IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 19, Issue 2 Ser. IV (Mar. – Apr. 2022), PP 01-07
www.iosrjournals.org

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

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Abstract:*This study aims to identify, analyze and rank factors affecting construction labor productivity in Ethiopian condominium house construction projects in Addis Ababa by using experts' opinions. To achieve this objective, 117 factors were selected 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 and their ranking is: 1) Management group; 2) Material group; 3) Motivation group, and 4) Manpower group. Among factors ranked in the top ten, six factors (60%) are from the management group; while two factors (20%) are from the motivation group, one factor (10%) is from manpower, and another factor (10%) is from the material group. In conclusion, this study could be an input to parties involved in Ethiopian condominium house construction projects in achieving higher labor productivity. It is also essential to focus and act on the critical factors affecting construction labor productivity and mitigate related challenges since the benefit of the increased productivity in the construction of projects is colossal to all.*

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

Date of Submission: 29-03-2022 Date of Acceptance: 10-04-2022

I. Introduction

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 [1]. 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 [2].[1] has identified low productivity and quality as one of the weaknesses, problems, and constraints hampering the performance and development of the industry.

In the Ethiopian Integrated Housing Development Program (IHDP), a government-led and financed housing provision program for low-and middle-income households, 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 [3]. Cognizant of the fact that construction is labor oriented industry and greatly relies on labor, and labor productivity directly affects construction productivity [4], it is therefore vital to understand factors affecting labor productivity in the context of the construction of condominium houses through IHDP to improve the construction productivity.

Labor productivity is one of the most important factors that affect the physical progress of any construction project [14].It is influenced by various factors whose impact can be quantified in productivity models and play an important role in estimating the cost, scheduling, and planning [4]. Therefore, as the performance of labor could be affected by many factors and is usually linked to the performances of the time, cost, and quality according to [5], it is imperative to study and identify factors that affect labor productivity.

[6] 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. [7] identified 40 factors and grouped them into five are labor, managerial, materials and equipment, environmental, and financial. [8] 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. [7] identified 30 productivity factors that were classified under three primary categories: (1) human/labor, (2) industrial, and (3) management. [9] identified 34 factors and grouped them into eight, namely: Manpower, Managerial, Environmental, safety, Material/Equipment, Schedule, Motivation, and Quality. [10] 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.

In Ethiopia, besides a lack of comprehensive and updated construction labor productivity standards and norms, there is a lack of information regarding different factors affecting labor productivity in the construction of projects. Hence, in this study 117 factors were selected 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. The objective of this studywas to identify major factors negatively affecting labor productivity in condominium house construction through IHDP and to statistically analyze and rank factors negatively affecting labor productivity in condominium house construction through IHDP.

II. Methods

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. 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 questionnaire and discard unreliable factors.

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

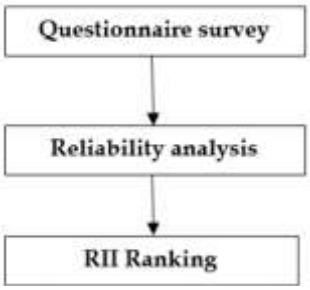

Fig. 1: Research method.

2.1 Questionnaire survey

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.

2.2 Reliability Analysis

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 groups which is shown in table 1. For reliability analysis, Cronbach ‘s alpha method was used to assess basic consistency on the bases of average correlation between the data measured identically. By this method, the reliability of group level and individual level were evaluated.

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 [11]. After considering the result of the first reliability analysis, five factors were deleted due to low item-total correlation. As shown in Table 1 and Table 2 the final reliability analyses were conducted after deleting 5 factors.

For analyzing data, the Relative Importance Index (RII) technique was used according to the following formula [11],[12].

$$RII\ (\%) = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + n_1}{5(n_5 + n_4 + n_3 + n_2 + n_1)}\ x\ 100 - -(1)$$

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 the labor productivity.

III. Results of Data Analysis and Discussion

3.1 Reliability Analysis

Table no 1 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

3.2 Manpower Related

The relative importance indices and ranks of the eight factors classified under the Manpower Related factors are shown in Table 2.

Table no 2 Ranking Labor productivity Manpower group.

A	Manpower Related	RII	Rank
	Group RII and Rank	53.69	4
1	Shortage of experienced labor	72.13	4
2	Inappropriate use of the skill of labor	61.64	42
3	Coordination problem among labors	59.67	43
4	Lack of skill of the workers	66.56	27
5	Poor health of workers	59.34	44
6	Overcrowded on site	54.10	47
7	Attendance of social factors (holiday, death)	56.07	46
8	Labor disloyalty	64.92	31

Table 2 - shows that the participants ranked "Shortage of experienced labor" 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.

3.3 Motivation Group

The relative importance indices and ranks of the nine factors classified under the Motivation group are shown in Table 3.

Table no 3 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	Lack of respect and recognition to the workers	66.56	27
3	Low salaries and wages (Low remuneration)	70.16	8
4	Unavailability of site facilities	58.03	45
5	Lack of workers retention scheme	68.20	19
6	Lack of response to employee grievance	61.97	41
7	Poor health and safety provision	64.26	34
8	Services offered to laborers (social insurance, medical care)	63.61	37
9	Non provision of transport means to workers	65.57	29

Table 3 shows that the participants ranked "Lack of financial motivation system (lack of incentive)" as the most important factor affecting labor productivity in the Motivation group, with an RII of 72.79%. This top-ranked factor is further ranked as the third in its effect among all factors explored.

3.4 Material Group

The relative importance indices and ranks of the eight factors classified under the Material factors are shown in Table 4.

Table no 4 Ranking Labor productivity Material group

D	Material	RII	Rank
	Group RII and Rank	65.69	2
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 4 shows that the participants ranked "Shortage of material in the market" as the most important factor affecting labor productivity in the Material group, with an RII of 73.11%. This top-ranked factor is further ranked as the second in its effect among all factors explored.

3.5 Management Group

The relative importance indices and ranks of the twenty-three factors classified under the Management related factors are shown in Table 5.

Table no 5 Ranking Labor productivity Management group

C	Management	RII	Rank
	Group RII and Rank	68.61	1
1	Poor site management	71.48	5
2	Lack of clear and daily task assignments to workers	68.61	16
3	Incompetent supervisors	69.51	10
4	Poor communication on site	68.52	17
5	Poor relations between management and workers	69.18	11
6	Lack of periodic meeting with labor	67.87	21
7	Lack of supervision of labor during work	69.84	9
8	Poor recruitment and changing of foremen	71.15	6
9	Lack of Coordination between crews	68.52	17
10	Poor communication and coordination among construction parties	73.44	1
11	Over employment of labor to accelerate works	65.57	29
12	Poor safety program which causes an accident during the construction	67.87	21
13	Frequent change orders	67.67	24
14	Lack of supervisor's experience	69.18	11
15	Unrealistic schedules and expectations of labor performance	64.92	31
16	Sub-contractor involvement	63.61	37
17	Poor Co-ordination of sub-contractors	69.18	11
18	Misunderstanding between labor and supervisor	66.89	26
19	Lack of construction planning/project schedule in place	70.82	7
20	Communication problems between sub-contractors	67.87	21
21	Insufficient supervision of subcontractors	69.18	11
22	Relationship between workers of subcontractor and workers of the main	68.20	19
23	Lack of experience of subcontractors	68.81	15

Table 5 shows that the participants ranked "Lack Poor communication and coordination between construction parties" as the most important factor affecting labor productivity in the Management group, with an RII of 73.44%. This top-ranked factor is further ranked as the first in its effect among all factors explored.

3.6 Overall Ranking

Overall Ranking of Factors affecting Labor Productivity according to Survey Results is illustrated in Table 6.

Table no 6 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 supervisor's 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	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	Manpower	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

Table 6 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 as 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 one factor (10%) was the material group. Comparing this study with previous studies in; Zimbabwe, Palestine, Egypt, and India; factors affecting construction labor productivity as shown in Table 7.A-C.

Table no 7A Overall Ranking of top 10 Factors affecting Construction labor productivity in Previous Studies

Ranking	Zimbabwe [6]	Palestine [7]	Egypt [8]
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	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	Working overtime
7	Plant breakdown	Payments delayed by the owner	Construction managers lack
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 no 7B Overall Ranking of top 5 Factors affecting Construction labor productivity in Previous Studies

Ranking	India [13]	Egypt [5]	Zimbabwe[6]
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	Suitability/adequacy of plant and
4	Shortage of Materials	Leadership and competency of construction	Supervisory incompetence
5	Motivation of Labor	Competency of labor supervision	Lack of manpower skills

Moreover, a comparison between the top 10 factors in the latest studies is shown in Table 7.C.

Table no 7C Comparison between survey result and the previous study

Ranking	Ranking Factor [5]	RII	Research Ranking Factor	RII
1	Laborer experience and skill	93.29	Poor communication and coordination among	73.44
2	Incentive programs	91.87	Shortage of material in the market	73.11
3	Availability of materials and their ease of	90.34	Lack of financial motivation system (lack of incentive)	72.79
4	Leadership and competency of construction	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	86.16	Poor recruitment and changing of foremen	71.15
7	Labor operating system (daily wage, lump	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	80.73	Lack of supervision of labor during work	69.84
10	Clarity of instructions and information	86.64	Incompetent supervisors assigned by the consultant	69.51

Table 7.B. Overall Ranking of top 5 Factors affecting Construction labor productivity in Previous Studies. Moreover, a comparison between the top 10 factors in the latest studies is shown in Table 7.C.

IV. Conclusion

Based on the aim of the study to identify, 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 reliability analysis showed that five independent groups were rejected due to low corrected item-total coefficient. Among the remaining four independent groups, the Management group with RII 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

The overall ranking of each factor shows "Poor communication and coordination among construction parties" with 73.44% RII has the highest effect on construction labor productivity of Ethiopian condominium houses constructions. Among factors ranked as 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 one factor (10%) was the material group.

In conclusion, since the benefit of the increased productivity in the construction industry is colossal to all parties, it is believed that the outcomes of this research could assist all parties involved in Ethiopian condominium house construction projects through IHDP, in achieving high labor productivity by focusing and acting upon the critical factors affecting construction labor productivity and mitigate related challenges. Moreover, it could help top decision-makers, consultants, and contractors to have a better understanding of factors affecting construction labor productivity in IHDP projects; and hence improve the productivity from the pre-planning stage through the course of the project's completion. Furthermore, the study could highlight a direction for other researchers for further research works in the area.

5. Recommendation

The management group has the highest effect on construction labor productivity with the highest RII percentage. From the top ten individual factors, 60% were from the management group including "Poor communication and coordination among construction parties" which was ranked first. Therefore, 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.

Acknowledgements

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.

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KokebeYifru, et. al. "Factors Affecting Labor Productivity in Government Housing Projects: Case of Ethiopian Condominium Housing Construction".*IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, 19(2), 2022, pp. 01-07.