Factors Affecting Labor Productivity in Government Housing Projects: Case of Ethiopian Condominium Housing Construction in Addis Ababa

By

Kokebe Yifru

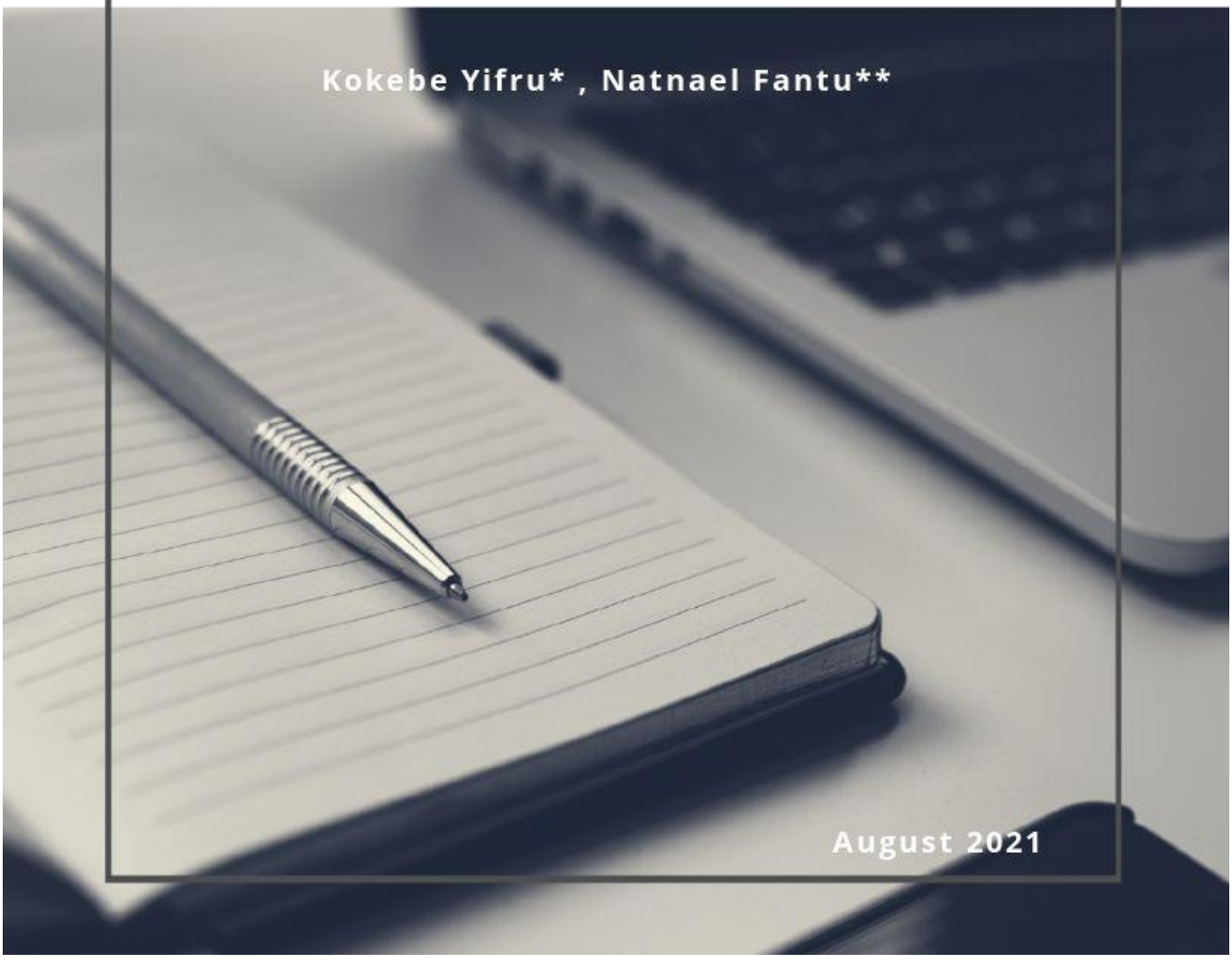
Natnael Fantu

A Final Research Report Submitted to Adama Science and Technology University

Adama, Ethiopia
February, 2023

Adama Science and Technology
University School of Civil Engineering
and Architecture

Factors Affecting Labor Productivity in Government Housing Projects: Case of Ethiopian Condominium Housing Construction



Kokebe Yifru* , Natnael Fantu**

August 2021

Abstract

Labor productivity is one of the most important factors that affect the physical progress of any construction project. Because construction is labor oriented industry, it heavily relies on the skills of its workforce. High productivity leads to lower unit costs to carry out a task or operation. It usually translates into superior profitability. Decreasing the productivity of projects has always been a major concern for the construction Industry. Therefore, the identification of critical factors impeding construction productivity to direct focused efforts towards productivity improvement in construction projects is the first step in the right direction. The objective of this study is to analyze factors affecting construction labor productivity, using experts' opinions, in Ethiopian condominium house construction projects through IHDP in Addis Ababa, where the productivity of the construction phase has not been as efficient as planned during the program's implementation. To achieve this objective, the study is conducted based on a questionnaire survey designed to gather all necessary information; Reliability analysis and the Relative Importance Index (RII) technique were adopted. To collect Data from conveniently available population members, a convenience sampling method was used. 117 factors were sorted and grouped into 9, namely: (a) Manpower; (b) Motivation; (c) Management; (d) Material; (e) Technical; (f) Tools and equipment; (g) Financial; (h) Environmental; and (i) other group. The result of the analysis of 51 structured questionnaires shows that four independent groups have a significant effect on the construction labor productivity in Ethiopian condominium house construction projects through IHDP in Addis Ababa, and their ranking is: 1) Management group; 2) Material group; 3) Motivation group, and 4) Manpower group. The results obtained are compared and contrasted with the previous work done in different countries. It is also recommended to facilitate the workflow among all participants and ensure their coordination and lay down better communication. Besides, it is essential to organize the work on sites with a qualified construction foreman. Appropriate Construction planning/project schedule should also be in place, and it is also important to devise a better alternative for materials supply. Moreover, it is better to motivate labor through incentives, to inspire, encourage, and stimulate the workforce. Since the construction of condominium houses in IHDP differs from the conventional construction method; there shall be a mechanism to bridge the demand for experienced labor by opting for a different alternative.

Keywords: *Construction, labor productivity, Ethiopia, productivity factors,*

Acknowledgments

The author would like to express his gratitude to Adama Science and Technology University (ASTU), the School of Civil Engineering and Architecture, and all reviewers for their constructive comments to enrich this research. This study was conducted in support of a Research Grant from ASTU.

Table of Contents

List of table

1 INTRODUCTION AND BACKGROUND

Construction productivity, in general, plays a key role in the success of a construction project (SU, YUN-YI, 2010). It may be used as an index for the efficiency of production (Ghate, P.R. and Minde, P.R., 2016). High productivity leads to lower unit costs to carry out a task or operation (SU, YUN-YI, 2010). A higher productivity level usually translates into superior profitability (M.Rojas, 2008). Hence, decreasing productivity of projects has always been a major concern for the construction Industry (Ghate, P.R. and Minde, P.R., 2016). Though many factors influence productivity in the construction industry, Labor productivity is one of the most important factors that affect the physical progress of any construction project (Vekaria, 2012). Because construction is labor oriented industry, it heavily relies on the skills of its workforce (Ghate, P.R. and Minde, P.R., 2016).

There is a strong need to develop innovative solutions to overcome common productivity problems that remain today. Identification of critical global factors impeding construction productivity to direct focused efforts towards productivity improvement in construction projects is the first step in the right direction (Hasan A. et al, 2018). Efforts to improve labor productivity in construction in developing countries must begin with an identification of the factors affecting productivity, their relative importance, and their potential for alteration (Moavenzadeh, 1987).

Identification and evaluation of factors affecting construction labor productivity have been conducted in the last decade in different countries; however, according to (Hasan A. et al, 2018) previous researchers have primarily focused on basic management factors and thereby, various physiological, psychological, and social Factors affecting construction productivity factors related to the construction workforce have remained unexplored. Any productivity improvement research or effort must consider both the actual work being performed and the workers doing the work to produce consistent and sustainable results (Ibid). In previous researches, while some researchers are convinced that some similarities in issues impeding productivity could be observed, others maintain that factors influencing productivity differ from site to site (Ibid). Moreover, researches conducted on factors affecting labor productivity in building projects were based on the understanding, knowledge, and experience of the

respondents and not related to any definite project (Gundecha, 2013). Accordingly, the studies deliberated homogeneity on features of the building projects even though building projects have heterogeneous nature of construction inputs and outputs, and the factors affecting labor productivity might be different among the projects. Thus, the finding of these types of studies might be skewed. However, projects could have a similar common feature that might contribute to factors pending construction labor productivity. Therefore, better results could be obtained if a study on factors affecting CLP in building construction projects could be conducted related to projects having notable common features and similarities that can construct many common factors that affect CLP.

In Ethiopia, besides a lack of comprehensive and updated construction labor productivity standards and norms, there is a lack of detailed study regarding different factors affecting labor productivity in the construction of projects. Therefore, it is important to identify critical factors hampering construction productivity as the first step towards productivity improvement in the industry. The study's focus on construction labor productivity (CLP) should be seen in relation to other research on CLP in Ethiopia and abroad. The studies done so far are either based on the views of limited participants or not related to any definite project, or they were conducted on projects with no notable common features. For example, (Mekides, 2016) in her study on Factors Affecting Labor Productivity on Building Construction Projects in Addis Ababa, domestic contractors of grade three and above and building projects undertaken by grade three and above contractors were used in her study. (HM Alinaitwe et al, 2007) in their study on factors affecting the productivity of building craftsmen in Uganda conducted a survey made on project managers of building projects in Uganda. (Benviolent Chigara, 2014) conducted a study on Factors Affecting Labor Productivity on Building Projects in Zimbabwe. Their study was based on the views of consultants and contractors from the building industry in Zimbabwe. However, the perceptions of various stakeholders in addition to contractors could present more elaborative results. A study on construction labor productivity should at least consider the perception of the three groups - the client, the consultant, and the contractor. Moreover, unless there are notable contributing factors for labor productivity loss among different projects; productivity differs among types of construction, crafts, geographic locations, sizes of projects, and so forth and changes over time (Moavenzadeh, 1987).

This study is related to condominium house construction projects in Addis Ababa through Ethiopian Integrated Housing Development Program (IHDP), a government-led and financed housing provision program for low-and middle-income households, where there are many similarities and common features among the projects. The similarities and common features according to (UN HABITAT, 2010) are the adoption of cost-effective construction techniques and systems, notably pre-cast concrete elements, that have reduced construction costs (by up to 30 percent) compared with conventional systems, improved the speed of construction, and facilitated the development of small and medium enterprises to produce construction elements. There are also common elements across all individual condominium projects: the housing design typologies, and costing and quantity surveying systems are consistent project-specific features. Each condominium project follows a similar process in project design and implementation. Building materials are centrally sourced and distributed. The Programme is entirely financed by public resources. Presently, the Commercial Bank of Ethiopia is the only independent financial resource for the housing programme in Ethiopia. Besides, condominium unit beneficiaries are required to make a down payment out of their savings to secure their unit.

Therefore, to identify factors affecting construction labor productivity in the IHDP where the performance is by far below the planned program, it is vital to analyze and rank the critical factors within the context of the program and as per the identified research gaps. First, since previous researchers on CLP have primarily focused on basic management factors (Hasan A, 2018), it is important to incorporate physiological, psychological, and social factors affecting construction productivity factors related to the construction workforce for a better comprehensive result. Second, as building projects are unique despite some superficial similarities, the results obtained from previous studies on labor productivity within different projects might be misleading. Such studies should be conducted; for better results, the projects should have distinguished common features that could have a potential impact on labor productivity.

It has been noted that in IHDP, however, there are similar and common features among all projects: the construction techniques and systems, the participation of small and medium enterprises that produce construction elements, consistent projects specific features, the similarity of process in project design and implementation for each condominium projects, the centrally sourced and distributed building materials and program financing. Thus, these features might create many common factors that can have an effect on construction labor productivity among the projects. Moreover, since the implications of emerging technologies, site amenities, and workers' welfare initiatives on CLP are yet to be examined in sufficient detail (Hasan A. et al, 2018), it is important to incorporate the related factors to the study within the context of the construction of condominium houses through IHDP.

1.1 **PROBLEM STATEMENT**

The construction industry has important contributions to the Ethiopian economy, as demonstrated by its share in the gross domestic product (GDP). However, the inefficient and deteriorated state of the construction industry, in general, with poor performance has detrimental effects on the development of the industry (MUDCo, 2012). Several construction activities in the country have not been completed in time and are faced with high cost and time overrun. As a result, they have incurred additional financial costs and have taken a longer time than initially (EEA, 2006/07). (MUDCo, 2012) has identified low productivity and quality as one of the weaknesses, problems, and constraints hampering the performance and development of the industry. Moreover, according to a study conducted by (Chia F. et al, 2010) the comparative analysis of construction labor productivity using the real (purchasing power parities converted) and nominal construction expenditure, Ethiopia is ranked 76th and 77th among the 79 selected countries on real and nominal construction expenditure measurement basis with construction labor productivity equals 14,827.21 International Dollars/Employee and 3,460 US Dollars/Employee respectively. Moreover, compared to other African countries in the study, Ethiopia stands last: Madagascar is the 1st, Mauritius is the 2nd, South Africa is the 3 rd, and Egypt Arab Rep. is the 4th in both measurement basis. Likewise, according to (UN-HABITAT, 2010), in the IHDP, the productivity of the construction phase has not been as efficient as planned during the program's implementation thus far delaying completion by as much as a year on some sites. Approximately 50 percent of condominium sites are behind schedule.

Cognizant of the fact that construction is labor oriented industry and greatly relies on labor, and labor productivity directly affects construction productivity (Prachi R. Ghate, 2016), it is therefore vital to understand factors affecting labor productivity in the context of the construction of condominium houses through IHDP.to improve construction productivity.

2 RESEARCH OBJECTIVE

The objective of this study is to analyze factors affecting construction labor productivity in Ethiopian condominium house construction projects through IHDP in Addis Ababa; by the result industry practitioners could develop a wider and deeper perspective of the factors affecting labor productivity, and guide construction parties directly involved in the project for better productivity by mitigating the causes. Accordingly, the specific objectives are:

- To statistically analyze factors negatively affecting labor productivity in condominium house construction through IHDP.
- To rank the identified factors negatively affecting labor productivity in their order of their relative importance

3 SIGNIFICANCE OF THE RESEARCH

The benefit of increased productivity in the construction industry is enormous to all parties in the industry. It can be viewed from two perspectives, the consumer and the contractor. From the consumer's perspective, increased productivity lowers costs, shortens construction schedules, offers more value for the money, and achieves better returns on investments. From the contractor's perspective, increased productivity leads to a more satisfied customer, while also providing a competitive advantage and in return leading to faster turnover and increased profits (Horner 2001, Cited in Casey, 2007).

Therefore, this study attempted to Identify and Rank Factors affecting Construction Labor Productivity in Government Housing Projects through IHDP in Addis Ababa. The study is in line with the Research Priority of Adama Science and Technology (ASTU), Theme 4: Construction and Urban Development- Project performance evaluation and benchmarking

systems, under Research Priority 4: Infrastructure (ASTU 2015). Even though the study was conducted in Addis Ababa city IHDP, the results and findings could be adapted to other major towns in the country where the projects are underway. Hence, it could also help to mitigate the challenges that affect labor productivity and assist the program able to meet its objective.

Moreover, it could also help top decision-makers, consultants, and contractors to understand Factors affecting Construction Labor Productivity in IHDP projects; and hence improve the productivity from the pre-planning stage through the project's completion to meet the objective of the program. The study could also give direction to other researchers, policymakers, and other parties in the industry.

4 LITERATURE REVIEW

Productivity is the main determinant of national living standards. It refers to how well an economy uses the resources it has available by relating the number of inputs to outputs (Treasury, 2000). It is considered a key source of economic growth and competitiveness and, as such, is basic statistical information for many international comparisons and country performance assessments (Krugman, 1994).

Though most economists would agree with the importance of productivity to an individual enterprise, an industry, or an economy, unfortunately, no such agreement exists when it comes to an actual, precise definition of "productivity" and which of the numerous alternative approaches to measuring productivity are suitable for a given task. (Yi, 2013). There is no standard definition of productivity and any current misunderstandings about productivity appear to stem from at least nonstandard terminology (Mostafa E. Shehata, 2011). The term Productivity, however, is used and defined in many different ways. According to (R.chitra, and Ruchi Kumari, 2018) productivity in economics refers to the measure of output from production processes, per unit of input. It is the ratio of output to all or some of the resources used to produce that output. (Krugman, 1994) define productivity as a ratio between the output volume and the volume of inputs; which in other words, measures how efficiently production inputs, such as labor and capital, are being used in an economy to produce a given level of output. Simply put, according to (Syverson, 2011),

productivity is production efficiency: how much output is obtained from a given set of inputs.

Different measures of productivity serve different purposes. It is important to choose a measure that is appropriate to the purpose (Randolph H. Thomas, 1990).

(Randolph H. Thomas, 1990) defined different aspects of measures as follows:

1. *Economic models:*

The department of Commerce, Congress, and other governmental agencies use a productivity definition in the following form:

$$\text{Total Factor Productivity } (\mathbf{TFP}) = \frac{\text{Total output}}{\text{Labor} + \text{Material} + \text{Equipment} + \text{Energy} + \text{Capital}} - - - (1a)$$

$$\text{Total Factor Productivity } (\mathbf{TFP}) = \frac{\text{Dollars of output}}{\text{Dollars of inputl}} - - - - (1b)$$

TFP is really an economic model measured in terms of dollars, since dollars are the only measure common to both inputs and outputs. Eq. 1 is useful for policy-making and evaluating the state of the economy, but it is not useful to contractors. It can be highly inaccurate if applied to a specific project or site because of the difficulties in predicting the various inputs. For example, the Federal Highway Administration may be interested in:

$$\text{Productivity } = \frac{\text{Output}}{\text{Design} + \text{Inspection} + \text{Construction} + \text{Right} - \text{of} - \text{way}} - - (2a)$$

$$\text{Productivity } = \frac{\text{Lane mile}}{\text{Dollars}} - (2b)$$

The definition is also useful in policy-making and for broad program planning. Eq. (2) is also subject to significant inaccuracies when applied to individual projects.

2. *Project-specific models:*

A more accurate definition that can be used by governmental agencies for specific program planning and by the private sector for conceptual estimates on individual projects is:

$$\text{Productivity} = \frac{\text{Output}}{\text{Labor} + \text{Equipment} + \text{Materials}} - -(3a)$$

$$\text{Productivity} = \frac{\text{Square feet}}{\text{Dollars}} - - - - - - - - - - - - - (3b)$$

Design professionals use productivity data in this form.

3. Activity-Oriented Models

A contractor is more likely to define productivity using a narrowly defined version of Eq. (3), where the units of output are specific for generic kinds of work. Typical units are cubic yards, tons, and square feet. Various related activities, such as formwork, steel reinforcement, and concrete placement, can be combined using the earned-value concept (Thomas and Kramer,1987, cited in Thomas et al., 1990, p. 707). Productivity is expressed as units of output per dollar or work-hour.

At the project site, contractors are often interested in labor productivity. It can be defined in one of the following ways (Thomas and Mathews, 1985 cited in Thomas et al., 1990, p. 707):

$$\text{Productivity} = \frac{\text{Output}}{\text{Labor cost}} - - - - - - - - - - - - - - - (4)$$

$$\text{Productivity} = \frac{\text{Output}}{\text{Work} - \text{hour}} - - - - \quad (5)$$

There is no standard definition of productivity and some contractors use the inverse of Eq. 5:

$$\text{Productivity} = \frac{\text{Labor costs or work} - \text{hours}}{\text{Output}} - - - - - (6)$$

Eq. 6 is often called the unit rate. Still other contractors rely on the performance factor as a measure of productivity

$$\text{Productivity} = \frac{\text{Estimated unit rate}}{\text{Actual unit rate}} - - - - - - - - - (7)$$

The meaning of the term productivity varies with its application to different areas of the construction industry (Randolph H. Thomas, 1990). In the industry Productivity is one of the most frequently discussed topics because of its critical importance to the profitability of most construction projects, (Yi, 2013). Many terms are used to describe productivity in the

industry: performance factor, production rate, unit person-hour (p-h) rate and others. (Dozzi, S.P. and AbouRizk, S.M, 1993). It is usually taken to mean labor productivity, that is, units of works placed or produced per man-hour (R.chitra, Ruchi Kumari, 2018). According to (Treasury, 2000), labor productivity looks at the output produced per unit of labor input. The most common indicators are output per worker and output per hour worked. It is the physical progress achieved per p-h, e.g., p-hs per linear meter of conduit laid or p-hs per cubic meter of concrete poured, according to (Dozzi, S.P. and AbouRizk, S.M, 1993). It is typically expressed as an output-input ratio. Single-factor productivity measures reflect units of output produced per unit of a particular input. Labor productivity is the most common measure of this type, though occasionally capital or even materials productivity measures are used (Syverson, 2011).

Labor productivity is a measure of the overall effectiveness of an operating system in utilizing labor, equipment, and capital to convert labor efforts into useful output, and is not a measure of the capabilities of labor alone (Nithya, K. and Saravanan, M.M., 2015). It is considered one of the best indicators of production efficiency. Higher productivity level usually translates into superior profitability (M.Rojas, 2008). It also directly affects construction productivity (Ghate, P.R. and Minde, P.R., 2016). This is because construction continues to be a labor-intensive industry, despite many technological advances (M.Rojas, 2008). 30% to 50% of the total cost of the project is spent on labor. (M.Rojas, 2008). Besides, the quality of the construction largely depends upon the quality of work done by labor (Prachi R. Ghate, Prof. Pravin R. Minde, 2016).

From the above literatures it can be seen, productivity is defined in many ways that reflect the different perspectives of the construction industry. For clarity, it is important to set operational definition before entering into analyzing factors affecting the construction labor productivity. In this study, labor productivity is defined by Eq. 5 and is expressed in terms of unit per work-hours.

Construction labor productivity is influenced by various factors whose impact can be quantified in productivity models that play an important role in estimating the cost,

scheduling, and planning. (R.chitra, Ruchi Kumari, 2018). Therefore, as the performance of labor could be affected by many factors and usually linked to the performances of the time, cost, and quality according to (El-Gohary, K.M. and Aziz, R.F., 2014), it is imperative to analyze factors affecting construction productivity to identify the major factors that imped the construction labor productivity and set remedial measures. Identification of major factors negatively affecting construction labor productivity is the first step in the right direction towards productivity improvement in construction projects.

To this end, (Chigara and Moyo, 2014) identified 40 factors which were grouped into seven: plant and equipment-related factors, materials-related factors, management-related factors, manpower-related factors, motivation-related factors, technical related factors, and other factors.

(Mahamid, 2013) identified 40 factors and grouped them into five are labor, managerial, materials and equipment, environmental, and financial.

(Sherif M. et al. 2014) identified 27 productivity factors, classified four primary groups: (a) Technological; (b) Management; (c) Human/Labor; and (d) External.

(Soham and Rajiv, 2013) identified 27 factors that could affect labor productivity categorized into four main groups: (1) technological group. (2) Human/labor group (3) management group& (4) external group.
(El-Gohary, K.M. and Aziz, R.F., 2014) identified 30 productivity factors that were classified under three primary categories: (1) human/labor, (2) industrial, and (3) management.

(P. Ghoddousi and M. R. Hosseini, 2012,) identified 34 factors and grouped them into eight, namely: Manpower, Managerial, Environmental, safety, Material/Equipment, Schedule, Motivation, and Quality.

(P. Ghoddousi and M. R. Hosseini, 2012,) identified a total of 31 factors and divided them into 7 broad categories as material/tools, Construction method/technology, management/planning, supervision, reworks, weather, and Jobsite conditions.

Table I Factors Affecting Labor Productivity identified by different Authors

No.	Chigara and Moyo, 2014	Mahamid, 2013	(Henry Mwanaki Alinaitwe, 2007)
1	Suitability or adequacy of Plant and equipment	Political situation	Incompetent supervisors
2	Plant breakdown	Equipment shortages	Lack of skills of the workers (eg inexperienced, poorly trained)
3	Shortage of tools and equipment	Old and Inefficient equipment	Rework, eg poor work done
4	Inefficiency of equipment	Lack of labor experience	Lack of tools/equipment
5	Unavailability of material	Poor site management	Poor construction method (eg poor sequencing of work items)
6	Late deliveries of material	Poor communication and coordination between construction parties	Poor communication (eg inaccurate instructions, inaccurate drawings)
7	Insufficient or poor material handling	Delay payments by the owner	Stoppages because of work being rejected by consultants
8	Supervisory incompetence	Low wages	Political insecurity (eg insurgency, wars)
9	Instruction delays	Rework	Tools/equipment breakdown
10	Inspection delays	Misuse of time schedule	Harsh weather conditions
11	Lack of coordination	Lack of training sessions for labors	Stoppages because of insolvency
12	Poor communication	Lack of financial motivation system	Poor recruitment and changing of foremen
13	Poor management practice	Frequent change orders	Stoppages because of disputes with owners/consultants
14	Poor relations between management and workers	Material shortages	Incomplete drawings and design changes
15	Increasing laborers in order to accelerate works	Lack of labors in the market	Alcoholism and drug abuse
16	Compliance to statutory regulations (NSSA, NEC)	Low quality of raw materials	Poor economic conditions of workers (eg poor pay)
17	Absenteeism	Lack of supervisors experience	Material shortages/delays
18	Working for long periods without holiday	Payment delay by the contractor to the labors	Poor labour composition (eg poor ratio of tradesmen to labourers)
19	Lack of manpower skills	Unsuitable materials storage location	Absenteeism of workers
20	Lack of labor experience	Payment delay by the contractor to the suppliers	Disruption of power/water services (eg power load shedding)
21	Inappropriate use of skills	Bad relations between labors and management team	Labour disputes (eg industrial action)
22	Low remuneration	Lack of labor surveillance	Poor site conditions (eg height, shape, etc)
23	Lack of incentive schemes	Weather changes	Poor health of workers (eg sickness, general weakness)
24	Availability of site facilities	Project location	Workers turnover, recruitment and changing crews
25	Worker retention schemes	Poor soil conditions	Design complexity
26	Lack of worker respect or recognition	Working within a confined space	Poor access (eg poor scaffolds)
27	Health and safety provisions	Inspection delay	Design changes
28	Lack of training sessions	Labor disloyalty	Inspection delay
29	Late payment of salaries and wages	Bad labor relations	Accidents at work sites
30	Alterations of design during project execution	Labor personal problems	Overcrowding on the site
31	Poor site layout and organization	Large Project size	Interference from other trades or other crew members
32	Incomplete drawings	Availability of alternative opportunities	Too much instruction time (eg to workers)
33	Poor site conditions	Poor terrain conditions	Working overtime
34	project complexity	Over manning	Adherence to regulatory requirements
35	Construction methods	Misunderstanding between labors and superintendents	Attendance to social factors (eg deaths of relatives, parties, etc)
36	Crew size inefficiency	Craft turnover	Small construction volume
37	Alterations of schedule	Poor soil drillability	
38	Reworks	Improper construction method	
39	Inclement weather	Lack of competition	
40	On-site accidents	Labor absenteeism	

Table II Factors Affecting Labor Productivity identified by different Authors

No	Sherif M. et al. 2014	Soham et al (2013)	Shamil George Naoum, (2016)
1	Payment delay	Clarity of technical specification	Ineffective project planning
2	Skill of labor	The extent of variation/change order During execution	Delay caused by design error and variation orders
3	A shortage of experienced labor	Coordination level among design disciplines	Communication system
4	Lack of labor supervision	Design complexity level	Work environment
5	Motivation of labor	Rework	Constraints on a worker's performance
6	Working over time	Site lay out	Design and buildability-related issues
7	Construction managers lack of leadership	Inspection delay/stringent by the engineer	Management/leadership style
8	High humidity	Site restricted access	Procurement method
9	Clarity of technical specification	Motivation of labour	Lack of integration of the management information system for the project
10	High/low temperature	Skill of labour	Management of material on site
11	Proportion of work subcontracted	Physical fatigue	Team/group integration during construction
12	Physical fatigue	A shortage of experienced labour	Experience and training
13	Construction method	Construction managers lack of leadership	Control system on site
14	High wind	Lack of labour supervision	Group co-ordination/overcrowding on site
15	Inspection delay/stringent by the engineer	Working over time	Project structure/authority and influence on site
16	Rework	Crew size and composition	Specification
17	Crew size and composition	Unsuitability of storage location	Ineffective site planning leading to program disruption
18	Unsuitability of storage location	Accidents as a result of poor site safety programme	Supervision of subordinate
19	Coordination level among design disciplines	Proportion of work subcontracted	Delay/rework
20	Design complexity level	Unrealistic schedules and expectation of labour performanc	Site safety
21	The extent of variation/change order During execution	Shortage of materials	Clarity of tasks
22	Shortage of materials	Construction method	Clarity of client brief and project objectives
23	Site layout	Payment delay	Site managers involvement at contract stage
24	Accidents as a result of poor site safety program	High/low temperature	Accuracy of tech. information
25	Rain	High humidity	Construction technology and methods
26	Unrealistic scheduling and expectation of labor performance	High wind	Poor scheduling of project activities
27	Site restricted access	Rain	Sub-contractor involvement
28			Co-ordination of sub-contractors
29			Direct V sub-contract labor
30			Job security
31			Availability of skilled workers
32			Interference on workmanship
33			Poor selection of project personnel
34			Lack of consultation in the decision-making process
35			Attitude of site personnel
36			Mismatch of beliefs among personnel on site
37			Management of equipment/use of inappropriate tools/equipment for operations
38			Resentment of company policy
39			Contract administration skill
40			Delegation of responsibilities
41			Knowledge of techniques
42			Inefficient site layout
43			Response to employee grievances

44		Salary and incentives
45		Reappraisal of site managers and promotion
46		Opportunities to exercise skill

Table III Factors Affecting Labor Productivity identified by different Authors

No.	(El-Gohary, K.M. and Aziz, R.F., 2014)	Shashank K et al. 2014	(P. Ghoddousi and M. R. Hosseini, 2012,)
1	Laborer experience and skill	Lack of labor skills	Utilizing the traditional construction methods instead of modern technology
2	Incentive programs	Increase of laborer age	Site manager is not experienced to handle challenges that arise in the field
3	Availability of materials and their ease of handling	Labor absenteeism	Lack of proper tools and equipment on-site
4	Leadership and competency of construction management	Lack of training	Operatives do not pose skills and experience to perform the task
5	Competency of labor supervision	Labor personal problem	Site manager does not have the ability in training workers to perform their jobs properly
6	Construction technology (construction method and material)	Poor site management	There is shortage of material in the market
7	Labor operating system (daily wage, lump sum)	Poor communication	The company executes that type of project for the first time
8	Planning, work flow, and site congestion	Misunderstanding between labor and supervisor	Materials have not arrived onsite yet
9	Constructability (integrated design and construction)	Lack of periodic meeting with labors	The thermal environment is not comfortable (i.e. heat, cold, humidity)
10	Clarity of instructions and information exchange	Weather changes	The tasks are not properly planned and realistically sequenced
11	Surrounding events (revolutions)	Project location	The work needs to be redone due to changes in design, drawings or specifications
12	Weather effect (temperature, humidity)	Working with confined place	Skilled workers are not adequate on jobs
13	Laborer age	Large project size	There is no construction planning/project schedule in place
14	Distance between site and cities	Payment delay	Workers have to adopt awkward postures or exert considerable physical force to perform the jobs
15	Services offered to laborers (social insurance,medical care)	Non provision of transport means	There are frequent tools/equipment breakdowns due to aging or poor maintenance
16	Effect of labor availability—work capacity (shortage)	Lack of financial motivation system	The works need to be redone frequently due to poor quality of documents, drawings or specifications.
17	Project specifications	Lack of places for eating and relaxation	The jobsite layout is poor
18	Over time (up to 4 h after 8 h=day)	Material shortage	Stoppage because of inspection delays
19	Project scale	Unsuitable material storage location	Disruption of power services
20	Available quantity of the daily work (workload)	Old and inefficient equipment	Congestion and overcrowding on the site/interference among people working in the jobsite
21	Work interruptions (design changes)	Tools and equipment shortages	Disruption of water services
22	Effect of labor availability—work capacity (excess)	Working 7 days per week without taking holiday	The site is slippery or steep imposing terrible conditions
23	Work at heights	Poor work planning	Management does not support safety planning
24	Degree of laborer education	Overcrowding	The work needs to be redone due to the damage after the work was complete
25	Rest time(s) during the work day	Misuse of time schedule	The works need to be redone because it fails quality control inspection or testing

26	Total project duration (total work hours)	Ignore safety precautions	There were errors in fabrication that needs to be corrected in rework
27	Construction management type (individuals, firms)	Accident	Work and break frequencies and durations are not properly organized
28	Over time (more than 4 h after 8 h=day)	No safety engineer in site	There are not adequate water coolers, toilets, convenient store or covered rest area onsite in the vicinity of active work force
29	Management of subcontractors	Insufficient lighting	
30	Type of the project (industrial, residential)	Working at high places	
31		Low quality raw materials	
32		High quality of required works	
33		Rework	
34		Quality inspection delay	

To summarize, based on past studies and previous literature, 117 factors were selected for this study and grouped into 9 according to their characteristics, namely: Manpower related factors, Motivation related factors, Management related factors, Material related factors, Technical related factors, Tools and equipment-related factors, Financial related factors, Environmental related factors, and Other factors.

Table IV: Factors for the study

Manpower Related Factors	Motivation Related Factors	Management Related Factors
Shortage of experienced labor	Lack of financial motivation system (lack of incentive)	Poor site management
Physical Fatigue	Lack of respect and recognition to the workers	Lack of clear and daily task assignments to workers
Labor Turnover	Lack of training sector for labor	Incompetent supervisors assigned by the consultant
Inappropriate use of skill of labor	Late payment of salaries(wage) to labors	Instruction delays by consultant
Lack of labor experience	Low salaries and wages (Low remuneration)	Poor communication on site
Labor Absenteeism	Unavailability of site facilities	Poor relations between management and workers
Coordination problem among labors	Lack of workers retention scheme	Increasing labour in order to accelerate work
Working for a long period	Lack of response to employee grievance	Lack of periodic meeting with labour
Lack of skill of the workers	Poor health and safety provision	Lack of supervision of labour during work
Poor labor composition	Services offered to laborers (social insurance, medical care)	Poor recruitment and changing of foremen
Poor health of workers	Non provision of transport means to workers	Lack of Coordination between crews
Overcrowded on site		Crew size inconsistency by adding or deleting crew members.
Attendance of social factors(holiday, death)	**Environment Related Factors**	Delay in inspection and supervision by Consultant
Lack of labor in the market	Inclement weather (Harsh weather conditions) (Weather effect)	Misuse of time schedule
Labor disloyalty	Poor site conditions (eg height, shape, etc)	Reassignment of manpower from one task to another
Labor age	Poor soil conditions	Over employment of labor to accelerate works
Crew size and composition	Poor terrain conditions	Poor safety program which causes accident during construction
Over inspection of labor	Bad ventilation	Poor planning and scheduling of manpower
Material Related Factors	Noise	Frequent change orders
Unavailability of material	Violation of safety precautions	Lack of supervisors experience
Late deliveries of material(Delayed material delivery by the supplier)	Accidents	Unrealistic schedules and expectation of labour performance
Insufficient or poor material handling	Working at high places	Sub-contractor involvement
Material shortages/delays	Insufficient Lighting	Poor Co-ordination of sub-contractors

Availability of materials and their ease of handling

Unsuitable material storage location
Low quality of raw materials as a result rework

Shortage of material in the market

Increase in the price of material
Lack of proper tools and equipment on-site

Technical Related Factors

Poor construction methods (eg Poor sequencing of items)

Problems associated to clarity of specification

Incomplete drawings
Project complexity/unfamiliarity of projects to workers
Rework (eg poor work done)
Alteration of project work schedule
Alteration of design during project execution
Poor site layout and organization

Crew size inefficiency
High quality of required work
The company executes that type of project for the first time

Constructability (integrated design and construction)
Poor communication (eg inaccurate instructions, inaccurate drawings)
Utilizing the traditional construction methods instead of modern technology

High humidity

Financial Related Factors

Delay payments by the owner

Lack of financial motivation system

Low wages
Payment delay by the contractor to the labors
Payment delay by the contractor to the suppliers

Tools and Equipment Related Factors

Suitability or adequacy of Plant and equipment (Lack of tools/equipment)
Plant breakdown (Tools/equipment breakdown)

Inefficiency of equipment (Old)

Other Factors

Political situation (Surrounding events)
Cultural and social related problems
Large project size

Misunderstanding between labour and supervisor
Lack of construction planning/project schedule in place
Moving resources on and moving off to projects
Coordination problems of main contractor and sub-contractors
Communication problems between sub-contractors
Insufficient supervision of subcontractors
Relationship between workers of subcontractor and workers of main contractor

Lack of experience of subcontractors

Regulation

Contract type

Supervisors absenteeism
Lack of site managers experience
Incompetent supervisors
Poor recruitment and changing of foremen
Poor site management
Poor communication and coordination between construction parties
Planning, work flow, and site congestion

Clarity of instructions and information exchange
The tasks are not properly planned and realistically sequenced

5 RESEARCH METHODOLOGY

This research is conducted based on a questionnaire survey designed to gather all necessary information, reliability analysis, and the Relative Importance Index (RII) technique was adopted. To collect Data from conveniently available population members, a convenience sampling method was used. The method used in this study is shown in fig. 1 below.

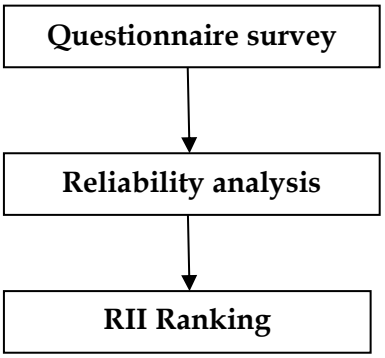


Fig. 1: Research method

Questionnaire survey: To collect data on factors affecting labor productivity in condominium housing construction projects through IHDP.

Reliability analysis: Conducted for each group to assess the reliability of the responses and discard unreliable factors.

RII Ranking: RII technique was used for analyzing data and to assess the general and overall ranking of the factors.

6 RESULTS OF DATA ANALYSIS AND DISCUSSION

A total of 72 questionnaires were distributed to the construction experts from projects members composed of Contract Administrator, Project Manager, Resident Engineer, Site Engineer, Office Engineer, and Forman. Of these, 51 questionnaires were successfully filled and returned. The response rate was therefore 70.83%. Once the data was collected the analysis was done as per questionnaires that were used to collect the data.

A. Reliability Analysis

Because tests are not reliable, it is important to explore score reliability in virtually all studies (Vacha-Haase, 1998). Reliability pertains to the consistency of scores. The less consistency within a given measurement, the less useful the data may be in analysis (Ritter, 2010). Internal consistency estimates relate to item homogeneity, or the degree to which the items on a test jointly measure the same construct (Henson, 2001). When using Likert-type scales it is imperative to calculate and report Cronbach's alpha coefficient for internal consistency reliability for any scales or subscales one may be using (Gliem, 2003). Thus, in this study for reliability analysis, Cronbach's alpha method was used to assess basic consistency reliability on the bases of average correlation between the data measured identically. By this method, the reliability of group level and individual level were evaluated.

Cronbach's alpha value is computed by using the below-stated formula (Ritter, 2010).

$$\alpha = \frac{K}{K-1}\left[1 - \left(\frac{\sum \sigma_k^2}{\sigma_{total}^2}\right)\right]$$ Cronbach alpha----------(8)

Wherein:

- K= number of items,
- $\sum \sigma_k^2$ = k item score variance sum
- σ_{total}^2 = scores variance on total measurement.

Another way to calculate alpha, is to use a statistical software program such as SPSS. Select Analyze > Scale >Reliability Analysis (George, 2019). Thus, for this study SPSS software was used to calculate Cronbach's alpha value to explore score reliability.

Table: V

A rule of thumb for Cronbach's alpha

Cronbach's Alpha	Internal Consistency
α > 0.90	Excellent
α > 0.80	Good
α > 0.70	Acceptable
α > 0.60	Questionable
α > 0.50	Poor
α < 0.50	Unacceptable

Source: (George, 2019)

From table V, Cronbach's Alpha value above 0.90 shows excellent internal consistency, above 0.80 is good, above 0.70 is acceptable, above 0.60 is questionable, above 0.50 is poor, and below 0.50 is unacceptable. The Cronbach's alpha has a value between 0 and 1. The closer the Cronbach's alpha value to 1, the greater the internal consistency of the item within the scale (George, 2019). In general, as items are more correlated, shared variance increases, increasing internal consistency; therefore increasing the magnitude of the alpha

coefficient (Ritter, 2010). A generally accepted lower limit value of Cronbach's alpha and item-total correlate is 0.7, although it drops to 0.6 in exploratory research (Gottems, 2018). After considering the result of the reliability analysis, five factors were deleted due to low item-total correlation. As shown in Table VI and Table VII the final reliability analyses were conducted after deleting 5 factors.

Table VI

Reliability Analysis Results

No.	GROUP	CRONBACH'S ALPHA VALUE
A	Manpower	0.766
B	Technical	0.531
C	Motivation	0.804
D	Financial	0.098
E	Management	0.950
F	Material	0.868
G	Tools and Equipment	0.321
H	Environmental	0.112
I	Other	0.085

From table VI , Technical related factors with Cronbach's alpha value 0.531 shows poor internal consistency; Financial related factors with Cronbach's alpha value 0.098, Tools and Equipment related factors with Cronbach's alpha value 0.321, Environmental related factors with alpha value 0.112, and Other factors with alpha value 0.085 indicate poor and unacceptable internal consistency according to (George, 2019). Thus, the factors were deleted due to low item-total correlation.

Table VII

Final Reliability Analysis Results

No.	GROUP	CRONBACH'S ALPHA VALUE
A	Manpower	0.766
B	Motivation	0.804
C	Management	0.950
D	Material	0.868

Table VII shows, the four group factors with Cronbach's alpha value greater than 0.7. Which is above the accepted lower limit value of Cronbach's alpha, according to (Gottems, 2018).

B. RII Ranking

For analyzing data, the Relative Importance Index (RII) technique was used according to the following formula (Madhan, A & I, Gunarani, 2018); (Hickson and Ellis , 2014))

$$RII\ (\%) = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + n_1}{5(n_5 + n_4 + n_3 + n_2 + n_1)} \text{ x } 100 - -(9)$$

Where n1, n2, n3, n4, and n5 are the number of respondents who selected: (1) very low effect/non-effect, (2) low effect, (3) medium effect, (4) high effect, and (5) very high effect. The weighting given to each factor by the respondents ranged from 1 to 5.

These rankings made it possible to cross-compare the relative importance of the factors as perceived by respondents. Each factor's RII perceived by all respondents should be used to assess the general and overall rankings to give an overall picture of factors affecting construction labor productivity in Ethiopian condominium housing construction projects through IHDP in Addis Ababa.

6. RESULTS

The effect of each of the 48 factors explored on construction labor productivity in Ethiopian condominium housing construction projects through IHDP in Addis Ababa is determined. The overall factors are classified under nine major categories as follows: Manpower group, Motivation group, Management group, Material group, Technical group, Tools and equipment group, Financial group, Environmental group, and Other group.

The RII percentage rank within the corresponding category and the overall ranks of the factors investigated are presented, discussed, and compared to previous related research findings as follows.

6.1. Manpower Related

The relative importance indices and group rank for **Manpower** related factors and ranks of the eight factors classified under the **Manpower** Related factors are shown in Table VIII.

Table VIII

Ranking Labor productivity Manpower group

A	Manpower Related	RII(%)	Rank
	Group RII and Rank	53.69	4
1	Shortage of experienced labor	72.1	4
2	Lack of skill of the workers	66.6	27
3	Labor disloyalty	64.9	31
4	Inappropriate use of the skill of labor	61.6	42
5	Coordination problem among labors	59.7	43
6	Poor health of workers	59.3	44
7	Attendance of social factors(holiday, death)	56.1	46
8	Overcrowded on site	54.1	47

Table VIII - shows that the participants ranked **Manpower** related factor as the fourth important group factor affecting labor productivity among all groups with an RII of 53.69%. Moreover, "Shortage of experienced labor" is ranked as the most important factor affecting

labor productivity in the **Manpower** group with an RII of 72.13%. This top-ranked factor is further ranked as the fourth in its effect among all factors explored.

6.2. Motivation Group

The relative importance indices and ranks of the nine factors classified under the **Motivation group** are shown in Table IX.

Table IX

Ranking Labor productivity Motivation group

B	Motivation	RII(%)	Rank
	Group RII and Rank	**65.69**	**2**
1	Lack of financial motivation system (lack of incentive)	72.79	3
2	Low salaries and wages (Low remuneration)	70.16	8
3	Lack of workers retention scheme	68.2	19
4	Lack of respect and recognition to the workers	66.56	27
5	Non provision of transport means to workers	65.57	29
6	Poor health and safety provision	64.26	34
7	Services offered to laborers (social insurance, medical care)	63.61	37
8	Lack of response to employee grievance	61.97	41
9	Unavailability of site facilities	58.03	45

Table IX- shows that the participants ranked **Motivation** related factor the second most important group factor affecting labor productivity among all groups with a RII of 65.69%. Moreover, “Lack of financial motivation system (lack of incentive)” is ranked as the most important factor affecting labor productivity in **the Motivation** group, with a RII of 72.79%. This top-ranked factor is further ranked as the third in its effect among all factors explored. Besides, “Low salaries and wages (Low remuneration)” is also ranked the second most important factor affecting labor productivity in **the Motivation** group, with a RII of 70.16%. This top-ranked factor is further ranked as the eighth in its effect among all factors explored.

6.3. Material Group

The relative importance indices and ranks of the eight factors classified under the **Material factors** are shown in Table X.

Table X

Ranking Labor productivity Material group

C	Material	RII(%)	Rank
	Group RII and Rank	**63.69**	**3**
1	Shortage of material in the market	73.11	2
2	Unsuitable material storage location	67.21	25
3	Insufficient or poor material handling	64.92	31
4	Late deliveries of material(Delayed material delivery by the supplier)	63.93	35
5	Availability of materials and their ease of handling	63.93	35
6	Material shortages/delays	63.61	37
7	Low quality of raw materials as a result of rework	62.95	40
8	Unavailability of material due to design provision	49.84	48

Table X shows that the participants ranked **Material** related factors as the third most important group factor affecting labor productivity among all groups with a RII of 63.69%. Moreover, "Shortage of material in the market" is ranked as the most important factor affecting labor productivity in **the Material** group, with a RII of 73.11%. This top-ranked factor is further ranked second in its effect among all factors explored.

6.4. Management group

The relative importance indices and ranks of the twenty-three factors classified under the **Management related factors** are shown in Table XI below. It shows that the participants ranked Management related factor as the first important group factor affecting labor productivity among all groups with a RII of 68.61%. Moreover, "Lack of Poor communication and coordination among construction parties" is ranked as the first most important factor affecting labor productivity in the Management group, with a RII of 73.44%. This top-ranked factor is further ranked first in its effect among all factors explored. "Poor site management" is ranked the second most important factor affecting labor productivity in the Management group, with a RII of 71.48%. This factor is further ranked fifth in its effect

among all factors explored. “Poor recruitment and changing of foremen” is ranked the third most important factor affecting labor productivity in the Management group, with a RII of 71.15%. This factor is further ranked as the sixth in its effect among all factors explored. ”Lack of construction planning/project schedule in place” is ranked as the fourth most important factor affecting labor productivity in the Management group, with a RII of 70.82%. This factor is further ranked seventh in its effect among all factors explored. “Lack of supervision of labor during work” is ranked as the fifth most important factor affecting labor productivity in the Management group, with a RII of 69.84%. This factor is further ranked ninth in its effect among all factors explored. “Incompetent supervisors” is ranked as the sixth most important factor affecting labor productivity in the Management group, with a RII of 69.51%. This factor is further ranked tenth in its effect among all factors explored. In addition, “Poor relations between management and workers”, “Lack of supervisors experience”, “Poor Co-ordination of sub-contractors”, and “Insufficient supervision of subcontractors” are equally ranked in the Management group, with a RII of 69.18%. These factors are further ranked eleventh in their effect among all factors explored.

Table XI

Ranking Labor productivity Management group

D	Management	RII (%)	Rank
	Group RII and Rank	**68.61**	**1**
1	Poor communication and coordination among construction parties	73.44	1
2	Poor site management	71.48	5
3	Poor recruitment and changing of foremen	71.15	6
4	Lack of construction planning/project schedule in place	70.82	7
5	Lack of supervision of labor during work	69.84	9
6	Incompetent supervisors	69.51	10
7	Poor relations between management and workers	69.18	11
8	Lack of supervisors experience	69.18	11
9	Poor Co-ordination of sub-contractors	69.18	11
10	Insufficient supervision of subcontractors	69.18	11
11	Lack of experience of subcontractors	68.81	15
12	Lack of clear and daily task assignments to workers	68.61	16
13	Poor communication on site	68.52	17
14	Lack of Coordination between crews	68.52	17

15	Relationship between workers of subcontractor and workers of the main contractor	68.2	19
16	Lack of periodic meeting with labor	67.87	21
17	Poor safety program which causes an accident during the construction	67.87	21
18	Communication problems between sub-contractors	67.87	21
19	Frequent change orders	67.67	24
20	Misunderstanding between labor and supervisor	66.89	26
21	Over employment of labor to accelerate works	65.57	29
22	Unrealistic schedules and expectations of labor performance	64.92	31
23	Sub-contractor involvement	63.61	37

6.4. Overall Ranking

Overall Ranking of Factors affecting Labor Productivity according to Survey Results is illustrated in Table XII.

Table XII

Overall Ranking of Factors affecting Labor Productivity

No	Group	Factors Affecting Construction Labor Productivity	RII	Rank
1	Management	Poor communication and coordination among construction parties	73.44	1
2	Material	Shortage of material in the market	73.11	2
3	Motivation	Lack of financial motivation system (lack of incentive)	72.79	3
4	Man Power	Shortage of experienced labor	72.13	4
5	Management	Poor site management	71.48	5
6	Management	Poor recruitment and changing of foremen	71.15	6
7	Management	Lack of construction planning/project schedule in place	70.82	7
8	Motivation	Low salaries and wages (Low remuneration)	70.16	8
9	Management	Lack of supervision of labor during work	69.84	9
10	Management	Incompetent supervisors	69.51	10
11	Management	Poor relations between management and workers	69.18	11
12	Management	Lack of supervisors experience	69.18	11
13	Management	Poor Co-ordination of sub-contractors	69.18	11
14	Management	Insufficient supervision of subcontractors	69.18	11
15	Management	Lack of experience of subcontractors	68.81	15
16	Management	Lack of clear and daily task assignments to workers	68.61	16
17	Management	Poor communication on site	68.52	17
18	Management	Lack of Coordination between crews	68.52	17
19	Motivation	Lack of workers retention scheme	68.20	19
20	Management	Relationship between workers of subcontractor and workers of the main contractor	68.20	19

21	Management	Lack of periodic meeting with labor	67.87	21
22	Management	Poor safety program which causes an accident during the construction	67.87	21
23	Management	Communication problems between sub-contractors	67.87	21
24	Management	Frequent change orders	67.67	24
25	Material	Unsuitable material storage location	67.21	25
26	Management	Misunderstanding between labor and supervisor	66.89	26
27	Man Power	Lack of skill of the workers	66.56	27
28	Motivation	Lack of respect and recognition to the workers	66.56	27
29	Motivation	Non provision of transport means to workers	65.57	29
30	Management	Over employment of labor to accelerate works	65.57	29
31	Manpower	Labor disloyalty	64.92	31
32	Management	Unrealistic schedules and expectations of labor performance	64.92	31
33	Material	Insufficient or poor material handling	64.92	31
34	Motivation	Poor health and safety provision	64.26	34
35	Material	Late deliveries of material(Delayed material delivery by the supplier)	63.93	35
36	Material	Availability of materials and their ease of handling	63.93	35
37	Motivation	Services offered to laborers (social insurance, medical care)	63.61	37
38	Management	Sub-contractor involvement	63.61	37
39	Material	Material shortages/delays	63.61	37
40	Material	Low quality of raw materials as a result of rework	62.95	40
41	Motivation	Lack of response to employee grievance	61.97	41
42	Manpower	Inappropriate use of the skill of labor	61.64	42
43	Manpower	Coordination problem among labors	59.67	43
44	Manpower	Poor health of workers	59.34	44
45	Motivation	Unavailability of site facilities	58.03	45
46	Manpower	Attendance of social factors(holiday, death)	56.07	46
47	Manpower	Overcrowded on site	54.10	47
48	Material	Unavailability of material due to design provision	49.84	48

Table XII shows that the surveyed participants ranked "Poor communication and coordination among construction parties" as the most important factor affecting labor productivity among the overall factors with RII (73.44%). Moreover, among factors ranked in the top ten, six factors (60%) were from the management group; while two factors (20%) were from the motivation group, one factor (10%) was from the manpower, and one factor

(10%) was from the material group. Comparing this study with previous studies in: Zimbabwe, Palestine, Egypt, and India; factors affecting construction labor productivity as shown in Table XIII.A-C.

Table XIII.A. Overall Ranking of top 10 Factors affecting Construction labor productivity in Previous Studies

Ranking	Zimbabwe Chigra et al. (2014)	Palestine Mahamid (2013)	Egypt Hafez et al. (2014)
1	Unavailability of materials	Political situation	Payment delay
2	Late payment of salaries and wages	Equipment shortages	Skill of labor
3	Suitability/adequacy of plant and equipment	Old and inefficient equipment	A shortage of experienced labor
4	Supervisory incompetence	Lack of labor experience	Lack of labor supervision
5	Lack of manpower skills	Poor site management	Motivation of labor
6	Lack of labor experience	Poor communication and coordination between construction parties	Working overtime
7	Plant breakdown	Payments delayed by the owner	Construction managers lack leadership
8	Late delivery of materials	Low wages	High humidity
9	Shortage of tools and equipment	Rework	Clarity of technical specification
10	Low remuneration.	Misuse of schedule	High/low temperature

Table XIII.B. Overall Ranking of top 5 Factors affecting Construction labor productivity in Previous Studies

Ranking	India Soham et a.l (2013)	Egypt Khaled M. et al. (2014)	Zimbabwe Chigara and Moyo (2014)
1	Delay in payments	Labor experience and skills	Unavailability of materials
2	Skill of Labor	Incentive programs	Late payment of salaries and wages
3	Clarity of Technical Specification	Availability of the material and ease of handling	Suitability/adequacy of plant and equipment
4	Shortage of Materials	Leadership and competency of construction management	Supervisory incompetence
5	Motivation of Labor	Competency of labor supervisin	Lack of manpower skills

Moreover, a comparison between the top 10 factors in the latest studies is shown in Table XIII.C.

Table XIII.C. Comparison between survey result and a previous study

Ranking	Khaled M. et al.(2014) Ranking Factor	RII	Research Ranking Factor	RII
1	Laborer experience and skill	93.29	Poor communication and coordination among construction parties	73.44
2	Incentive programs	91.87	Shortage of material in the market	73.11
3	Availability of materials and their ease of handling	90.34	Lack of financial motivation system (lack of incentive)	72.79
4	Leadership and competency of construction management	88.40	Shortage of experienced labor	72.13
5	Competency of labor supervision	87.43	Poor site management	71.48
6	Construction technology (construction method and material)	86.16	Poor recruitment and changing of foremen	71.15
7	Labor operating system (daily wage, lump sum)	84.54	Lack of construction planning/project schedule in place	70.82
8	Planning, workflow, and site congestion	82.01	Low salaries and wages (Low remuneration)	70.16
9	Constructability (integrated design and construction)	80.73	Lack of supervision of labor during work	69.84
10	Clarity of instructions and information exchange	86.64	Incompetent supervisors assigned by the consultant	69.51

7. CONCLUSION AND RECOMMENDATION

Based on the aim of the study to analyze and rank, according to relative importance, factors affecting labor productivity in Ethiopian condominium housing construction projects through IHDP in Addis Ababa from the experts' opinion, nine independent groups of factors were assembled; namely: Manpower group, Motivation group, Management group, Material group, Technical group, Tools and equipment group, Financial group, Environmental group, and Other groups.

The results of the reliability analysis showed that five independent groups were rejected due to a low corrected item-total coefficient. Among the remaining four independent groups, the Management group with RII of 68.61% has the highest effect on labor productivity. The four independent groups were also ranked based on the RII ranking.

1) Management group

2) Material group

3) Motivation group

4) Manpower group

Among factors ranked in the top ten, six factors (60%) were from the management group; while two factors (20%) were from the motivation group, one factor (10%) was from manpower, and another factor (10%) was from the material group.

The result of the study depicted that Management related factors are ranked the first important group of factors affecting labor productivity among all groups with a RII of 68.61%. From this group, “Lack Poor communication and coordination among construction parties” with a RII of 73.44% is ranked first in the group and first among all factors explored. “Poor site management” with a RII of 71.48% is ranked second in the group and fifth among all factors explored. “Poor recruitment and changing of foremen” with a RII of 71.15% is ranked third in the group and sixth among all factors explored. ”Lack of construction planning/project schedule in place” with a RII of 70.82% is ranked fourth in the group and seventh in its effect among all factors explored. “Lack of supervision of labor

during work" with a RII of 69.84% is ranked fifth in the group and ninth among all factors explored. "Incompetent supervisors" with a RII of 69.51% is ranked sixth most important factor affecting labor productivity in the Management group and tenth in its effect among all factors explored. The above factors are also ranked as the most important factor affecting labor productivity in different studies. A study conducted by (Mahamid,2013) in Palestine "Lack Poor communication and coordination among construction parties" was ranked sixth with their effect among the top ten principal factors impacting labor productivity of Public Construction projects in Palestine. Moreover, "Poor site management" is also ranked fifth among the top ten principal factors in the same study by (Mahamid,2013), and this factor is also ranked sixth by its effect among all factors in the analysis of key factors affecting the variation of labor productivity in construction projects in India by a study conducted by (Shashank K et al, 2014). (Chigra et al. 2014) also ranked "Incompetent supervisors" fourth in their effect among all factors affecting labor productivity on building projects in Zimbabwe.

Therefore, factors related to Management are the major factors that hamper construction labor productivity as they have been also explored in different studies. Since construction projects involve many actors such as the client, designers, contractors, project managers, and users and each of them has its role, requirement, and objective, it is, therefore, the role of construction managers to plan, coordinate, and manage every aspect of a building project from start to finish. However, in most developing countries there is a shortage of managers for construction or at the very least a shortage of adequately qualified ones. Developing and upgrading managers is a considerably difficult and time-consuming process primarily because experience is so important (Moavenzadeh,1987). Being the case, the problem might be exacerbated when a project poses a unique feature in construction management processes like that of condominium housing construction projects through IHDP. Therefore, it requires more effort to address the challenge related to Management through the course of planning to execution, and important to set a plan that facilitates the workflow among all participants.

"Poor communication and coordination among construction parties", has a direct impact on the overall progress of projects and construction productivity. Since there are several parties

involved in condominium housing construction projects through IHDP, it is critical to ensure their coordination and lay down better communication throughout the project. The integration among the parties shall be strengthened to ensure that there always be better communication and coordination among the parties at every level of project implementation to enhance labor productivity. Besides, "Poor site management" is another major factor that affects labor productivity. Thus, it is mandatory to organize the work on-site, making sure it's completed on time, within budget, and with better productivity. It is also important to make sure things run smoothly at a job site. Among others, there shall be a qualified construction foreman responsible for coordinating and supervising a team of crew members at every project site. "Poor recruitment and changing of foremen", however, has a direct impact on the flow of work and could significantly affect the project if the staffing process resulted in the hiring of unqualified personnel. For better labor productivity, moreover, all details of construction projects shall be prepared ahead and put in place. Or else, "Lack of construction planning/project schedule in place" shall significantly hamper the overall management of the project and affects directly the labor productivity. To ensure better labor productivity and complete projects on time and within budget, it is mandatory to work hard on the effort necessary for construction planning/project schedule in place.

The finding also indicates that Material related factors are among the major factors affecting CLP in Ethiopian condominium housing construction projects through IHDP in Addis Ababa. Material-related factors are ranked the third most important group factor affecting labor productivity among all groups with an RII of 63.69%. From the group "Shortage of material in the market" is ranked as the most important factor affecting labor productivity, with a RII of 73.11%. This top-ranked factor is further ranked second in its effect among all factors explored. Similarly, in a study conducted by (P. Ghoddouis et al, 2012), "Shortage of material in the market" is ranked sixth important factor affecting construction labor productivity in their survey on the factors affecting the productivity of construction projects in Iran.

Shortage of material in the market is the source of the lack of material for construction projects. Lack of material is a universal problem and has a significant degrading effect on

on-site productivity for both developed and developing countries (Hasan A. et al, 2018). When a timely and adequate supply of materials is not possible, workers might slow down their pace or output in anticipation of delivery, resulting in idle times and low labor productivity.

A central feature of the IHDP construction projects, however, is the centrally sourced and distributed building materials. All materials (cement, reinforcing bars, electricity and sanitation equipment, etc.) are purchased in bulk by the ministry to reduce cost and control quality (UN HABITAT, 2010). However, some materials including aggregate and sand are supplied by the contractors, Therefore it is important to devise a better alternative for materials supply that are purchased in bulk by the ministry. Since most materials are imported there is a wide market option to access. The supply should also be consistent with the work schedule of the contractors to minimize the effect of the unavailability of material on labor productivity during construction due to a shortage of material in the market.

The motivation-related factor is ranked the second most important group factor affecting labor productivity among all groups with a RII of 65.69%. “Lack of financial motivation system (lack of incentive)” is ranked as the most important factor affecting labor productivity in the Motivation group, with a RII of 72.79%. This top-ranked factor is further ranked as the third in its effect among all factors explored. Besides, “Low salaries and wages (Low remuneration)” is also ranked as the second most important factor affecting labor productivity in the Motivation group, with a RII of 70.16%. This top-ranked factor is further ranked as the eighth in its effect among all factors explored. In the same way, Chigra et al. (2014) also ranked “Low salaries and wages (Low remuneration)” the tenth-factor affecting construction labor productivity in Zimbabwe. Besides, Mahamid (2013) ranked this factor eighth as the top factor affecting construction labor productivity in Palestine.

The motivation of the labor force is of paramount importance because the quality of human performance at the workplace depends largely upon motivation. That is, higher motivation brings higher productivity (Aynur Kazaz, 2008). Effective motivation demands a specific

process and effort. This must be visible to the workers and be linked to the rewards system (Olomolaiye, 1988). The motivation of labor through incentives can inspire, encourage, and stimulate the workforce to achieve great accomplishments. Motivation can also create an environment that fosters teamwork and collective initiatives to reach common goals. Therefore, there shall be a motivation scheme on project sites for better labor productivity. In general, Money is one of the most powerful motivators of construction workers (Aynur Kazaz, 2008). Hence, it is essential to use this tool systematically together with other motivators.

Manpower-related factors are ranked the fourth most important group factor affecting labor productivity among all groups with an RII of 53.69%. In the Manpower group "Shortage of experienced labor" is ranked as the most important factor affecting labor productivity with an RII of 72.13%. This top-ranked factor is further ranked as the fourth in its effect among all factors explored. Similarly "Shortage of experienced labor" is ranked third among all factors identified by Hafez et al. (2014) in Egypt.

The construction industry is labor oriented industry and therefore, construction productivity is highly reliant on the skills and experience of the workforce. The experience becomes significantly essential especially when there is an implementation of a new technique and system in construction projects. Since, one of the features of the construction of condominium houses in IHDP is the adoption of cost-effective construction techniques and systems, notably pre-cast concrete elements that differ from the conventional construction method; there should be a mechanism to bridge the demand for experienced labor by opting for a different alternative. Otherwise, a “shortage of experienced labor” forces the construction companies to employ low experienced labor which severely affects construction labor productivity.

In conclusion, a study on factors affecting labor productivity in Ethiopian condominium housing construction projects through IHDP in Addis Ababa is the first step toward improving the productivity of the programme. Since the benefit of increased productivity

in construction is colossal to all parties, it is important to mitigate factors affecting labor productivity to achieve high labor productivity with a better understanding. The above major factors identified by this study could help top decision-makers, consultants, and contractors to improve productivity from the pre-planning stage through the course of the project's completion. However, deeper studies require to pinpoint the cause and impact of the identified factors affecting construction labor productivity to improve labor productivity in Ethiopian condominium house construction projects through IHDP. Furthermore, this study could highlight a direction for other researchers for further research works in the area.

However, many factors can affect the identification and comparison of labor productivity factors within and among different projects, particularly when one must ensure the factors specified are comparable. Identifying factors affecting construction labor productivity within different construction projects poses special problems because construction projects are unique, despite some superficial similarities. Even in the case of IHDP where there are common elements across all individual condominium projects, no projects are identical because they have different features related to Management, Manpower, Equipment, and Technical issues. Hence, generalizing the finding of this study to all condominium construction projects could have some limitations. Furthermore, for better accuracy of results, it is recommended to validate the opinion of the experts by project-specific analysis and onsite studies on factors affecting labor productivity with productivity measurements. Moreover, it is practical to anticipate that a location can have an impact on labor productivity due to various field disturbances, especially geographical and climatic conditions.

REFERENCES

El-Gohary K.M and Remon Fayek Aziz. (2014). Factors Influencing Construction Labor Productivity in Egypt. *JOURNAL OF MANAGEMENT IN ENGINEERING*, 30(1): 1-9.

Aynur Kazaz, E. M. (2008). Effect of basic motivational factors on construction workforce productivity in. *Journal of Civil Engineering and Management*, DOI: 10.3846/1392-3730.2008.14.4.

Benviolent Chigara and Tirivavi Moyo. (2014). Factors Affecting Labor Productivity on Building Projects in Zimbabwe. *International Journal of Architecture, Engineering and Construction*, 3(1):57-65.

Dozzi, S.P. and AbouRizk, S.M. (1993). *Productivity in Construction (p.44).* Ottawa: Institute for Research in Construction, National Research Council.

EEA. (2006/07). *Report on the Ethiopian Economy, The Current State of the Construction Industry. Volume VI.* Addis Ababa. Ethiopia.

El-Gohary, K.M. and Aziz, R.F. (2014). Factors influencing construction labor productivity in Egypt. *Journal of management in engineering*, 30(1), pp.1-9.

George, D. a. (2019). *IBM SPSS statistics 26 step by step: A simple guide and reference.* Routledge.

Ghate, P.R. and Minde, P.R. (2016). *Importance of measurement of labour productivity in construction.* In ResearchGate.

Gliem, J. a. (2003). Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert-Type Scales. *2003 Midwest Research to Practice Conference in Adult, Continuing, and Community Education* (pp. 82-88). Columbus, OH: The Ohio State University.

Gottems, L. C. (2018). Good practices in normal childbirth: reliability analysis of an instrument by Cronbach's Alpha. *Revista Latino-Americana de Enfermagem* , Gottems, Leila Bernarda Donato, et al. "Good practices in normal childbirth: reliability analysis of an instrument by Cronbach's Alpha." Revista Latino-Americana de Enfermagem 26 (2018).

Gundecha, M. M. (2013). *STUDY OF FACTORS AFFECTING LABOR PRODUCTIVITY AT A BUILDING.* Fargo, North Dakota: North Dakota State University.

Hasan A, e. a. (2018). Factors affecting construction productivity: a 30 year systematic review. *Engineering, Construction and Architectural Management*, https://doi.org/10.1108/ECAM-02-2017-0035.

Henry Mwanaki Alinaitwe, J. A. (2007). Factors affecting the productivity of building craftsmen - studies of Uganda. *, Journal of Civil Engineering and Management*, 13:3,

169-176, DOI: 10.1080/13923730.2007.9636434.

Henson, R. K. (2001). Understanding Internal Consistency Reliability Estimates: A Conceptual Primer on Coefficient Alpha. *Measurement and Evaluation in Counseling and Development* , 34:3, 177-189, DOI: 10.1080/07481756.2002.12069034.

Hickson and Ellis . (2014). Factors affecting construction labour productivity in Trinidad and Tobago. *J Assoc Professional Eng Trinidad Tobago.* , 42(1):4–11).

Krugman, P. (1994). Defining and measuring productivity. *The Age of diminishing Expectations*.

M.Rojas, E. (2008). *Construction Productivity: A Practical Guide for Building and Electrical Contructors.* U.S.A: J Ross Publishing.

Madhan, A & I, Gunarani. (2018). Factors Affecting Construction Labour Productivity using Questionnaire Survey. *International Journal of Engineering & Technology.*, 7. 309. 10.14419/ijet. v7i3.12.16048.

Mahamid, I. (2013). Principal Factors Impacting Labor Productivity of Public Construction Projects in Palestine:Contractors' Perspective. *International Journal of Architecture, Engineering and Construction*, Vol 2, No 3, 194-202.

Mekides, A. (2016). A STUDY ON FACTORS AFFECTING LABOR PRODUCTIVITY ON BUILDING CONSTRUCTION PROJECTS IN ADDIS ABABA, ETHIOPIA. Addis Ababa, Ethiopia.

Mistry Soham, Bhatt Rajiv . (2013). Critical FactorsAffecting Labour Productivity In Construction Projects: Case Study Of South Gujarat Region Of India . *International Journal of Engineering and Advanced Technology (IJEAT)*, Volume-2, Issue-4.

Mostafa E. Shehata, K. M.-G. (2011). Towards improving construction labor productivity. *Alexandria Engineering Journal*, 321–330.

MUDCo. (2012). *CONSTRUCTION INDUSTRY POLICY.* Addis Ababa. Ethiopia.: Ministry of Urban Development and Construction.

Nithya, K. and Saravanan, M.M. (2015). Evaluation of factors improving jobsite productivity. *Advance Engineering and Applied Sciences: An International Journal*, 5(2), pp.28-31.

Olomolaiye, P. a. (1988). A survey of construction operative motivation on selected sites in Nigeria. *Building and Environment,23(3)*, pp.179-185.

P. Ghoddousi and M. R. Hosseini. (2012,). A survey of the factors affecting the productivity of construction projects in Iran. *Technological and Economic Development of Economy* , vol. 18, no. 1, pp. 99–116, doi: 10.3846/20294913.2012.661203.

Parviz Ghoddousi, Mohammad Reza Hosseini. (2012). A survey of the factors affecting the

productivity of construction projects in Iran. *Technological and Economic Development of Economy*, 99-116.

Prachi R. Ghate, Prof. Pravin R. Minde. (2016). *IMPORTANCE OF MEASUREMENT OF LABOUR PRODUCTIVITY IN.* Maharashtra.

R.chitra, Ruchi Kumari. (2018). ANALYSIS OF FACTORS AFFECTING ON LABOUR PRODUCTIVITY IN CONSTRUCTION INDUSTRY BY USING RII METHOD. *International Journal of Pure and Applied Mathematics, 119* (12), Volume 119 No. 12 2018, 9399-9411.

Randolph H. Thomas, W. F. (1990). Modeling construction labor productivity. *Journal of Construction Engineering and Management, ASCE 116 (4)*, 705-726.

Ritter, N. L. (2010). Understanding a widely misunderstood statistic: Cronbach's alpha. Understanding a Widely Misunderstood Statistic: Cronbach's α. *annual meeting of the Southwest Educational Research Association* (pp. 1–17). New Orleans: Texas A&M University.

Shashank K,Dr. Sutapa Hazra,Kabindra Nath Pal. (2014). Analysis of Key Factors Affecting the Variation of Labour Productivity in Construction Projects. *International Journal of Emerging Technology and Advanced Engineering*, Volume 4, Issue 5,152-160 .

Sherif M. Hafez, Remon F. Aziz, Enas S. Morgan, Madeha M. Abdullah, Eman K. Ahmed . (2014). Critical factors affecting construction labor productivity in Egypt . *American Journal of Civil Engineering* , 2(2): 35-40.

SU, YUN-YI. (2010). *DISSERTATION Submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Civil Engineering in the Graduate College of the University of llinois at Urbana-Champaign.* Urbana, Illinois.

Syverson, C. (2011). What determines productivity? *Journal of Economic literature*, 49(2), pp.326-65.

Treasury, H. (2000). Productivity in the UK: The Evidence and the Government's Approach [print and Electronic]. *The Evidence and the Government's Approach [print and Electronic]*. UK: HM Treasury.

UN-HABITAT. (2010). *The Ethiopia Case of Condominium Housing: The Integrated Housing Development Programme. .* Nairobi: United Nations Human Settlements Programme.

Vacha-Haase, T. (1998). Reliability Generalization: Exploring Variance in Measurement Error Affecting Score Reliability Across Studies. *Educational and Psychological Measurement*, 58(1):6, http://dx.doi.org/10.1177/0013164498058001002.

Vekaria, S. (2012). Labour Productivity in Construction. *International Journal of Advance Research in Engineering, Science And Management (IJARESM)*, pp.2394-1766.

Yi, W. a. (2013). Critical review of labor productivity research in construction journals. *Journal of management in engineering*, 30(2), pp.214-225.

Approval of Investigators

We hereby declare that the research report entitled

"Factors Affecting Labor Productivity in Government Housing Projects: Case of Ethiopian Condominium Housing Construction in Addis Ababa" "

is our original work; all sources are duly acknowledged and the report is compiled by incorporating the necessary comments and suggestions given by the reviewers.

	Name	Signature	Date
Principal Investigator	Kokebe Yifru		
Co-Investigator	Natnael Fantu		
Co-Investigator			
Co-Investigator			

Approval of Reviewers

I hereby confirm that (PI)Dr./Mr. _____has accomplished his/her work as per the approved proposal and incorporated all the comments given by the reviewers in his/her terminal report of the project entitled

_____

	Name	Signature	Date
Reviewer 1.			
Reviewer 2.			

Approval: **School Ethical Review Board (School Scientific Committee)**

	Name	Signature	Date
1.			
2.			
3.			
4.			