Assessment of Factors Affecting Labor Productivity on Road Construction Projects in Oromia Region, Bale Zone

Prof. Emer T. Quezon, Melese Mengistu, Getachew Kebede

Abstract—Road construction in Ethiopia is booming and radiating from Addis Ababa towards North-East and East-West directions to fulfil its long term development program. Transportation is a prime mover to all sectors in the country to uplift the economic activities of the populace in the locality. In most countries, experience and related literatures have revealed that road construction labor costs accounted at 30-60% of the total cost of a project, depending on the terrain and source of materials, labor and equipment to be utilized. Therefore, construction labor productivity plays a vital role to the performance and profitability of road construction projects.Road sector construction projects in Ethiopia are means through which development strategies are achieved. This research study gives insight on the assessment of the factors affecting labor productivity in road construction projects through a structured questionnaire survey of 83 respondents working on construction road projects in Oromia Region, Bale Zone. Respondents were required to rate how the 61 factors affecting labor productivity with respect to the importance and frequency of occurrence. Understanding these factors is helpful for the construction professionals who work on the initial phase of construction planning in order to efficiently deliver the project plan and to solve poor labor productivity. The results of this survey were then analyzed using the Relative Importance Index (RII) and ranked. The reliability of these 61 factors for assessing the effect on labor productivity were tested by Chronbach's alpha measurement, and the results indicated that the 30 factors tested are reliable (α= 0.973), and checked by SPSS. Result of this analysis showed that there are 11 groups which have significant impacts on the labor productivity ranked as Material and Equipment Factor with RII=0.819, Manpower and Work Force Factor with RII=0.764, Management Factor with RII=0.737, Quality Factors with RII=0.720, Supervision Factor with RII=0.699, Safety Factor with RII=0.691, Motivation Factor with RII=0.682, Schedule Factor with RII=0.647, Political Factor with RII=0.620, Natural and environmental Factor with RII=0.566 and Cultural and Religious Factor with RII=0.541. Based on the results of this research study, the top factors that affect labor productivity includes: Lack of experience of labor, Material construction shortage, Lack of labour skills, Accident, Tools and Equipment shortage, Labor's bad habit, Poor site management, Lack of Labor surveillance, Payment delay and Ignore safety precautions. Therefore, this research study suggests that the contractors should assign project managers and construction supervisors with sufficient managerial skills in road construction projects so that when there are any problems which may arise, it would be acted and solved immediately at the project site. On the other hand, the role of the Ethiopian government in project implementation is very significant, which requires proper attention to the productivity issue to enforce hard and fast laws and regulation which help to obtain productive work force in the road construction industry.

Index Terms—Contractors, Economic and social development, Factors affecting labor productivity, Government role, Managerial skills, Road construction, Road sector in Ethiopia.

1 INTRODUCTION

There is no doubt that the construction industry is a key activity in any economy; it influences, and is influenced by the gross domestic product (GDP) of that nation (Cox et al, 1998, cited in Madi, 2003) but construction industry share of GDP in developed countries is more than construction industry share of GDP in developing countries (Cox et al, 1998, cited in Madi, 2003).

It is evident that the socioeconomic development of any country is highly dependent on the amount of economic and social infrastructure, whether it is public or private. One of the major sectors contributing to infrastructure growth is the construction industry. The construction industry is also the highest recipient of the government budget in terms of government development programmers'. Hence a little improvement in this sector will undoubtedly generate a lot of benefit.

In most countries, experience and literature have revealed that construction labor costs account for 30-60% of the total cost of a project [1]. Therefore, construction labor productivity is a critical importance to the profitability of most construction projects. Many researchers have identified these problems as factors that affect the productivity of construction and will subsequently affect the performance of a company and the overall economy of the country.

Researchers have long been a concerned to the Problems with increasing productivity, in which the identification and evaluation of the factors that affect productivity have become critical issues faced by project managers for a long time in order to increase productivity in construction. To achieve the income expected from any construction project, it is important to have control of the productivity factors that contribute to the integrated composition of production, such as labor, equipment, and cash flow.

The Ethiopian construction industry suffers from delays and cost overruns, which are indicators of productivity problems. Very little has been done in terms of labor

productivity with respect to the road construction industry. In an effort to try and correct this situation this research study carried out assessment of factors affecting labor productivity. Knowing the factors affecting Labor Productivity could be used in improving labor productivity in construction sites and determines the required resources to execute the activities of the projects and required duration which is in conformity with specifications contracted time of the project.

There are many researchers worldwide had been done on labor productivity, which investigating factors that affect labor productivity. But none of them address the factors that affect labor productivity in Ethiopian road construction. Even-though the construction industries in every corner (George and Mallery, 2003) of the world have many common features, they are different in features such as methods of construction, perception of labor, management of the construction project, labor culture of work and others.

By understanding the behaviors of construction industry of Ethiopian, investigation of factors that affect labor productivity in road construction of projects is very essential. The researcher is inspired to assess the factors related to Ethiopian contexts and provide practical suggestions and recommendations aiming to upgrade the knowledge in order to improve the labor productivity in road construction projects in Ethiopia, specifically Bale zone. The following are the specific objectives of the research study:

□ To identify and discuss the various factors affecting labor productivity in road construction.
□ To determine the cause of poor labor productivity in road construction projects.
□ To determine the significance of factors affecting labor productivity
□ To determine and analyze the Relative Important Index (RII) of those factors
□ To provide recommendations aiming to improve the poor labor productivity in road construction projects.

The research study assesses the important factors affecting labor productivity in road construction. Understanding these factors is helpful for the construction professionals who work on the initial phases of construction planning in order to efficiently deliver the project plan. The main goal of the research study is to provide essential information about factors affecting labor productivity to the project management teams who enable the project's success.

This research study is helpful for further research studies on construction management on road construction in other areas of Ethiopia. The findings of the study would inform the stakeholders about factors affecting labor productivity in road construction in Bale zone. This enlightens the way to solve problems related to poor labor performance and low productivity of labor. For the Construction Companies this gives guidance and an overview on Labor Productivity in road construction projects in building a suitable Labor Productivity Plan with its characteristic and condition.

Likewise for Construction Companies in Ethiopia, this serves as a wake-up call about the main factors affecting to the fluctuation of labor productivity in the construction project and they can probably manage Labor Productivity more effectively. This stud (George and Mallery, 2003) y is conducted in some selected road construction projects found in Oromia Region, Bale zone. It concerned with road construction only and did not take into account the other categories of construction industry like heavy engineering construction (tunnels, bridge, dams), industrial projects (factories and workshops), and utility construction (sewage and water supply). The research focuses on labor productivity without including total factor productivity and financial productivity. This research also includes evaluation of the factors affecting labor productivity and way of improving the system.

2 RESEARCH METHODOLOGY

2.1 Study Area

This research would present the factors affecting the productivity of labor in road construction projects in the Bale Zone. It is located in Oromia Region in South East, and around 450 km from Addis Ababa. According to World Bank memorandum, May 24, 2004, 11% of the inhabitants of Bale have an access to electricity only because of the small road density of 11.4 kilometers per 1,000 square kilometers as compared with the national average of 30 kilometers [11]. Even though the road coverage of the sunwas very small in the past, nowadays, there is a great progress being undertaken by the government. Before 5 years, there was no asphalt road in the zone, and this is the reason why the asphalt road connecting Bale to Shashamanne is highly booming thesocioeconomic activity of the zone.

Figure 1: Map of Bale Zone

2.2 Research design

One of the principal purpose of the design is to help avoid the

situation in which the collected data do not address the initial research questions (Robson, 1993, cited in El Sawalhi, 2002). Site interview and structured questionnaire had been used in this research.

2.3 Methodology for this Research

The basic methodology which was considered to achieve the objectives have been addressed the following issues:

□Objective One

There were61 factors affecting labor productivity in road construction projects that has been selected for this study. These factors are grouped into 11 which are considered in the distribution of questionnaires, summarized and collected according to previous studies and other factors recommended by the local experts.

□Objective Two

The relative importance index method (RII) is used to determine the most significant cause of poor labor productivity in road construction projects in Bale Zone. Depending on responses from respondents the determination of significant and nonsignificant factors affecting labor productivity is done using statistical tests.

□Objective Three

Statistical test using SPSS software, the correlation and the relativity of the data are checked. The significance of factors affecting labor productivity is determined by using hypothesis test and two tailed test.

□Objective Four

A structured questionnaire survey approach is considered to study the impact of various attributes and factors affecting labor productivity in road construction projects in the study area. The Relative Importance Index method (RII) was used here to determine labor perceptions of the relative importance of factors affecting labor productivity in road construction projects in Bale Zone.

□Objective Five

The recommendation is based on the findings from the computation of the Relative Importance Index method (RII), ranking and the statistical analysis.

2.4 Questionnaire Distribution

The target groups that had been considered in this study are workers in road construction projects in Bale Zone. Nine (9) road projects are selected which are known well organized and have a significant number of manpower. The road projects were similar to each other in terms of the road typeunder construction, human resource they had, the budget of the project and the like. Since the size is less than 30, there was no need to determine the sample size. The sample size of the research study comprised of 9 road projects type only. A total of 90 questionnaires was distributedto 9 road construction projects and 10 questionnaires distributed for each selected road construction projects Bale Zone.

2.5 Data Measurement

In this research, ordinal scales were employed. Ordinal scale isa Ranking or a Rating data that normally use integers in ascending or descending order as shown in table 2.1.

Table 2.1Ordinal scale used for data measurement

Item	Very high Important	High Important	Medium Important	Low Important	Very low Important
Scale	5	4	3	2	1

While the Relative Importance Index method (RII) was used to determine different road projects perceptions of the relative importance of the factors affecting labor productivity in road construction projects. The RII is computed as follows [2].

$$RII=\frac{\sum W}{A\times N} \quad (1)$$

Where:

W is the weight given to each factor by the respondents and ranges from 1 to 5

A = the highest weight = 5

N = the total number of respondents

$$W = \sum[(f_1 \times n_1)+(f_2 \times n_2)+(f_3 \times n_3)+\ldots\ldots\ldots+(fn \times nn)] \quad (2)$$

Where:

fn = score ranking

nn = corresponding number of responses

2.6 Statistical tests of data

2.6.1 Reliability statistics

This section shows the test of reliability of questionnaire according to the study. The reliability of an instrument is the degree of consistency which measures the attribute; it is supposed to be measuring. The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Reliability can be equated with the stability, consistency, or dependability of a measuring tool. The test is repeated to the same sample of people on two occasions and then compares the scores obtained by computing a reliability coefficient (Polit& Hunger, 1985).According to George and Mallery, 2003, Chronbach's coefficient alpha is designed as a measure of internal consistency, that is, do all items within the instrument measure the same thing? Chronbach's alpha is used here to measure the reliability of the questionnaire between each field. The normal range of Chronbach's coefficient alpha value between 0.0 and + 1.0. The closer the Alpha is to 1, the greater the internal consistency of items in the instrument being assumed. The formula that determines alpha is fairly simple and makes use of the items (variables), k, in the scale and the average of the inter-item correlations[3].

$$\alpha=\frac{k\,r}{1\,k\,1\,r} \quad (3)$$

As the number of items (variables) in the scale (k) increases the value becomes large. Also, if the inter correlation between

items is large, the corresponding will also be large. Since the alpha value is inflated by a large number of variables, then there is no set interpretation as to what is an acceptable alpha value. A rule of thumb that applies to most situations are:
0.9 Up to 1.0, Excellent
0.8 Up to 0.9, Good
0.7 Up to 0.8, Acceptable
0.6 Up to 0.7, Questionable
0.5 Up to 0.6, Poor
0.0 Up to 0.5, Unacceptable

3 RESULTS AND DISCUSSION

The questionnaires are designed to collect data regarding the major factors affecting labor productivity in road construction projects in Bale Zone and analyzed hereunder.

3.1 Response rate

A total of 83 questionnaires were collected and valid out of 90 respondents solicited as shown in table 3.1.

Table 3.1:Response rate

Projects	Distributed Questionnaires	Collected Questionnaires	The rate of Return (%)
Project 1	10	8	80
Project 2	10	10	100
Project 3	10	9	90
Project 4	10	9	90
Project 5	10	10	100
Project 6	10	8	80
Project 7	10	10	100
Project 8	10	9	90
Project 9	10	10	100
Total	**90**	**83**	**92.22**

Ninety (90) questionnaires were distributed to the selected 9 road construction projects in the study area. For each project, 10 questionnaires weredistributed.

3.2 General Information

3.2.1 Grade of contractor

Among the construction organizations that responded to the questionnaire; six of them were1st grade GC contractor and two of them were 2nd grade GC contractor, and one wasthe 3rd grade GC contractor.

3.2.2 Typical Size of Projects

In table 3.2, shows the size of the projects in the Bale Zone undertaken by the respondents' companies.

Table 3.2: Typical Size of Projects

Typical Size of Project	No. of Projects
5-10 Millions	2
10-100 Millions	5
> 100 Millions	2

3.2.3. Composition of Respondent

The respondents are composed of Project manager, Resident engineer (client's supervisor), Construction supervisor, engineer (Office and site), Construction manager, mason, foreman, superintendents and other. The project managers and engineers were composed of 17% at different levels, and 57%, respectively,while,there were 26% respondents composed of mason, foreman, superintendent and others.
The respondents were contacted directly to the project sites to ascertain some issues to address the questionnaires requirements in this research study as well as to ensure credibility and reliability of the findings.

3.2.4 Years of experience of the respondent

Based on table 3.3, there were 11% of the respondents have experienced between 1 to 5 years in road construction projects, while 51% have experienced between 2 to 5 years and 38% have worked in road projects for more than 5 years. This revealed that the respondents have enough insight in the subject project being studied, and therefore the responses were enough to warrant adequate findings.

Table 3.3: Experience of the respondent

Respondent	Years of experience
Project manager	5-10
Engineer	1-5
Construction supervisor	2-5
Other	5-10

3.2.5 Level of education

About 69% of respondents have bachelor degree and master's degree in level of education, and 31% of respondents acquired college training. This showed that the respondents have enough education to assure the questionnaire are filled up properly relating the factors that affect labor productivity in road construction projects.

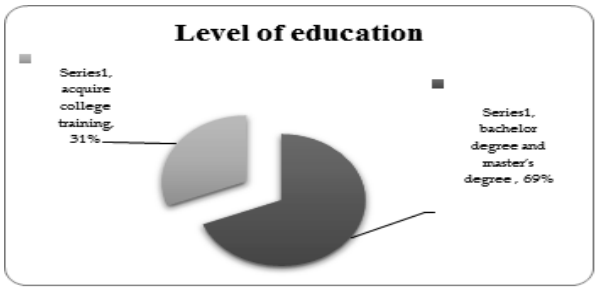

Figure 3.1: Level of Education of Respondent to Questionnaire

3.3 Factors Affecting Labor Productivity in Road Construction Projects

The results of this study provide an indication of the Relative Importance Index and Rank of Factors Affecting Labor Productivity in Road Construction Projects in Bale Zone. Table

3.4 below shows the summary of the Relative Importance Index (RII) of all factors and its corresponding ranked.

Table 3.4: The Relative Importance Index (RII) and Ranked of Factors Labor Productivity

Factors	Ordinal scale					Total	RII	Rank
	5	4	3	2	1			
1) Manpower/Work Force Factor								
F1. Lack of experience.	250	116	9	2	0	377	0.908	1
F2. Labor Disloyalty.	175	40	45	26	10	296	0.713	23
F3. Misunderstanding among laborers.	180	84	30	24	4	322	0.776	20
F4. Labor's bad habit	230	120	15	2	1	368	0.887	6
F5. Lack of labor skills	240	108	21	2	0	371	0.894	3
F6. Increase of laborer's age	85	60	39	32	22	238	0.574	50
F7. Labor absenteeism	200	116	36	4	0	356	0.858	12
F8. Labor personal problem	130	72	42	30	10	284	0.684	25
F9. Ability to adapt to change and new environments	120	56	51	22	17	266	0.641	33
F10. Worker´s integrity	170	40	48	22	12	292	0.704	24
2) Management Factor								
F11. Poorsite management	245	108	6	2	4	365	0.88	7
F12. Poor communication and coordination between construction parties	160	112	30	24	1	327	0.788	19
F13. Lack of periodic meeting with labors	100	64	42	18	24	248	0.598	45
F14. Improper planning and scheduling of work	190	128	15	16	0	349	0.841	16
F15. Crew size and composition	195	128	27	2	2	354	0.853	14
F16. Construction managers lack of Leadership	90	76	60	20	16	262	0.631	37
F17. Change orders	105	76	45	32	12	270	0.651	31
F18. Disputes	100	80	51	30	11	272	0.655	30
3) Motivation Factor								
F19. Payment delay	215	112	36	0	0	363	0.875	9
F20. No provision of transport means	180	128	30	10	0	348	0.839	17
F21. Lack of Incentive payments and financial Rewards	140	80	27	16	18	281	0.678	26
F22. Lack of place for eating and relaxation	80	32	45	32	28	217	0.523	60
F23. Lack of training sessions	90	36	45	36	23	231	0.556	54
F24. Relaxation allowances	80	36	60	32	22	230	0.553	55
F25. Amount of payment	200	116	36	4	0	356	0.858	12
F26. Discontinuity of work	85	52	40	44	18	239	0.575	49
4) Schedule Factor								
F27. Working 7 days per week without rest	85	64	57	32	15	253	0.61	41
F28. Overcrowding	95	60	60	30	14	259	0.625	38
F29. Misuse of time schedule	85	60	42	40	17	244	0.588	47
F30. Length of work day	85	60	54	40	13	252	0.607	42
F31. Working overtime	130	72	30	36	11	279	0.672	27
5) Material/Equipment Factor								
F32. Material shortage	245	120	9	2	0	376	0.906	2
F33. Old and inefficient equipment	165	128	30	16	0	339	0.817	18
F34. Tools and equipment shortage	240	120	6	0	3	369	0.889	5
F35. Distance of materials storage location	115	76	45	26	13	275	0.663	29
6) Supervision Factor								
F36. Misunderstanding between labor and supervisor	110	76	48	32	10	276	0.665	28
F37. Inadequate supervisors' skills	95	68	39	20	24	246	0.593	46
F38. Supervision delays	190	124	30	6	1	351	0.846	15
F39. Lack of Labor surveillance.	230	124	6	0	4	364	0.877	8
F40. Lack of Clarity of daily task assignment	145	72	48	30	5	300	0.723	22
F41. Insufficient supervision of subcontractors	115	72	48	6	23	264	0.636	35
F42. Improper coordination of subcontractors	95	68	51	24	18	256	0.617	40
F43. Delay in responding to a request for information	105	64	60	20	16	265	0.639	34
7) Safety factor								
F44. Ignore safety precautions	225	116	6	12	1	360	0.867	10
F45. Absence of insurance for Accident	85	40	51	38	20	234	0.564	53
F46. Accident at project site	240	116	9	4	1	370	0.892	4
F47. Absence of protective safety gear	115	56	30	42	15	258	0.622	39
F48. Working in high places	75	76	60	46	6	263	0.634	36
F49. Insufficient lighting	105	44	24	40	23	236	0.569	51
8) Natural/environmental Factor								
F50. Climate and Weather conditions	75	76	48	36	15	250	0.602	43
F51. Project location	110	48	36	22	26	242	0.583	48
F52. Project site Distance from town	65	32	54	36	26	213	0.514	61
9) Cultural and religious factor								
F53. Cultural differences among laborers	75	44	45	34	25	222	0.536	59
F54. Working on holiday	85	34	45	34	26	224	0.539	58
F55. Difference of language among laborers	95	32	33	46	22	228	0.549	56
10) Quality								
F56. Low quality raw materials	80	80	42	28	19	249	0.6	44
F57. Quality of recorded works	215	100	36	6	0	357	0.86	11
F58. Rework	215	108	27	2	3	355	0.855	13
F59. Quality inspection delay	85	38	54	38	20	235	0.566	52
11) Political factor								
F60. Labor Law and taxation policies	85	34	45	38	23	225	0.543	57

F61.	Security of project site	155	80	39	38	0	312	0.752	21

Based on the above table, the top five (5)ranked factors that highly affected labor productivity in road construction projects; are: lack of labor experience with RII= 0.908 ranked 1st, construction material shortage with RII=0.906 ranked 2nd, lack of labor's skill with RII=0.894 ranked 3rd, Accident on the project site with RII=0.892 ranked 4th, and tools and equipment shortage with RII= 0.889 ranked 5th.

3.4Relative Importance Index and Ranked Group of Factors

Table 3.5: Relative Importance Index (RII) and Ranked Major Groups Affecting Labor Productivity

Group of factors		Total	RII	Rank
1)	Manpower/Work Force Factor	3170	0.764	2nd
2)	Management Factor	2447	0.737	3rd
3)	Motivation Factor	2265	0.682	7th
4)	Schedule Factor	1287	0.647	8th
5)	Material &Equipment Factor	1359	0.819	1st
6)	Supervision Factor	2322	0.699	5th
7)	Safety factor	1721	0.691	6th
8)	Natural/environmental Factor	705	0.566	10th
9)	Cultural and religious factor	674	0.541	11th
10)	Quality factors	1196	0.720	4th
11)	Political factor	537	0.620	9th

As shown in the above table Material and Equipment Factor has ranked 1st from 11 groups of factors with RII 0.819. This means that, it is the most dominant factor that affects labor productivity in road construction. Manpower and Work Force Factor ranked 2nd place with RII of 0.764, and while Management Factor ranked in the 3rd place with RII of 0.737. Quality factors are ranked 4th with RII of 0.720. The group of factors that ranked on the 5th place is Supervision Factor with RII of 0.699 followed by Safety factor on the 7th place with RII of 0.682. Political factor is ranked on the 8th place with RII of 0.647 and Schedule Factor on the 9th place with RII of 0.620. Natural/environmental Factor and Cultural and Religious factor ranked 10th and 11th with RII of 0.566 and 0.541, respectively.

3.4.1 Manpower and Work Force Factor

Under the Manpower and Work Force Factor, there were 10 sub-factors listed and each of them are ranked according to their corresponding RII in each group. Manpower and Work Force Factor has been ranked 2nd among the 11 groups of factors that affect labor productivity with a relative importance index of 0.819.Thisrevealed that the factors listed under this group are highly affected the labor productivity in road construction projects. Below shows the summary of the Relative Importance Index (RII) and ranked Manpower and Work Force factor.

Table 3.6: Manpower and Work Force Factors ranked according to RII

Manpower/Work Force factors		Total	RII	Total rank	Rank in group
F1.	Lack of experience.	377	0.908	1st	1st
F2.	Labor Disloyalty.	296	0.713	23rd	6th
F3.	Misunderstanding among laborers.	322	0.776	20th	5th
F4.	Labor's bad habit	368	0.887	6th	3rd
F5.	Lack of labor skills	371	0.894	3rd	2nd
F6.	Increase of laborer's age	238	0.574	50th	10th
F7.	Labor absenteeism	356	0.858	12th	4th
F8.	Labor personal problem	284	0.684	25th	8th
F9.	Ability to adapt to change and new environments	266	0.641	33rd	9th
F10.	Worker´s integrity	292	0.704	24th	7th

From the manpower and work force group of factors, lack of experience is ranked in the 1st place with RII of 0.908, and also ranked in 1st place from all factors with RII 0.908.This shows that experienced labors have high productivity and this should be the major target for contractors to finish the work within the budget and time. Lack of labor skills is ranked 2nd from this group, but ranked on 3rd from overall factors. Labor's bad habit is among most significant factors affecting labor productivity ranked 3rd from its group and ranked 6thfrom the overall. Labor absenteeism, Misunderstanding among laborers and Labor Disloyalty ranked 4th, 5th, and 6th from this group and 12th, 20th and 23th from overall factors, respectively. The factor ranked on the 7th place is Worker´s integrity, even though it is ranked 24th from overall factors. Labor personal problem, Ability to adapt changes and new environments and Increase of laborer, age ranked from 8th to 10th from their group with RII of 0.684, 0.641, 0.574, respectively and ranked 25th, 33th and 50th from the overall list of factors.

3.4.2 Management factors

The management group of factors has 8 sub factors which ranked according to their relative importance index (RII) value. The study identified the core factors that affect Labor Productivity, under management factors include: Poor site management, Poor communication and coordination between construction parties, Lack of periodic meeting with labors, Improper planning and scheduling of work, Crew size and composition, Construction managers lack of Leadership, Change order and Disputes. This group of factor ranked in 3rd with RII of 0.737 from the 11 major groups of factors. Any

management problems would tend to reduce the output of labor. The laborers should follow all instructions, and if the managers are weak to lead and manage all scope of works, the laborers productivity would also tend to decrease. The ranked in the groupis shown below:

Table 3.7: Summary of Ranked Management Factors

2) Management factors	Total	RII	Overall rank	Rank in group
F11. A poor site management	365	0.88	7th	1st
F12. Poor communication and coordination between construction parties	327	0.788	19th	4th
F13. Lack of periodic meeting with labors	248	0.598	45th	8th
F14. Improper planning and scheduling of work	349	0.841	16th	3rd
F15. Crew size and composition	354	0.853	14th	2nd
F16. Construction managers lack of Leadership	262	0.631	37th	7th
F17. Change orders	270	0.651	31th	6th
F18. Disputes	272	0.655	30th	5th

A poor site management is the most affecting labor productivity and ranked 1st from this group with RII 0.88 and 7th from the overall factors. Crew size and composition, improper planning and scheduling of work, Poor communication and coordination between construction parties and Disputes are ranked from 2nd to 5th in their group with RII of 0.853, 0.841, 0.788 and 0.655 respectively but ranked 14th, 16th, 19th, and 30th from the overall factors. Change ordersranked on the 6th place and 31th from the overall with relative importance index of 0.651. Construction managers' lack of Leadership and Lack of periodic meeting with labors ranked 7th and 8threspectively, but ranked 37th and 45th position with an RII value of 0.631 and 0.598.

3.4.3 Motivation Factors

Motivation is extremely important. Non motivated employees can have several negative effects on the work. These include friction on the job, substandard output in quality, a high turnover of employees, absenteeism, tardiness, and many of the disciplinary problems that should be avoided.

Human potential is boundless, but it requires motivation order to excel (Schrader, 1972 cited in Fagbenle, 1997 Wachira, 2000). Motivation may come in various forms such as money, recognition, bonus, job security, participation in decision-making. It is therefore the responsibility of the contractor to quickly identify the most demanding motivators for the operations and make use of it. Surprisingly, most of the respondents did not attach any great importance to this factor. It must be stressed here, that lack of motivation has always led to high staff turnover in the construction industry, thereby leading to lack of continuity in the organization.

There are 8 sub-factors related to motivation factor are shown in table 3.8. These sub-factors includes: payment delay, Non provision of transport means, Lack of Incentive payments and financial Rewards, lack of places for eating and relaxation, lack of training sessions, Amount of payment and Discontinuity of work. Motivation factor is ranked on the 7th position with RII of 0.682.

Table 3.8: Summary of Ranked Motivation Factors

3) Motivation Factors	Total	RII	Overall Rank	Rank in group
F19. Payment delay	363	0.875	9th	1st
F20. No provision of transport means	348	0.839	17th	3rd
F21. Lack of Incentive payments and financial Rewards	281	0.678	26th	4th
F22. Lack of place for eating and relaxation	217	0.523	60th	8th
F23. Lack of training sessions	231	0.556	54th	6th
F24. Lack of Relaxation allowances	230	0.553	55th	7th
F25. Amount of payment	356	0.858	12th	2nd
F26. Discontinuity of work	239	0.575	49th	5th

Motivation factors are among the factors those affect labor productivity even though it ranked 7th as a whole. From this group payment delay is the most severe factor affecting labor productivity; ranked with 1st and 9th from overall factor. Amount of payment, Non provision of transport means, Lack of Incentive payments and financial Rewards and lack of training sessions ranked from 2nd to 6th position and ranked on 12th, 17th, 26th, 49th, and 54th position in the overall rank of factors. Lack of Relaxation allowances ranked 7th in the group and 55th in overall rank with (RII=0. 553). Lack of places for eating and relaxation is ranked 8th in group, 60th rank in overall rank with RII of 0.523.

3.4.4 Schedule compression Factors

In a typical road construction project, a contractor may often find that the time normally expected to perform the work will not benefit. The reduction of time available to complete a project is commonly known throughout the construction industry as schedule compression happens. Schedule compression is a problem because it negatively impacts labor productivity in various ways, and it becomes a source of dispute between the owners and contractors. Schedule Compression includesfactor working 7 days per week without rest, Overcrowding, Misuse of time schedule, Length of a work day and working overtime. Schedule compression factor

ranked 8th with RII= 0.647.

Table 3.9: Summary of Ranked Work Schedule Compression Factors

4) Schedule compression Factors	Total	RII	Overall rank	Rank in group
F27. Working 7 days per week without rest	253	0.61	41st	3rd
F28. Overcrowding	259	0.625	38th	2nd
F29. Misuse of time schedule	244	0.588	47th	5th
F30. Length of work day	252	0.607	42nd	4th
F31. Working overtime	279	0.672	27th	1st

Working overtime is ranked 1st with RII= 0.672, and 27th from the overall factors. Schedule of longer work days than a standard eight-hour work day lowers output and efficiency through physical fatigue and mental attitude. While, overcrowding is ranked 2nd with RII=0.625 from the schedule compression factor. This problem will persist when work planners hire too many workers for the estimated work scope and duration. Sometimes, when laborers in certain areas are scarce, supervisors may overcompensate for potential absenteeism and turnover, which creates overstaffing. Another cause is the false assumption that increased manning will always result in increased worker productivity. Working 7 days per week without rest ranked 3rd with RII of 0.61. Workingin weeks greater than 40-hour work week lowers the productivity and motivation of workers. The length of a work day and Misuse of time schedule ranked 4th and 5th position in their group and ranked 42th and 47th from the overall factors, respectively.

3.4.5 Material and Equipment Factor

Material and Equipment are very important, without this, work cannot be done progressively or to the required quality. This study has been refined and collected 4 sub-factors related to the main factor of material and equipment which includes: Material shortage, Old and inefficient equipment, Tools and equipment shortage and distance of materials storage location.

Table 3.10: Summary of Ranked Material and Equipment Factors

5) Material/Equipment Factors	Total	RII	Overall rank	Rank in group
F32. Material shortage	376	0.906	2nd	1st
F33. Old and inefficient equipment	339	0.817	18th	3rd
F34. Tools and equipment shortage	369	0.889	5th	2nd
F35. Distance of materials storage location	275	0.663	29th	4th

Lack of material and lack of equipment was highlighted as the most critical factor affecting the labor productivity because materials are essential for the construction process. Material shortage is ranked 1st from this group and 2nd out of 61 factors with RII of 0.906. According to Kazaz et al (2008), stated that lack of material is a universal problem and has a significant degrading effect on site productivity for both developed and developing countries. When adequate supply of material is not possible, workers try not to exhaust their current stockpile of supplies, so they slow down their pace or output in anticipation of a delivery, resulting in idle times and cost overruns. Tools and equipment shortage is ranked 2nd in its group and 5th place in overall factor rank with RII of 0.889. This will cause when there is not enough tools and equipment to meet the needs of the project. Old and inefficient equipment and distance of materials storage location ranked 3rd and 4th in their group with RII of 0.817, 0.663 and ranked 18th and 29th in the overall ranking, respectively.

3.4.6 Supervision Factor

Proper monitoring and supervision of laborers while working is a vital aspect of any organization because both it can result in extension of project time and cost, and the quality on site is controlled through inspection of the work completed by the crews. To improve the supervision work, it is necessary to identify the factor effect on it. The supervision factor ranked 5th position with RII= 0.699 from among the group of factors. All supervision factors have a high impact on labor productivity.

Table 3.11: Summary of Ranked Supervision Factors

6) Supervision Factor	Total	RII	Overall Rank	Rank in group
F36. Misunderstanding between labor and supervisor	276	0.665	28th	4th
F37. Inadequate supervisors' skills	246	0.593	46th	8th
F38. Supervision delays	351	0.846	15th	2nd
F39. Lack of Labor surveillance.	364	0.877	8th	1st
F40. Lack of Clarity of daily task assignment	300	0.723	22th	3rd
F41. Insufficient supervision of subcontractors	264	0.636	35th	6th
F42. Improper coordination of subcontractors	256	0.617	40th	7th
F43. Delay in responding to a request for information	265	0.639	34th	5th

Lack of Labor surveillance is the most significant factor that affects labor productivity from this group of factors ranked 1st and 8th position in the overall ranking with RII of 0.877. The immediate supervisor should inspect and follow up the work of laborers and should assist them if they encounter problems. Supervision delay is ranked 2nd from this group and ranked

15th position in the overall rank with RII of 0.846.This occurs when supervision is diverted from productive, planned, and scheduled work. Supervision delay is also caused by an increase in manpower, work areas, or project size without an increase in supervision. Lack of Clarity of daily task assignment, Misunderstanding between labor and supervisor, and Delay in responding to a request for information is ranked from 3rd to 5th position and ranked22th, 28th, 34th position in the overall ranking, respectively. Insufficient supervision of sub-contractors ranked 6th withRII=0.636 and 35th in overall ranking. Improper coordination of subcontractors ranked 7th with RII=0.617 and 40th in overall ranking. Inadequate supervisors' skills ranked 8th with RII=0.593 and 48th out of 61 overall factors.

3.4.7 Safety factors

Safety is very important aspects of construction projects to avoid hazardous endeavors which may cause work-related injuries and accidents. Safety group of factors is ranked 6th with RII= 0.691. The table below shows the summary of rank safety factor group

Table 3.12: Summary of Ranked Safety Factors

7) Safety factors	Total	RII	Overall Rank	Rank in group
F44. Ignore safety precautions	360	0.867	10th	2nd
F45. Absence of insurance for Accident	234	0.564	53th	6th
F46. Accident at project site	370	0.892	4th	1st
F47. Absence of protective safety equipment and clothing	258	0.622	39th	4th
F48. Working in high places	263	0.634	36th	3rd
F49. Insufficient lighting	236	0.569	51th	5th

Accident atthe project site is one of the most factors affecting labor productivity, which is ranked 1st from this group, and ranked 4th position in the overall ranking with RII=0. 892. Occurrence of accident on laborers is not only affecting the productivity of the injured laborer; but it also affects and slows down the productivity of the other workers. Ignore safety precautions ranked 2ndwith RII=0. 867, and 10th position in the overall ranking of factors. Working in high places, Absence of protective safety equipment and clothing, and insufficient lighting ranked from 3rd to 5th with RII= 0.634, 0.622, and 0.569, and ranked 36th, 39th, 51th in position in overall ranking. Absence of insurance for Accident; affect the motivation of labor to do work under risky condition and this factor ranked 8th with RII= 0.564 and 53th out of the 61 factors.

3.4.8 Natural and Environmental Factors

Labor is affected by unfavorable weather conditions. For instance, when weather apparel such as raincoats or heavy jackets is necessary, labor is hindered. Hot weather, in particular, has both a physiological and psychological effect on workers.

Table 3.13: Summary of RankedNatural and Environmental Factors

8) Natural/environmental Factors	Total	RII	Overall Rank	Rank in group
F50. Climate and Weather conditions	250	0.602	43th	1st
F51. Project location	242	0.583	48th	2nd
F52. Project site Distance from town	213	0.514	61th	3rd

Climate and Weather conditions ranked 1st from this group of factors with RII = 0.602, and43th in overall ranking. Performing work in a change of season, temperature zone, or climate change resulting in work performed in either very hot or very cold weather, rain, or other changes in temperature or climate can impact workers beyond normal conditions. The most effective solution to curb away the effect of inclement weather is planning with a consideration for seasonal conditions. Project location and Project site distance from town ranked 2nd and 3rdwith RII=0. 583, 0.514 from their group and ranked 48th and 61th position in the overall ranking, respectively.

3.4.9 Cultural and Religious Factor

There are some Cultural and religious factors that affect productivity of labor which includes, Cultural differences, working on a holiday, Difference of language among laborers. Cultural and religious factor ranked 11th with RII= 0.541.

Table 3.14: Summary of Ranked Cultural and Religious Factors

9) Natural/environmental Factors	Total	RII	Overall Rank	Rank in group
F53. Cultural differences among laborers	222	0.536	59th	3rd
F54. Working on holiday	224	0.539	58th	2nd
F55. Difference of language among laborers	228	0.549	56th	1st

Difference of language among laborers is affecting the labor productivity and ranked 1st from this group, and 56th in the overall ranking with RII of 0.549. Working on holiday ranked 58th in the overall ranking with RII= 0.539. If workers work on holidays, there is only a cost factor for holiday pay, but there is usually a loss of productivity as well. It may be addressed as a morale factor since workers are away from families, working instead of enjoying the holiday break. Cultural differences among laborers is ranked 3rd from this group with RII= 0.536.

3.4.10 Quality factor

Quality factors are ranked 4th withRII=0. 720 out of the group of factors.

Table 3.15: Summary of Ranked Quality Factor

10) Quality factor	Total	RII	Overall Rank	Rank in group
F56. Low quality raw materials	249	0.6	44th	3rd
F57. Quality of recorded works	357	0.86	11th	1st
F58. Rework	355	0.855	13th	2nd

The above table shows the quality of required works is ranked 1stt in the quality factor group, with RII= 0.86, and it is 11th among all 61 factors affecting labor productivity. Rework was ranked 2nd in the quality factor group, with RII=0. 855, and 13th among all 61 factors being identified. A low quality raw material is ranked 3rd with RII = 0.6, and 44th among all 61 factors. While, quality inspection delay is ranked 4th, and 52nd position in the overall ranking of factors.

3.4.11 Political Factors

The government taxation policies influence willingness to work. Law and order situation, the security of the project siteis essential for high productivity in the road construction projects.

Table 3.16: Summary of Ranked of Political Factors

11) political factor	Total	RII	Overall Rank	Rank in group
F59. Labor Law and taxation policies	225	0.543	57th	1st
F60. Security of project site	312	0.752	21st	2nd

Security of the project site is ranked on the 1st position from this group with RII=0. 752, and ranked 21st in the total ranking of factors while; labor law and taxation policies are ranked 2nd with RII= 0.543, which was ranked 57th position in the overall ranking of factors.

3.5Degrees of agreement between projects

The projects which were evaluated, values of Chronbach's Alpha were in the range from 0.9 and 1. This range is considered excellent; since the result ensures reliability of response of each project. Chronbach's Alpha equals 0.979 for the entire projects which indicate an excellent reliability of the entire response data. One of the more common measures used is the Pearson correlation, which estimates a relationship between two interval variables. The correlation between the projects are measured by Pearson Correlation, and some have excellent correlation between projects. Most correlation between the projects fall within the good range, while few are falling in an acceptable range.

4 CONCLUSION AND RECOMMENDATION

4.1 Conclusion

To improve construction labor productivity, one must identify and recognize the influence of the primary factors affecting productivity. This research has identified 61 factors affecting labor productivity, ranked according to their relative severity from the perception of different respondents which include project managers, construction supervisors, engineers and others, who have been working in road construction projects in the Bale Zone.

□ **Workforce factor:** Manpower and Work Force Factor has been ranked second from 11 groups of factors that affect labor productivity with relative importance index of 0.819. The result of the "laborer experience and skill" factor agrees with the fact that the Ethiopian construction industry suffers from the lack of trained and skilled workers. In other words, the investment in manpower is very valuable, especially in a country like Ethiopia with a relatively high population and with abundance of labor. Hence, the outcome of this research revealed the importance of enhancing construction labor skills and their experience, which can help augment better performance in the construction industry and to uplift the overall economy.

□ **Management factor:** The main task of any managers is to plan, direct and control. Poor management results in poor productivity. The management ineffectiveness causes delays which result in poor productivity. Management factor is ranked on the 3rd position with RII= 0.737. Any management problems, will tend to reduce the output of laborers.

□ **Motivation**: Motivation is extremely important. Even though the motivation factor is ranked on the 7th position, it must be stressed here that none motivated employees can have several negative effects on the work done. These include friction on the job, substandard output in quality, a high turnover of employees, which leads to lack of continuity, absenteeism, tardiness, and many others. Therefore, motivation should be exercised in various forms such as money, recognition, bonus, job security and participation in decision-making.

□ **Schedule compression Factors:** Working longer days or adding days of work on prolonged basis will result in increased injuries and safety problems. Compression of Schedule negatively affects labor productivity in various ways, negative outcomes of lower labor productivity rates, higher project costs and it becomes a source of dispute between the owners and contractors. As workers become tired from long periods of work, they begin to adjust their pace or slow their productivity to avoid fatigue. When forced to work overtime, the employee became disgruntled, causing low morale among

other employees. Overtime is expensive to the contractor in terms of both additional wages and lost productivity. Although conditions exist when schedule compression is necessary, this can usually be avoided by proper project planning and crew size.

□ **Material and Equipment:** Material and equipment factor is ranked 1st with RII=0.819. The findings revealed the importance of the "availability of the materials and their ease of handling" is highly affecting labor productivity. This requires the contractor to prepare a careful delivery plan for the required materials. Also, it reflects the need for proper and efficient selection of the location of material storage. Material and Equipment are very important, as without these, the work cannot be done progressively with the required quality.

□ **Supervision Factor:** In order to improve the supervision work, it is necessary to identify the factor that affects on it. The supervision factor ranked 5th position with RII=0.699. Although unnecessary supervision will increase the cost of work, insufficient supervision will result in confusion, delays and decrease productivity. The labor productivity is increased by increasing the number of man hours per day, in which the field supervisor would spend in contact with the crews.

□ **Safety factors:** Employees who do not feel tend to be overly cautious when performing their work tasks, thus noticeably slowing productivity. A clear and safe job site is conducive to obtaining maximum productivity of labor crews. Hence, many construction companies realize the importance of safety on job site productivity. Contractors are required by agencies to have in place an active construction safety program. The cost of safety implementation program is considerably less, than the cost of lost productivity by the laborers.

□ **Natural and environmental Factors:** Bad weather is not adequately anticipated; forcing changes in schedules, production, and damage to completed work. Weather can affect some construction materials, such as concrete and mortar, as well as the efficiency of the laborers. Protective clothing, such as rain gear or cold weather gear is necessary to avoid reduction of productivity. Hot weather, in particular, has both a physiological and psychological effect on workers. Initial project planning should consider seasonal weather conditions. Flexibility should be built into the work schedule to allow for downtime during inclement weather. Therefore, special consideration is necessary for crews working in non ideal weather conditions.

□ **Cultural and religious factor:** Cultural and religious factor ranked 11th with RII=0.541. Since the study area composed of diversified in languages and cultures. Hence, proper composition of worker and crews should have to be considered.

□ **Quality factor:** Low quality of completed portions of the construction projectwill cause redoing work. Therefore, this affects the production rate and decreases the output of the laborers. Work redone maintained a position as one of the worst problems leading to poor productivity. This research study found out that the amount of times spent on rework was between 4.9–7.7 man-hour per week. While, laborers spent an average of 14.3% of their time redoing work. Relative to this, proper, clear and on time quality inspection should have to be done.

□ **Political factors**: Any security issue related to project site should solve prior to inception of projects. The right of way issues and environmental impact assessment should be addressed properly because it will cause treat against the smooth flow of working conditions at the project site.

4.2 Recommendation

4.2.1 Recommendations for the contractors

It is necessary for the contractorsimprove poor labor productivity because the low productivity of labor will cause delay and cost overrun of the road construction projects. Unsolved labor problems on construction sites can also cause labor turnout, which leads to lack of labor force. Contractors should assign a project manager and construction supervisors with sufficient managerial skills in project supervision of road projects so that any problem during the progress would be solved immediately. Sufficient Construction materials on project site should be delivered prior to the start of the project. Materials should be stored at appropriate locations and should be easily accessible and close to project in order to avoid wasting labor time for multiple-handling of materials. Also, contractors should provide strong assistance and support regarding the continual training of their workers. Labor training and periodic meeting with laborers should be done in order to know the problem among laborers for more productive output. Experienced person should be delegated for every technical task of the project and training should be given in order to improve productivity. In addition, keeping moral support on the laborer has also a significant effect on productivity. Accident and any safety problems should be minimized because overcoming these problems has producedsignificantly help in improving poor productivity of laborers on site and to avoid delay of work rises due to injuries of workers.

Change orders and design errors should be avoided as much as possible. These factors can be costly and time consuming if the work has been done. Work sequences can also be affected due to rework. To achieve the desired results, the time required in implementing change orders and to make corrections in drawings and specifications should be estimated and scheduled without affecting the project-time completion.

5.2.2 Recommendations for the Government Bodies

Road is the major infrastructure which accelerates the growth and transformation plan. Without the construction of a road network, the ongoing growth, transformation plan does not

meet its goal, improving the productivity of labor contributes greater role construction of quality roads without the delay and costs overran. For the government, it should be considered as a major concern, to enforce hard and fast laws and regulation that helps to obtain productive work force in the road construction. In this regard, the governmental policy should encourage and pay more attention to formal technical education and apprenticeship programs. It is recommended that the Ethiopian government should enhance and encourage the accessibility to construction materials, either through local availability or by direct imports. This would improve competitiveness among material suppliers, thus helping local contractors to overcome their financial and liquidity problems. It should be a common interest of contractors, consultants, employers, and policymakers in Ethiopia, to improve the productivity level of the road construction sector. The outcomes of this study will assist in achieving this goal by focusing and acting upon the most significant factors perceived to affect the efficiency of road construction labor Productivity. The results will become worthwhile in determining the major steps to improve labor productivity in the Ethiopian road construction industry.

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□ Prof. Emer T. Quezon is currently professor of Civil Engineering at Jimma Institute of Technology, Jimma University, Jimma, Ethiopia, and he was assistant professor at the University of Saint Louis, Tuguegarao City, Cagayan, Philippines. Also, he is a regular member of the Transportation Science Society of the Philippines (TSSP), and Life Member of the Philippine Institute of Civil Engineers (PICE). Email address: quezonet09@yahoo.com.

□ Melese Mengistuhas earned his master's degree in Civil Engineering at Jimma Institute of Technology, Jimma University, Jimma, Ethiopia.

□ Getachew Kebede is currently a senior lecturer of Civil Engineering and Ph.D Student in Construction Management at Jimma Institute of Technology, Jimma University, Jimma, Ethiopia. Email address: getchitaly@yahoo.com

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