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Effects of Materials, Tools and Equipment on Labour Productivity in Reinforced Concrete Construction Works in Kenya. A Case Study of Construction Projects in Nairobi County

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Abstract: **The construction industry plays a vital and effective role in both developed and developing countries, and is considered as one of the most labour-intensive sectors all over the world. This paper endeavors to establish the effects of issues concerning construction materials, tools and equipment on labour productivity in reinforced concrete construction works in the Kenyan construction industry. The study involved site surveys and observations where construction projects were ongoing in Nairobi County, and a descriptive survey research design was used for the study. The target population was all construction workers clustered into skilled and unskilled labour, site supervisors and site managers, where purposive and judgmental sampling was employed to 150 respondents at 45 construction sites. Data was collected using structured questionnaires and oral interviews; and analyzed using descriptive statistics, correlation and regression analysis to describe the relationships between the study variables. The results of this study showed that the following factors, arranged in order of importance were the most significant in their effect on labour productivity: (1) unavailability of construction materials; (2) poor quality of construction materials; (3) unavailability of tools and equipment; (4) inefficiency of tools and equipment; (5) lack of personal protective equipment. The findings of the study fill a gap in knowledge of the effects of materials, tools and equipment on labour productivity in reinforced concrete construction works, which can be used by industry practitioners to develop better strategies to improve efficiency and realize effective utilization of the labor force, hence assist in achieving a reasonable level of competitiveness, timeliness and cost-effective construction.**

Key words: Labour productivity, Resources, Tools and equipment, Materials, Construction workers

1. INTRODUCTION

The construction industry plays a vital and effective role in both developed and developing countries, and is considered as one of the most labor-intensive industries all over the world (Ghodrati et al. 2018). This is because of its dynamic nature and easy relation to other sectors in the economy. The output of the construction industry is of significant importance for the development and growth of a nation. According to the European Construction Industry Federation report, and as cited by Sharmil (2015), the construction industry contributes to 9.7 percent of the gross domestic product in the European Union with a total construction value of EUR1,186 billion in 2010 and providing 6.6 percent of total employment in Europe. This implies that construction productivity must improve and should be the focus of construction research and development. According to the New Zealand Sectors Report (2013) the construction sector is the fifth largest sector in the New Zealand economy. It employs over 170,000 people, 7.6% of the workforce. According to China Engineering News-Record (2012) following 30 years of development the Chinese construction industry has continuously strengthened its position as a pillar industry. Currently, there are over 60,000 construction enterprises of all kinds in China, employing more than 40 million workers. Chinese construction enterprises have notably improved their strength and international reputation. Similarly, the Indian construction industry has as well garnered more importance in the last two decades because of the opening up of Indian markets and the arrival of mega projects for infrastructure development. Hence the performance of Indian construction projects has been very encouraging. The construction sector contributes nearly 10 percent of India's GDP and is emerging as one of the key growth sectors in the economy, having grown more than 12 percent over the last one decade (India Economic Survey Report, 2019).

Kenya has a well-established construction industry that comprises businesses mainly involved in the construction of commercial and residential buildings, government infrastructural projects and affiliated trade services. The construction industry is a major contributor to the Gross Domestic Product (GDP) in the Kenyan economy and plays a leading role in determining economic growth. According to the Kenya National Bureau of Statistics (KNBS, 2021), the real estate and construction sectors have been some of the main drivers of economic growth in Kenya for the last five years. The Kenyan construction industry contributed 11.5 percent of the GDP in 2021, which makes it clear that Kenya has a well-developed construction industry.

Construction projects utilize huge amount of resources on and off the field in various forms including; construction plant, materials, tools and equipment, labour, along with finances, time and space. Optimal utilization of available resources is a key factor in maximizing the productivity and minimizing cost

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of construction projects. Most of the construction agencies focus on material and equipment management to reduce cost and increase efficiency (Aparna & Linu, 2015). However, the construction labour force is the most dynamic element in the construction industry accounting to a cost 30 to 40 percent of the total construction budget. Therefore, labour productivity plays an equal role in the success of a project especially in today's world of high labour expenses. The construction industry accounts for a large proportion of the country's total employment and makes a significant contribution to the country's overall income. For instance, (Lopes, Oliveira & Abreu, 2017; Momade, et al. 2020) reported that the construction industry has created jobs and employment to many and is positively associated with the success and progress of any economy. One of the most important factors affecting the construction industry's growth is productivity and it is associated with labour performance.

1.1 Resource factors in construction

The crucial factors in successful implementation of a construction project not only depends on the quality and quantity of work, but also largely depends on availability of resources (Nagaraju et al. 2012). All activities in the project schedule and work plan require allocation of resources. Each activity is allocated with a specific resource and must be completed within a given time line, otherwise it may adversely affect the overall duration and completion of the project. The time and related cost are directly dependent on the available resources. The time required may be determined by dividing the productivity associated with the resources used on the activity into the defined quantity of work for the activity. The best combination of resources to use for performing a construction activity is based on contractor's ability to identify the interdependencies of the various resources.

The limited-resource allocation problem arises in many construction projects especially when the amount of resources available to the contractor is limited. The scheduling objective is to hold project duration to a minimum while resolving the resource conflict by shifting the activities until the resource requirements are available. Availability of resources has been recognized by a number of researchers as a driving force and essential for the successful performance of construction projects. For instance, Tukel and Rom (1998) noted that availability of resources as being a main performance constraint in projects in diverse industries. Chua et al. (1999) further confirmed the necessity of resource availability to the success of construction projects. In measuring business performance in construction, Bassioni et al. (2005) underlined the role of resource availability in the overall construction business outcomes.

1.2 Labour productivity

Productivity in construction projects is often broadly defined as output per labour hour. Since labour constitutes a huge part of the overall construction budget and the quantity of labour hours in performing a task in construction is more susceptible to the influence of management than are materials or capital, this productivity measure is often referred to as labour productivity**.** Borcherding et al. (1986) referred to construction labour productivity (CLP) in terms of labour cost to the quantity of outputs produced. Horner and Talhouni (1995) referred to CLP in terms of earned hours. It relies on the establishment of a set of standard outputs or "norms" for each unit operation. Thus, a number of "earned" hours are related with each unit of the completed work. The challenges with this concept, however, is in establishing reliable "norms," for setting standards. It also depends on the method used to measure productivity, and on the extent to which account is taken of all the factors which affect it. A project specific model is normally represented by equation 1:

$$\text{Productivity} = \frac{\text{Output}}{\text{Labour} + \text{Equipment} + \text{Material}} \quad \text{..Eqn1}$$

From the above equation, Labour, Equipment and Materials are seen to be key factors of productivity. Therefore, when labour is factored in productivity the key determinants of labour productivity will be equipment and materials. According to Mahamid et al. (2013), labour productivity is important in determining the success of a project. However, it might be affected by many unforeseen variables. These variables may include factors related to labour which include but not limited to; tools and equipment, materials, construction methods, political forces, financial capability and environment impacts.

2. REVIEW OF RELATED LITERATURE

According to the World Bank Annual Development Report (2019), almost 80% of revenues in developing nations is channeled in to infrastructure development and construction. Construction labour constitutes between 30-40% of total project cost in construction projects.

Kenya being a developing nation has experienced a boom in construction in both the public and private sectors. According to the KNBS Economic Survey Report (2021), the construction sector in Kenya registered a growth of 11.8 per cent in 2020 compared to growth of 5.6 per cent in 2019. This growth is attributed to the fact that the government has invested heavily in the construction sector in order to improve on infrastructure such as road networks and at the same time provide new residences for the citizens. With increase in population, opportunities exist in the construction of residential, commercial and industrial buildings, including prefabricated low-cost housing. Further, the private sector has induced real estate investment which has greatly and positively impacted the construction industry in the country.

Despite the tremendous growth performance in the construction industry in Kenya, there are various factors that have been reported to be a major challenge hindering achievement of set targets. Among them being the issues of labour and cost of construction. Therefore contractors and builders have to think deeper on how to sort this problem. Majority of construction agencies focus on material and equipment management to reduce cost and increase efficiency. Time and cost overruns of construction projects are widely attributed to poor productivity of construction labour force. Therefore output of the project is measures by successful completion within the time scheduled and budget.

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While contractors and private sector developers employ huge numbers of labour on various construction activities, the costs associated with these engagements are high and therefore must be matched with a similar level of productivity/output. Statistics indicate that current labour productivity levels fall below average while wages are on a steady rise. It is therefore important to carry out a scientific research to understand the factors that affect labour productivity in all its aspects, in order to come up with methods of optimization and improvement. More specifically, there is need to relate the effect of materials, tools and equipment on labor productivity.

The Resource Dependency Theory (RDT) was developed by Jeffrey and Gerald (1987). The RDT theory explains on a set of power relationships based on exchange of resources (Pfeffer & Alison, 1987). It acknowledges that a firm may not possess all the resources they might require in the process of value creation, hence becoming dependent on each other (Hunt & Morgan, 1996). This theory is particularly effective in transportation and storage of materials required for the construction project. Transportation and storage must be done effectively since the material used in the process is very limited. The resource dependency theory is relevant to this study as it highlights the key project aspects such as sourcing materials and transport of the materials from the supplier that directly influence project performance. Therefore, every project is dependent on a good material management to yield the required results.

The two-factor theory of motivation by Frederick Herzberg in the 1950's analyzing the responses of 200 accountants and engineers who were asked about their positive and negative feelings about their work. Herzberg found two factors that influence employee motivation and satisfaction. The first is motivator factors: these are factors that lead to satisfaction and motivate employees to work harder whereas the second is hygiene factors. These factors can lead to dissatisfaction and a lack of motivation if they are absent hence lowering employees' productivity. However, while motivator and hygiene factors both influenced motivation, they appeared to work completely independently of each other. The significance of this theory to the study is that for the happiest and most productive workforce, there is need to work on improving both motivator and hygiene factors. Employees should feel appreciated and supported, given plenty of feedback and made to understand how they can grow and progress through in a firm. Construction tools and equipment are also important in assisting manpower resources in stepping up the efficiency of the work by saving huge amount of time and cost. Hence, adequate and efficient equipment use is more advantageous for project as compared to the application of obsolete and inadequate equipment (Kaliba et al., 2009).

3. RESEARCH METHOD AND ANALYSIS

Descriptive survey research design was used for this study target population was all construction stakeholders clustered into skilled and unskilled labour, site supervisors and site managers. The labour productivity data was collected from 41 different construction sites in the County of Nairobi. The data collection duration spanned for a period of 3 months during

Construction productivity is affected by the guiding policy of the company regarding the selection of tools and equipment. In short, the policy provides for the type and number of equipment required as well as getting the right balance between maintainability and replacement is a crucial decision-making process by the company.

Materials are the essence of any construction project and represent a substantial proportion of the total value of the project. Materials are considered as a must for the success of construction projects, which accounted for nearly 70 percent of the project cost (Enshassi et al., 2007). Therefore, efficient use of material is very critical in achieving successful completion of project as any issue related to material will significantly influence the project as a whole (Koushki et al., 2005). Material management system includes the fundamental functions required in any construction project such as identifying, acquiring, storing, distributing and disposing of materials. Durdyeu et al. (2011) identified factors that affect materials in labour productivity as material shortages, tools and equipment shortages, unsuitability of materials location, delay in arrival of materials, poor quality of materials supplied and inefficiency of equipment.

Talhouni (1990) classified four categories of factor responsible for affecting productivity on construction sites as: (1) management, (2) site, (3) design, and (4) weather; whereas Sugiharto (2003) further allocated the key factors impinging upon construction productivity in Indonesia into the following three categories: (1) characteristics of contractors, (2) inadequate management strategy, and (3) organization's focus. Soekiman *et al*. (2011) stated that various factors affect the performance of laborers in projects which are usually linked to the performance of project cost, time, and quality. They divided these factors into 15 different groups namely, design, execution plan, material, equipment, labour, health and Safety, supervision, working time, project factor, quality, financial, leadership and coordination, organization and owner/consultant. Cunningham (2013) noted that when a contractor chooses to invest in improving the status of his or her workers by not only good pay but also working conditions normally gains through quality work and a reduced need for supervision. It was noted that temporary labour which comes at lower cost finally results to high supervision cost and can damage the firm's reputation and incur considerable remedial costs if the quality of work is poor.
From the foregoing review of relevant literature, it is evident that research in the area of construction industry has been done but not in a comprehensive approach. Therefore this research seeks to bridge the existing literature gap by studying two resource factors: Materials, and Tools/ equipment and their effect on labour productivity in construction projects in Kenya.

which a total of 110 productivity data questionnaires were administered. Construction workers involved in road construction projects, buildings, water supply and waste water works were targeted. During the study, structured questionnaires with open and close-ended (Likert Scale) questions were administered to the construction workers, by way of interviews. Others were requested to fill the questionnaires by themselves and submit. The

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interviewee's responses were then collated in appropriate formats and prepared for analysis.
The targeted population comprised of skilled and unskilled labour, site supervisors and site managers. The researcher used the purposive type of sampling to select the respondents based on their involvement in construction activities. The purposive type of sampling is adequate where the

target population is heterogeneous hence making it difficult for the researcher to be specific (Kothari, 2004). The study targeted at least 150 respondents, 50 from each of the three clusters.

The desired sample size of 110 respondents was determined using Yamane's formula, (Yamane, 1967)

$$n = N/ (1+N (e)^2) \quad \text{.....Eqn 2}$$

Where **n** = desired sample size

N = size of the population (number of construction workers) =>150

e = the desired confidence interval (precision level) => 0.05

110 = 150/(1+150(0.05)^2

Data was analyzed using descriptive statistics and presented using statistical tools such as mean as a measure of central tendency, frequencies and percentages, since they are very useful for showing and summarizing data when any complex models are needed. Statistical Package for Social Sciences (SPSS) version 20.0 package aided the descriptive analysis.

4. RESULTS AND DISCUSSION

Table 1 presents the results from the pilot study where 10% of the target population was involved. It was observed that the reliability and internal consistency of the items constituting tools and equipment, materials and labour productivity was achieved. The individual Cronbach's Alphas for these variables were 0.89, 0.85 and 0.77 respectively, which were above the required cut off minimum value of 0.7. Therefore all the items in the questionnaire were reliable. The interpretation was that all the items in the research instrument were eligible for inclusion in further collection of data and analysis.

Table 1 Reliability Test

Variables	**Cronbach's Alpha** (estimated)
Tools and equipment	0.89
Materials	0.85
Labour productivity	0.77

4.1 Response rate

The figure above indicates that out of the 150 questionnaires administered, only 110 were returned. The overall response rate was thus found to be 73% which was very high. 40 or 27% of the respondents did not respond. The interpretation was that the high response rate was essential to obtain sufficient observations for further analysis. Since the number of questionnaires returned was more than 30, the study was able to proceed to inferential analysis.

4.2 Descriptive statistics

Table 2 presents the relevant results which show on a scale of 1 to 5 (where 1= strongly disagree and strongly agree = 5). From the results all the mean values of the constructs were above 3. Unavailability of tools 3.1727, wrong tools for the job 3.3182, inefficiency of tools 3.3636, tools repair/replacement duration 3.6364, unavailability of personal protective equipment (PPEs) 3.5364, inadequacy of PPEs 3.6091. This shows that tools and equipment factors had significant effects on the labour productivity. The interpretation was that almost all the respondents were to a greater extent in agreement with the various constructs on tools and equipment with a very minimal variance

Table 2 Tools and equipment issues

Statement	*Mean*	*Std. Deviation*
Unavailability of tools	3.1727	.70202
Wrong tools for the job	3.3182	.66266
Inefficiency of tools	3.3636	.63140
Tools repair/replacement duration	3.6364	.48325
Unavailability of personal protective equipment (PPEs)	3.5364	.50096
Inadequacy of PPEs	3.6091	.49019

The study sought to examine the respondent's level of awareness on the effect levels of materials provided. Table 3 presents the relevant results which show on a scale of 1 to 5 (where 1= strongly disagree and strongly agree = 5); inadequate

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construction materials 3.2182, timely supply of construction materials 3.3909, quality of materials supplied 3.4000, materials stored close to the site 3.7000. This shows that construction materials had significant effects on the labour productivity. The interpretation was that majority of the respondents were in agreement with the various constructs on material with a very minimal variance.

Table 3 Materials issues

Statement	*Mean*	*Std. Deviation*
Inadequate construction materials	3.2182	.74664
Timely supply of materials	3.3909	.67858
Quality of materials supplied	3.4000	.66636
Storage of materials close to site	3.7000	.46035

The study sought to examine the respondent's level of agreement to various measures of labour productivity. Table 4, presents the relevant results which show on a scale of 1 to 5 (where 1= strongly disagree and strongly agree = 5). We are able to complete our project in time 1.8364, the tools/equipment we use help to complete the job faster 1.6909, the tools/equipment are available for us to use 1.6364, the environment we work in is always encouraging 1.3636, we have adequate availability of construction materials all the time 1.4636. The interpretation was that majority of the respondents were in agreement with the various constructs on labour productivity with a very minimal variance.

Table 4 Labour productivity

Statement	*Mean*	*Std. Deviation*
Projects are completed in time	1.8364	.71070
The tools/equipment we use help to complete job faster	1.6909	.67383
Availability of adequate materials enhances labour productivity	1.6364	.63140
The environment we work in is always encouraging	1.3636	.48325
We have adequate availability of construction materials all the time	1.4636	.50096

4.3 Correlation analysis

From table 5 it can be observed that the correlation between the independent variables and the dependent variable was high and positive at 0.658 and 0.835 for Tools and equipment and Construction materials respectively. The implication was that the high correlation between labour productivity and its determinants was good for regression analysis. The correlation between the independent variables was found to be low and positive. The interpretation was that the level of multicollinearity between the independent variables was not very high, which meant that the influence of each variable in the regression was relevant.

From the results, it is observed that materials had the greatest effect on labour productivity, followed by tools and equipment which had the least effect.

Table 5 Correlation analysis

		Labour productivity	Tools & Equipment	Materials
Labour productivity	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	110		
	Sig. (2-tailed)	.003		
	N	110		
Tools & Equipment	Pearson Correlation	0.658**	1	
	Sig. (2-tailed)	.000		
	N	110	110	
	Sig. (2-tailed)	.002	.000	
	N	110	110	
Materials	Pearson Correlation	0.835**	0.148**	1
	Sig. (2-tailed)	.000	.000	
	N	110	110	110
	Sig. (2-tailed)	.001	.040	.000
	N	110	110	110

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed)

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4.4 Regression analysis

Table 6 presents the R-Square and Adjusted R-Square test statistics for the test of the hypothesis. There were significant effects of the two variables on labour productivity. From the results, the two test statistics were R-Square 0.909 and Adjusted R-Square 0.907 respectively. The interpretation of this was that there was a linear association between tools/equipment, materials and labour productivity. The conclusion was that there was strong relationship between tools/equipment materials and labourproductivity.

Table 6 Model summary

R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Durbin-Watson
			R Square Change	F Change	df1	df2	Sig. F Change	
.909	.907	.07713	.909	480.785	5	104	.0001	2.043

a. Predictors: (Constants), Tools and equipment, construction materials
b. Dependent Variable: Labour productivity

Table 7 presents the F-statistics for the test on the relationship between Tools and equipment, materials and Labour productivity. From the results the F-statistics had values of 480.785 and the p-values of 0.0001 for models. The interpretation of this was that there was a collective linear association between Tools and equipment, Materials and Labour productivity.

Table 7 Analysis of variance

Model		Sum of Squares	df	Mean Square	F	p-value
	Regression	14.301	5	2.860	480.785	0.0001[b]
	Residual	.619	104	.006		
	Total	14.920	109			

a. Dependent Variable: Labour productivity
b. Predictors: Constants: Tools/equipment, Materials

4.4.1 Tools and equipment

From table 8, the regression coefficient of tools and equipment was found to be 1.036. This value shows that holding other variables in the regression model constant, an increase in tools and equipment by one unit causes the labour productivity to increase by 1.036 units. The positive effect shows that there is a good association between tools/equipment and labour productivity. The coefficient was found to be positive and also statistically significant with a t-statistic value of 2.567. The standard error was found to be 0.041 and the p-value was found to be 0.0001. The collinearity statistics of tolerance and VIF of 0.427 and 2.344 respectively show that the model was well specified.

4.4.2 Materials

From table 8, the regression coefficient of materials was found to be 1.257. This value shows that holding other variables in the regression model constant, an increase in materials by one unit causes the labour productivity in the construction industry to increase by 1.257 units. The positive effect shows that materials issues have the greatest effect labour productivity. The coefficient was found to be positive and also statistically significant with a t-statistic value of 4.630. The standard error was found to be 0.040 and the p-value was found to be 0.0010. The collinearity statistics of tolerance and VIF of 0.256 and 3.909 respectively show that the variables coefficients are truly independent.

Table 8 Regression coefficients results

Model	Coefficients		t-statistics	p-value	Collinearity Statistics	
	B	Std. Error			Tolerance	VIF
(Constants)	6.192	0.161	38.567	0.0019		
Tools/equipment	1.036	0.041	2.567	0.0001	0.427	2.344
Materials	1.257	0.040	4.630	0.0010	0.256	3.909

The fitted regression model is:

$$Y = 6.192 + 1.036\ X_1 + 1.257\ X_2 + \varepsilon \ldots \text{Eqn 3}$$

The first null hypothesis for the study was; *$H0_1$ Tools and Equipment factors have no significant effect on labour productivity in productivity in construction projects in Kenya*. The alternative null hypothesis was that tools and equipment have a significant effect on labour productivity in construction

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projects. From the findings of this study it was noted that tools and equipment had a positive significant effect on labour productivity. The conclusion is that the study rejects the first null hypothesis **H0₁** and fails to reject the alternative hypothesis.

The second null hypothesis was; ***H0₂*** *Materials factors have no significant effect on labour productivity in in construction projects in Kenya*. The alternative null hypothesis was that materials have a significant effect on labour productivity in construction projects in Kenya. From the findings of this study it was noted that materials had a positive significant effect on labour productivity. The conclusion is that the study rejects the second null hypothesis **H0₂** and fails to reject the alternative hypothesis.

5. CONCLUSIONS AND RECOMMENDATIONS

The study concludes that there is a direct relationship between materials, tools/equipment and labour productivity in construction projects.
A positive deviation of the independent variables results in a positive change in the dependent variable (labour productivity). Timely provision of materials to construction sites be given a key consideration to ensure good utilization of the labour resource.

Stakeholders in the construction industry should ensure that they provide adequate and appropriate tools and equipment to ensure optimum labour productivity at their construction sites. Productivity is as a result of the combination of labour, materials, tools and equipment. Therefore labour productivity output is a product of tools and equipment and materials. This study recommends that construction stakeholders should focus on providing the appropriate tools and equipment to ensure productivity.

REFERENCES

[1] Aparna. B., and Linu T. K. (2015), "Influential Factors Affecting Labour Productivity in Concreting of Columns", International Journal of innovations in Engineering and Technology. Vol. 5 (2), 2319-1058.
[2] Bassioni, H.A., Price, A.D.F. and Hassan, T.M. (2005) Building a conceptual framework for measuring business performance in construction: an empirical evaluation. *Construction Management and Economics*, **23**, 495–507.
[3] Borcherding, J.D., Palmeter, S.B. and Jansma, G.L. (1986), "Work force management programs for increased productivity and quality work", spring meeting, EEI Construction Committee, pp. 4-9.
[4] Chua, D.K.H., Kog, Y.C. and Loh, P.K. (1999) Critical success factors for different project objectives. *Journal of* Construction *Engineering and Management*, **125**(3), 142–50.
[5] Chui, W, K and Bai, Y (2010), "Comparison of construction labour productivity between U.S and China", *Construction research congress*, ASCE.
[6] Cunningham, T. (2013). Factors Affecting the Cost of Building Work—An Overview. Dublin Institute of Technology, Dublin, 1-21.
[7] Dai, J. and Goodrum, P.M., 2012. Generational differences on craft workers' perceptions of the factors affecting labour productivity. Canadian Journal of Civil Engineering. Vol. 39, 1018 1026.
[8] Durdyeu, S., & Mbachu, J. (2011). On-site labour productivity of New Zealand construction industry: Key constraints and improvement measures. Australasian Journal of Construction Economics and Building. 11 (3), p18-33.
[9] Durdyev, S. and Mbachu, J. (2011), "On-site labour productivity of New Zealand construction industry: key constraints and improvement measures", Australasian Journal of Construction Economics and Building, Vol. 11 No. 3, pp. 18-33.
[10] Enshassi, A., Mohamed, S., Mayer, P. and Abed, K. (2007), "Benchmarking masonry labor productivity", Journal of Productivity and Performance Management, Vol. 56 No. 4, pp. 358-368.
[11] Ghodrati, N., Yiu, T.W., Wilkinson, S. (2018), Unintended consequences of management strategies for improving labour productivity in construction industry. *J Safety Res* 2018 *67*107-116.
[12] Goodrum, P., Zhai, D. and Yasin, M. (2009), "Relationship between changes in material technology and construction productivity",
[13] Hunt, Shelby D. and Morgan, Robert M. (1996), "The Comparative Advantage Theory of Competition," Journal of Marketing, 59 (April), 1–15.
[14] Icmeli-Tukel O. and Rom, W. O. (1998). Analysis of the Characteristics of Projects in Diverse Industries. *Journal of Operations Management*, (forthcoming)
[15] Jarkas, A.M., 2010. Buildability factors affecting formwork labour productivity of building floors. Canadian Journal of Civil Engineering. Vol. 37, 1383-1394
[16] Journal of Construction Engineering and Management, Vol. 135 No. 4, pp. 278-287.
[17] KNBS, Economic survey Report (2021). *Kenya National Bureau of statistics.* Nairobi: Government printer.
[18] Kothari, C. R. (2004). Research methodology: Methods and techniques. New Delhi: New Age International (P) Ltd, Publishers.
[19] Lopes, J., Oliveira, R., Abreu, M. The Sustainability of the Construction Industry in Sub-Saharan Africa: some new evidence from recent data. *Procedia Engineering* 2017 *172*, 657 664.http://doi.org/doi:%2010.1016/j.proeng.2017.02.077
[20] Mahdi, S.S., SangHyun, L. and Fayek, A.R. 2011. Understanding construction workforce absenteeism in industrial construction. Canadian Journal of Civil Engineering. Vol. 38, 849 858
[21] Momade MH, Shahid S, Hainin MRB, Nashwan MS, Tahir UA. 2020. Modelling labour productivity using SVM and RF: a comparative study on classifiers performance. Int J Construction Management. 1–11.
[22] Mugenda, O. and Mugenda, A.N., 1999. Research methods, quantitative and qualitative approaches. African Centre for Technology Studies.
[23] Nagaraju S.K., Sivakonda B.K., Chaudhuri A., (2012), "Resource management in construction projects", *Engineering Science and Technology: An International Journal (ESTIJ), ISSN: 2250-3498, Vol. 2*
[24] New Zealand Sectors Report (2013). An overview of the construction sector in New Zealand economy.
[25] Polit, D., Hungler, B. 1993. Essentials of nursing research: Methods, appraisal and utilization. 3RD Edition, Lippincott, Philadelphia.
[26] Sharmil G. Naum. (2015), "Factors influencing labor productivity on construction sites", *International Journal of Productivity and Performance Management*, Vol. 65 (3) pp. 401 421.
[27] Shen, Z., Jensen, W., Berryman, C. and Zhu, Y. 2010. Comparative study of activity-based construction labor productivity in the United States and China. Journal of Management in Engineering. Vol. 27 (2), 116-124.
[28] Soekiman, A., Pribadi, K.S., Soemardi, B.W. and Wirahadikusumah, R.D. (2011). Factors relating to labour productivity affecting the project schedule performance in Indonesia", Journal of Construction Engineering and Management, Vol.14, pp.865-873. P 990-999
[29] Sugiharto, A.L.W.I. (2003). Factors Influencing Construction Productivity in Indonesian Context. Tarumangara University. In Proceeding of the East Asian Society for Transportation Studies, Vol 4.
[30] Tang, J. and MacLeod, C. 2006. Labour force ageing and productivity performance in Canada. Canadian Journal of Civil Engineering. Vol. 39 (2), 582-603