to identify the managerial level that is going to use the final processed information. Thus the parameters of measurement vary with purpose and level of management; the same is true for construction productivity.

Construction productivity measures can be divided into two depending on their purpose [32]. These are:

a) System based productivity measures
b) Goal based productivity measures

System based productivity measures: These are measures which show the efficiency of the total project in turning all inputs into output. Thus they provide a ratio between the total outputs of the project to its inputs. System based productivity measures are good indicators of the efficiency of organizations hence they can be readily applied for external benchmarking. In addition it is easy to interpret such kind of values.

In system based measures, it is not possible to measure intangible inputs and outputs, hence more practically; this term is also called multi factor productivity. Besides the data requirement of such measures is enormous and hence it has a limited use as a measure of efficiency. This leads to the application of other measures, which emphasis on certain goals.

Goal based productivity measures: These are measures that are used to measure the efficiency of a certain productivity factor comparatively. Deploying the different input and output factors it is possible to create a variety of goal based measures. They are of many kinds but the most usual goal based productivity measures are labour productivity and capital productivity.

The advantage of these kinds of measures is that it requires few input factors to be measured, hence reduced cost and time for data collection and analysis.

Goal based measures dose not absolutely measure the productivity of the selected factor hence needs standards to measure the productive efficiency of the factor comparatively, hence interpretation of the results is relatively difficult as compared with system based.
As the title of this study is to measure the productivity of labour in construction site, goal based measure, specifically; labour efficiency measures will be applied.

Area / Level	Total productivity	Labour productivity	Capital productivity
Site management			
Administrative management			
Technical management			

STUDY FOCUS

Table 4.1 Productivity Measurement Matrix

4.3 Labour Productivity and Its Measurement

Labour productivity is the measure of the efficiency of labour in turning input, being expressed as man hours, to out put. That is:

$$\text{Labour productivity [52, 26]} = \frac{\text{Out put (in units)}}{\text{Input (MH)}} \quad \text{---------- [Eq.1]}$$

This definition is designed to measure productivity performance and improve efficiency of workers in producing some output. Others define labour productivity as:

$$\text{Labour productivity [52]} = \frac{\text{Output}}{\text{Input cost (wages)}} \quad \text{---------- [Eq.2]}$$

Both these measures require a standard comparable to the actual conditions to measure productivity efficiency but if the company has a sound costing system the second alternative may be employed. Most other measures of productivity evaluates efficiency directly rather than using standard and actual productivity to measure efficiency.

$$\text{Labour productivity efficiency [9]} = \frac{\text{Actual units produced}}{\text{Standard units}} \quad \text{---------- [Eq.3]}$$

Or

$$\text{Labour productivity efficiency [9, 26]} = \frac{\text{Clocked time worked}}{\text{Standard time earned}} \quad \text{---------- [Eq.4]}$$

Equations 2, 3 and 4 are designed for the purpose of controlling cost and work schedule. As the final objective of this study is improvement of labour productivity at site level the definition given by equation 1 is applied for this research.

Labour is defined as a task that requires the exertion of body and mind or both [21]. Labour is an important source in productions management system including construction because it is the one that combines all the other resources namely materials, plant, equipment, and finance in order to produce the various construction products. The endeavor to control costs particularly in these hard economic times, must be geared towards better control and management of labour mainly because labour is the one resource that affects all other resources and it is most susceptible to improvement. Consultants via specifications, control material and plant costs; and profit and overhead are generally controlled by competition, then this leaves labour as one resource open to improvement [21].

Knowledge of the value of labour productivity is important for the front line supervisor to improve the productivity of its crew; the administrator manager in controlling costs and schedules and the site manager for managerial decisions in his environment. Labour productivity is also very important for the head company for many decision involving alternatives between labour and machine and to estimate competitive bid. However unlike other resources the determination of accurate labour productivity is highly uncertain if it is not supported with a continuous work measurement system. A work measurement system is a management system designed to analyze the touch labour content of operations, establish labour standards for that operation, measure and analyze

variances from those standards and continuously improve both the operation and labour standards used in that operation.

To introduce a work measurement system a construction company shall prepare a system plan for implementing, operating, and maintaining work measurement in its operation. As a minimum the plan should provide guidance on establishing and maintaining standard accuracy, conducting engineering value analysis to improve operations, revisiting standards and related system data and using labour productivity standards as an input to budgeting, estimating, production planning, and performance evaluation.

4.3.1 Labour Productivity Performance Parameters (Benchmarks)

It is important to note that labour productivity is the measure of the overall effectiveness of an operating system in utilizing labour, equipment and capital to convert labour efforts into useful output, and is not a measure of the capabilities of labour alone. Hence labour productivity can show the efficiency of labour if it is used comparatively, not absolutely. We have seen also that productivity measurement informations required also varies with managerial level (Table 4.1).Hence there is a need to establish benchmarks for lower level measures to monitor single activities and higher level measures to gauge project and industry wide performance.

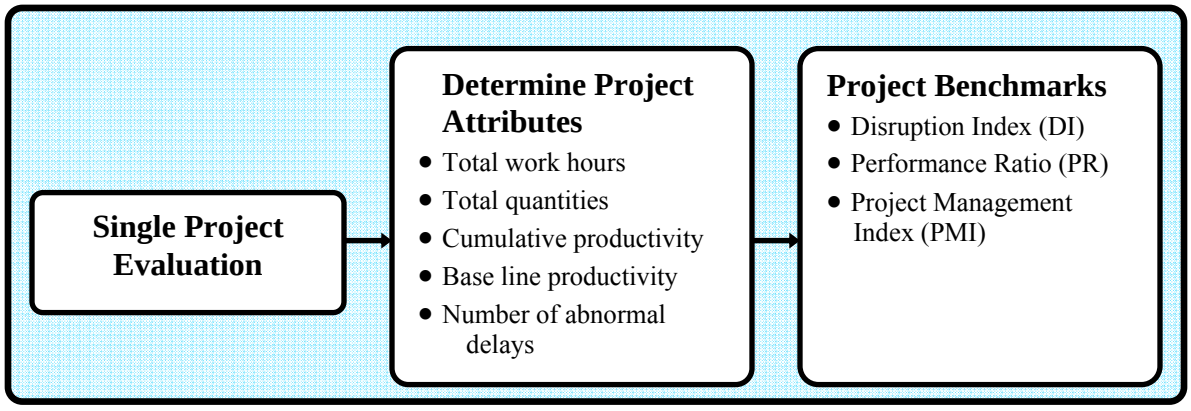
For continual assessment and improvement of labour productivity at any managerial level, it is advisable to establish bench marks for the purpose of comparisons. Benchmarking is defined as "a systematic and continuous measurement process; a process of continuously measuring and comparing an organization business process against business leaders anywhere in the world to gain information which will help the organization to improve its performance" (Koskela, Osman & Abdel-Razek, Madigan, and Olomolaiye) [cited by 42].Benchmarking can be internal, external, classic, traditional, process, performance, functional, strategic or a combination. The idea behind each is the same; to identify measure, compare, perform gap analysis, adapt and implement new ideas [42].

In construction there are two commonly used benchmarks that use labour productivity as a major input. These are:

a) Project level labour productivity benchmarks
b) Work team (Crew) level labour productivity benchmarks

Project level labour productivity benchmarks: These are labour productivity benchmarks that are designed to compare the efficiency of one project with another. Essentially, the benchmarks are external to the project and can be used to compare the efficiency of any two projects working over comparable conditions, often projects under the same corporate management.

The commonly used model in project level labour productivity benchmarks is the site based model of Thomas and Zavrski [cited by 42]. This model was an analytical approach to compare labour productivity in one project to that of another. The elements of the model are:



Box 4.2 Single Project Evaluation Model (Thomas) [cited by 42]

Unlike others Thomas has defined productivity as the ratio between work hours and output. That is:

$$\text{Labour productivity} = \frac{\text{Working hours}}{\text{Output}} \quad \text{---------- [Eq.5]}$$

In addition he made his investigation based on project resources and factors that inhibit construction progress such as congestion, sequencing, weather and rework. Thomas

established benchmarks on disruption, total labour performance and management contribution and he defined his benchmarks as below.

Disruption index (DI): This is an index which measures the amount of lost work days in the construction life of a project or activity. It is calculated as:

$$\text{Disruption}^{1}\ \text{Index} = \frac{\text{Number of abnormal (Disrupted) Work days}}{\text{Total number of work days}} \quad \text{-------- [Eq.6]}$$

Performance Ratio (PR): This is an index that helps to measure the productivity of the exemplar performance. The lower the value, the more productive the exemplar performance. It is calculated as:

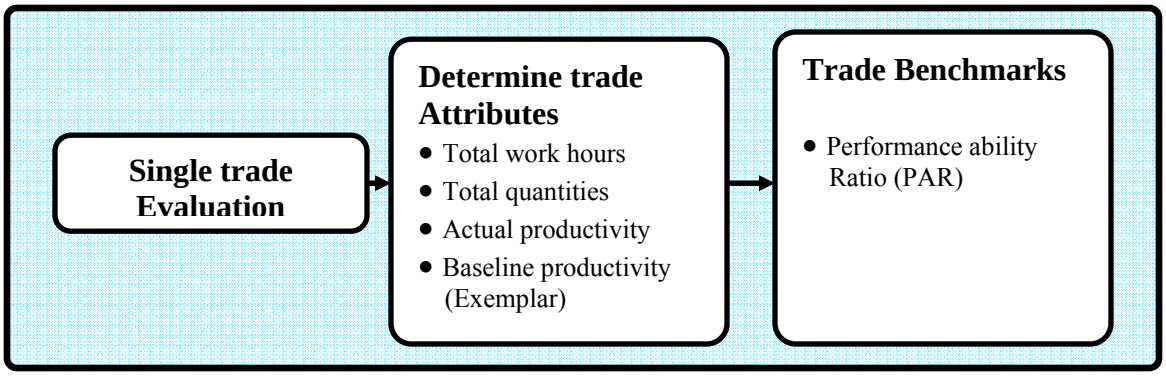
$$PR = \frac{\text{Cumulative productivity}}{\text{Expected baseline}^{2}\ \text{productivity}} \quad \text{---------- [Eq.7]}$$

Project management Index (PMI): This is a dimensionless parameter that reflects the contribution of project management to the cumulative labour performance on the project. The lower the PMI, the better was the project management's influence on overall performance. It is calculated as:

$$PMI = \frac{\text{Cumulative Productivity-Baseline Productivity}}{\text{Expected baseline Productivity}} \quad \text{------- [Eq.8]}$$

Work team (Crew) level labour productivity benchmarks: These are labour productivity benchmarks that are designed to show the efficiency of a work team or trade by comparing the with the best work performance through its past activity life. Essentially, these kinds of bench marks are internal and can be used to evaluate the productivity performance of a work team against its best achievement in the past. These are also benchmarks that this study uses. Alfeld has used these measures to evaluate crew performance and for continual productivity improvement.

1. Disruption is temporary stoppages of works due to bad weather, poor work sequencing, congestion or lack of resources in which the total productive time during the cause is only 50% of the normal productive time.
2. Baseline productivity is the best performance that a contractor can achieve for a particular design. It is a productivity of labour when resources are available and disruptions are practically minimal.



Box 4.3 Work team Performance Evaluation Model

This model unlike the above (Box 4.2) defines labour productivity as stipulated in equation No.1 in section 4.3 and it is used to asses the productivity of the studied trades for this study. That is:

$$\text{Performance ability ratio (PAR)} = \frac{\text{Standard performance}}{\text{Actual performance}} \quad \text{---------- [Eq.9]}$$

The higher the value of PAR; there is high potential for a work team to improve its performance where as the lower value shows that the trade work is performed efficiently. A PAR value less than 1 show that the actual performance is grater than the exemplar hence this actual performance will be the next exemplar for future works. But to apply the above concept for productivity improvement we must make the working practices of the trade under consideration be comparable. This can be made by establishing standard working practice and standard productivity for the trade under consideration. Hence the following section discusses how we determine trade attributes particularly standard productivity before the introduction of performance based measurement and on site actual productivity rates.

4.3.2. Labour Work Methods Development

Productivity standards are essential components to determine the performance ability ratio of trades. However, before the project management establishes productivity standards it must decide what work methods will be used in the production process [56].

Development of standards work methods needs revisiting the existing production methods to identify and describe the existing methods to minimize unnecessary motion which significantly reduce workers' productive time. Past experience and experimentation have provided a general classification system for method analysis, which greatly facilitates formulation of workable solutions. The first phase of method analysis is to study the work being performed at a single work station or interrelationships among several work stations [56].

According to their scope method analysis is divided in to two. These are:

a) Intra work station method study
b) Inter work station method study

Intra work station method study: This is a method study which studies the movement of man and machines at a single work stations [57].Here the analysis is highly detailed and concerned with the minutest aspects of the task. In the description and analysis of intra work station tasks, the work methods are often divided in to three general categories:

1. Single operator, using only hand tools
2. Single operator, using a single machine
3. More than one operator or more than one machine

For each of these categories there is a separate approach, but all three approaches are actually variations on the same theme. All provide a means for delineating the sequence in which elements of work are accomplished by each significant work performer under study. In the case of the single operator using hand tools, the significant work performers are his two hands and hence a standard chart called *operator chart* or *left and right hand chart* are used [56].

In the case of the second intra work station tasks involving machines, the significant work performers are the operator himself and the machine .Accordingly the *man machine chart* is used for method description and study [56].

In the case of the third intra work station tasks involving a combined effort of man and machines a chart shall be prepared for each man and machine to describe and study the task; such kind of chart is called *multiple activity analysis chart.*

Inter work station method study: This is a methodology which studies the movement, flow, of a material or semi processed product from one work station to another [56].Here the analyst approaches the existing work by taking bird's eye view, or "big picture" perspective of the production process.
The most appropriate descriptive form for this kind of conceptual method study is *the process* chart [56],[57].This chart presents the overall picture of the production process, each step of the production process being divided into *operation, transportation, storage, inspection and delay* [56].

This study dose not research the work methods of the production trades in detail how ever it stresses the fact that for effective performance management the productivity standards shall be developed by applying efficient and consistent *procedural methods or standard practice*, which are the basis for establishing labour productivity standards. More over it should be known that development of standard and new work methods improve productivity by reducing unnecessary motion and energy.

4.3.3 Labour productivity standard development

It is mentioned that work measurement is one approach that leads the way to good performance management. Work measurement involves the use of productivity standards to measure and control the time required to perform a particular task or a group of tasks. Productivity labour standards are measures time it should take for a qualified worker to produce a fixed quantity of a particular operation [3].

With out reliable and accurate productivity estimates, it would be impossible to improve existing operations and management or effectively plan new ones, decide on layout and routing considerations; or design new work methods. In addition without appropriate productivity data, the efficiency of work and resource scheduling would be in doubt.

These data are also some times used as a basis for product design, work sequencing and workplace design. But it should be recognized that the form of labour productivity standards varies with the purpose of the measurement. Accordingly labour productivity standard forms can be displayed as shown below:

No	Forms of Labour Productivity Standards	Purpose of Labour Productivity Standards
1	Expected (average) labour productivity standards	Used primarily to judge efficient work Methods and work area layouts
2	95 th percentile labour productivity standards	Used primarily to balance a paced production by labour; production equipment where material shortage is improbable
3	Expected (average) labour productivity Standards plus some allowance for non-working time	Used primarily for labour cost estimation, delivery time quotations, scheduling and as an initial productivity improvement standard.

Table 4.2 Forms and Use of Labour Productivity Standards [6]

Besides, according to their development labour productivity standards could be divided into two. These are:

a) Engineered productivity standards
b) Non-Engineered productivity standards

Engineered productivity standards: These are standards that are developed using recognized principles of engineering and work measurement [6].The standards developed define the time necessary for a qualified worker, working at a normal pace[1], under capable supervision, and experiencing normal fatigue and delays, to a defined amount of work of a specified quality when following the prescribed method [2].

An engineered standard contains two basic elements; these are normal time, which is the timed cycle time of the job for a normal worker; a personal, fatigue and delay (PF&D) allowance. Its standard development consists of three stages; these are analysis phase in

which the job is divided into convenient, discrete components, commonly known as elements; measurement phase in which the specific measurement technique is used to establish the time required to complete each element of work and a synthesis phase, in which the various elemental times are added, together with appropriate allowance, to construct the standard time for the job. For the purpose of developing standard productivity the amount of task accomplished during the measurement period shall be known as well, which will yield the standard productivity when divided by the standard time.

There are three commonly used methods to develop engineered standards; these are direct time study, predetermined data, and work sampling [6].

Direct time study: Direct time study is the approach most frequently employed to set labour output standards by observing the work of a single operative for short timed cycle tasks. The rationale for using direct time study rests on the assumption that a valid output standard can be estimated by observing a single worker performing a particular task provided of course that he has sufficient skill to perform the task and that he works according to the standard method developed by method study.

That is:

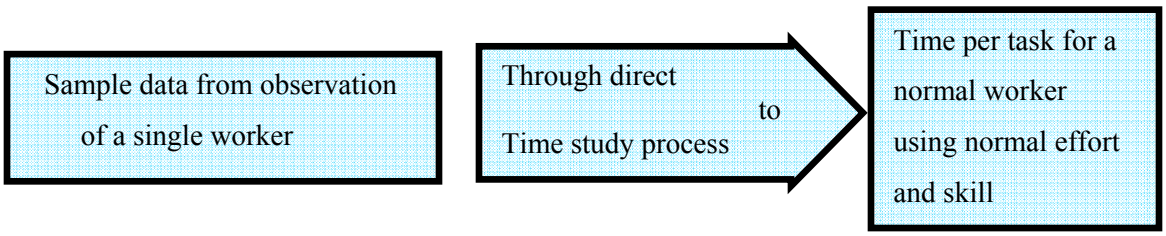


Figure 4.1 The Essence of Direct Time Study [57]

Determination of labour productivity standards by direct time study involves the following steps, as discussed in the order below.

Data collection: The first step in preparing direct time study standard is to record the work conditions associated with the task. This information usually consists of a sketch of

the work place layout and detailed description of work method being used, including all tools, fixtures and materials. The description of how and what conditions a task is performed is called a standard practice.

Determination of task elements: Once standard practice is recorded, the task must be analyzed into units of motions involved in the work performance; these units are commonly called elements. Task performance analysis is required in order to identify the component parts for timing purposes.

Determination of sample size: we know that it is clearly impossible to determine the task performance rate of an average worker by training an entire labour force to do a particular job, timing them at normal pace, and then computing the mean performance rate from the data so derived. What is needed is a method of estimating normal performance with only a modest expenditure of time and money; hence this is possible by the application of sampling techniques. Thus methods shall be developed to increase the accuracy of data so to be collected. This is possible by increasing number of observations by optimizing the amount of energy and expenditure required to collect the data. Accordingly earlier practices have developed two methods of determining sample size of observations. These are:

a) Stastical methods approach
b) Standard practices approach

A stastical method approach: In an attempt to eliminate the need for judgment in this phase of the time study procedure, a stastical approach has been proposed for use in the determination of the number of work cycles to be studied. The reasoning which justifies this approach is that an operator who is performing a given element of work at a fairly constant pace will not always complete that element in exactly the same length of time. This is because their will be chances variations in the operator's motion pattern and pace and in the position of materials and tools which the operator works. As a result in the long run, the operator will generate distribution of elapsed times for the element under

consideration. Accordingly the number of observations required for a certain level of confidence is calculated as:

$$N' = \left[\frac{Z\sqrt{m\Sigma X_i^2 - (\Sigma X_i)^2}}{D\,\Sigma X_i}\right]^2 \quad \text{[Eq.10]}$$

Where Z= constant which reflects the probability requirement

D=maximum percentage deviation from the population mean which is acceptable and reflects an established accuracy requirement

For a 95% level of confidence, we have:

$$N' = \left[\frac{40\sqrt{N\,\Sigma\,X_i^2 - (\Sigma X_i)^2}}{\Sigma X_i}\right]^2 \quad \text{[Eq.11]}$$

Where X_i is the i^{th} observation for a particular element, N is the number of cycles observed up to this point; ΣX_i is the sum of all N of the X_i measures, and N'is the required number of cycles that should be observed.

A standard practice approach: The other method that is commonly applied to determine the size of observation required is the empirical method that is developed by different practitioners. These practitioners use number of cycles per year and cycle durations as variables which determine the number of observations .Different companies have recommended their empirical methods but the most notably one is the one that is recommended Ronald press company in America [cited by 6].

Determination of select time: Following the determination of elemental tasks and in parallel with deciding number of observations the analyst shall determine the time required by a normal operator to accomplish each elemental task by decimal stop watch. After each elemental task has been timed for the selected number of observations, then the analyst should decide on the representative cycle time. To do this he simply computes arithmetic mean of the times recorded for each element .However before calculating the average cycle time the data connected should be evaluated for its consistency. The average observed time for each element is then recomputed with out these unrepresentative times, and the new mean is called the select time. The select time for an

entire task may then be computed by finding the sum of the select times for all elements of the task.

Rating the operator performance: Rating the performance means determining the efficiency of the operator at the workplace. The efficiency of any operator to do a certain task depends on the skill; effort and difficulty of a work. There are number of rating systems that are developed in different practices. However the most commonly used rating systems are [57]:

1. Tempo rating
2. Objective rating
3. Westinghouse system

Tempo rating: This is a type of rating system in which the analyst concentrates on the rate of movement of the operator to determine his efficiency. It can be used bas a basis for ascertaining the efficiency at which something is being done because of the relationship which exists between tempo and efficiency. The nature of this relationship is that when an operator is being timed while following prescribed method, the elapsed time for a given element of work will be inversely proportional to the operator's rate of movement, tempo. However, before he can react to the tempo he observes, the analyst must know what a normal tempo mean. Normal tempo will not be the same for every job, because it is affected by the difficulty of the task.

Objective rating: This is a system of rating that is similar to tempo rating except that documented standards are developed from long term experience. The rating is based on two factors; one is observed pace, and the other is job difficulty. In so far as job difficulty is concerned, the system requires that the analyst describe each element of the job being studied in terms of six categories of job characteristics. These are: amount of body used, foot pedals, bimanualness, eye hand coordination, handling requirements and weight [57].The most commonly used one is the one that was developed by Marvin E.Mundel [58].

The Westinghouse system: This system calls for taking four factors into consideration. They are (1) the skill with which the operator performs an activity, (2) the effort which

the operator expends, (3) the condition under which the study is being made, and (4) the consistency of the operator's elapsed times [57]. Skill is defined as the proficiency at following a prescribed method; effort, as the will to work; conditions, as the environment in which the operator is working while being studied, as compared with what the environment usually is; and consistency, as the degree of uniformity in the elapsed times for a given activity.

For a number of reasons, there is no certainty that this system of performance rating will yield accurate results. However, it is just as important to realize that the thousands of organization s which have used these methods to develop millions of time standard have found that with relatively few exceptions, the resultant standards have been sufficiently accurate to satisfy their needs and demands of their employees for reasonable standards.

Determine normal time: Having timed the operator and estimated the operator's efficiency, the analyst can now go on to calculate the normal time for the task.
If elemental rating approach was employed, each elemental average elapsed time is then multiplied by the corresponding performance rating factor to obtain the elemental normal time, and the elemental normal times are added to obtain the total normal time for the task where as if the overall rating factor are employed, the total normal time calculated by multiplying the sum of the elemental average elapsed time by the overall performance rating factor.

Determine the allowance time: Normal time is a fair measure of production output provided all external factors are ok. But for the actual operations, there are factors which affect the productivity of workers external to the job; these external factors must be handled by means of "allowances". Delays that are caused by these external factors are nor controllable by the worker being studied and are called unavoidable delay. There are two methods of estimating allowance times for standard development. These are:

1. A production study
2. Work sampling

No	Unavoidable Delay Type	Examples Of Causes	Study Method
1	Delay which the operator cannot control	Equipment break down, Waiting for instruction, Waiting for materials & supplies, returning unn cessary materials, etc.	Production study, Work sampling
2	Irregular work elements	Preparing work place, reci eving and giving instruction etc.	Production study, Work sampling
3	Contractually allowed rest periods	Tea breaks, personal time ,etc	Production study, Work sampling

Table 4.3 Table of unavoidable Delay types and their Causes

A production study: This is a method of estimating the amount of allowance time of an operator by continuously studying the operator for a period of eight hours. For this study, the job can be divided into only three elements. These are (1) unavoidable delay (2) avoidable delay, and (3) normal activity, which is any activity accounted for by the normal time. The amount of allowance to be added is calculated by the following relationship:

$$\text{Allowance factor} = 1 + \frac{\text{Unavoidable delay hours}}{\text{Normal activity hours}} \quad \text{----------} \quad \text{[Eq.12]}$$

Work Sampling: This is similar to production study except that discrete observations are made on the operator to determine the proportion, and then the time lost due to unavoidable delay. For this purpose the analyst needs to prepare an observation sheet and then makes a series of random, intermittent visits to work stations at which the task is being performed. Allowance factor calculation is similar to the production study method.

Determination of sample size: The approach used for determination of sample size is similar to the one recommended under sample size determination for time study. Applying the method of stastics the number of observations can be estimated by trial and error as:

$$N= (Z/Dp')^2 [p' (1-p')] \quad \text{[Eq.13]}$$

Where Z is a constant for a certain level of confidence obtained from table, D maximum percentage of deviation from the population proportion and p' is assumed population proportion of normal activities. For a probability of 90% and sample proportion within 15%, the appropriate equation will be:

$$N= (1.645/0.15p')^2 [p' (1-p')] \quad \text{[Eq.14]}$$

Determine the standard time: After determining the amount of time lost due to unavoidable delay, then the standard time is a calculated as a sum of normal time and allowance time.

Determine standard labour productivity: At the end of the time study the amount of task that is accomplished during the study shall be measured; the ratio of this quantity to the standard time determined above is the standard labour productivity. The standard labour productivity is the baseline by which we compare with the actual productivity to judge our productivity performance.

Predetermined data: This method of standard development is used when a large number of true estimates are needed for reoccurring work involving many similar elements [6]. Individual time studies and work studies are expensive and time consuming for such activities. Such method is also advantages as it dose not interfere with normal works as it shall be conducted in experiential laboratory. More over the standard so developed is available before the work hence can be used as an input for any managerial decision problems.

The fundamental principle of predetermined time studies is that all manual work can be subdivided into basic motion units [57].

1. The formulas in the standard development are presented to explain concepts of standard creation which are the most important tools of measuring productivity (to create full and continuous flow of productivity concept); though the standard development is not researched in this thesis due to lack of resources and time

These elements are much smaller than elements in time study and are called therblings[1]. There are two types of predetermined data. These are:

a) Microscopic data
b) Macroscopic data

Microscopic data: This method of standard development views manual work as a series of elementary motions such as reaching, grasping, positioning, etc [57]. Charts are available which list the time it takes for an average worker to complete various elementary motions. Since almost any physical task can be broken down in to appropriate listings of micro motions, these charts of micro data allow organizations to compute time estimates for tasks before they are actually performed. The time to accomplish each elementary motion is corrected for pace hence such kind of times requires correction for job difficulty and allowance factors only. Microscopic data is composed of small motions, hence building of the total activity times will need a catalog of these block times. Thus determination of the order and number of this block times need fixed speed movie. The film frame applicable to each movement could then be counted in to activity time. Then the activity time obtained will be corrected for job difficulty and allowance to produce the standard time.

Macroscopic data: This method is used when there is a large number of different short cycled jobs involving many similar activities, macro data often provide a useful method of organizing time estimation data. Macroscopic methods assume that, as between jobs done on the same machine or similar machines, certain elements are constant irrespective of the specific operation. If certain elements are variable, then systems will be developed to estimate the time of the job elements in a predictable way. This method is commonly used in synthesizing times for many types of work, cleaning and maintenance activities. Other area of application includes office and secretarial work, warehousing work, and data processing.

1. Therblings is the inverse of the name Gilbreth, which is given to memorize the inventor of this method Gilbreth.

Work sampling: This method is commonly used to estimate the amount of unavoidable delay; however with a little modification it can be used to develop standard time for labour intensive operations. The expense of using time study to develop time estimates for long cycle or infrequently of irregularly occurring activities is often prohibitive. For such activities, there is a formal, direct observation method of measurement that avoids the need for continuously observing and timing the activities of one worker by utilizing sampling techniques. This approach of work measurement is also called ratio delay study, involves randomly taking a series of instantaneous observations over a prolonged period from which activity time are then inferred.

The basic principle of this method is that the time spent on each activity is directly proportional to the number of observations provided observations are done in a random order [57].This method is also universally accepted as a good method of measuring labour productivity for long and intermittent activities such as construction [23].

It has the following advantages over direct time study.

- It is most economical as it involves discrete observations.
- It can be conducted with less competent analyst; moreover, the process of data collection will not disturb the operator as the direct time study.
- It is possible to reduce the duration of the study by increasing the number of observations in a work sampling method where as with direct time study the duration required to produce a data comparable in accuracy with work sampling is highly prohibitive

The following steps as elaborated sequentially shall be followed to establish work standards by activity sampling.

Definition of work: This is the action of defining the work of operator being studied so that the analyst could differentiate type of work conducted by the operator. Business round table has classified work types as direct work, supportive work and delay (Table 4.4).

No	Work types	Operations
1	Direct work	Productive actions, picking up tools in the work area,measurement, holding materials, inspecting for fit, all clean up, etc.
2	Supportive work	Supervision, instruction giving, carrying materials or tools, walking empty handed to get materials or tools, etc
3	Delay	Waiting for another trade, material or tools, standing, sitting non action, personal time, late start and early quit, etc

Table 4.4 Classification of Work Types and Operations for Work Sampling Study [23]

Determine sample size of observations: The accuracy of work sampling depends on the number of observations. It is axiomatic that the accuracy of the sampling process will increase in direct proportion to the size of the sample taken. The practical problem is to decide how large a sample should be taken to yield the required accuracy. The number of observations also depends on the percent of total working time occupied by the activity being observed. If the activity is more frequent, observations will be less and vice versa. The number of observations can be determined by [Eq.7] of section on determining allowance time on direct time study.

Making observations by designing appropriate formats: appropriate formats containing desirable classifications of works and definitions shall be prepared and presented to data collectors, after enough elaborations.

Determine the observed time from the data collected: The proportion of direct time can be obtained by taking the proportion of direct work observations to the total work. Hence

Observed time= (Study Duration) X (Proportion of Direct Work)

Determine normal and standard time respectively: After selecting the appropriate rating and allowance time determining method, determine the efficiency of the operator and the amount of allowance time as discussed on the section of direct time study. Then,

Normal time= (Observed time) X (worker's efficiency)

Standard time= Normal time +Allowance time

Determine standard labour productivity: At the end of the time study the amount of task that is accomplished during the study shall be measured; the ratio of this quantity to the standard time determined above is the standard labour productivity.
It is not the focus of this research to develop standards for labour productivity of various trades but the researcher recognizes the fact that for proper productivity performance management it is mandatory to establish realistic labour productivity standards which can be used as a basis for exemplar performance standards.

Non-engineered productivity standards: These are standards that are developed by simulating, estimating and analyzing past data and experience of the works [6]. Despite their inaccuracy these methods are commonly used by most construction industries of developing countries, because their development requires less time and expense and the productivity data can be obtained before entering into construction hence can be used for labour budgeting and pricing. More over some cost engineers believe that the productivity standard develop by this method is quite sufficient in accuracy for construction where there are so many assumptions. The common non engineered methods of work measurement are technical estimates, historical standards and staffing patterns.

Technical estimate: This is a method of standard development by which productivity of a worker to do a certain task is estimated from historical reports, standard data, and rough time studies in combination with the estimator judgment to produce the standard. It is usually done by experienced supervisors [6]. Standard developed by this method is commonly used for scheduling, controlling, priority ranking and costing.

Historical standards: This is a method of standard development by which productivity of a certain operative is estimated by collecting facts data of inputs and outputs and correlating them [6]. The data shall be collected for a sufficiently long period of time to represent the real trend, and the likely trend of the data for a certain future period is forecasted by applying simulation methods. The data then obtained is analyzed by applying descriptive stastics to determine the mean productivity of the operator. It is

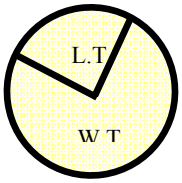
usually used for warehousing and administrative purposes but some countries[1] do also use this method to develop labour productivity standards.

Staffing pattern estimates: These are estimates that are used to asses the amount of indirect labour required for a certain construction team doing direct productive work [6]. It is based on assessing the ratio of indirect to direct personnel of past similar activities. It is commonly used for administrative purposes.

For the purpose of this research historical standard as listed in the project plan is used to determine the performance ability ratio (PAR) of masonry, concreting and steel bending trades.

4.3.4 Labour Productivity Accounting

For proper productivity management a contracting firm needs to establish a labour productivity accounting system. This involves measuring the amount of time a crew spends on a jobsite and its accomplishments. In general the amount of effective and lost working hours in a fixed paid time can be represented by the figure below.



L.T: Lost time

W.T: Work time

Figure 4.2 Amount of Work and Lost Time [7]

Clearly a contractor who can reduce the fraction of lost time each week will add hours to work time, there by accomplishing more for the same number of paid hours. Thus for a proper productivity management contractors shall account and manage the amount of lost time and the quantity of work accomplished. There are three methods of measuring lost time [7]. These are foreman delay survey, crew's time sheet and work sampling survey.

Foreman delay survey form: This is a form which tabulates the causes of delay and the amount of time lost. Often most frequent causes of work delay are printed on the form, with spaces left for foreman to add additional items.

1. The unapproved published productivity standard that was developed by the ministry of infrastructure used this method (Listed in bibliography list 14).

The form contains common causes of delay and others item for the foreman to fill up on and for each cause the foreman is expected to estimate the number of hours lost due to delay and the craftsmen involved. At the end of each week the survey forms are collected and tabulated. By correlating the reported lost time with the cause of delay, project management can take action to resolve the problem and eliminate delays (Box 4.4).

Crew's daily time sheet: Foreman reports the hours worked everyday by each individual in the crew. These hours are charged with specific work items. The total hours charged to each work item are summed, and then broken into work hours and lost hours. When ever foreman records lost hours for a work item, they also add a note to identify the cause of lost time.

Foreman Delay survey

Date: _____ Foreman: _____

Number in Crew: _____

Problems causing Delay

Problems	Number of hours	X	Number of men	=	Man hours
Rework for design change		X		=	
Rework for field error		X		=	
Rework for damage		X		=	
Waiting for materials		X		=	
Waiting for tools		X		=	
Waiting for equipment		X		=	
Waiting for directions		X		=	
Waiting for other trades		X		=	
_____		X		=	
_____		X		=	

Comments: _____

Box 4.4 a Foreman Delay Survey Form [7]

Work sampling: It offers a method to gather information about the amount of non productive man hours worked on a large construction project. The method uses random sampling techniques to determine the time the craftsmen spends at various activities through out the day. This method measures only the amount of time lost in a day only hence it shall be supplemented with craftsmen questioner to identify the full problem of low productivity.

For the purpose of this study work sampling method in conjunction with questioner is used to calculate the amount of lost time and their causes as it can be accomplished with in a short period of time; and as there was no experience in accounting lost time in Ethiopian building construction industry it is impossible to apply the above two techniques for this study.

The accounting method used by any of the above methods gives only the amount of lost time and their primary causes hence it is of little help for productivity improvement. For proper productivity management the root on site causes of low productivity should be known so that the management can easily intervene. The following chapter shows how management can identify the root causes of low productivity for continuous improvement.

Chapter 5. Productivity Improvement

5.1 General

Productivity improvement is not just doing things better; more importantly, it is doing the right things better. This section aims to identify the major factors or the right things, which should be the primary concern of any productivity improvement study.

The production process is a complex, adaptive on going social system. The interrelationships between labour, capital and the socio-organizational environment are important in the way they are balanced. Productivity improvement is how we successfully identify and use the main factors of the socio-production system. In connection with this we can identify three main productivity factor groups. These are job related, resource related and environment related [8]. This study focuses on the job related, labour related[1] and environmental related factors.

Any productivity improvement programme has a certain level influence for its application. Hence for managerial purposes the above factors may be classified as internal and external. For example, this study focuses on the above factors at operation level, more specifically project level.

In any of the production works the internal factors for production can be modeled as shown below (Figure 5.1). These internal factors can be classified as hard and soft factors, meaning, those which are difficult to change in the short period of time and those which can be changed within a short period of time. Construction works like any other production works also contains these factors to a different degree in different levels.

The focus of this study is the improvement of those factors which can be changed easily (soft), by applying the knowledge of management science and organizational management, more specifically performance based management.

1. Sometimes it is usually difficult to delineate the improvement of one factor of production from another because production work is by itself interrelated more over some factors are drivers of others hence the word related.

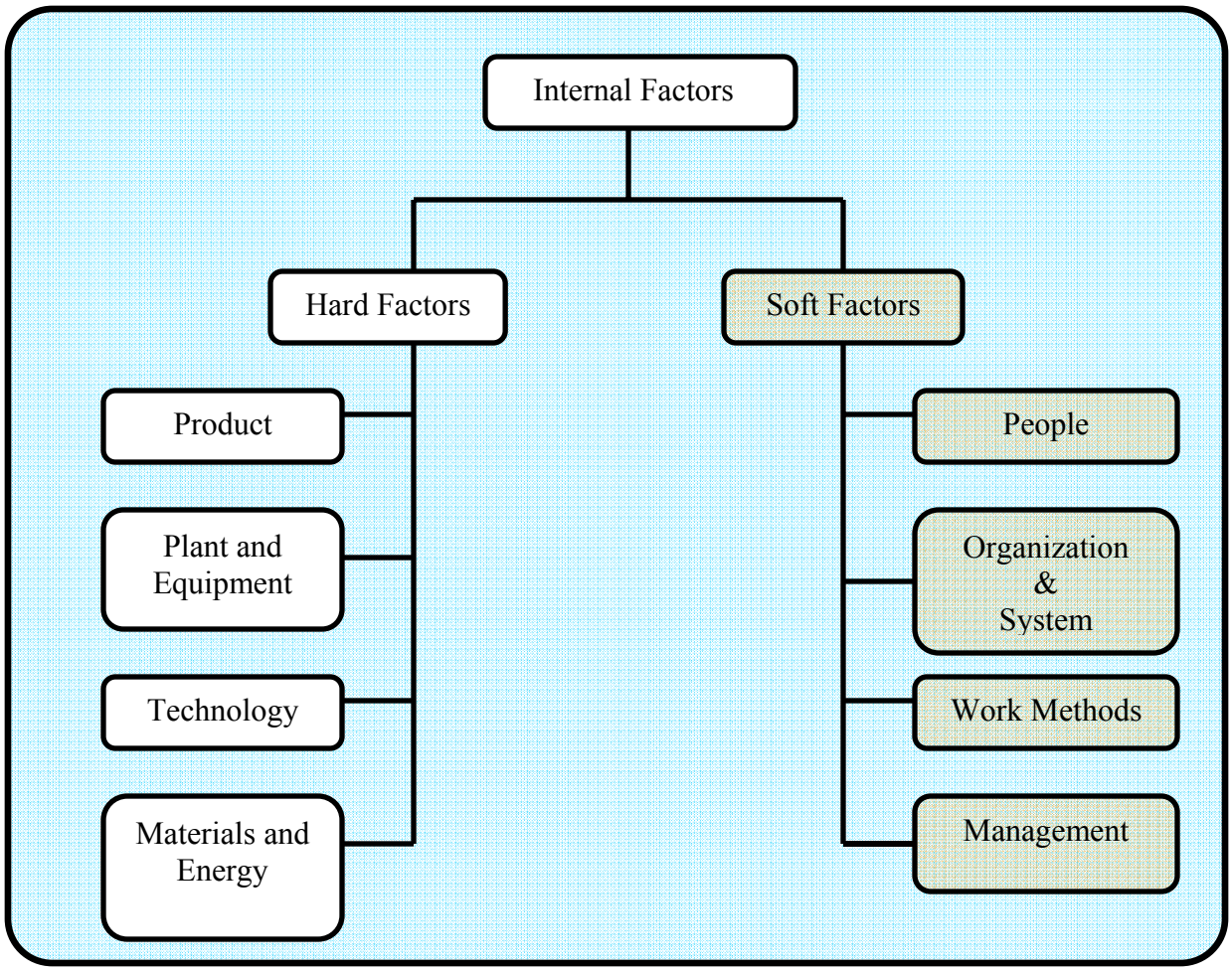


Figure 5.1.Production Factors Model at Organization Level [8]

As this study focuses on soft factors, it is essential to describe how we can improve the productivity of each factor.

People: as the principal source and the central factor in productivity improvement drives, the people in the organization all have a role to play as workers, engineers, managers, etc. The role of a person has two aspects: application and effectiveness application is the degree to which people are willing to apply labour to their work. This is explained by the law of behavior. Motivation of a person decreases if it is either satisfied or blocked from satisfaction. In order to stimulate and maintain motivation, the following should be done:

A set of values conducive to higher productivity should be developed in order to bring about changes in the attitude of managers, engineers and workers. Motivation is basic to all human behavior and to efforts in productivity improvement. Workers' success in

increasing productivity should be reinforced immediately not only in the form of money but also in providing recognition, respect involvement, learning opportunities and elimination of negative rewards.

Standards of performance play an important role in productivity. It should be set at a high but achievable level. If the standard set is too high, then the will to work decreases. The second factor in productivity improvement is effectiveness, is the extent to which the application of human effort brings the desired results in output and quality. It is a function of method, technique, personal skill, knowledge, attitude and aptitude the "ability to do". This can be improved through training and development, promotion, and career planning.

Hence the approaches that should be employed to improve labour productivity are: wages and salaries, training and education, social society, rewards, participation, attitude to work, supervision, cooperation, attendance, turn over and job security.

Organization and system: one area for improvement of productivity is the organization and system. The main reason for low productivity of firms is because of their rigidity. Systems are always designed for certain situations but things will not be the same for ever, all procedures designed should likewise change. Hence dynamism and flexibility should be incorporated into the system design in order to maximize productivity.

Work methods: improving work methods are very important in sectors such as building construction where much of the activities are labour intensive or intermediate. Work methods aim to make manual work more productive by improving the way the work is done, movements performed, tools used, the workplace laid out, the materials handled and equipments employed. Work methods are systematically improved by analyzing present methods, eliminating unnecessary work and performing necessary work efficiently.

Management style: much of the contributions in improving productivity are gained from improved management, because management is responsible for the effective use all

resources under its control. However, there is no perfect management style for all contexts, but effectiveness depends on when, how and to whom the manager applies the style.

5.2 Construction Labour Productivity Improvement

In chapter 4 we have defined labour productivity as the amount of out put produced per man hour hence it is better to see labour productivity in terms of work time model shown below (Table 5.1). From this model we can learn that productivity in construction can be improved by reducing wastage of time in the different time breakdown of operations. The model also shows possible productivity improvement mechanisms by external bodies besides the construction project site considered in this study.

Breakdown Of Work Operation Time	Method Improvement Strategies	Experts	Duration
Basic work Content of product or service	Improve basic process by research & development	Researchers	LT
Work content added Defects in design & Specification	Simplify product & Reduce variety	Designers	MT
Work content added By inefficient method of operation	Provide new plant, equipment & machinery; improve existing methods & procedures	System experts or Efficiency experts	ST

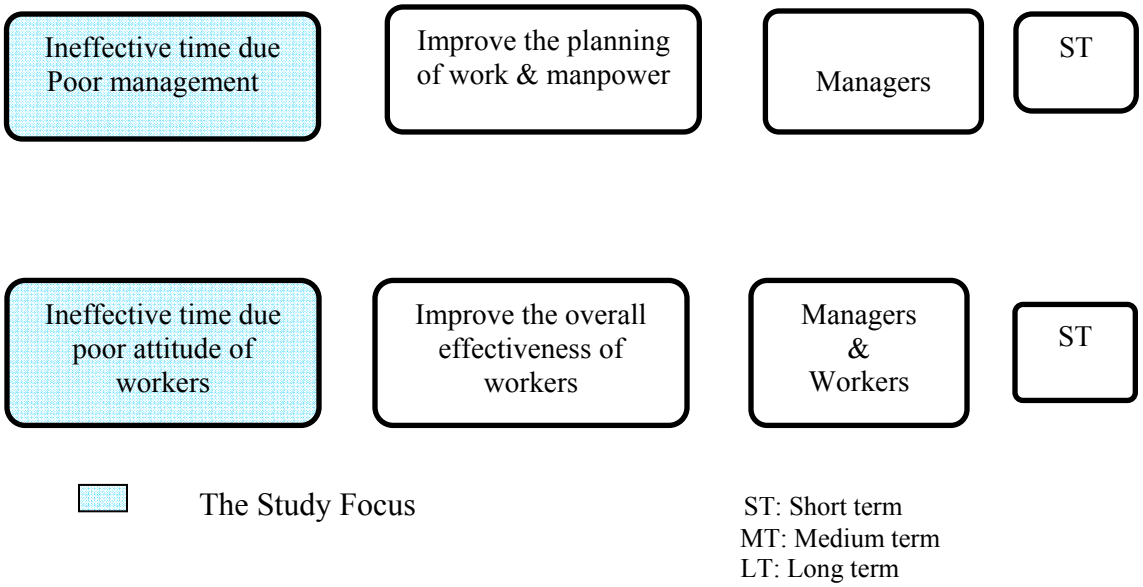


Table 5.1 Work Time Model, Improvement Method and Responsible Experts [8], [24], [32]

This being the productivity model in terms of time, how can we apply this to individual human being is something to be thought about. N.F.R.Maier (1973) in his book psychology in industrial organization and E.E.Lawer.III (1973) in his book Motivation in work organization summarize determinants of task performance as follows [Cited by 31]:

Performance= Ability X Motivation (Effort)

Ability= Aptitude X Training X Resources

Motivation = Desire X Commitment

The multiplication sign in this model signifies that all of the components are essential. Aptitude refers to the skills and abilities an employee brings to the job. Training can enhance most inherent abilities and can improve employee performance. In addition employees must be given technical, information and personnel resources to effectively perform assigned tasks. Motivation is an employee's desire and commitment and is manifested as effort. The above model is quite similar to the methods engineering model of Alfeld (1988).Alfeld has conceptually kept the construction performance of craftsmen is influenced by two factors, according to him environmental elements and behavioral elements. He again subdivided these elements as shown below:

No	1St Level Performance Elements	2nd Level Performance Elements
1	Environmental Elements	Information
		Resources
		Incentives
2	Behavioral Elements	Skills
		Capability[1]
		Motives

Table 5.2 a Model for Engineering Construction Performance [7]

Using this model it is possible to think about deficiencies in performance in actual site operations. However there are many problems in construction site, hence there is a need to identify the major problem by applying cause and effect tree and prioritization. But first initial pilot studies or other alternatives should be sought before designing the research meter.

In this study, previous studies in other countries are consulted [20], [21], [23], [24], [25], [26], [29], [50] and [52].How ever most of the efficiency problems that are collected are empirical hence it is very difficult to tie it with rational studies of management. That is each problem shall be categorized in the general theoretical model of management so that it will be possible to have the systematic view of the problem. This fact will be considered in this study. More over these studies do not consider problems related with leadership and organization, which are thought as most important factors to affect craftsmen productivity. In order to have a systematic view of all productivity problems, model for the whole construction site is necessary. Naoum S.G (2001) has proposed such a model (Figure 5.2). The model includes the various process factors which affect productivity but it dose not include technical factors which affect productivity such as production methods and facilities layout.

1. Capability is a term which measures man in terms of physique and mentality. The usual indicator more man's physique is health where as his state of mentality is intelligence.

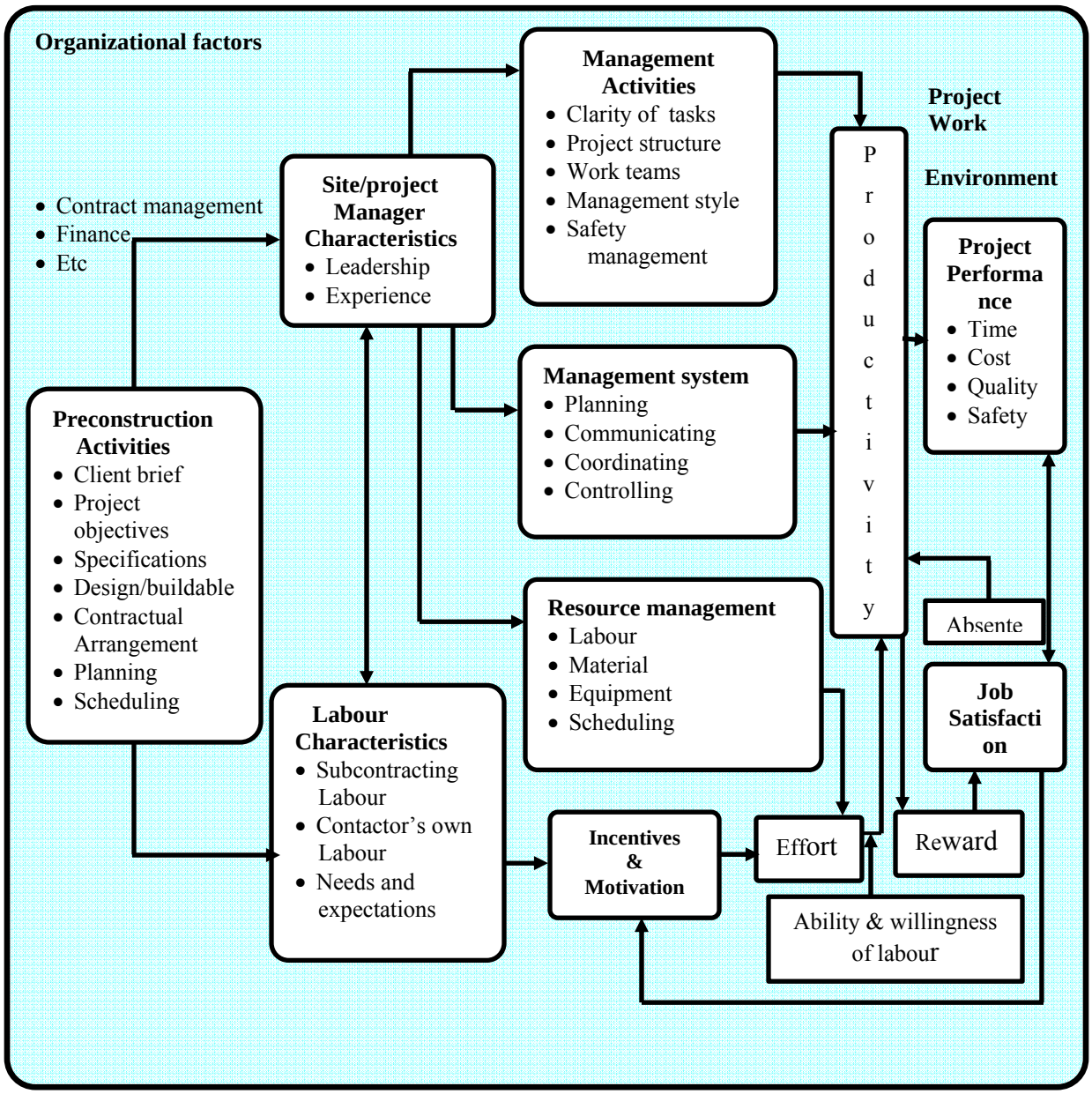


Figure 5.2 Process Model of Motivation and Productivity on a Construction Site [55]

These factors determine the amount of movement and energy expended to accomplish a task; in Ethiopia site layout of the total construction project is not usually done hence it is included as one parameter to be investigated.

The above model is a process type hence it is not suitable to develop meter and it shall be arranged as input- out put model. Looking at input-output model of Fryer (Box 4.1) we

can see that factors affecting project productivity performance may be external; that is influence from consultants, company head quarters or designers which the researcher calls it as preconditions and the others are internal. For the purpose of this study the internal factors are divided in to three. These are technical factors; management/control systems and organizational behaviors. Each of these factors are managed by scientific management method, traditional management method and human relations theory respectively. Hence in terms of input- output model the study can be systematically idealized as follows.

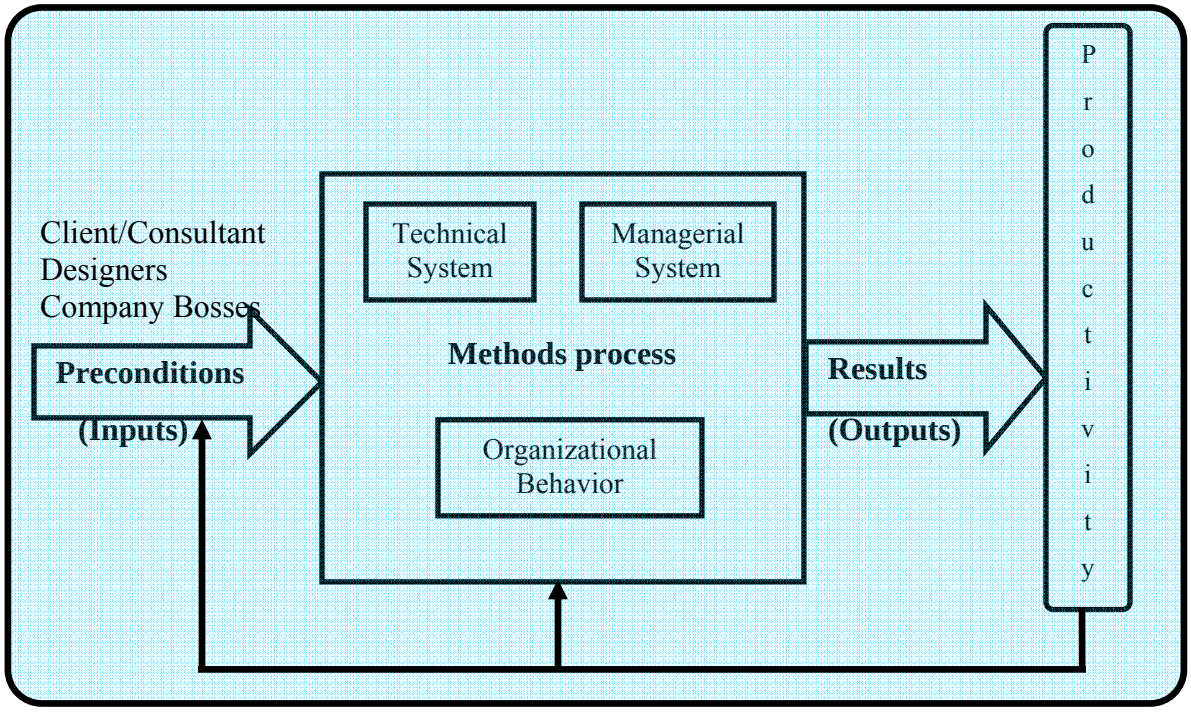


Figure 5.3 Systematic Views of Study Areas

Preconditions: As it is shown on the Fryer's model (Box 4.1), the productivity of a project site is influenced by decisions of the consultant/Client, designers and company heads. The magnitude of influence is dependent on the contractual arrangement of the contractor with various groups. Hence the role of consultants and designers is slightly different based on the above cause .How ever for practical reason we may take the traditional project delivery method to identify the role and duties of all parties as it is the

most common method in Ethiopia. This fact is taken into consideration to produce the questioner for preconditions.

Managerial system: These are methods or systems that are used in planning and controlling of projects. There are many checklists management that are developed by construction quality auditors measure the performance of a project for productivity. For this particular study the auditing tool that is developed by Optima Engineers to improve the productivity of Alberta construction is used after little modifications [52].The checklist contains the following components.

- Schedule management
- Work planning
- Progress and productivity
- Quality management
- Organization
- Labour relations
- Materials management and
- Tools management

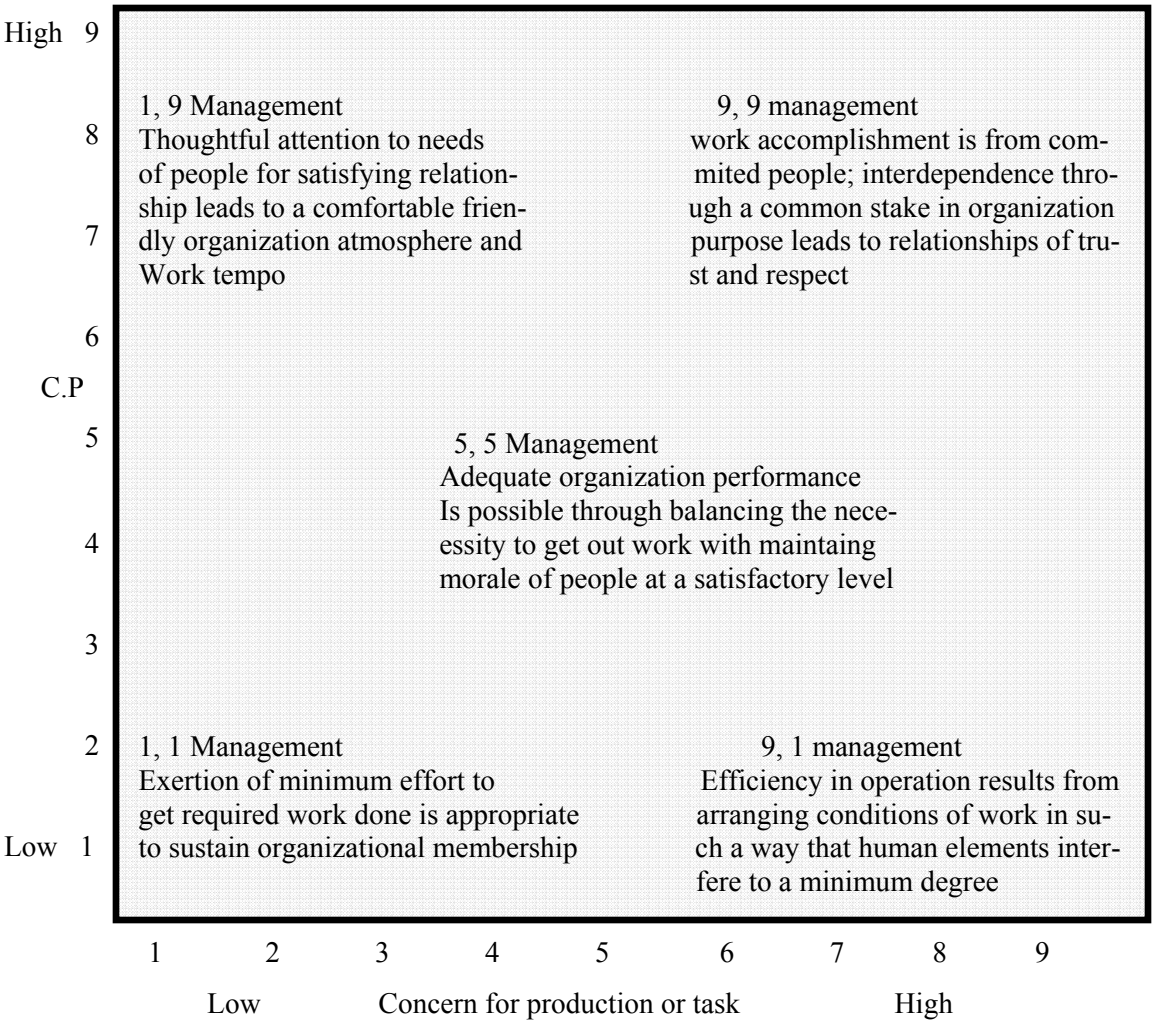
Technical system: These are systems that are laid down to economize motion and energy of workers. It involves the creation of good working methods, efficient construction facilities lay out and developing realistic work standard. This study dose not focus on work methods but it will measure contractors experience on the practice of creating effiecient construction facilities lay out and developing work team productivity standards.

Organizational Behavior: These are a system that refers to the social environment. It basically contains two sub systems. That is the workers social environment which comprises the attitude and behavior of workers towards their project; and the other is the leader's leadership style as it is seen from employees. These two subsystems affect the motivation of workers towards their work which is one of the most important determinants of operator's productivity.

Leadership: It is the most important parameter which affects organizational culture which in turn affects the peoples attitude and behavior; hence motivation to work. There are as many definitions as authors on leadership. For example Luthans (1998, pp.380) defined leadership as "When you boil it down, contemporary leadership seems to be a matter of aligning people towards common goals and empowering them to take actions needed to reach them'' (Sherman 1995). Fidler (1967) defined leadership with in the context of contingency theory. He stated leadership depends as much on the organization as the leader's own attributes. Except perhaps for the unusual case, it is simply not meaningful to speak of an effective leader and an ineffective leader; we can only speak of a leader who tends to be effective in one situation and ineffective in another [55].

There are three theories developed to explain leadership effectiveness [55] .These are: trait theory, style theory and contingency theory. The first theory considers a leader as having a set of trait or attributes which are not possessed by others. These traits are also called characteristics or qualities such as intelligence, confidence and decisiveness. The premise of trait theory is whether a leader is born with characteristics or made for them. The second theory looked into leadership style and studied whether the leader approaches the job to be done, or the people, or both. The third leadership theory looked into contingency factors which determined the best type of leadership towards success. In other words, is there a best way to lead a work force. It is important to note here that the three theories do not complement each other rather the general theory of leadership is integrates these theories.

This study used on one famous style of leadership that is the style theory of Blake and Mutton hence deserves discussion. This style leadership theory put leadership concern for people and production in to a scale of nine each (Box 5.1).How ever this theory needs establishing a significant relationship between leadership behavior and successful performance thus, contingency model, which is adopted from the model of organizations (Noaum, pp.271) is used in the study (Figure 5.4).



Box 5.1 Blake and Mutton Managerial Grid [55]

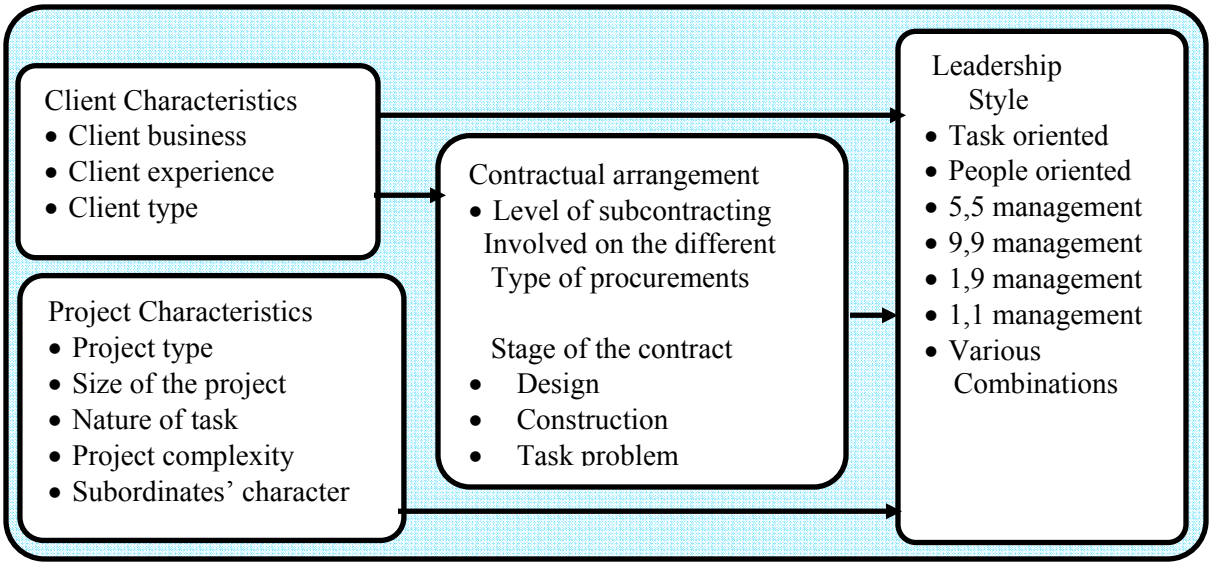


Figure 5.4 Leadership Model of Construction Projects used in the Study

Worker behavior: This is one of the parameter that affects the performance of individuals due to cultural influence of the organization; hence organizations must ensure that the organization environment is suitable for competitiveness. Many studies show that the effects of organizational values to productivity are significant. For culture to contribute a lot for increment of productivity the culture must fit to the external environment and be strong. Cameron and Quinn (1999) have developed good values to increase organizational competitiveness, productivity [59].

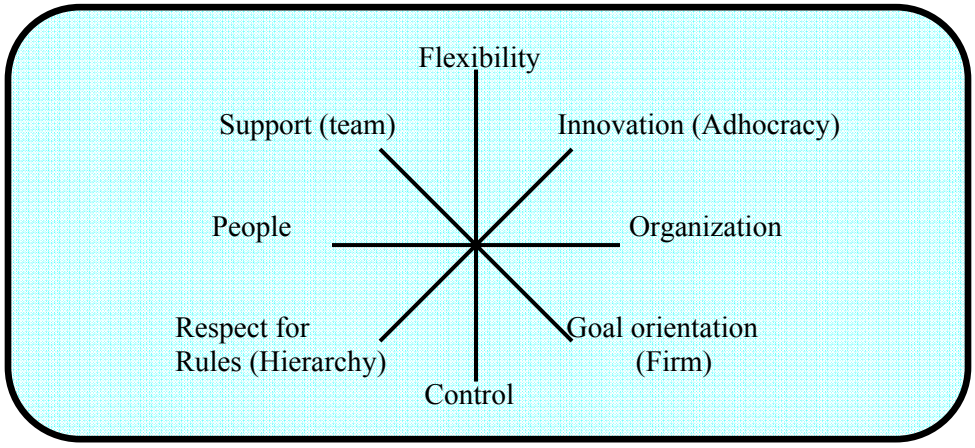


Figure 5.5 Competing Values of Organizations used for the Study

Part III. Discussion and Analysis

Chapter 6. Projects Context and Productivity Performance

6.1 Characteristics of Projects

Seven medium to high rise building sites in Addis Ababa (Considered as a case study in this research) are investigated for the study. The projects consisted of one commercial, two housing, two school and one religious buildings. The projects are conducted by different construction companies.

The table below offers a tabulated description of each project. For example project 1 is a commercial building, with a contract sum of 8.6 million birr, contract duration of 12 months and actual completion of 24%.

Proje Id	Type o building	Procureme method	Cost (Birr	Durati (mont	Sta o Cor leti
Proje 1	Commerc building	EPC	8,600,000	12	24
Proje 2	Housing project	EPC	16,849,459.	18	80
Proje 3	Public buildin	Other	47,000,00	36	76
Proje 4	School	EPC	36,320,245.	33	90
Proje 5	Religiou building	CM	15,287,051.	24	16
Proje 6	School	CM	12,000,00	24	95
Proje	Housing	EPC	15,000,00	14	10.1

7	Project				

EPC, traditional engineering procurement and construction; CM, construction management and 1USD= 8.60 Eth.Birr

Table 6.1 Characteristics of Projects Surveyed

The questioner designed in English was translated in to Amharic to serve the local craftsmen which has lack of understanding clearly if conducted in English language. The questioner was prepared centering on identifying the major labour productivity problems and magnitude of lost productive time. In addition possible managerial causes were presented for craftsmen for their opinions. Another questioner targeting project managers, engineers and superintendents was prepared to judge the capability of their managerial system to control productivity.

Over all, 18 craftsmen out of masonry, concreting and steel fixing trades were surveyed using structured questionesr,7 project managers and 14 supervisors consisting of site engineers and foremen were interviewed to asses their project management systems. The foreman questioner besides includes questions related with productivity problems and their magnitude.

6.2 Characteristics of Workers

78% of craftsmen surveyed were employed under main contractor, 11%under sub contractor and the remaining 11% as subcontractor labour only (Table 6.2).

Worked under	**Number of Building Operatives**			
	Masonry Mason	**Concrete Mason**	**Steel fixer**	**Total**
Sub contractor labour only	0	0	2 100%	2 11%
Sub contractor	0	0	2 100%	2 11%
Main contractor	6 43%	7 50%	1 7%	14 78%

Table 6.2 Type of Employer

This shows that most operatives are employees of contractors and hence contractors need to have leadership skills to increase their productivity. It is also interesting to see that some contractors outsource their work to labour contractors that is 11% of the operatives in this survey are labour contractors.

On the average, most craftsmen that are about 44% had worked with their present employers for less than two years (Table 6.3).This shows the slightly unstable pattern of employment in the Ethiopian construction industry. The most unfavorable one is with masons, 54%.This might be that mason have greater opportunity to change their work.

Worked under present Boss/Employer (years)	**Number of Building Operatives**			
	Masonry Mason	**Concrete Mason**	**Steel fixer**	**Total**
0-2	3	4	1	8
2-5	1	0	1	2
5-10	1	1	2	4
10-20	1	2	0	3
>20	0	0	0	0

Table 6.3 Length of Stay with the Employer

The majority of craftsmen had worked their present sites for up to 12 months (Table 6.4) The seven projects studied had been running for an average of 14 months at the time the surveys were carried out. It would be reasonable to assume that most of the craftsmen had been on site since project inception and would therefore be conversant with production problems.

Worked under present Project (months)	**Number of Building Operatives**			
	Masonry Mason	**Concrete Mason**	**Steel fixer**	**Total**
0-3	0	0	0	0
3-6	3	3	0	6
6-12	0	2	2	4
>12	3	2	3	8

Table 6.4 Length of Stay with the Present Project

The survey indicates that 94% of the craftsmen were aged below 40 which shows that construction craftsmanship is a young man's trade and hence if attention is given by the concerned body it can absorb a large amount of unemployed (Table 6.5).

The survey indicates that 83% do have experience from 5 up to 20 years, this shows that the Ethiopian craftsman do have longer practical experience thus if it is supplemented by appropriate training the potential of improvement would have been high (Table 6.6).

Age groups (years)	Number of Building Operatives			
	Masonry Mason	Concrete Mason	Steel fixer	Total
15-20	0	0	0	0
20-30	3	2	2	7
30-40	3	5	2	10
40-50	0	0	1	1
>50	0	0	0	0

Table 6.5 Ages of Construction Operatives

Experience (years)	Number of Building Operatives			
	Masonry Mason	Concrete Mason	Steel fixer	Total
0-2	0	0	1	1
2-5	0	1	0	1
5-10	4	3	0	7
10-20	2	3	3	8
>20	0	0	1	1

Table 6.6 Experience of Construction Operatives

The survey indicates that as the craftsmen experience is greater than 5 years they are highly needed for building projects of the government and commerce because these are

relatively large and complicated (Table 6.7). Moreover the high numbers of operatives with experience from 2 to 5 years in housing projects shows that a relatively many housing projects are undertaken in the country, as the projects are taken randomly.

The survey indicates that 78% were trained on site, learning from their seniors (Table 6.8). This is because in the majority of cases in developing countries construction work gangs and operatives consisted of neighbors and relatives of one village .Craftsmanship is acknowledged to be maintained through one generation passing skills on to the next in such a way.

Type of Building	**Number of Building Operatives**			
	Masonry Mason	**Concrete Mason**	**Steel fixer**	**Total**
Housing				
< 2 years	2	1	0	3
2-5 years	3	5	2	10
≥ 5 years	1	1	0	2
Public utility				
< 2 years	2	1	0	3
2-5 years	2	2	1	5
≥ 5 years	2	3	3	8
Commercial				
< 2 years	2	2	1	5
2-5 years	3	2	2	7
≥ 5 years	1	1	1	3

Table 6.7 Experience of Building Operatives by Building Type

Type of training	**Number of Building Operatives**			
	Masonry Mason	**Concrete Mason**	**Steel fixer**	**Total**
Apprenticeship	0	1	0	1
Formal trade school	1	1	1	3
On site trained	5	5	4	14
Government Workshop	0	0	0	0

Table 6.8 Types of Training/Education Background

The fact that only 17% have been formally trained in school, confirmed little attention being paid by the Education system[1] so far to proper skilled based education and training .It would also seem that main contractors are not aware of the importance of formal skill acquisition programme for craftsmen.

1. It is only now the education system has started to train tradesmen from TVET and higher level technicians from technical colleges.

6.3 Productivity Performance and Problems

6.3.1 Productivity Performance

The craftsmen questioner survey was conducted to judge the productivity performance of the concreting trade including steel fixing and masonry trade. During the survey it was found that the team size to accomplish the same task is different for each project; hence the team size for this survey can be taken averagely as indicated under table 6.9.

The survey indicated that the performance of all trades is below the standard[1] (Table 6.9).For example in project 1 the concrete and masonry trades produced only half of their standard (PAR=2). This shows that the site management should do a lot to detect the cause of such a low performance. However, from interview with the project supervisors it was learned that there is no experience in measuring crew performance; hence the problem was not known. This shows one of the deficiencies of traditional management which focuses on spying the tempo of workers solely, not on measuring their output.

Project Id	Concreting Trade			Masonry Trade			Steel fixing Trade		
	Actual (M3)	Planned (M3)	PAR[1]	Actual (M2)	Planned (M2)	PAR	Actual (Kg)	Planned (Kg)	PAR
Project 1	12.5	25	2	1.75^{+}	3.5^{+}	2	-	-	-
Project 2	-	-		-	-	-	-	-	-
Project 3	22	24	1.09	9	10	1.11	86	101	1.17
Project 4	25	35	1.4	8	10	1.25	100	100	1.0
Project 5	19.44	20	1.03	1.94^{+}	1.5^{+}	0.77*	576$^{\#}$	500$^{\#}$	0.87*
Project 6	20	30	1.5	8	10	1.25	375$^{\#}$	500$^{\#}$	1.33

Concreting team: 2 mason+27 DL+2 carp. + 1mixer+ 5DL+2vibrator

Masonry team: 1mason+1helper+4DL+1 mixer + 5DL

Steel fixing team: 1 bar bender + 2DL

Table 6.9 Table of Planned and Actual Productivity

In project 5, the amount of planned standard was low; this is due to the fact that there is less experience in setting standards and measurement. Another finding which supports the above statement is the percentage of craftsmen who could fill their planned and actual estimates are only 24% (Appendix A2, question No 1 & 2, pp. XXVII, XXIXV).

1. These are planned out put values that are used during planning; they are transferred historically from their past experience. Surprisingly, these values are not known by most crew foreman and craftsmen.

During an interview with one of the projects manager it was learnt that productivity standards are used during the preparation of their main schedule but I believe that, it is meaningless if the information used during planning is not transferred to the crew by planning. From the above finding we can understand that the *project management objectives are not appropriately transferred down to their crews showing that coordination that could have been obtained by this is lost.*

The survey also tried to asses the magnitude of the productivity problems in terms of lost time for the different possible causes. It was found that only 20% of the craftsmen and foremen dare to estimate the amount of lost time by each cause (Appendix A2, question No 3, pp. XXVII) .This shows that there is no experience in labour productivity accounting for the case study construction projects. According to the data collected and my observations the amount of productive time lost for the surveyed projects range from 3 to 4 hours, which means a craftsman in the case study Cps spends only 56 % of the total paid time due to administrative, technical and motivational caused delays (The result of the survey on appendix A2, Question No 3, pp.XXVII, XXIXV).

6.3.2 Labour on Site Productivity Problems

The survey also tried to rank productivity problems of each of the studied trades for supervisor to manage them by exception (Table 6.10).

No	Problem List	Concreting work		Masonry work		Bar bending		
		Rank of productivity	MR (*)	Rank of productivity	MR (*)	Rank of productivity	MR (*)	OMR (*)

		Problems			Problems			Problems				
		P4	P5		P4	P5		P3	P4	P5		
1	Lack of materials	1	1	1 (1)	1	1	1 (1)	1	1	1	1 (1)	1 (1)
2	Lack of tools	3	5	4 (3)	6	5	5.5 (4)	6	5	5	5.3 (5)	4.9 (5)
3	Accident	5	9	7 (7)	8	9	8.5 (7)	-	7	9	8 (9)	7.8 (9)
4	Rework	2	8	5 (5)	5	2	3.5 (2)	2	6	7	5 (4)	4.5 (3)
5	Change of workers	5	6	5.5 (6)	4	3	3.5 (2)	5	4	6	5 (4)	4.7 (4)
6	Interference	4	7	5.5 (6)	7	4	5.5 (4)	7	3	8	6 (6)	5.7 (7)
7	Absenteeism	6	11	8.5 (8)	8	10	9 (8)	3	-	11	7 (8)	8.2 (10)
8	Instruction delay	3	4	3.5 (2)	2	6	4 (3)	7	2	4	4.3 (3)	3.9 (2)
9	Change of supervisor	4	10	7 (7)	3	11	7 (5)	3	6	10	6.3 (7)	6.8 (8)
10	Less work load	7	2	4.5 (4)	8	7	7.5 (6)	5	-	3	2.7 (2)	4.9 (5)
11	Congestion	4	3	3.5 (2)	6	8	7 (5)	4	7	2	4.3 (3)	4.93 (6)

Table 6.10 Rank of Productivity Problems for the Studied Trades

Definition of abbreviations on table 6.10

MR; means mean rank of each problem; and OMR means overall mean rank of the problems in the studied projects

P3, P4, and P5 refers to the projects identification number

(*) rank of mean ranks and overall mean rank

The above table shows that the main productivity problems for concreting trade are lack of material, instruction delay and congestion, lack of tools, less work load, rework and change of workers and to masonry trades are lack of materials, rework and change of workers, instruction delay, lack of tools, change of supervisors and congestion. Whereas the problems for the steel fixing trade are lack of materials, instruction delay, rework change of workers, lack of tools, less work load and congestion.

Lack of materials: Over all this ranked first problem for all trades. This is understandable in that work cannot be done with out the necessary materials. The average

productive time lost by this problem as estimated by the craftsmen ranges from 45 to 60 minutes per day (See appendix A1, pp.IX). On interview with the supervisors the causes that contribute to this problem are poor administrative practices in project ware houses, poor

This foot note refers to Table 6.9

+ The activity is masonry construction using stone hence the measurement is in cubic meters

The numbers of teams involved for this activity in these projects are five times greater than number of teams in other projects.

1 PAR is the abbreviation for performance ability ratio and it is the ratio of standard productivity to actual. The term is mostly used in performance management in the sense that the standard used is the actual best.

inventory management, poor material scheduling and most importantly out right shortage of certain materials. This was traced due to cash flow problems experienced by the contractors. It is common to see projects being disrupted temporarily due to shortage of materials.

Instruction delay: This problem is identified as the second overall productivity problem. The average unproductive time lost by this cause as estimated by the craftsmen ranges from 10 to 40 minutes per day. On interview with the project engineers the causes that contribute to this problem is lack of proper planning at the crew level, low skill of foreman as it is common in Ethiopian construction to assign their relatives as supervisors of their job, and the existence of demotivated crew supervisors.

Rework: This problem is identified as the third overall productivity problem. The average unproductive time lost by this problem as estimated by the craftsmen ranges from 20 to 45 minutes per day. In this study rework is a major problem for masonry and steel fixing trade. On interview with supervisors the main causes for this problem are technical faults in both human and materials and changes of design after construction to mention a few.

Change of workers: This problem ranked as the fourth overall problem. The amount of productive time lost due to this cause ranges from 15 to 30 minutes per day .This problem is more frequent on bar bending and masonry work. The causes might be due to absenteeism or quit of job by workers or intentional workers change by foreman. It is

known that as the crew member change frequently it takes a longer time for the team to reach the performing stage[1] because of cultural confrontation between the new comer and the existing members. The poor understanding by foremen about this problem made them to change the crew member to solve other problems in other work teams.

Lack of tools: This problem ranked as the fifth overall problem. The amount of lost time due to this cause ranges from 13 to 30 minutes per day.

1. This is a stage when the work team attains the maximum cohesion to move as a unit

During my observation on some sites I learnt that concreting operations often stopped due to failure of vibrators and some of the tools used by the craftsmen need maintenance. As a whole the Ethiopian construction is poor in using power tools which are often used by other countries.

Less Workload: This problem ranked equally with lack of tools. The amount of time lost due to this cause ranges from 10 to 25 minutes per day (see appendix A1).The main cause of this problem is poor human power planning which is basically depends on labour productivity data. The quality of productivity data depends on the frequency of output measurement in the project. For example if the data underestimates the productivity of the working team then the team size will be large causing less workload on the established team. Most literatures have shown the relationship between over manning and productivity[2]. Percent of increase in manpower above the optimum is linearly related with a proportional decrease in productivity.

Congestion: This problem has ranked the sixth main productivity problem. The amount of productive time lost due to this case as per the judgment of the surveyed operatives is between 10 and 20 minutes per day. As all the survey was conducted in Addis and the city being old and unplanned, this problem is apparent. Project owners being interested in using their land effectively, reserve places for support shop areas and movement routes are often restricted. This indicates that manpower planners should consider not only workload but also availability of place in determining their crew size[3].

This section focused only on the major labour productivity problems; there are of course so many problems which are not included in this survey. The causes for all these problems are similarly enormous .Hence, the following chapter approaches these causes systematically to link them to the theoretical managerial studies for ease of intervention.

2. U.S army corps of engineers has produced a typical curve for American conditions.
3. U.S corps of engineers has produced a curve which shows the relation between percent of crowding , which causes over manning due to space narrowness, and percent of labour loss.

Chapter 7. Productivity Problems Causal Factors

7.1 General

On section 5.2 of the conceptual framework productivity causal factors are shown systematically on figure 5.3.According to that model project labour productivity is affected from the perspective of two phases. That is from the input phase which is depicted in the model as preconditions and the process phase which includes three main subsystems. These are managerial subsystems, technical subsystem and organizational subsystem.

The subsystems are large by themselves for example managerial subsystem contains 54 productivity factors categorized into five major categories which are interdependent to each other and organizational factors contains 42 factors that are grouped into six categories in which two of them are classified under leadership category and four of them under workers behavior (These factors are taken from other countries experience and theory ;and adopted for this research after considered the Ethiopian construction industry context).

It is necessary to reiterate and define causal factors of productivity so as to create continuity for discussion and analysis.

1. Preconditions involve activities that are done by external bodies outside the contractor's project environment. It includes the action of consultants, designers and company bosses on the project internal environment. The effect of these

bodies on the productivity of the whole site is significant. Some project managers claim that the effect of these external bodies on productivity of the whole site is more than the project management team.

2. Managerial subsystems are the conventional tools that are usually taught in most universities to manage project objectives of time, cost, quality and resource productivity. They are commonly called project management tools or standards. It involves the creation of schedules, cost standards, productivity standards and their control systems. The practical application of these factors in Ethiopian construction industry is questionable.

3. Technical subsystem are components related with the proper management of design implementation and construction methods, the development of standards and management of temporary facilities from their design up to their construction. Problems related with technical management may cause inefficiencies in the total working system and rework. This activity is not continually adopted in the Ethiopian construction industry.

4. Organization behavior subsystem contains components related with behavior and values of workers towards their project, and leadership degree of emphasis to wards production and people. This part is not usually known by engineers practicing project management in Ethiopia. But studies in developed countries show that the effect of this subsystem on productivity is significant.

I. Preconditions

1. Client characteristics and support
2. Consultant behavior and support
3. Company head quarters support

II. Managerial Subsystem

1. Schedule management
2. Construction work planning
3. Progress and Productivity
4. Quality management
5. Safety, organizations & labour relations
6. Resource management

III. Technical subsystem

IV. Organizational behavior subsystem

1. Leadership focus on production
2. Leadership focus on people
3. Innovativeness and growth
4. Effectiveness and clarity of goal
5. Community spirit
6. Communication

Box 7.1 Managerial Causal Factors of Low Productivity

7.2 Preconditions

Preconditions are factors which affect the productivity of a construction site by the action of external bodies. They are not controllable by the project management; however, the consultant project manager can control them to some extent by applying integration management.

Client: These are one of the most important bodies which influence the productivity of the project site by changing their requirement; the project scope. This action causes change and additional design to be produced causing temporary shortage of design information to the contractor unless prior design revision and engineering control is done

in before the execution of works. Studies made in other countries shows that percentage of change orders is directly proportional to loss of productivity[1].At other time clients may limit the project completion time but providing design changes in such a case the contractor may be forced to use overtime works which has also similar effect in reducing productivity[2].

1. This is the study made in Canada and published in Canadian journal of civil engineering, Volume 18, 1991 [Cited by 26]
2. Standard Graphs are produced by U.S army corps of engineers [cited by 26]

The survey of projects shows that the change in the requirement of the client scores a value of 2.92(Appendix A2, Interview question A.1, A.2 and A.3, pp XIII) meaning there is no as such much change in requirement of the client this might be caused due to the fact that most projects are procured by EPC and the designer is also the one who manages the project this might make the designer to make prior revision of drawings before implementation. But projects 4 and 5 show high instability in the client requirement; these projects are procured by the CM hence errors detected by the consultant are sent to the designer for revision causing delay; moreover the client being in contact with two bodies may initiate a change in scope. The survey also shows that there is no usual practice to review the building design by the owner for buildability.

Consultant/Designer: These are among the most important parties affecting the overall productivity of the construction site. It is known that design information in the form of drawings and specifications are one of the most important inputs of the construction process. Unless the engineering information is appropriately scheduled and controlled like other resources it will cause loss of productive time of workers.

The survey indicates that timeliness and clarity of decisions and acceptance by the consultant is low (Score 2.6) which demands the client for a different project delivery system. The client can reduce the problem related to this by using design and build system whereby early integration between the contractor and the consultant be facilitated.

Company head quarter: These also affect the productivity of the site as they are the providers of most resources to the construction project. Poor scheduling and communication between the project office and the head quarter contribute a lot besides cash flow problems in causing disruption of projects temporarily.

The survey indicates that the companies' effort in providing good project organization, resources and general support is adequate (Score 4.38).

Productivity causal factors such as preconditions, managerial system and technical system are assessed by interview, which is attached in appendix A2 targeting the different level of managers (i.e., Appendix A2, pp XIII-XVI, XIX-XXI and XXIV-XXVI).

7.3 Managerial Subsystem

Schedule management: One of the most important tools that are used to control productive time is a schedule as a project plan shows how and when the project to be executed. Analysis of structured interview of opinions collected from supervisors results a score of 3.6 for schedule management which shows that the practice of schedule management in the surveyed projects was not satisfactory (Interview Q., A1-8,pp.XIV). On interview with the supervisors it was learnt that the construction schedule is prepared independently without integrating with procurement and engineering schedules and at the same time the prepared schedules are not sent to appropriate personnel for administrative purposes. Hence, schedule management is left only for the project team where as construction schedule is affected by procurements in the head office which shows that there is no lateral coordination among participants for schedule management.

The interview also indicates that the practice of preparing successive schedules down the management hierarchy is not satisfactory. This statement supports the finding that upon questioning the craftsmen to fill their planned and actual production only 24% responded actively (Appendix A2, question No 1 & 2, pp. XXVII, XXIXV). This shows that the project management team objectives are not transferred properly to lower management hence there is low hierarchal coordination between the different management levels**.** Some project managers prepare schedule successively down the hierarchy but the preparation of the schedule by each managerial level is inconsistent with the project master schedule hence no coordination by this practice as well.

The survey investigated the practice of preparing construction progress curve resulting a score of 3.4 which shows that this activity was not often done hence the management team did not have a tool to monitor the progress of the work and rectify problems occurred.

Interview was made to investigate the practice of preparing manpower histogram; the survey indicates a score of 3.09 meaning the practice is below satisfactory. This shows that human resource was not given proper attention and its effect on the overall project cost and efficiency is not understood.

Another important parameter that was investigated is the practice of having project key dates and milestone schedule which scored 3.0 meaning the practice is below satisfactory. During an interview with the project leaders, even though there was no planned schedule on this matter, the practice of having control meetings among project participants was common. The researcher believes that the existence of such schedule is very important as it can act a leading indicator for performance so that subsequent correction could be made.

Last but not least in the schedule management is updating of the existing schedules and communicating the progress of the schedules to the appropriate management hierarchy. Investigations made on these matters shows a score of 4 for both activities. But during an interview with project managers the practice of preparing, updating and communicating schedule performance are done as contractual or formal obligations not as a tool of internal control.

Construction work planning: When the project enters into the construction phase short range detailed planning commences. Planning at the crew level involves the identification of complete resource requirements for each task, the verification of the availability of those resources when needed. The survey to investigate construction phase planning indicates a score of 4 for this managerial activity which indicates that it was done satisfactorily (Interview Q B9-16, pp.XIV).

However, during the interview it was learnt that defining the scope of work packages was seldom done in the surveyed projects and construction personnel usually enters construction without a clear understanding of work. This supports the statement the finding that instruction delay is the second most important cause of delay in Ethiopian construction.

The survey also made investigations on identifying and providing work package prerequisites resources. It is found that prerequisite of work packages are not provided satisfactorily (Score3.6). It was learnt that full and complete designs, tools, materials and specifications are seldom found. This is in support of the finding that lack of materials, tools and instruction delay are major productivity problems.

Though the opinion survey shows satisfactory, it was found during the interview that there is no as such proper plan for the execution of work packages. The planning is seldom done on papers and it is not hierarchically coordinated with the project master plan.

Progress and productivity: The purpose of a construction progress monitoring system is to provide a consistent method of measuring the physical percent complete of construction activities and to identify adverse trends in progress and productivity. The survey to investigate the practice of productivity measurement indicates a value of 3.6 which indicated the performance is below satisfactory (Interview Q C 17-22, pp XV). During interview with most project managers it was learnt that work measurement is conducted for the purpose of preparing payment certificate and monthly reporting hence no productivity measurement in the front line workers. In addition it was confirmed that no project has installed work measurement system to control productivity.

As the practice of work measurement, for productivity control is non existent in Ethiopian construction industry; no forecast of required manpower is made hence there is no base to accurately replan construction schedules.

In the craftsmen questioner to identify the amount of lost time due to the effect of different factors, it was only 20% of the craftsmen and foreman who dare to estimate the amount of lost time for each cause (Appendix A2, question No 3, pp. XXVII). This shows that there is no experience of measuring actual expended man hours.

Quality management: Project quality influences the success of the project at hand as well as the long term success of the contractor. Quality involves completing the task correctly to meet the governing specifications. If quality can not be achieved in once time then there will be high possibility of rework which mean high wasted man hour hence productivity. The survey to investigate the practice of quality management in the projects shows that their performance to wards this activity was satisfactory (Score 4.22) (Interview Q D 23-28,pp XV).But contrary to the above finding, interview with craftsmen shows that the third major productivity problem of the surveyed projects is rework, which is most often related with quality.

Interview with some managers, shows that there was no as such a plan to employ qualified workers, deploy quality materials and properly maintained tools especially in public projects. This is due to the fact that public project owners usually give highest attention in reducing cost than quality. In addition due to macro level managerial problems in contractor procurement policy, most projects try to finish the project with poor human and technical resources.

Interview about material quality control system shows that bulk procurements are usually done without approval of the consultant on samples of the materials. It is a frequent phenomenon to send back materials once purchased due to failure to pass the preliminary material control tests. At other times revisions of design will be made on the existing material at the expense of the contractor.

In the case of manpower, only 17% of the craftsmen are trained in formal trade school or apprenticeship which shows that contractors are not committed to enhance the quality of

their workers (Table 6.8). Enhancing the competency of workers could be easily made by appropriate on site practical and theoretical training.

During interview with project supervisors, I have learnt that no support is given by the upper management to increase pride in quality either in the form of quality control manual or financial incentives.

Safety management: Every one connected with a construction project should be concerned with the level of safety that is maintained on it. Job site safety influences productivity and morale which in turn can determine whether the project will be completed successfully or not. As a minimum, the level of safety on a project must comply with certain legislated criteria. Beyond these minimum requirements many real and often monetary benefits can be realized by promoting a safe working environment. There are many factors that contribute to a safe project. The survey finding to judge the level of safety management indicates a value of 3.5 for the surveyed projects meaning that the practice of safety management was below satisfactory (Interview Q E29-33, pp XV). In an interview with supervisors I have learnt that the no project has safety officer .The reason that was forwarded by supervisors was that accident rates in most building construction projects are minimal hence no attention is given. They also said that even though there are contractual provisions to make the work environment safe; there is less forward control to safety. The practice of keeping records of accident for along time is not satisfactory.

Organization: The success of any construction project is highly dependent on the quality of people who are managing the job. Ensuring that the right people are in place at the right time is important. The investigation had shown that the on site practice of work organizations of the surveyed projects score 3.28 meaning it is below satisfactory (Interview Q E 34-38,pp XV) During interview with project managers recruitment of workers in Ethiopian construction was not conducted objectively. The most often practice is to employ personnel based on recommendations from personnel inside the project. This may result employment of personnel based on relatives and friendship. It is true that

curriculum vitae evaluation may not result the correct personnel but the researcher believes that recommendations should be appropriately integrated with curriculum vitae.

Some supervisors believe that, most construction companies employ their relatives mostly because their management style is traditional which is based on spying the tempo of workers and management hence the shift towards objective recruitment could takes place in parallel with a change of labour management. The current practice shows that there is little involvement of production personnel on the employment of personnel planned to work with them.

The survey indicates that the site structure of projects is highly designed to reduce the amount of administrative personnel required to do the work. Most functions are done by single personnel integrally. This is support of the finding that the appropriateness of the structure of the project to productivity was below satisfactory.

Survey was conducted to judge the practice of preparing staff requirement plan and de staffing plan it was found that preparation of this plans is not common. However, some managers said that they prepare staffing plan though not supported by appropriate polices and procedures.

The survey that was conducted to judge the amount of crew supervisors who are trained in formal trade school is 17% including the craftsmen which shows that training programme of first line supervisors was not done. This is in support of the finding that the surveyed projects scored a value of 2.07 for this activity meaning almost no attention is given to increase the competence of supervisors.

Labour relations: on all construction projects, both union and non-union, construction labour relations are an important aspect of the job. In order to maximize the owner's value for his money, it is important that every one connected with the project be working to the same set of objectives. Developing good working relations with the trades' people who are working on the job can best assure that every one's objectives are being met. The

investigation has shown a value of 3.7 for the surveyed projects meaning the practice is not satisfactory (Interview Q E 39-41, pp XV). The survey repeatedly confirmed that human resource planning in the surveyed projects is minimal (Score3.46).This shows that costs related with labour force were not properly managed. A similar finding was obtained for the practice of training of crafts in the surveyed projects (Score3) .This is in support of the finding that only 17% of the lower work force is formally trained.

During an interview with the crafts and laborers (not a formal part of the study) they were complaining a lot about their job. This shows that there was no mechanism established in the project to handle such cases. On interview with the project managers it was said that there is no documented site polices and practices in place to recurrently answer workers' grievances. This is in support of the finding that a score of 3 was obtained for the projects.

The projects were surveyed for the existence of labour relations coordinator it was found that most projects have personnel department to offer this service. How ever, its activity is often reactive not proactive hence capacity building of this department shall be made.

Resource management: This part refers to the management of materials and tools which are essential to influence the effort to be exerted by the craft to accomplish his task. From problems survey it was found that lack of materials is the first problem of the surveyed projects this is caused not only by outright shortage but also due to poor planning materials **.**The survey has also showed 45 up to 60 minutes per day on average are lost due to material shortage .Lack of tools is also the fifth problem of productivity which causes a loss of about 13 to 30 minutes per day. These findings show that there is a deficiency of resource management in the surveyed projects. This supports the finding in this survey scoring a value of 3.8 for resource management (Interview Q 42-48, pp.XVI).

During interview with the project managers, it was found that there was no optimized material and tool control issuing procedure in all projects .The procedure being used is

too long and dose not take into considerations the cost that will be incurred due to loss of productive time of operatives.

Material resources are planned based on rough standard plans which are found some where. That is material usage standards are not properly developed for each company and hence some times more materials are purchased and in some other less causing material outright shortage. Similar findings is obtained for tools, no attention is given by management about tools and most often the appropriate tool is lacking, especially the use of power tools is limited; it is only on two surveyed projects that availability of power saw is rightly checked.

Interview also confirmed that a large time gap between purchase order and delivery of materials is common mainly caused by non reputable suppliers and poor contractual relations between the contractor and supplier. Hence project material managers should provide long lead time for purchase and confirm the existence of penalty or incentive clause in bidding documents.

Investigations made to asses the inventory management and system capability of projects shows that the use of bin cards to know the level of inventory at any time was minimal .In addition; no means is created to know the amount of materials out of warehouse. Almost all projects surveyed do not have material and tools accounting system hence little information available on materials and tools out of warehouse**.**

Hence, the case study projects shall establish material and tool control system containing information on purchase order status, quantities of materials and tools required, inventory levels and location of all materials and tools both inside and outside of the warehouse. In addition the construction site shall be gridded and coded to know the location of materials dumped out house.

7.4 Technical Subsystem

Temporary facilities management: Temporary facilities are facilities that are required for the completion or maintenance of projects but are subsequently removed because these facilities do not form part of the permanent facilities. In most cases the contractor designs the temporary facilities and is responsible for their maintenance and management. The survey made on this case show an average score of 4.25 which means satisfactory. But contrary to this on interview with some project managers revealed that temporary facilities are not planned consciously. No project could show on paper site layout design of temporary facilities and their bases. My observations on all projects showed that there could be different alternatives of placing temporary facilities such that the amount of lost time for tool checkout, material check out and other movement time can be reduced. Thus temporary facilities shall be designed by optimizing their cost with energy and productive time of workers. In connection with this the other most interesting problem observed was that all on site labour routes are full of scrap hence reducing the movement of workers and safety thus these scraps shall be collected timely and placed in the appropriate place. Some contractors remove these scraps at the end of most works this has left the advantage that could have been obtained earlier by reducing hindrances to workers, hence increasing labour productivity.

During my observation on some projects it was found that project office location in most projects was excellent. That is they are located in a place where any worker must pass through to get into the work hence simplifying communication between administrative and site staff.

Another important observation that was made is that in some projects prefabrication and shop areas are not appropriately located. For example rebar areas are located far from steel fixing areas requiring more travel by workers for installation. The reinforcement bar is not appropriately stacked to ease screening and avoid unnecessary cleaning.

In general, the researcher is not satisfied with the layout of temporary facilities, project offices and shop areas in the surveyed projects. On site observation by the researcher confirms that these components are not laid out properly so as to increase the productivity

of workers. Contrary to my observation project managers opinion shows satisfaction which might be caused due to lack of knowledge about principles of motion economy[1].

Work methods management: This involves the follow up of the on site implementation of design drawings and specifications by engineers[2]; and checking of the construction methods[3] followed by the craftsmen. The first part is done by both the consultant staff and the contractor engineers. Observation and interview with project managers shows that this is sufficiently done by all projects.

1. The principle of motion economy states sets of laws that are established for human body, workplace and tool and equipment so as to economize human energy and time.
2. Engineers are concerned about what is implemented or installed on site and
3. Technicians and craftsmen supervisors are concerned about how to install it; that is about the process.

Engineers of both the contractor and consultant devote much of their time in these activities. The second one, checking construction methods, is not sufficiently done. This is because of low level of knowledge in construction starting from engineers and craftsmen and unavailability of construction standards to be followed. Most engineers claim that this is highly technical and shall be left to lower supervisors; similarly the supervisors claim that this is highly technical and shall be left to the craftsmen and this left the craftsmen as the only responsible body for construction methods. This is one of the reasons why craftsmanship transferred from generation to generation with its all inefficiencies in Ethiopia**.** Unlike other countries, project structures in most projects do not place a separate trained staff for construction methods supervision. The practice is to assign this responsibility to highly experienced but untrained superintendents and foremen.

Upon examining the actual site operations, it was found that most crew supervisors are less in capacity and skill than craftsmen hence construction methods supervision was not satisfactory. This might be the cause for earlier findings that instruction delay and rework are major problems of the surveyed construction projects.

Work standards: This involves the establishment of the amount of work that is to be done by any of its craftsmen in a given working hour or day. Motivations of workers do not come only by appropriate leadership but also realizable standard. Realizable standards make workers to strive to attain them and accurate evaluation of workers would be possible which increases the motivation of workers. In addition introducing engineered working standards in any construction firm is productivity improvement because standard development involves elimination unnecessary activities which add no value to the work.

Examination of the actual site operations in surveyed projects shows that only 24% of craftsmen and supervisors know their standard and actual productivity. This shows that the necessary tool to maintain motivation of craftsmen was not installed. It is true that there is no standard construction method laid out in the form of process chart for Ethiopian construction works; however using actual site operations it is possible to establish productivity standards which are better than nothing. All the above issues indicate that the Ethiopian construction management like most other fields is traditional; it is not supported by measurements to reveal at least certain facts.

7.5 Organizational Behavior Subsystem

Leadership: any organization or project is founded to perform specific tasks through people. Construction people need a leader to direct and guide people, influence their thoughts and behavior, motivate them and control them to work towards goals that are regarded by the people. Productivity problems related with change of workers and supervisors and absenteeism are caused mostly by leadership and its related behavioral deficiencies. For the purpose of this study the Blake and Mutton leadership style theory in combination with the contingency model discussed in the conceptual framework is used for analysis.

Focus on production: Analysis of the survey on leadership focus towards production shows a score of 4.38 (equivalent to 6.57 on Blake scale) meaning satisfactory. However, from the questioner it was found that leadership focus, to organize its workers so as to

foster production was unsatisfactory. The survey indicates that the focus towards production in all projects is near average from Blake best, which is 9.

Focus on people: Analysis of the survey on leadership focus towards people shows a score of 3.91 (equivalent to 5.86 on Blake scale) meaning unsatisfactory according to the measurement scale of this study. The survey shows that less attention was given to hear workers problems and support given by management to involve workers in plan preparation was minimal.

But observation of the characteristics of the client shows that most of the project owners, 71%, are public making accountability towards budget is important hence leadership shall make emphasis on cost less on time requiring more people oriented type of leadership. The survey further indicates that almost all buildings are standard types containing commercial, housing and public projects with a project cost more than 15 million requiring people oriented type of leadership. The above preconditions show that the construction leadership of the surveyed projects gave little emphasis towards people.

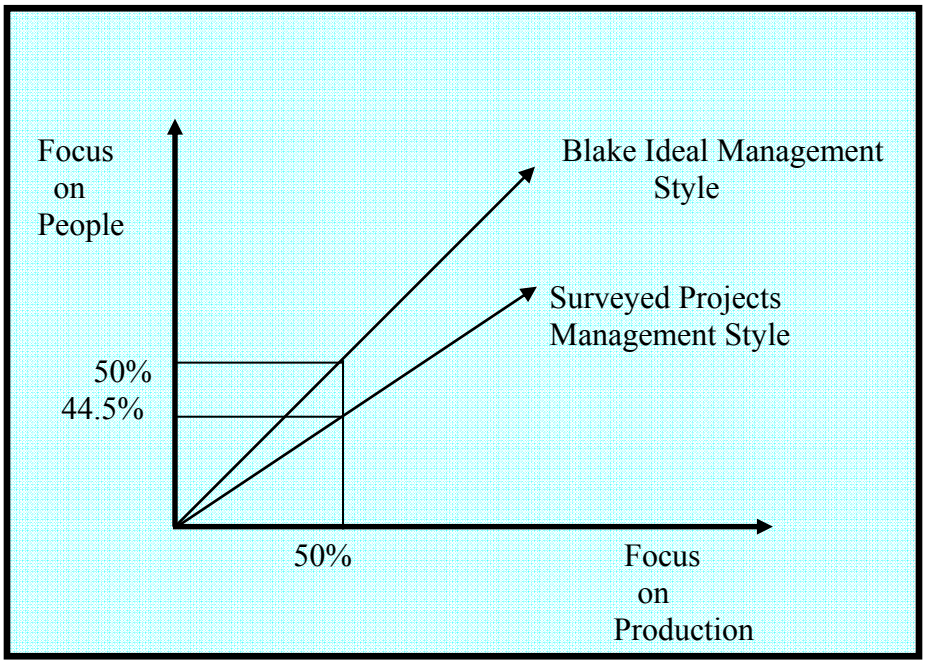


Figure 7.1 Graph of Ideal Management of Blake and Surveyed Projects

From the graph, it can be seen that the Ethiopian construction give a little bit higher emphasis to production this is reasonable as construction projects are unique and technical than other organizations on which Blake made study.

According to this investigation the surveyed projects, construction leadership show an average Blake scale of (6.57, 5.86)[2] which is near to Blake middle of the road leadership. Even though the best type of management style depends on the situation the survey indicates that as the leadership increases its concern of production and people, production increased. For example, project three accomplished more with leadership scale of (6.28, 5.82) than project one with Blake scale of (5.98, 5.65).This shows that the construction leadership of the surveyed projects lacks capacity of knowledge or otherwise to raise productivity even though the degree of emphasis towards production and people is acceptable.

Work behavior: productivity of any employee in an organization is affected by the values and attitudes of workers or the organizational culture. The organizational culture affects the internal working environment which in turn affects the attitude of people inside, then their motivation and effectiveness, which is one of the determinants of productivity. Organizational culture is the ways things are done within the internal environment of the workplace. In order for the organization to survive the external pressure of the environment, they need to continuously change their culture to fit into the environment in which they operate and create a new strong culture. Productivity problems such as change of workers and supervisors, absenteeism and accidents may be caused by social component of the organizational culture. The frame work of Cameron and Quinn[1] is used to analyze the projects as shown in the conceptual framework.

Innovativeness and satisfaction: This is a culture that creates conducive environment for employees to design and implement new methods that increases productivity. The survey shows a value 3.98 meaning unsatisfactory. This shows that the surveyed projects management shall create a suitable environment to tap workers will to work efficiently and adopt new work methods.

Effectiveness and clarity of goals: This is a culture that helps each employee to see the objective of his work and its contribution to the goal of the organization. This is based on the assumption that if workers clearly know the objective of their work then their motivation will increase, hence productivity. The survey of the projects shows a value of 4.3 meaning satisfactory. However, the survey indicates there was interruption of work and lacks of information, which sometimes reduce the clarity of the goals.

Community spirit: This is a culture which shows whether the project employees move as a unit for a common objective or not. The survey shows a value of 4.02 meaning satisfactory. But the survey shows that collaboration between different group workers is minimal.

1. This theory is equally applicable for large organization; including a country
Survey of project one and three shows an equal communication score of 3.99 but three has a relatively high score of community spirit hence producing more than one.

Communication: This is a culture which shows the level of integration of workers laterally and hierarchically based on factual information. The survey shows a value of 4.45 meaning satisfactory; contrary to this during the interview it was said that feedback information on work accomplished by work teams; from the management was minimal causing loss of will to work.

Part IV. Recommendation and Conclusion

Chapter 8.Recommendations and Conclusions

The aim of this chapter was to present the study findings and their practical implications by employing project objectives and findings and their relationships. It contains three sections titled, research findings and conclusions, research practical implications and the study limitation and further recommendations.

8.1 The Research Findings and Conclusions

Productivity Performance: Unlike developed countries the construction projects management in Ethiopia is traditional; there is no experience in measuring at least certain performances to reveal certain facts. It was confirmed during the survey that no project had installed labour productivity measurement for the purpose of management. The basis of human resource planning and schedule preparation was based on non engineered standards developed at national level.

The study made productivity measurement of three trades, namely concreting trade, masonry trade and steel fixing trade and showed that except one project for masonry and steel fixing trade all projects had performance ability ratio (PAR) greater than one (Table 6.9) meaning the productivity performance was low. The analysis was made based on the planned standard that was used for schedule preparation, which most of the crew foremen did not have the prior knowledge about it. Additionally, the use and development of productivity standards as a tool for management was not known by the project management it self.

Another survey in the study to determine the amount of productive time of the target trades revealed that on the average a trade craftsman spends only 56% of the total paid time productively the remaining being wasted due to various administrative, technical and motivational caused delays. The main productivity problems identified in the study as per their degree of influence are lack of materials, instruction delay, rework ,change of workers, lack of tools and less work load and congestion (Table 6.10).The average amount of productive time lost by each problem as judged by the craftsmen and foremen is shown in the appendix (appendix A1).

Productivity Problems Causative Factors: an open system view of the productivity problems of the studied trades had showed that there are four significant causative factors for low productivity. These are preconditions, managerial subsystem, technical subsystem and organizational behavior subsystem (Figure 5.3) and (Box 7.1).

Preconditions: the level of instability in client requirement for the surveyed projects are low but clients applying the method of construction management as a project delivery system had showed instability in requirements than applying traditional methods. Additionally timeliness and clarity of decisions, and acceptance by the project consultants was low; the understanding by the consultant that information is one of the most important inputs for construction is low.

The construction companies' effort in providing appropriate project organization, resources and general support is adequate but the supply of construction materials as per the scheduled set was low due to low financial capacity and constraints of cash flow.

Managerial subsystems: findings related with this subsystem are many hence they are presented under various topics.

Schedule management: the general practice of schedule management in the surveyed projects was low. It is true that this system was laid out by most projects but they were not done properly and with qualified data besides they were seldom used for internal control purposes. There was no practice observed to integrate the construction schedule with procurement and engineering schedules, though the later' schedules were not often produced. Though, schedules were prepared at top management level; successive and consistent schedules that can be used as operational control tools at work package and crew level were not produced. Even at higher levels the practice of preparing construction progress curves and manpower histogram was minimal. The study also revealed that the practice of producing milestone schedule for integrating different participants was low where as preparation, updating and communicating schedule performance are satisfactory though they are done as formal obligation than for the purpose of schedule management.

Progress and productivity: the study finds that progress and productivity follow up and measurement was not done satisfactorily. It was found that measurements conducted in the surveyed projects were for the purpose of preparing payment certificate and reports. There was no measurement done to estimate productivity of any particular crew hence many of planning functions in the projects were done with poor quality data collected from somewhere. In general, the study concludes that there was no any productivity measuring system installed in any of the projects.

Quality: the study finds from the workers opinion that the quality performance of the projects was satisfactory; however rework was found as the third major productivity problem. In most projects systems are not installed to control quality of materials before bulk

purchase and delivery was made to the projects. It is common to see in some projects materials dumped in bulk but failed the primilary tests. Another problem that was seen in connection with this was only 17% of the surveyed project lower supervisors and craftsmen were trained. In general, it can be concluded that no quality control system was installed in any of the projects in the form of manuals or otherwise.

Safety: the level of safety management in the surveyed projects was not satisfactory as the accident rates these contractors experienced were minimal. The experience of enforcing safety problems on site by supervisors and regulatory bodies was not satisfactory.

Organization: the practice of site organization of the surveyed projects was not satisfactory. The major problem lies in employment practice where by recommendation from early employee was given more weight; creating a more subjective method of employment, hence avoiding the chance of obtaining competitive personnel by open tendering. The other finding related with this topic was that most projects tried to reduce administrative personnel hence assigning too much activities on few individuals the will cause some of the administrative works not to be done properly.

Labour relations: the practice of functions of on site labour relations was not satisfactory. Due to lack of appropriate data and awareness to labour related costs human resource planning was not sufficiently done on site. There was huge gap between the so called “human resource plan’’ and actual workers on site. Site observations indicate that there was a lot of grievance by workers but there was no system installed to entertain the case. The function of the human relations officer in projects was seen more reactive than proactive.

Materials and tools management: the practice of tools and materials management in the surveyed projects was not satisfactory. It was not possible to see paper on site systems to control tools and materials out of the ware house. There was no established manual or other wise which provides material usage standards for major activities. It was also confirmed that craftsmen were not provided with well maintained and appropriate tools besides the observation that few sites use power tools.

In general, the above findings show that the surveyed projects do not have systems that can be used to manage the projects. Some of the project management system that were laid out are not supported with recurrent and reliable information. Some of the reasons for the non existent of project management systems are: lack of knowledge on open system theory hence the importance of these system to productivity are not understood, lack of commitment by the management to collect on site data, low practice in the use of project management software, bad project culture which undermine administrative works and the additional cost incurred.

Technical subsystem: findings related with this subsystem are presented in two subtopics.

Work methods management: the research had found that the follow up and checking to confirm the implementation of design drawings and specifications was done sufficiently on site. Most engineers both from the contractor and the consultant devote much of their time on this activity. But the management of construction methods that was followed by the craftsmen was not done satisfactorily. Higher supervisory staffs claim that this is highly technical and shall be left for the craftsmen; leaving the latter as the only method experts. It was learnt that higher construction experts are not formally trained in trade schools and hence lacks capacity in transferring and controlling their knowledge to the craftsmen. It was also confirmed that no project has established construction methods manual to be used by site craftsmen.

Standard development: The study had found that no standard was used for management though all projects need productivity standards for the purpose of scheduling. The productivity standard that was used in the schedule was not transferred down to the crews. Of course, the standards that were used in the schedule were estimates collected from some where and should not be considered as realistic physical targets.

In general, the above findings show that construction methods management were not done in a scientific way as demands due to lack of trained manpower in construction methods in the projects ;and standards were used only for planning purposes at higher level; hence could not be used for controlling crew performances.

Organizational behavior subsystems: findings related with this subsystem are presented in to two topics even though both sometimes integrate each other.

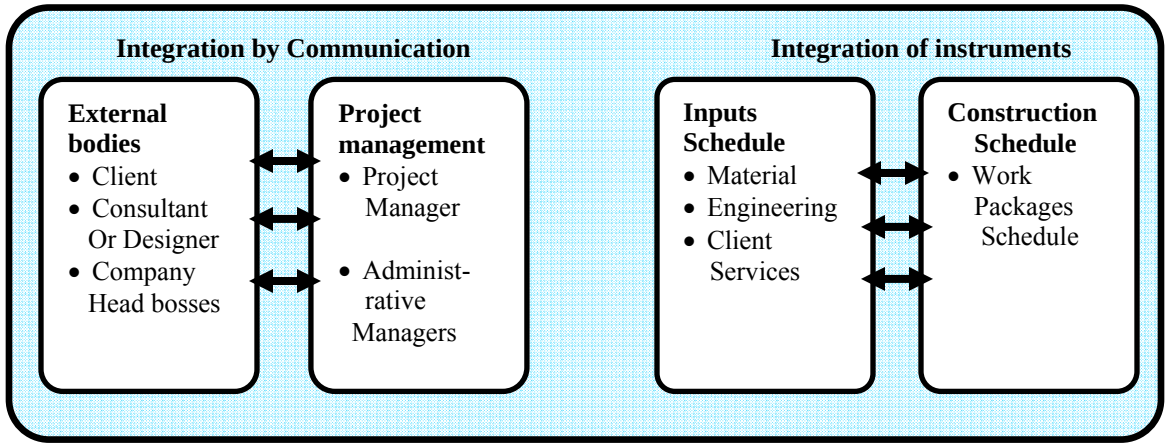
Leadership: the study has found that the focus of leadership to production was adequate but it was found that leadership effort to organize workers to foster production was minimal; whereas the attention towards people was found low especially on matters to hear workers problem and involvement of them in plan preparation. The survey had found that the leadership capability and emphasis can be put in Blake scale as (6.57, 5.86) (Figure 7.1).This means the surveyed projects leadership is near to the middle of the road leadership. When this type of leadership is compared to the ideal management of Blake, that is (9, 9) management style, the project leaders lacks capacity or otherwise to increase their emphasis towards people and production.

Work Behavior: the study has found that except one culture, which is innovativeness and satisfaction, all other important cultures of productivity were satisfactorily done by the surveyed projects. How ever it should be understood that these cultures should be developed into strong cultures to contribute a lot for productivity.

In general, the contribution of organizational behavior to productivity is high; therefore engineering management practitioners should develop their knowledge of project management systems by integrating with knowledge of organizational behavior to enhance productivity.

8.2. The Research Theoretical Implications and Conclusion

The researcher has observed that labour productivity is a wide concept influenced by a multitude of factors and bodies. Hence, productivity improvement needs integration of these bodies outside the project environment (Box 8.1) and effective communication internally within the formal structure. The researcher believes that the effect of preconditions on the project labour productivity can be improved by appropriate integration management using schedule, control meetings and reports.



Box 8.1 Integration of Participants and Instruments for Effective Productivity Improvement

Another thing that was observed was that management of projects needs knowledge of systematically viewing construction operations so as to manage every part within the perspectives of the whole; this is system thinking. Most practicing engineers thought that knowledge of project management systems was sufficient to manage construction projects but this study indicates that the effect of work behavior and leadership to workers productivity is also significant.

8.3 The Research Practical Recommendations

Government: the construction industry leaders should reinforce construction techniques universities opened, technical and vocational schools and colleges with human and technical resources. Representatives of the private construction sector shall be involved in the design of curriculum and other issues which are deemed important.

Clients: Clients can influence the productivity of their site by applying appropriate project procurement system so as to foster earlier integration between external bodies. For example by applying design and build method clients can integrate the effects of designers and contractors into one body hence reducing efforts required for communication.

Consultants: Consultants can contribute a lot in enhancing site productivity by applying the concepts of open systems theory and integration management.

Contractors: Contractors shall try to install comprehensive project management information systems to their projects integrated with properly designed on site data collection system; especial emphasis should be given to materials and productivity management systems.

Contractors and regulatory bodies shall establish current and engineered productivity standards that can be used for the purpose of internal management and regulatory work.

Contractors shall understand the effect of tools and simple machines in improving productivity hence they give emphasis to introduce these to the domestic industry so as to be competitive as other countries.

Contractors should not be discouraged in introducing measurement systems for certain performances seeing the immediate cost incurred. The implementation of it has high leverage in reducing costs related with labour inefficiencies.

Contractors shall encourage their project leaders in introducing competitive values through their working environment.

Project managers: Practicing project managing engineers should understand that management of projects will not require only knowledge of project management systems but also construction techniques and organizational behavior. Hence they shall reinforce their knowledge of systems with construction techniques and organizational behavior.

Project managers shall introduce productivity measurement system at crew level so as to have reliable planning and controlling system to manage their work.

Project managers should not continue to lead projects subconsciously as practiced to day they shall understand the basic theories and their implementation in construction site.

Lower level supervisors and foreman: These personnel lack not only blue collar training in techniques but also knowledge of organizations. Hence contractors and industry leaders should try to enhance the capacity supervisors by providing appropriate training in techniques and some knowledge of organizational behavior.

8.4. The Research Limitations and Recommendations

One of the serious problems found was scarcity of data related with productivity of crews and their problem. This made the researcher to make certain surveys to reveal certain facts besides aligning the study strategy as case study. But after preparing the research instruments it was found that contractors were not cooperative to respond their views with adequate willingness due to lack of trust and inclination to mystify everything thus the researcher tried to curb this problem by creating relational network with company leaders and project managers.

During the data collection and interview it was found that the construction work force and management were low in education and motivation to perceive the management world hence close contact and revisit was made to minimize the problem.

The research could be made better by focusing on one factor affecting productivity problem but any researcher or reader should not lose sight of the perspective of the whole while studying only one part[1]. Alternatively one could get better result by studying the projects closely up to the end of the project duration so as to judge the project by himself than involving project participants having little knowledge to perceive the management world.

The following titles are recommended to be assessed in detail to curb the existing productivity problems in the Ethiopian construction industry;

- **The relation between each factor of labour productivity identified in the study and productivity by creating control projects if possible;**
- **The effect of project culture on construction labour productivity;**
- **Assessing the method of construction being implemented on certain trades and their improvement;**
- **The effect of project procurement system on project site productivity;**
- **Assessing and introducing material management system for the local construction industry;**
- **Assessing and introducing crew level productivity measurement system for the local construction industry;**
- **Developing computerized productivity data processing system for management.**

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1. This was made partly intentional as most project managers lack in viewing projects systematically; it also gives clues for those researchers who want to do detailed studies on some factors as there are few books written on the full system components of construction. Most project management books emphasize only management systems, not on others.

Raw Response Data Summary Sheet

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1																	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
Project Manager	Preconditions &												Management and Technical factors					
Project 1	2	2	n a	4	2	4	6	4	4	2	2	2	2	2	2	1	4	2
Project 2	4	6	6	4	6	2	2	2	2	6	6	6	6	6	4	4	6	6
Project 3	2	1	1	6	1	2	2	2	2	6	6	6	4	4	4	4	4	4
Project 4	1	2	4	6	4	4	4	4	4	6	4	6	4	4	6	6	6	4
Project 5	4	6	1	2	2	2	2	2	4	6	4	6	6	6	6	4	6	4
Project 6	2	1	1	4	2	1	1	1	2	2	4	4	2	1	4	2	2	2
Others	4	4	2	2	2	2	2	2	2	2	4	2	2	2	2	1	2	1
Site engineers													Management and Technical factors					
Project 1																		
Project 2													4	4	6	4	2	4
Project 3																		
Project 4																		
Project 5																		
Others																		
Foreman													Management and Technical factors					
Project 1													4	4	1	4	2	1
Project 2													6	4	6	4	2	4
Project 3													4	2	4	4	2	2
Project 4													6	6	6	4	4	6
Project 5																		
Others													6	4	4	2	2	2

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1														
	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33
Project manager	Management and Technical factors														
Project 1	2	4	2	2	2	2	2	1	2	2	4	4	4	2	2
Project 2	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Project 3	6	6	4	4	4	4	4	4	4	6	6	6	4	4	4
Project 4	6	6	4	4	4	6	6	6	6	4	4	6	6	6	6
Project 5	6	6	4	4	6	6	6	6	6	6	6	6	4	4	4
Project 6	4	4	2	4	2	4	4	4	2	4	6	6	2	2	2
Others	2	2	2	2	2	2	2	2	4	4	4	2	2	2	2
Site engineers	Management and Technical factors														
Project 1															
Project 2	6	6	6	6	4	6	6	6	6	6	6	6	6	6	6
Project 3															
Project 4															
Project 5															
Others															
Foreman	Management and Technical factors														
Project 1	1	1	2	4	4	4	4	4	4	6	4	4	1	1	1
Project 2	4	2	4	4	6	6	6	6	6	6	6	6	6	6	6
Project 3	4	2	4	2	4	2	4	4	4	4	2	2	4	2	2
Project 4	6	4	4	4	4	4	6	4	6	6	6	6	4	4	4
Project 5															
Others	2	4	4	6	4	4	6	4	6	2	6	4	4	2	4

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1														
	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48
Project manager	Management and Technical factors														
Project 1	1	4	4	2	2	2	4	2	2	2	1	4	2	2	4
Project 2	6	6	6	6	6	6	6	6	4	4	4	4	6	6	6
Project 3	4	6	1	6	2	4	4	6	6	6	6	6	6	4	6
Project 4	4	6	4	6	4	6	6	4	4	4	4	6	6	6	4
Project 5	4	6	4	4	4	4	6	2	6	4	4	6	4	4	6
Project 6	1	6	4	6	6	4	4	1	2	2	2	1	2	1	1
Others	2	4	4	2	2	4	4	1	1	1	1	2	1	1	2
Site engineers	Management and Technical factors														
Project 1															
Project 2	6	6	4	4	4	4	6	1	2	2	4	4	4	4	4
Project 3															
Project 4															
Project 5															
Others															
Foreman	Management and Technical factors														
Project 1	1	2	4	4	4	2	2	4	6	4	4	4	4	4	4
Project 2	6	6	4	4	4	6	6	1	2	2	4	1	4	2	4
Project 3	2	4	4	4	4	4	4	4	4	4	2	2	4	2	2
Project 4	4	4	6	6	6	6	6	6	6	6	4	6	6	6	6
Project 5															
Others	4	4	6	4	6	2	4	1	4	4	2	2	2	2	4

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1										
	Q49	Q50	Q51	Q52	Q53	Q54	Q55	Q56	Q57	Q58	Q59
Project manager	Management and Technical factors										
Project 1	4	1	4	2	1	4	2	2	4	4	4
Project 2	6	4	4	6	6	6	6	6	6	6	6
Project 3	4	1	4	2	4	4	4	4	6	4	6
Project 4	6	4	4	4	4	4	4	4	6	4	4
Project 5	6	2	2	4	4	4	4	4	6	6	4
Project 6	2	1	2	2	2	2	4	4	2	1	4
Others	2	1	2	2	2	4	2	4	2	2	4
Site engineers	Management and Technical factors										
Project 1											
Project 2	4	1	4	2	1	4	4	4	4	2	4
Project 3											
Project 4											
Project 5											
Others											
Foreman	Management and Technical factors										
Project 1	2	1	6	4	4	4	2	4	4	1	4
Project 2	4	1	4	4	2	6	4	6	4	4	6
Project 3	4	2	1	2	4	4	2	4	4	2	4
Project 4	6	6	6	6	6	6	6	6	6	6	4
Project 5											
Others	4	2	2	2	4	6	6	4	6	6	2

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1										
	Q60	Q61	Q62	Q63	Q64	Q65	Q66	Q67	Q68	Q69	Q70
Project manager	Management and Technical factors										
Project 1	2	4	4	4	4	4					
Project 2	6	6	6	6	6	6					
Project 3	6	6	6	4	6	6					
Project 4	4	4	6	6	6	6					
Project 5	6	6	6	6	6	6					
Project 6	4	2	2	2	2	2					
Others	2	2	2	1	2	2					
Site engineers	Management and Technical factors										
Project 1											
Project 2	4	4	4	4	4	4					
Project 3											
Project 4											
Project 5											
Others											
Foreman	Management and Technical factors										
Project 1	1	2	4	4	4	4					
Project 2	4	4	6	6	6	6					
Project 3	4	2	4	4	4	4					
Project 4	4	4	4	6	4	6					
Project 5											
Others	2	6	6	4	2	4					

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1																	
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
Craftsmen	Leadership and work behavior factors																	
Project 1																		
Concrete work craftsman	6	4	4	4	6	4	6	4	2	4	6	6	6	4	2	4	6	6
Masonry work craftsman	4	4	6	4	6	1	6	4	4	4	2	4	2	6	4	2	4	2
Bar bender	1	2	6	1	6	1	2	6	1	6	6	2	2	2	1	6	1	4
Project 2																		
Concrete work craftsman	6	6	6	6	6	4	2	4	1	2	2	6	6	2	4	4	6	4
Masonry work craftsman	6	6	6	4	6	4	2	4	6	4	2	4	4	4	4	2	6	4
Bar bender	4	4	4	4	6	6	6	6	6	6	6	4	6	6	4	4	6	6
Project 3																		
Concrete work craftsman	6	2	4	4	4	2	4	1	1	2	2	4	2	4	2	1	2	4
Masonry work craftsman	4	2	4	4	4	1	1	4	4	4	6	2	6	6	4	6	2	4
Bar bender	6	6	6	6	6	6	6	6	6	4	6	4	4	6	4	4	4	4
Project 4																		
Concrete work craftsman	6	6	6	6	6	2	6	4	4	4	4	6	6	6	6	4	6	6
Masonry work craftsman	6	6	6	6	6	2	6	4	4	4	4	6	6	6	6	4	6	6
Bar bender	4	6	4	4	6	4	6	4	2	2	4	4	6	6	4	2	6	4
Project 5																		
Concrete work craftsman	4	4	6	4	-	4	4	6	4	4	4	6	6	6	6	6	6	4
Masonry work craftsman	6	4	4	4	6	4	-	4	-	4	4	6	6	6	6	6	6	6
Bar bender	4	6	6	2	6	1	4	2	-	4	-	4	4	4	4	1	6	6
Project 6																		
Concrete work craftsman	2	6	2	6	2	1	6	2	1	2	4	1	1	1	6	2	6	1
Masonry work craftsman	6	4	6	6	4	1	2	2	2	2	2	6	4	4	2	4	1	4
Bar bender																		

Target group	Rated scaled Questions; Vo= very often, O= often, St= sometimes, No=None ; Scale Vo: O: St: No= 6:4:2:1														
	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33
Craftsmen	Leadership and work behavior factors														
Project 1															
Concrete work craftsman	6	1	4	6	6	2	6	6	4	6	1	6	4	2	6
Masonry work craftsman	1	6	2	4	6	1	4	4	6	4	6	6	4	4	4
Bar bender	2	1	2	2	6	2	2	1	2	2	4	2	2	2	2
Project 2															
Concrete work craftsman	6	6	6	6	4	4	6	6	4	6	1	4	6	4	6
Masonry work craftsman	4	1	6	6	4	4	6	2	4	4	1	4	6	4	6
Bar bender	4	4	4	4	4	4	6	6	6	6	6	6	6	4	4
Project 3															
Concrete work craftsman	2	4	4	2	2	2	4	1	2	2	4	2	4	2	4
Masonry work craftsman	4	2	4	2	2	2	4	4	2	4	1	2	4	2	4
Bar bender	4	4	4	4	2	4	6	4	6	6	2	6	6	4	4
Project 4															
Concrete work craftsman	4	2	2	6	4	4	6	6	6	6	2	6	6	2	4
Masonry work craftsman	4	2	2	6	4	4	6	6	6	6	2	6	6	2	4
Bar bender	2	2	2	6	2	2	4	6	6	6	2	4	6	2	6
Project 5															
Concrete work craftsman	2	4	4	6	2	1	4	6	4	4	6	6	4	6	2
Masonry work craftsman	2	4	6	6	2	1	4	6	2	6	6	6	4	4	6
Bar bender	2	6	6	6	2	2	4	1	4	6	4	2	6	1	4
Project 6															
Concrete work craftsman	6	2	6	6	2	4	6	1	1	4	2	4	4	6	6
Masonry work craftsman	-	2	2	6	2	1	6	6	6	6	1	4	6	6	4
Bar bender															

	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48
Craftsmen	Leadership and work behavior factors														
Project 1															
Concrete work craftsman	6	6	6	4	6	4	6	4	4						
Masonry work craftsman	4	2	2	6	4	6	6	6	4						
Bar bender	2	1	1	2	2	2	2	2	2						
Project 2															
Concrete work craftsman	6	6	6	6	6	6	6	2	6						
Masonry work craftsman	6	6	4	6	6	6	6	4	6						
Bar bender	6	4	4	6	4	4	4	4	4						
Project 3															
Concrete work craftsman	4	4	4	4	2	4	4	2	2						
Masonry work craftsman	4	4	4	2	4	4	2	2	4						
Bar bender	4	4	4	4	4	6	6	6	6						
Project 4															
Concrete work craftsman	6	6	4	2	6	6	6	6	6						
Masonry work craftsman	6	6	4	2	6	6	6	6	6						
Bar bender	4	6	4	2	6	6	6	6	6						
Project 5															
Concrete work craftsman	6	4	4	1	2	4	4	4	4						
Masonry work craftsman	4	4	4	1	4	6	6	-	-						
Bar bender	6	4	2	2	4	6	4	4	4						
Project 6															
Concrete work craftsman	6	6	6	6	6	6	6	1	2						
Masonry work craftsman	6	2	2	2	4	4	2	4	4						
Bar bender															

Response Data of Productive Time Loss Due To Listed Problems

No.	Problem List	Concreting Work					Masonry Work					Bar Bending					
		Productive time loss by Projects					Productive time loss by Projects					Productive time loss by Projects					T.Avg. loss (min)
		P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5	
1	Lack of materials	45			50					60				45	60		45-60
2	Lack of tools	20			30					20				13	20		13-30
3	Accident	-			20					10				-	10		10-20
4	Rework	20			45					25				50	15		20-50
5	Change of workers	30			40					30				15	25		15-30
6	Interference	-			25					15				10	30		10-30
7	Absenteeism	-			15					10				30	-		10-30
8	Instruction delay	30			45					50				25	40		25-50
9	Change of supervisor	-			30					45				30	15		15-45
10	Less work load	25			10					10				30	-		10-25
11	Congestion	20			25					20				25	10		10-20
12	Others	30			-					-				30	-		<30

ግንቦት1998 ዓ.ም

ለውድ መላኸ

በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጂ የሁለተኛ ዲግሪ ማሙያ፣ ጥናት መጠይቅ

በአዲስ አበባ ዩኒቨርሲቲ በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጅ የሁለተኛ ዲግሪን እየሰራሁ እገኛለሁ በመሆኑም ለመመረቂያ የሚሆን አንድ የጥናት ርዕስ መርጬ ጥናታዊ ሪፖርት እንዳዘጋጅ ይጠበቃል፡፡ ለጥናቱ የመረጥኩት ርዕስ የጉልበት ምርታማነት በኮንስትራክሽን ፕሮጀክቶች መለካት የሚል ሲሆን ጥናቱም በሦስት የግንባታ ሙያዎች ላይ ያነጣጠረ ሲሆን የሚከተሉትን ነገሮች ይመረምራል፡፡

1. የጉልበት የምርታማነትን ጊዜ የሚያባክኑ ቀጥተኛ ችግሮች ምን እንደሆኑ ኮንስትራክሽን ፕሮጀክቶችን ይፈትሻል
2. ለጉልበት ምርታማነት ዝቅተኛነት መንስኤ የሆኑ የኮንስትክሽን የአመራር ችግሮችንና መፍትሔዎቻቸውን ይፈትሻል

በመሆኑም ከዚህ ወረቀት ላይ የተያያዙትን መጠይቆች እንደሞሉልኝ እጠይቃለሁ፡፡ የሚሰጡት መረጃ ለጥናቱ ብቻ እንደሚውል እያረጋገጥኩኝ መጠይቁን የሞሉትን ፕሮጀክቶች ካንፓኒዎች ስም እደማይጠቀስ አረጋጣለሁ፡፡በተጨማሪም የጥናቱ ኮፒ በተጠየቀ ጊዜ ለመስጠት ፈቃደኛነቴን እገልጻለሁ፡፡

ከሰላምታ ጋር

ቴዎድሮስ ዓለሙ

አማካሪ

ውብሸት ጀካለ (ዶ/ር)

(ይህ መጠይቅ በመላኸ ቡድን ውስጥ የፕሮጀክት ኃላፊ ወይም መሀንዲስ ለሚወክሉ ብቻ የተዘጋጀ ነው)

ትዕዛዝ

ይህ መጠይቅ ሦስት ርዕሶች የያዘ ሲሆን እነሱም አጠቃላይ የፕሮጀክቱ መረጃ፣ የምርታማነት ቅድመ ሁኔታዎችና የአመራር ስልትና ቴክኒካዊ ሁኔታዎች ናቸው፣ በመሆኑም፡

1. አጠቃላይ መረጃ ስር ለቀረቡ ጥያቄዎች የሚመለከተውን ካሉት አማራጮች ሰረዝ በማድረግ ይሙሉ የሚሞላውን ደግሞ በክፍት ቦታው ላይ ይሙሉ

2. በምርታማነት ቅድመ ሁኔታዎችና አመራር ስልትና ቴክኒካዊ ሁኔታዎች ያሉትን ጥያቄዎች ምን ያህል እንደሚተገበሩ እንዲሁም በእያንዳንዱ ጥያቄ ላይ ያሉትን ለመለካት እንዲያሰቡትና ለኢንተርቪው ከሚመጡ ባለሙያዎች ጋር ለውይይት የተወሰነ ጊዜ እንደመድቡልን፣

3. ምን ያህል እንደሚተገበሩ ለመገመት ይረዳ ዘንድ እያንዳንዱ የኢንተርቪው ጥያቄ በመጠይቅ መልክ ቀርቧል ለነዚህም አራት አማራጮች ተሰጥተዋል፡፡

በየ	በጣም የተለመደ	6
የ፡	የተለመደ	4
አጊ፡	አንዳንድ ጊዜ	2
ምን	ምንም	1

በመሆኑም ካሉት አማራጮች የትኛው የእርስዎን ፕሮጀክት እንደሚጠቁም ከሚጠይቀው ባለሙያ ጋር በመወያየት የተሰጡትን አመራጮች አንዱን ይምረጡ፡፡

ማሰሰቢያ፡- በመጠይቁ ላይ ያሉት ርዕሶች እንደመላሽ ቡድኑ የአመራርና የሙያ ደረጃ የተከፋፈለ ስለሆነ ሁሉም ርዕሶች በአንድ ላይ በአንድ መላሽ ቡድን መጠይቅ ላይ ላይኖሩ ይችላሉ፡፡

የምርታማነት ሥልት መለኪያዎች የጽሁፍ መጠይቅ

አጠቃላይ መረጃ

1. በየትኛው የቁጥጥር አመራር ደረጃ ላይ ይሠራሉ? ----------

2. የዚህ ህንፃ ፕሮጀክት አይነት ምንድን ነው?

- ☐ ትምህርት ቤት
- ☐ ሁለገብ
- ☐ ቢሮ
- ☐ አፓርትመንት
- ☐ ሱቅ
- ☐ ሌላ

3. ይህንን ፕሮጀክት ሲያገኙ ደንበኛው ይጠቀምበት የነበረው የግዥ ዘዴ የትኛው ነው?

- ☐ ዲዛይንና ግንባታ ለአንድ ፓርቲ
- ☐ ባህላዊ ዘዴ
- ☐ የኮንስትራክሽን አመራር ዘዴ
- ☐ ሌሎች

4. የፕሮጀክቱ የውለታ ጊዜ ስንት ወር ነው ? ----------

5. የፕሮጀክቱ የውል ዋጋ ስንት ነው? ---------- ብር

6. የተሰራው የሥራ መጠን በፕርሰንት ስንት ይሆናል? ---------- %

የሥራ ምርታማነት ቅድመ ሁኔታዎች መለኪያ ቃለ መጠይቅ

A	ባለቤት	መለኪያ			
A.1	የባለቤቱ ፋላጐት ወጥነት፣	በየ	የ	አጊ	ምን
1.	የሥራ መጠንና አይነት ለውጥ፣				

2.	የፕሮጀክቱ ጊዜ የመለወጥ ሁኔታ፣				
A.2..	**የባለቤት ግዥ ካለ፣**				
3.	በውል ውስጥ ባለቤቱ እንዲያቀርብ ስምምነት የተደረሰባቸው ጥሬ እቃ እና አገልግሎት የማቅረብ ሁኔታ፣				
A.3.	**ባለቤቱ ለፕሮጀክቱ ቡድኑ ያለው ድጋፍ፣**				
4.	አጠቃላይ ድጋፍ በባለቤቱ ለፕሮጀክት ቡድኑ፣				
5.	የግንባታ ዲዛይኑን ለግንባታ አመቺነት መከለስ፣				
B.	**አማካሪ፣**				
6.	ከአማካሪዎች ውሳኔ እና ተቀባይነት በፍጥነት የማግኘት ሁኔታ፣				
7.	የአማካሪዎች ውሳኔ ግልጽነት ፣				
8.	ፕሮጀክቱ የተከለሱ ዲዛይኖችን በጊዜ የማግኘት ሁኔታ፣				
9.	አጠቃላይ ድጋፍና ተነሳሽነት በአማካሪው ፣				
C	**በ ዋና መ/ቤት፣**				
10	በፕሮጀክቱ ተስማሚ የሆነ አደረጃጀት መዘርጋት፣				
11.	ለሥራ የሚያስፈልጉ ሃብቶችን በፍጥነት ማቅረብ፣ ሁኔታ፣				
12.	አጠቃላይ ድጋፍና ተነሳሽነት ፣				

መግለጫ፣ በየ፡ በጣም የተለመደ፣ የ፡ የተለመደ አጊ፡ አንዳንድ ጊዜ

ምን፡ ምንም

መለኪያ፣ በየ፡ 6 የ፡ 4 አጊ፡ 2 ምን፡ 1

የ አመራር ስልት እና ቴክኒካዊ ሁኔታዎች ቃለ መጠይቅ

		መለኪያ			
A	**የጊዜ እቅድ አመራር**	**በየ**	**የ**	**አጊ**	**ምን**
1	የኮንስትራክሽን ስራዎች የጊዜ እቅድን ከምሕንድስና እና ከግዥ የጊዜ ሰሌዳዎች ጋር የመዛመድ ሁኔታ ፣				
2.	ወጥነት ያላቸው ከዋናው ፕሮጀክት የጊዜ ሰሌዳ ጋር የሚጣጣሙ በተለያዩ ደረጃ ለሚገኙ የሥራ ኃላፊዎች				

	ሊያገለግሉ የሚችሉ የሥራ እቅዶች መኖር ፣				
3.	ሳምንታዊ የግንባታ እቅድ መኖር ፣				
4.	የግንባታ ሂደትን የሚያሳይ ከርቭ ማዘጋጀት ፣				
5.	የግንባታ የሰው ሃይል የሚያሳይ ግራፍ ማዘጋጀት፣				
6.	ፕሮጀክቶችን ለመገምገም የሚያስችሉ ቁልፍ ቀኖችንና ምልክቶችን የያዘ የጊዜ ሰሌዳ መኖር፣				
7.	የስራ ጊዜ ሰሌዳውን ፣ በተወሰኑ ጊዜያት መከለስ፣				
8.	ሳምንታዊና ወርሃዊ የሥራ ጊዜ ሰሌዳ ሪፖርት ማዘጋጀት ፣				
B	የሥራ እቅድን በሥራ ፓኬጅ ደረጃ ፣				
9.	የሚሠራውን የሥራ ፓኬጆች መጠን መወሰን፣				
10.	የሥራ ፓኬጆችን ቅድመ ሁኔታዎችን መለየትና ማሟላት፣				
11.	የሥራ ፓኬጆችን ሲያቅዱ ጥንቃቄን ከግምት ውስጥ ማስገባት፣				
12.	የሥራ ፓኬጆችን እቅድ ከግንባታ እቅዶች ጋር ያለውን ማጣጣም ፣				
13.	ውጤታማና ቆጣቢ የአሠራር ስልቶችን መጠቀም፣				
14.	ለሥራ ፓኬጆች የሚያስፈልጉ ሃብቶችን የመለየት ሁኔታ፣				
15.	የሥራ ፓኬጅ ሃላፊዎችን መመደብ ፣				
16.	ችግሮችን የመለየትና የመፍታት እንዲሁም የሥራ ሂደቱን መከታተል፣				
C.	የሥራ ሂደትና የምርታማነት መጠን ፣				
17.	የተሠሩ ሥራዎችን የሥራ መጠን በትክክል መለካት፣				

24.	የሰራትኞንና የተቆጣጣሪዎችን ብቃት ማሳደግ፣				
18.	የተሰሩ ሥራዎችን በጊዜው የመለካትና የመከታተል፣				
25.	የአመራር ድጋፍ በጥራት ላይ ፣				
19.	ለሥራው አስፈላጊ የሆነ የሰው ሰአትን መተንበይ ፣				
26.	በሥራ ጥራት እና ውበት ላይ ያለውን አቅም ማሳደግ፣				
20.	የምርታማነት ሬሽዮን ለማስላት እውነተኛና በስታንዳርድ				
27.	የጥራት ጉድለቶችን መቆጣጠርና ሪፖርት ማድረግ፣ የሚገኘው ሰአትን ማነፃፀር ፣				
28.	የጥራት ቁጥጥር ማካሄድ ፣				
21.	የሰራተኞችን የሥራ ምርታማነትን በየጊዜው መለካትና				
E	የአደጋ ጥንቃቄ አደረጃጀት እና የሰራተኞች ግንኙነት፣				
29.	በአደጋ ጥንቃቄ ሰራተኞች እና፣ ተቆጣጣሪዎችን ማሰልጠን፣				
22.	ለእያንዳንዱ የግንባታ ሥራ የጠፋውን ሰአት በትክክል መለካት፣				
30.	አደጋን ሊቀንሱ የሚችሉ ስልቶችን መጠቀም እና አቅዶችን መንደፍ፣				
D	የጥራት አስተዳደር ፣				
23.	የማቴሪያል ጥራት ቁጥጥር ፣				

31.	የአመራር ድጋፍ በአደጋ ጥንቃቄ ላይ				
32.	ለድንገተኛ አደጋ ያለ ዝግጅት፣				
33.	የደረሱ አደጋዎች ሪከርድ እና እስታስቲክስ መያዝ፣				
34.	የሰው አመራረጥ ዘዴን መቆጣጠር፣				
35.	አደረጃጀትና የሪፖርቲንግ መዋቅር፣				
36.	የሰው ኃይል ቅጥር እና ስንብት እቅድና ፕሮሲጀር መኖር፣				
37.	የሰው ኃይል እቅድ ማዘጋጀት፣				
38.	ለእጅ ባለሙያዎች ሥልጠና መስጠት፣				
39.	የሰራተኞችን ብሶት የማስተናገድ ሁኔታ፣				
40.	የሰራተኞችን ፍላጐት የማሟላት ሁኔታ ፣				

41.	የሰራተኞን ግንኙነት የሚያዳብር ባለሙያ መመደብ፣				
F	**የሃብት አጠቃቀምና አመራር፣**				
42.	የግንባታ እቃን አያያዝና አጠቃቀም በእቅድ የመምራት ሁኔታ፣				
43.	የጥሬ እቃ የአገዛዝ ሥርአት ቀልጣፋነት፣				
44.	የተገዛን ጥሬ እቃ የመቀበል እና የማከፋፈል ሥርአት መኖር ፣				
45.	በንብረትነት ያለ ጥሬ እቃ መጠንን ለማወቅ እና ለመቆጣጠር የሚያስችል አስራር መኖር፣				
46.	የጥሬ እቃ አጠቃቀም ለማሳለጥ የሚረዳ ቆጣቢ የመረጃ መረብ መዘርጋት፣				
47.	ለእጅ ባለሙያዎች አስፈላጊ የሆኑ መሣሪያዎችን የማቅረብ ሁኔታ፣				
48.	የእጅ መሣሪያ አጠቃቀምና አያያዝ ለማሻሻል የተዘረጋ የቁጥጥር ሥርዐት መኖር				
G	**የግንባታ ቦታና ፋሲሊቲዎች ፕላን**				
49.	ጊዜያዊ ፋሲሊቲዎች ከመገንባታቸው በፊት በዕቅድ ታስበው የመሥራት ሁኔታ፣				
50.	የፕሮጀክት ቢሮዎች ከመሰራታቸው በፊት በዕቅድ ታስቦ የመሥራት ሁኔታ፣				
51.	የመሣሪያና የጥሬ እቃ ማስቀመጫ ቦታዎችን በዕቅድ አስቦ የመሥራት ሁኔታ፣				
52.	የውሃ የመብራት የፍሳሽ ፋሲሊቲዎችን በጥናትና በዕቅድ				

	አስቦ የመሥራት ሁኔታ፣				
53.	የግንባታ ካምፕን በጥናትና በዕቅድ አስቦ የመሥራት ሁኔታ፣				

መግለጫ፣ በየ፡ በጣም የተለመደ፣ የ፡ የተለመደ አጊ፡ አንዳንድ ጊዜ ምን፡ ምንም

መለኪያ፣ በየ፡ 6 የ፡ 4 አጊ፡ 2 ምን፡ 1

ግንቦት 1998 ዓ.ም

ለውድ መላሽ

በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጂ የሁለተኛ ዲግሪ ማሙያ፣ ጥናት መጠይቅ

በአዲስ አበባ ዩኒቨርሲቲ በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጅ የሁለተኛ ዲግሪን እየሰራሁ እገኛለሁ በመሆኑም ለመመረቂያ የሚሆን አንድ የጥናት ርዕስ መርጬ ጥናታዊ ሪፖርት እንዳዘጋጅ ይጠበቃል፡፡ ለጥናቱ የመረጥኩት ርዕስ የጉልበት ምርታማነት በኮንስትራክሽን ፕሮጀክቶች መለካት የሚል ሲሆን ጥናቱም በሦስት የግንባታ ሙያዎች ላይ ያነጣጠረ ሲሆን የሚከተሉትን ነገሮች ይመረምራል፡፡

1 የጉልበት የምርታማነትን ጊዜ የሚያባክኑ ቀጥተኛ ችግሮች ምን እንደሆኑ ኮንስትራክሽን ፕሮጀክቶችን ይፈትሻል
2 ለጉልበት ምርታማነት ዝቅተኛነት መንስኤ የሆኑ የኮንስትክሽን የአመራር ችግሮችንና መፍትሔዎቻቸውን ይፈትሻል

በመሆኑም ከዚህ ወረቀት ላይ የተያያዙትን መጠይቆች እንደሞሉልኝ እጠይቃለሁ፡፡ የሚሰጡት መረጃ ለጥናቱ ብቻ እንደሚውል እያረጋገጥኩኝ መጠይቁን የሞሉትን ፕሮጀክቶች ካንፓኒዎች ስም እደማይጠቀስ አረጋጣለሁ፡፡በተጨማሪም የጥናቱ ኮፒ በተጠየቀ ጊዜ ለመስጠት ፈቃደኛነቴን እገልጻለሁ፡፡

ከሰላምታ ጋር

አማካሪ

ቴዎድሮስ ዓለሙ ውብሸት ጀካለ (ዶ/ር)

(ይህ መጠይቅ በመላሽ ቡድን ውስጥ የሳይት መሀንዲስ ወይም ሱፐርዒንቴንዳት ብቻ ለሚወክሉ የተዘጋጀ ነው)

ትዕዛዝ

ይህ መጠይቅ ሦስት ርዕሶች የያዘ ሲሆን እነሱም አጠቃላይ የፕሮጀክቱ መረጃ፣ የምርታማነት ቅድመ ሁኔታዎችና የአመራር ስልትና ቴክኒካዊ ሁኔታዎች ናቸው፣ በመሆኑም፡

1. አጠቃላይ መረጃ ስር ለቀረቡ ጥያቄዎች የሚመለከተውን ካሉት አማራጮች ሰረዝ

በማድረግ ይሙሉ የሚሞላውን ደግሞ በክፍት ቦታው ላይ ይሙሉ

2. በምርታማነት ቅድመ ሁኔታዎችና አመራር ስልትና ቴክኒካዊ ሁኔታዎች ያሉትን ጥያቄዎች ምን ያህል እንደሚተገበሩ እንዲሁም በእያንዳንዱ ጥያቄ ላይ ያሉትን ለመለካት እንዲያስቡትና ለኢንተርቪው ከሚመጡ ባለሙያዎች ጋር ለውይይት የተወሰነ ጊዜ እንደመድቡልን፣

3. ምን ያህል እንደሚተገበሩ ለመገመት ይረዳ ዘንድ እያንዳንዱ የኢንተርቪው ጥያቄ በመጠይቅ መልክ ቀርቧል ለነዚህም አራት አማራጮች ተሰጥተዋል፡፡

በየ	በጣም የተለመደ	6
የ፡	የተለመደ	4
አጊ፡	አንዳንድ ጊዜ	2
ምን	ምንም	1

በመሆኑም ካሉት አማራጮች የትኛው የእርስዎን ፕሮጀክት እንደሚጠቁም ከሚጠይቀው ባለሙያ ጋር በመወያየት የተሰጡትን አመራጮች አንዱን ይምረጡ፡፡

ማሰሰቢያ፡- በመጠይቁ ላይ ያሉት ርዕሶች እንደመላሽ ቡድኑ የአመራርና የሙያ ደረጃ የተከፋፈለ ስለሆነ ሁሉም ርዕሶች በአንድ ላይ በአንድ መላሽ ቡድን መጠይቅ ላይ ላይኖሩ ይችላሉ፡፡

የ አመራር ስልት እና ቴክኒካዊ ሁኔታዎች ቃለ መጠይቅ

		መለኪያ			
A	የጊዜ እቅድ አመራር	በየ	የ	አጊ	ምን
1	የኮንስትራክሽን ስራዎች የጊዜ እቅድን ከምሕንድስና እና ከግዢ የጊዜ ሰሌዳዎች ጋር የመዛመድ ሁኔታ ፣				
2.	ወጥነት ያላቸው ከዋናው ፕሮጀክት የጊዜ ሰሌዳ ጋር የሚጣጣሙ በተለያዩ ደረጃ ለሚገኙ የሥራ ኃላፊዎች ሊያገለግሉ የሚችሉ የሥራ እቅዶች መኖር ፣				
3.	ሳምንታዊ የግንባታ እቅድ መኖር ፣				
4.	የግንባታ ሂደትን የሚያሳይ ከርቭ ማዘጋጀት ፣				
5.	የግንባታ የሰው ሃይል የሚያሳይ ግራፍ ማዘጋጀት፣				
6.	ፕሮጀክቶችን ለመገምገም የሚያስችሉ ቁልፍ ቀኖችንና ምልክቶችን የያዘ የጊዜ ሰሌዳ መኖር፣				
7.	የስራ ጊዜ ሰሌዳውን ፣ በተወሰኑ ጊዜያት መከለስ፣				
8.	ሳምንታዊና ወርሃዊ የሥራ ጊዜ ሰሌዳ ሪፖርት ማዘጋጀት ፣				
B	የሥራ እቅድን በሥራ ፓኬጅ ደረጃ ፣				
9.	የሚሠራውን የሥራ ፓኬጆች መጠን መወሰን፣				
10.	የሥራ ፓኬጆችን ቅድመ ሁኔታዎችን መለየትና ማሟላት፣				
11.	የሥራ ፓኬጆችን ሲያቅዱ ጥንቃቄን ከግምት ውስጥ ማስገባት፣				
12.	የሥራ ፓኬጆችን እቅድ ከግንባታ እቅዶች ጋር ያለውን ማጣጣም ፣				
13.	ውጤታማና ቆጣቢ የአሠራር ስልቶችን መጠቀም፣				
14.	ለሥራ ፓኬጆች የሚያስፈልጉ ሃብቶችን የመለየት ሁኔታ፣				
15.	የሥራ ፓኬጅ ሃላፊዎችን መመደብ ፣				
16.	ችግሮችን የመለየትና የመፍታት እንዲሁም የሥራ ሂደቱን				

	መከታተል፣				
C.	**የሥራ ሂደትና የምርታማነት መጠን ፣**				
17.	የተሠሩ ሥራዎችን የሥራ መጠን በትክክል መለካት፣				

40.	የሰራተኞችን ፍላጌት የሚሟላት ሁኔታ ፣				
18.	የተሰሩ ሥራዎችን በጊዜው የመለካትና የመከታተል፣				
19.	ለሥራው አስፈላጊ የሆነ የሰው ሰአትን መተንበይ ፣				
20.	የምርታማነት ሬሽዮን ለማስላት እውነተኛና በስታንዳርድ የሚገኘው ሰአትን ማነፃፀር ፣				
21.	የሰራተኞችን የሥራ ምርታማነትን በየጊዜው መለካትና ለግንባታ አመራሩ ሪፖርት ማድረግ፣				
22.	ለእያንዳንዱ የግንባታ ሥራ የጠፋውን ሰአት በትክክል መለካት፣				
D	**የጥራት አስተዳደር ፣**				
23.	የማቴሪያል ጥራት ቁጥጥር ፣				
24.	የሰራትኞንና የተቆጣጣሪዎችን ብቃት ማሳደግ፣				
25.	የአመራር ድጋፍ በጥራት ላይ ፣				
26.	በሥራ ጥራት እና ውበት ላይ ያለውን አቅም ማሳደግ፣				
27.	የጥራት ጉድለቶችን መቆጣጠርና ሪፖርት ማድረግ፣				
28.	የጥራት ቁጥጥር ማካሄድ ፣				
E	**የአደጋ ጥንቃቄ አደረጃጀት እና የሰራተኞች ግንኙነት፣**				
29.	በአደጋ ጥንቃቄ ሰራተኞች እና፣ ተቆጣጣሪዎችን ማሰልጠን፣				
30.	አደጋ ሊቀንሱ የሚችሉ ስልቶችን መጠቀም እና እቅዶችን መንደፍ፣				
31.	የአመራር ድጋፍ በአደጋ ጥንቃቄ ላይ				
32.	ለድንገተኛ አደጋ ያለ ዝግጅት፣				
33.	የደረሱ አደጋዎች ሪከርድ እና እስታስቲክስ መያዝ፣				
34.	የሰው አመራረጥ ዘዴን መቆጣጠር፣				
35.	አደረጃጀትና የሪፖርቲንግ መዋቅር፣				
36.	የሰው ኃይል ቅጥር እና ስንብት እቅድና ፕሮሲጀር መኖር፣				
37.	የሰው ኃይል እቅድ ማዘጋጀት፣				
38.	ለእጅ ባለሙያዎች ሥልጠና መስጠት፣				
39.	የሰራተኞችን ብሶት የማስተናገድ ሁኔታ፣				

41.	የሰራተኞን ግንኙነት የሚያዳብር ባለሙያ መመደብ፣				
F	**የሃብት አጠቃቀምና አመራር፣**				
42.	የግንባታ እቃን አያያዝና አጠቃቀም በእቅድ የመምራት ሁኔታ፣				
43.	የጥሬ እቃ የአገዛዝ ሥርአት ቀልጣፋነት፣				
44.	የተገዛን ጥሬ እቃ የመቀበል እና የማከፋፈል ሥርአት መኖር ፣				
45.	በንብረትነት ያለ ጥሬ እቃ መጠንን ለማወቅ እና ለመቆጣጠር የሚያስችል አስራር መኖር፣				
46.	የጥሬ እቃ አጠቃቀም ለማሳለጥ የሚረዳ ቆጣቢ የመረጃ መረብ መዘርጋት፣				
47.	ለእጅ ባለሙያዎች አስፈላጊ የሆኑ መሣሪያዎችን የማቅረብ ሁኔታ፣				
48.	የእጅ መሣሪያ አጠቃቀምና አያያዝ ለማሻሻል የተዘረጋ የቁጥጥር ሥርዐት መኖር				
G	**የግንባታ ቦታና ፋሲሊቲዎች ፕላን**				
49.	ጊዜያዊ ፋሲሊቲዎች ከመገንባታቸው በፊት በዕቅድ ታስበው የመሥራት ሁኔታ፣				
50.	የፕሮጀክት ቢሮዎች ከመሰራታቸው በፊት በዕቅድ ታስቦ የመሥራት ሁኔታ፣				
51.	የመሣሪያና የጥሬ እቃ ማስቀመጫ ቦታዎችን በዕቅድ አስቦ የመሥራት ሁኔታ፣				
52.	የውሃ የመብራት የፍሳሽ ፋሲሊቲዎችን በጥናትና በዕቅድ አስቦ የመሥራት ሁኔታ፣				
53.	የግንባታ ካምፕን በጥናትና በዕቅድ አስቦ የመሥራት ሁኔታ፣				

መግለጫ፣ በየ: በጣም የተለመደ፣ የ: የተለመደ አጊ: አንዳንድ ጊዜ ምን: ምንም

መለኪያ፣ በየ: 6 የ: 4 አጊ: 2 ምን: 1

ግንቦት 1998 ዓ.ም

ለውድ መላሽ

በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጂ የሁለተኛ ዲግሪ ማሙያ፣ ጥናት መጠይቅ

በአዲስ አበባ ዩኒቨርሲቲ በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጅ የሁለተኛ ዲግሪን እየሰራሁ እገኛለሁ በመሆኑም ለመመረቂያ የሚሆን አንድ የጥናት ርዕስ መርጬ ጥናታዊ ሪፖርት እንዳዘጋጅ ይጠበቃል፡፡ ለጥናቱ የመረጥኩት ርዕስ የጉልበት ምርታማነት በኮንስትራክሽን ፕሮጀክቶች መለካት የሚል ሲሆን ጥናቱም በሦስት የግንባታ ሙያዎች ላይ ያነጣጠረ ሲሆን የሚከተሉትን ነገሮች ይመረምራል፡፡

1 የጉልበት የምርታማነትን ጊዜ የሚያባክኑ ቀጥተኛ ችግሮች ምን እንደሆኑ ኮንስትራክሽን ፕሮጀክቶችን ይፈትሻል
2 ለጉልበት ምርታማነት ዝቅተኛነት መንስኤ የሆኑ የኮንስትክሽን የአመራር ችግሮችንና መፍትሔዎቻቸውን ይፈትሻል

በመሆኑም ከዚህ ወረቀት ላይ የተያያዙትን መጠይቆች እንደሞሉልኝ እጠይቃለሁ፡፡ የሚሰጡት መረጃ ለጥናቱ ብቻ እንደሚውል እያረጋገጥኩኝ መጠይቁን የሞሉትን ፕሮጀክቶች ካንፓኒዎች ስም እደማይጠቀስ አረጋጣለሁ፡፡በተጨማሪም የጥናቱ ኮፒ በተጠየቀ ጊዜ ለመስጠት ፈቃደኛነቴን እገልጻለሁ፡፡

ከሰላምታ ጋር
ቴዎድሮስ ዓለሙ

አማካሪ
ውብሸት ጀካለ (ዶ/ር)

(ይህ መጠይቅ በመላሽ ቡድን ውስጥ ፎርማን ለሚወክሉ ብቻ የተዘጋጀ ነው)

ትዕዛዝ
ይህ መጠይቅ ሁለት ርዕሶች የያዘ ሲሆን እነሱም የአመራር ስልት ና ቴክኒካዊ ሁኔታዎች እና የምርታማነትን ውጤት በመጠየቅ መለካት የሚሉ ናቸው፡፡
በመሆኑም፡

1 አጠቃላይ መረጃ ስር ለቀረቡ ጥያቄዎች የሚመለከተውን ካሉት አማራጮች ሰረዝ በማድረግ ይሙሉ የሚሞላውን ደግሞ በክፍት ቦታው ላይ ይሙሉ

2 በምርታማነት ቅድመ ሁኔታዎችና አመራር ስልትና ቴክኒካዊ ሁኔታዎች ያሉትን ጥያቄዎች ምን ያህል እንደሚተገበሩ እንዲሁም በእያንዳንዱ ጥያቄ ላይ ያሉትን ለመለካት እንዲያስቡትና ለኢንተርቪው ከሚመጡ ባለሙያዎች ጋር ለውይይት የተወሰነ ጊዜ እንደመድቡልን፣

3 ምን ያህል እንደሚተገበሩ ለመገመት ይረዳ ዘንድ እያንዳንዱ የኢንተርቪው ጥያቄ በመጠይቅ መልክ ቀርቧል ለነዚህም አራት አማራጮች ተሰጥተዋል፡፡

በየ	በጣም የተለመደ	6
የ፡	የተለመደ	4
አጊ፡	አንዳንድ ጊዜ	2
ምን	ምንም	1

በመሆኑም ካሉት አማራጮች የትኛው የእርስዎን ፕሮጀክት እንደሚጠቁም ከሚጠይቀው ባለሙያ ጋር በመወያየት የተሰጡትን አመራጮች አንዱን ይምረጡ፡፡

ማሰሰቢያ፡- በመጠይቁ ላይ ያሉት ርዕሶች እንደመላሽ ቡድኑ የአመራርና የሙያ ደረጃ የተከፋፈለ ስለሆነ ሁሉም ርዕሶች በአንድ ላይ በአንድ መላሽ ቡድን መጠይቅ ላይ ላይኖሩ ይችላሉ፡፡

የ አመራር ስልት እና ቴክኒካዊ ሁኔታዎች ቃለ መጠይቅ

		መለኪያ			
A	የጊዜ እቅድ አመራር	በየ	የ	አጊ	ምን
1	የኮንስትራክሽን ስራዎች የጊዜ እቅድን ከምሕንድስና እና ከግዢ የጊዜ ሰሌዳዎች ጋር የመዛመድ ሁኔታ ፣				
2.	ወጥነት ያላቸው ከዋናው ፕሮጀክት የጊዜ ሰሌዳ ጋር				

	የሚጣጣሙ በተለያዩ ደረጃ ለሚገኙ የሥራ ኃላፊዎች ሊያገለግሉ የሚችሉ የሥራ እቅዶች መኖር ፣				
3.	ሳምንታዊ የግንባታ እቅድ መኖር ፣				
4.	የግንባታ ሂደትን የሚያሳይ ከርቭ ማዘጋጀት ፣				
5.	የግንባታ የሰው ሃይል የሚያሳይ ግራፍ ማዘጋጀት፣				
6.	ፕሮጀክቶችን ለመገምገም የሚያስችሉ ቁልፍ ቀኖችንና ምልክቶችን የያዘ የጊዜ ሰሌዳ መኖር፣				
7.	የስራ ጊዜ ሰሌዳውን ፣ በተወሰኑ ጊዜያት መከለስ፣				
8.	ሳምንታዊና ወርሃዊ የሥራ ጊዜ ሰሌዳ ሪፖርት ማዘጋጀት ፣				
B	**የሥራ እቅድን በሥራ ፓኬጅ ደረጃ ፣**				
9.	የሚሠራውን የሥራ ፓኬጆች መጠን መወሰን፣				
10.	የሥራ ፓኬጆችን ቅድመ ሁኔታዎችን መለየትና ማሟላት፣				
11.	የሥራ ፓኬጆችን ሲያቅዱ ጥንቃቄን ከግምት ውስጥ ማስገባት፣				
12.	የሥራ ፓኬጆችን እቅድ ከግንባታ እቅዶች ጋር ያለውን ማጣጣም ፣				
13.	ውጤታማና ቆጣቢ የአሠራር ስልቶችን መጠቀም፣				
14.	ለሥራ ፓኬጆች የሚያስፈልጉ ሃብቶችን የመለየት ሁኔታ፣				
15.	የሥራ ፓኬጅ ሃላፊዎችን መመደብ ፣				
16.	ችግሮችን የመለየትና የመፍታት እንዲሁም የሥራ ሂደቱን መከታተል፣				
C.	**የሥራ ሂደትና የምርታማነት መጠን ፣**				
17.	የተሠሩ ሥራዎችን የሥራ መጠን በትክክል መለካት፣				

23.	የማቴሪያል ጥራት ቁጥጥር ፣				
18.	የተሰሩ ሥራዎችን በጊዜው የመለካትና የመከታተል፣				
24.	የሰራተኞችንና የተቆጣጣሪዎችን ብቃት ማሳደግ፣				
19.	ለሥራው አስፈላጊ የሆነ የሰው ሰአትን መተንበይ ፣				
25.	የአመራር ድጋፍ በጥራት ላይ ፣				
20.	የምርታማነት ሬሾዮን ለማስላት እውነተኛና በስታንዳርድ				
26.	በሥራ ጥራት እና ውበት ላይ ያለውን አቅም ማሳደግ፣ የሚገኘው ሰአትን ማነፃፀር ፣				
27.	የጥራት ኬዲሊዶችን መቆጣጠርና ሪፖርት ማድረግ፣				
21.	የሰራተኞችን የሥራ ምርታማነትን በየጊዜው መለካትና				
28.	የጥራት ቁጥጥር ማካሄድ፣ አግባብ አመራሩ ሪፖርት ማድረግ፣				
E	**የአደጋ ጥንቃቄ አደረጃጀት እና የሰራተኞች ግንኙነት፣**				
29.	በአደጋ ጥንቃቄ ሰራተኞች እና፣ ተቆጣጣሪዎችን ማሰልጠ				
D	**ጥራት አስተዳደር ፣**				

30.	አደጋ ሊቀንሱ የሚችሉ ስልቶችን መጠቀም እና እቅዶችን መንደፍ፣				
31.	የአመራር ድጋፍ በአደጋ ጥንቃቄ ላይ				
32.	ለድንገተኛ አደጋ ያለ ዝግጅት፣				
33.	የደረሱ አደጋዎች ሪከርድ እና እስታስቲክስ መያዝ፣				
34.	የሰው አመራረጥ ዘዴን መቆጣጠር፣				
35.	አደረጃጀትና የሪፖርቲንግ መዋቅር፣				
36.	የሰው ኃይል ቅጥር እና ስንብት እቅድና ፕሮሲጀር መኖር፣				
37.	የሰው ኃይል እቅድ ማዘጋጀት፣				
38.	ለእጅ ባለሙያዎች ሥልጠና መስጠት፣				
39.	የሰራተኞችን ብሶት የማስተናገድ ሁኔታ፣				
40.	የሰራተኞችን ፍላጐት የማሟላት ሁኔታ ፣				

41.	የሰራተኞን ግንኙነት የሚያዳብር ባለሙያ መመደብ፣				
F	**የሃብት አጠቃቀምና አመራር፣**				
42.	የግንባታ እቃን አያያዝና አጠቃቀም በእቅድ የመምራት ሁኔታ፣				
43.	የጥሬ እቃ የአገዛዝ ሥርአት ቀልጣፋነት፣				
44.	የተገዛን ጥሬ እቃ የመቀበል እና የማከፋፈል ሥርአት መኖር ፣				
45.	በንብረትነት ያለ ጥሬ እቃ መጠንን ለማወቅ እና ለመቆጣጠር የሚያስችል አሰራር መኖር፣				
46.	የጥሬ እቃ አጠቃቀም ለማሳለጥ የሚረዳ ቆጣቢ የመረጃ መረብ መዘርጋት፣				
47.	ለእጅ ባለሙያዎች አስፈላጊ የሆኑ መሣሪያዎችን የማቅረብ ሁኔታ፣				
48.	የእጅ መሣሪያ አጠቃቀምና አያያዝ ለማሻሻል የተዘረጋ የቁጥጥር ሥርዐት መኖር				
G	**የግንባታ ቦታና ፋሲሊቲዎች ፕላን**				
49.	ጊዜያዊ ፋሲሊቲዎች ከመገንባታቸው በፊት በዕቅድ ታስበው የመሥራት ሁኔታ፣				
50.	የፕሮጀክት ቢሮዎች ከመሰራታቸው በፊት በዕቅድ ታስቦ የመሥራት ሁኔታ፣				
51.	የመሣሪያና የጥሬ እቃ ማስቀመጫ ቦታዎችን በዕቅድ አስቦ				

	የመሥራት ሁኔታ፣				
52.	የውሃ የመብራት የፍሳሽ ፋሲሊቲዎችን በጥናትና በዕቅድ አስቦ የመሥራት ሁኔታ፣				
53.	የግንባታ ካምፕን በጥናትና በዕቅድ አስቦ የመሥራት ሁኔታ፣				

መግለጫ፣ በየ፡ በጣም የተለመደ፣ የ፡ የተለመደ አጊ፡ አንዳንድ ጊዜ ምን፡ ምንም

መለኪያ፣ በየ፡ 6 የ፡ 4 አጊ፡ 2 ምን፡ 1

የምርታማነትን ውጤት በጽሁፉ መጠየቅ መለካት

1. በአንድ የሥራ ቀን /8 :00/ ሰዐት/ በአማካይ በእቅድ እንዲሰሩት የተያዘ የሥራ ስዐት መጠን ስንት ነው? /ውጤቱን ከእቅድዎ ወይንም ከተቆጣጣሪዎ ይጠይቁ::/

   ☐ ብረት ማጠፍና መትከል ---------- ኪ.ግ. በቀን
   ☐ ግንበኛ ----------ሜ.ካ በቀን
   ☐ የአርማታ /ኮንክሪት/ ሥራ ----------ሜትር ኩብ በቀን

2. በአንድ የሥራ ቀን /8፡ ሰዐት/ ያመረቱት የሥራ ውጤት በአማካይ ስንት ይሆናል?
   ☐ ብረት ማጠፍና መትከል ---------- ኪ.ግ በቀን
   ☐ ግንበኛ ---------- ሜ.ካ. በቀን
   ☐ የአርማታ /ኮንክሪት/ ሥራ ---------- ሜትር ኩብ በቀን

3. ለትርፋማ ሰአት መባከን መንስኤ የሆኑት የትኞቹ ናቸው፤ የሁኑትን በመለየት በቀን ካሉ ስምንት የሥራ ሰአቶች ስንት ሰአት እንደሚባክን ያስቀምጡ፣ ችግሮች ባላቸው ድግግሞሽ መጠን በደረጃ ያስቀምጡአቸው::

የችግር ዓይነት	የሚባክን ሰአት	ደረጃ
የግንባታ እቃ እጥረት		
የእጅ መሣሪያ እጥረት		
አደጋ		
ድጋሚ ሥራ		
የሰራተኛ መለወጥ		
ጣልቃ ገብነት		
ቀሪ መሆን		

የሥራ ትእዛዝ መዘግየት		
የተቆጣጣሪ መቀየር		
የሥራ ማነስ		
የሥራ ቦታ ጥበት		
ሌሎች ካሉ		

ግንቦት 1998 ዓ.ም

ለውድ መላሽ

በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጂ የሁለተኛ ዲግሪ ማሙያ፣ ጥናት መጠይቅ

በአዲስ አበባ ዩኒቨርሲቲ በኮንስትራክሽን ማኔጅመንትና ቴክኖሎጅ የሁለተኛ ዲግሪን እየሰራሁ እገኛለሁ በመሆኑም ለመመረቂያ የሚሆን አንድ የጥናት ርዕስ መርጬ ጥናታዊ ሪፖርት እንዳዘጋጅ ይጠበቃል፡፡ ለጥናቱ የመረጥኩት ርዕስ የጉልበት ምርታማነት በኮንስትራክሽን ፕሮጀክቶች መለካት የሚል ሲሆን ጥናቱም በሦስት የግንባታ ሙያዎች ላይ ያነጣጠረ ሲሆን የሚከተሉትን ነገሮች ይመረምራል፡፡

1 የጉልበት የምርታማነትን ጊዜ የሚያባክኑ ቀጥተኛ ችግሮች ምን እንደሆኑ ኮንስትራክሽን ፕሮጀክቶችን ይፈትሻል
2 ለጉልበት ምርታማነት ዝቅተኛነት መንስኤ የሆኑ የኮንስትክሽን የአመራር ችግሮችንና መፍትሔዎቻቸውን ይፈትሻል

በመሆኑም ከዚህ ወረቀት ላይ የተያያዙትን መጠይቆች እንደሞሉልኝ እጠይቃለሁ፡፡ የሚሰጡት መረጃ ለጥናቱ ብቻ እንደሚውል እያረጋገጥኩኝ መጠይቁን የሞሉትን ፕሮጀክቶች ካንፓኒዎች ስም እደማይጠቀስ አረጋጣለሁ፡፡በተጨማሪም የጥናቱ ኮፒ በተጠየቀ ጊዜ ለመስጠት ፈቃደኛነቴን እገልጻለሁ፡፡

ከሰላምታ ጋር
ቴዎድሮስ ዓለሙ

አማካሪ
ውብሸት ጀካለ (ዶ/ር)

(ይህ መጠይቅ በመላሽ ቡድን ውስጥ የእጅ ባለሙያ ለሚወክሉ ሆነው በአርማታ ስራ፣ በብረት እና በግንብ ስራ ለተሰማሩ የተዘጋጀ ነው)

ትዕዛዝ

ይህ መጠይቅ ሦስት ርዕሶች የያዘ ሲሆን አጠቃላይ መረጃ፣ የፕሮጀክቱ ማህበራዊ ሁኔታና የምርታማነት ውጤት በመጠይቅ መለካት የሚሉ ናቸው፡፡

1. በአጠቃላይ መረጃ ስር ለቀረቡ ጥያቄዎች የሚመለከተውን መልስ ላይ ሰረዝ ያድርጉ
2. የፕሮጀክቱ ማህበራዊ ሁኔታ ለመለካት ከተቀመጡት አራት አማራጮች ማለትም

በየ	በጣም የተለመደ	6
የ፡	የተለመደ	4
አጊ፡	አንዳንድ ጊዜ	2
ምን	ምንም	1

ያላቸውን ክብደት በማገናዘብ አንዱን ይምረጡ

3. የምርታማነትን ውጤት መለካት የሚለውን መጠይቅ የዕቅድዋን መጠን ተቆጣጣሪውን በመጠይቅ የሰሩትን የሥራ መጠን ደግሞ በመለካት ክፍት ቦታዎችን ይሙሏቸው፣ እንዲሁም የሚባክነውን ሰዓት መጠን በአመታዊ አማካኝ በቀን ምን ያህል እንደሆነ ይገምቱ፡፡

ማሰሰቢያ፡- በመጠይቁ ላይ ያሉት ርዕሶች እንደመላሽ ቡድኑ የአመራርና የሙያ ደረጃ የተከፋፈለ ስለሆነ ሁሉም ርዕሶች በአንድ ላይ በአንድ መላሽ ቡድን መጠይቅ ላይ ላይኖሩ ይችላሉ፡፡

የምርታማነት ስልት መለኪያዎች የጽሁፉ መጠየቅ

አጠቃላይ መረጃ

1. የእርስዎ የእጅ ሞያ ምንድን ነው? ----------

2. በዚህ ፕሮጀክት ውስጥ የቀጣሪዮ ደረጃ ምንድን ነው?

☐ በኮንትራት ሥራ የወሰደ ሞያተኛ ☐ የንኡስ ሥራ ተቋራጭ ሥራ ተቀጣሪ

☐ የዋና ሥራ ተቋራጭ ተቀጣሪ

3. ከአሁን ከሚሠሩት ቀጣሪዎ ጋር ለስንት አመታታ ሰርተዋል ?

☐ እስከ 2 ዓመት ☐ ከ2-5 ዓመት ☐ ከ5-10 ዓመት ☐ ከ10-20 ዓመታት ☐ ከ20 ዓመት በላይ

1. እዚህ ፕሮጀክት ለስንት ወራት ሰርተዋል ?

☐ እስከ 3 ወር ☐ ከ3- 6 ወር ☐ ከ6-12 ወር ☐ ከ12 ወር በላይ

2. እድሜዎ ስንት ነው ?

☐ ከ15 -20 ☐ ከ20-30 ☐ ከ30-40 ☐ ከ40-50 ☐ ከ50 በላይ

3. ከዚህ በታች ለተጠቀሱት የህንፃ አይነቶች የስንት አመት ልምድ አለዎት ?

1. የመኖሪያ ቤት ሥራ፣ ☐ ከ2 ዓመት በታች ☐ ከ2- 5 ዓመት ☐ ከ5 ዓመት በላይ

2. የመንግስት ህንፃ፣ ☐ ከ2 ዓመት በታች ☐ ከ2- 5 ዓመት ☐ ከ5 ዓመት በላይ

3. የንግድ ህንፃ፣ ☐ ከ2 ዓመት በታች ☐ ከ2- 5 ዓመት ☐ ከ5 ዓመት በላይ

4. አሁን በያዙት የእጅ ሞያ የስንት አመት ልምድ አለዎት ?

☐ እስከ 2 ዓመት ☐ ከ2- 5 ዓመት ☐ ከ5-10 ዓመት ☐ ☐

ከ10-20 ዓመት ከ20 ዓመት በላይ

5. እዚህ ደረጃ በእጅ ሞያ ሊደርሱ የቻሉት እንዴት ነው?

☐ የተግባርና የንድፈ ሃሳብ ትምህርት በቀጣሪ ድርጅቴ በማግኘቴ

☐ በሥራ ልምድ በአካበቱት እውቀት ብቻ

☐ በሙያ ት/ቤቶች በመሠልጠን

☐ የመንግስት ድርጅቶች በአቋቋሙአቸው ወርክሾፖች ውስጥ በመሰልጠን

የማኑበራዊ ሁኔታዎች የጽሁፉ መጠየቅ

A	አመራር	መለኪያ			
A.1	ሥራ ተኮር አመራር	በየ	የ	አጊ	ምን
1.	ውሳኔ አሰጣጥ ኃላፊነትንና ተግባርን መሰረት ባደረገ መልኩ ማካሄድ፣				
2.	ግልጽ የሆነ የሥራ ህጉችና ግቦች የመኖር፣				
3.	ሥራዎች በተቀመጠላቸው የሥራ ትእዛዝ /Specification/ እና ጥራት እንዲከናወኑ የአመራሩ ክትትል፣				
4.	ስራተኞች የፕሮጀክቱን የአሰራር ስልትና ህግ መከተል፣				
5.	የሥራ ንድፎችን /Plans/የመከተል፣				
6.	ስራተኞችን ለሥራ ስልጠት በሚረዳ መልኩ ማደራጀት፣				
7.	የተገኙ የሥራ ውጤቶችን የማክበርና የማጽደቅ፣				
A.2	ሰው ተኮር አመራር፣				
8.	ስራተኞችን ማዳመጥ፣				
9.	በዕቅድ ዝግጅት ሰራተኞች እንዲሳተፉ ማበረታታት፣				
10.	የሰራተኞችን ችግር መረዳት፣				
11.	የሰራተኞችን ሀሳብ ለመቀበል መሞከር፣				
12.	በተቆጣጣሪዎች/Forman/መርካት፣				
13.	የሰራተኞችን የሥራ ስሜት መቀስቀስ፣				
14.	የሥራ ስልቶችን ማስረዳት፣				
15.	ለበጐ እና ለመጥፎ ተግባራት ፍፃሜ መልስ /Feed back/ መስጠት				

16.	ስራተኞች በሙያቸው እራሳቸውን እንዲያዳብሩ መደገፍ፣				
B	**የሥራ ቡድኑ ፣ መጠን፣ ፀባይ እና ባሕል**				
B.1	**የቡድኑ መጠንና ሥርዓት**				
17.	የቡድኑ መጠንና የተቆጣጣሪዎች /Supervisors/ ብዛት ይስማማል፣				
18.	የሥራ ቡድኑ ተገቢው ሚና ያላቸው አባላትን ይዟል፣				
19.	የቡድኑን የሥራ ህይወት ማቆየት፣				
20.	የቡድኑ አባላትን መቀያየር፣				
B.2.	**የቡድኑ ፀባይና ባሕል**				
B.2.1.	**ርካታና እድገት፣**				
21.	በቂ የሆኑ አዲስና ፈታኝ ሥራዎች መኖር፣				
22.	የሥራ ርካታ ማግኘት፣				
23.	በሙያ የማደግ ዕድል ማግኘት፣				
24.	ስራተኞች ውሳኔ አሰጣጥ ላይ ተጽእኖ ማድረግ፣				
25.	ስራን ጥሩ የማድረግ ጽናት፣				
26.	አዲስና ውጤታማ የሥራ ስልቶችን የተገበሩን ማበረታታት፣				
B.2.2.	**ውጤታማነትና የሥራ ዓላማ ግልጽነት፣**				
27.	ሥራውና የሥራ ትዕዛዝት ወጥ ናቸው፣				
28.	የሥራው ሂደት ግልጽ ነው፣				
29.	የመረጃ እጥረት ለሥራችን እንቅፋት አይደለም፣				
30.	የፎርማኑ ውሳኔ ተቀባይነት አለው፣				
31.	የሥራ ሁኔታው ጥሩ ነው፣				
32.	የሥራው አፈሳሰስ አይቆራረጥም፣				
33.	የሥራ የእጅ መሣሪያ ትክክልነት፣				
34.	ችግሮችን በአፋጣኝ መፍታት፣				
B.2.3.	**የመተባበር መንፈስ ፣**				
35.	በሰራተኞች መካከል የመተባበር መንፈስ ጥሩ የመሆን፣				
36.	የሥራ አካባቢው በሰራተኞች መካከል ያለው የመተባበር መንፈስ ጥሩ የመሆን ፣				
37.	ከሌሎች ሠራተኞች ድጋፍ ማግኘት፣				
38.	አለመግባባቶችን መፍታት፣				
B.2.4.	**የመረጃ ግንኙነት ፣**				

39.	በቂ መረጃ መስጠት፣				
40.	መረጃ በግልጽ መስጠት፣				
41.	በተገኘው ውጤት ላይ መረጃ መስጠት፣				
42.	የመረጃው አስተማማኝነት፣				

መግለጫ በየ፡ በጣም የተለመደ፣ የ፡ የተለመደ አ.ጊ፡ አንዳንድ ጊዜ
ም፡ ምንም

መለኪያ፣ በየ፡ 6 **የ**፡ 4 **አ.ጊ**፡ 2 **ም**፡ 1

የምርታማነትን ውጤት በጽሁፉ መጠየቅ መለካት

1. በአንድ የሥራ ቀን /8 :00/ ሰዐት/ በአማካይ በእቅድ እንዲሰሩት የተያዘ የሥራ ስዐት መጠን ስንት ነው? /ውጤቱን ከእቅድዎ ወይንም ከተቆጣጣሪዎ ይጠይቁ::/

   ☐ ብረት ማጠፍና መትከል ---------- ኪ.ግ. በቀን
   ☐ ግንበኛ ----------ሜ.ካ በቀን
   ☐ የአርማታ /ኮንክሪት/ ሥራ ----------ሜትር ኩብ በቀን

2. በአንድ የሥራ ቀን /8፡ ሰዐት/ ያመረቱት የሥራ ውጤት በአማካይ ስንት ይሆናል?
   ☐ ብረት ማጠፍና መትከል ---------- ኪ.ግ በቀን
   ☐ ግንበኛ ---------- ሜ.ካ. በቀን
   ☐ የአርማታ /ኮንክሪት/ ሥራ ---------- ሜትር ኩብ በቀን

3. ለትርፋማ ሰአት መባከን መንስኤ የሆኑት የትኞቹ ናቸው፤ የሁኑትን በመለየት በቀን ካሉ ስምንት የሥራ ሰአቶች ስንት ሰአት እንደሚባክን ያስቀምጡ፣ ችግሮች ባላቸው ድግግሞሽ መጠን በደረጃ ያስቀምጡአቸው::

የችግር ዓይነት	የሚባክን ሰአት	ደረጃ
የግንባታ እቃ እጥረት		
የእጅ መሣሪያ እጥረት		
አደጋ		
ድጋሚ ሥራ		
የሰራተኛ መለወጥ		
ጣልቃ ገብነት		
ቀሪ መሆን		
የሥራ ትእዛዝ መዘግየት		
የተቆጣጣሪ መቀየር		
የሥራ ማነስ		
የሥራ ቦታ ጥበት		
ሌሎች ካሉ		

May, 2006

Dear sir/Madam

Re: Thesis, Msc in Construction management and Technology

I am currently undertaking a Master of Science degree in construction Management and Technology at Addis Ababa University. In fulfillment of this thesis I am required to research a topic area and produce a thesis. The topic I have chosen is measurement of labour productivity in construction projects, emphasizing on three construction trades, and I am investigating the following issues:

1. Direct problem areas causing a loss in productive time of labour in construction projects.
2. The managerial causes for low labour productivity in construction projects and their improvement mechanisms.

I would be grateful if you could complete the attached questionnaire. Needless to say, the information provided will be treated with strict confidence and individual projects or companies will not be identified.
Equally, a copy of the summary report can be availed, if requested.

Yours faithfully, Advisor

Tewodros Alemu Wubishet Jekale (Dr.Ing.)

[The attached questionnaire is prepared for respondents of group consisting Project manager or Project engineer only]

Instruction

This interview questioner contains three titles. These are general project information, productivity preconditions; and managerial and technical systems.

1. Tick one of the four alternatives for questions under the title general project information and fill with hard facts information in the blank space.
2. Judge the level of practice of each of the questions under the title productivity preconditions, managerial and technical systems. In addition get prepared to measure each question and allocate some time for interview.
3. Select one of the alternatives under listed here in conjunction with practitioners who come to your office.

Vo= very often	6
O= often	4
St= Sometimes	2
No=None	1

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Productivity Methods measurement by Written Questioner

General Information

1. In what supervisory management level are you working? ----------

2. What is the purpose of this building project?

☐ School ☐ Office ☐ Apartment ☐ Shopping

☐ Multi-purpose ☐ Others

3. Which procurement method was used by your Client?

☐ Design and Build ☐ Traditional Method

☐ Construction Management Method ☐ Others, please Specify --------

4. What is the contract duration of the project? ---------- Months.

5. What is the total contract cost of the building? ---------- Birr.

6. How many percent of the work is done now? ---------- %

7. By how many percent the project is ahead or lags from the expected time -----%

Measurement of Productivity Preconditions by Interview

A	**Client**	**Scale**			
A.2	**Client procurements**				
1	Change in scope of work				
2	Change in completion time of the project				
3	Timely procurement of materials or services agreed to be				

	delivered by the client				
A. 3	**Cooperation by the client**				
4	General support for the smooth functioning of the project team				
5	Review the construction design for buildability				
B	**Consultant**				
6	Decisions and acceptances have been received quickly from the consultant				
7	The consultant decision have been unambiguous				
8	The site has received design on time				
9	The construction designer has taken the site suggestions into account				
10	Willingness to asses alternatives in case of design changes				
11	General support to the contractor				
C	**Company head quarters**				
12	Providing appropriate site organization				
13	Provision of adequate resources				
14	Responsiveness for the project supplier procurement questions				
15	Support in compiling subcontracts				
16	General support and motivation				

Legend: Vo = very often O = Often St = Some times No = none

Scale: Vo: O: St: No = 6:4:2:1

Management Systems &Technical factors Measurement by Interview

A	**Schedule management**	**Scale**			
1	Integrating engineering, procurement and construction Schedule based on CPM	Vo	O	St	No
2	Producing successive levels of construction schedules consistent with project master schedule				
3	Producing weekly construction work plan				
4	Producing construction progress curve				
5	Producing Construction manpower histogram				
6	Having project key dates & milestones schedule				
7	Schedule updated & progresses at regular intervals				

8	Schedule weekly and monthly reports				
B	**Work planning**				
9	Defining the scope of work packages to be executed				
10	Work packages prerequisites identified and completed				
11	Planning work packages with safety considerations				
12	Work plans consistent with the project construction schedule				
13	Use of effective and efficient construction methods				
14	Define resource requirements for work packages				
15	Identification of who is responsible for a work packages				
16	Checking work progress while identifying and solving unforeseen problems				
C	**Progress and quantity**				
17	Accurate measurement of physical percent complete of construction activities				
18	Regular progress and actual work measurement				
19	Forecast of final construction man hours				
20	Calculate productivity ratio by comparing actual & earned man hours				
21	Regular progress and worker productivity review &reports to construction management				
22	Accurate measurement of expended man hours per construction activity				
D	**Quality management**				
23	Material quality control				
24	Enhancing competency of workers and supervisors				
25	Management support				
26	Enhancing pride in workmanship				
27	Non conformance reporting & inspection				
28	Quality inspection				
E	**Safety, Organizations & labour relations**				
29	Training of workers & supervisors				
30	Planning for methodology & hazards				
31	Preparation of Safety programme				

32	Management support				
33	Emergency preparedness				
34	Records & stastics				
35	Control of Personnel selection methods				
36	Organization &reporting structure				
37	Staffing and destaffing plans and procedures				
38	Training programme for supervisors				
39	Work force planning				
40	Apprenticeship &training programme for craftsmen				
41	Grievance handling				
42	Work force requirement				
43	Labour relations coordinator				
F	**Resource management**				
44	Materials planning				
45	Purchasing				
46	Receiving & issuing				
47	Inventory management				
48	Materials management system				
49	Contents of tool kits issued to craftsman				
50	Assignment of tools not included in kits				
51	Control of theft, loss &breakage				
G	**Construction site layout &Facilities**				
52	Site planning of temporary facilities				
53	Site planning of project offices				
54	Layout of lay down areas				
55	Site planning of water, power &sanitary facilities				
56	Construction camp planning				

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May, 2006

Dear sir/Madam

Re: Thesis, Msc in Construction management and Technology

I am currently undertaking a Master of Science degree in construction Management and Technology at Addis Ababa University. In fulfillment of this thesis I am required to research a topic area and produce a thesis. The topic I have chosen is measurement of labour productivity in construction projects, emphasizing on three construction trades, and I am investigating the following issues:

1. Direct problem areas causing a loss in productive time of labour in construction projects.
2. The managerial causes for low labour productivity in construction projects and their improvement mechanisms.

I would be grateful if you could complete the attached questionnaire. Needless to say, the information provided will be treated with strict confidence and individual projects or companies will not be identified.

Equally, a copy of the summary report can be availed, if requested.

Yours faithfully, Advisor

Tewodros Alemu Wubishet Jekale (Dr.Ing.)

[The attached questionnaire is prepared for respondents of group consisting site engineer or superintendent only]

Instruction

This interview questioner contains three titles. These are general project information, productivity preconditions; and managerial and technical systems.

1. Tick one of the four alternatives for questions under the title general project information and fill with hard facts information in the blank space.
2. Judge the level of practice of each of the questions under the title productivity preconditions, managerial and technical systems. In addition get prepared to measure each question and allocate some time for interview.
3. Select one of the alternatives under listed here in conjunction with practitioners who come to your office.

Vo= very often	6
O= often	4
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No=None	1

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1	Integrating engineering, procurement and construction Schedule based on CPM	Vo	O	St	No
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[The attached questionnaire is prepared for respondents of group Forman only]

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This interview questioner contains three titles. These are general project information, productivity preconditions; and managerial and technical systems.

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2. Judge the level of practice of each of the questions under the title productivity preconditions, managerial and technical systems. In addition get prepared to measure each question and allocate some time for interview.
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Management Systems &Technical factors Measurement by Interview

A	Schedule management	Scale			
1	Integrating engineering, procurement and construction Schedule based on CPM	Vo	O	St	No
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Productivity Results Measurement by Written Questioner

1. What is the average daily targeted output of your trade per unit of man hour?

☐ Steel bar bender and fixer: ---------- kg/hour

☐ Mason doing masonry wall: ---------- M^2/hour

☐ Concreting work: ---------- M^3/hour

2. What is the average daily actual output of your trade per unit of man hour?

☐ Steel bar bender and fixer: ---------- kg/hour

☐ Mason doing masonry wall: ---------- M^2/hour

☐ Concreting work: ---------- M^3/hour

3. Which of the following are direct causes for the loss of productive time are applicable to your site, if they are, please specify the amount of labour hours lost and rank them according to their frequency?

Problem	Hours lost	frequency
Lack of materials		
Lack of tools		
Accident		
Rework		
Changing of workers		
Interference		
Absenteeism		
Supervision Delay		
Changing of foreman		
Too much work		
Over crowded		
Others, Please specify		

May, 2006

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Yours faithfully, Advisor

Tewodros Alemu Wubishet Jekale (Dr.Ing.)

[The attached questionnaire is prepared for respondents of group craftsmen only representing concrete placing, reinforcement bar placing and masonry work trades]

Instruction

The questioner contains three titles. These are general information, social system and productivity measurement questioner.

1. Tick one of the alternatives for each of the questions under the general information.
2. Select one of the alternatives under listed here by analyzing their weight;

Vo= very often	6
O= often	4
St= Sometimes	2
No=None	1

3. Fill your planned and actual productivity under productivity measurement title. In addition make a guess of the average annual daily productive time loss for each problem in the table.

Remark: The titles in this attached questioner is divided according to the managerial and technical capabilities of the target groups thus all titles may not be available at the same time in one target group.

Productivity methods measurement written Questioner

General Information

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

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

☐ Subcontractor labour only ☐ Subcontractor ☐ Main contractor

3. For how much length of time have you been with the present employer?

☐ 0 up to 2 years ☐ 2 up to 5 years ☐ 5 up to 10 years

☐ 10 up to 20 years ☐ Greater than 20 years

4. For how much length of time have you been with this project?

☐ 0 up to 3 months ☐ 3 up to 6 months ☐ 6 up to 12 months

☐ Greater than 12 months

5. How old are you?

☐ 15 up to 20 years ☐ 20 up to 30 years ☐ 30 up to 40 years

☐ 40 up to 50 years ☐ Greater than 50 years

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

☐ 0 up to 2 years ☐ 2 up to 5 years ☐ 5 up to 10 years

☐ 10 up to 20 years ☐ Greater than 20 years

7. How many years of experience do you have for each of the following types of buildings?

1. Housing: ☐ Less than 2 years ☐ 2 up to 5 years ☐ Greater than 5 years
2. Public: ☐ Less than 2 years ☐ 2 up to 5 years ☐ Greater than 5 years
3. Commercial: ☐ Less than 2 years ☐ 2 up to 5 years ☐ Greater than 5 years

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

☐ Apprenticeship ☐ Formal trade schools (TVET)

☐ On site trained ☐ Government workshop

Social Factors written Questioner

A	**Leadership**	**Scale**			
A.1	**Focus on production**	**Vo**	**Of**	**St**	**No**
1	Clear division of responsibility is followed in decision making				
2	The site has clear rules of operation				
3	Work goals are clear				
4	Compliance with work specification and quality requirements is monitored				
5	Division of tasks and duties is clear				
6	People comply with the assigned division of work and duties				
7	People follow the methods and rules set for the operation				
8	Plans are followed accurately				

9	The workers are organized well				
10	Work results are respected				
A.2	**Focus on people**				
11	The foreman listens to workers				
12	The foreman encourages workers to participate in planning				
13	The foreman understands worker's problem				
14	The foreman is willing to try out workers' ideas				
15	I am satisfied with my foreman				
16	The foreman treats workers equally				
17	The foreman motivates workers				
18	The foreman explains work methods enough				
19	The foreman reaction to mistakes is justified				
20	The foreman gives feedback on good performance				
21	The foreman supports worker's effort to develop themselves				
22	Sharing information with the foreman is useful				
B	**Work group size, behavior & Culture**				
B.1	**Group size and composition**				
23	Group size is in congruent with the number of supervisors				
24	There is good team composition in terms of role				
25	Supervisors maintain long team life				
26	Supervisor changes group members				
B.2	**Group Behavior and culture**				
B.2.1	**Satisfaction and growth**				
27	There are enough new and challenging duties				
28	Work gives satisfaction				
29	Opportunities to develop professionally are good				
30	Workers have enough influence in decision making				
31	Autonomous operation is supported				
32	Work endurance is good				

33	Applying new work methods is encouraged				
B.2.2	**Effectiveness and clarity of tasks**				
34	Work and operating instructions are consistent				
35	The operation process is clear				
36	Lack of information concerning work is not hindrance				
37	Decision making is fast				
38	Work conditions are good				
39	The amount of work is steady				
40	Work tool is appropriate				
41	Problems are solved quickly				
B.2.3	**Community spirit**				
42	Community spirit among the nearest co-workers is good				
43	Community spirit on the whole site is good				
44	It is easy to get help from workers				
45	Conflict are dealt with and resolved				
B.2.4	**Communication**				
47	Enough information is given				
48	Information is given openly				
49	Information is given on the results achieved				
50	Information is reliable				

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Productivity Results Measurement written Questioner

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Others, Please specify		

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