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Assessment of the Effect of Labour Productivity Factors on Health and Safety Hazards in Building Construction Projects: Case Study in Uganda

Nathan Natukunda[1,*], Samuel Waweru[2], Benerdette Sabuni[2], Basil lro Ong'or[2]

[1]Department of Civil and Environmental Engineering, Kyambogo University, Kampala, Kyambogo, Uganda
[2]Department of Civil and Structural Engineering, Masinde Muliro University of Science and Technology, Kakamega, Kenya

Abstract Globally, the building construction industry has been recognized as the main contributor to economic growth and development. In Uganda, its labour intensive nature which creates employment opportunities across all skill levels to meet rising housing demand. Despite its economic importance, the industry is persistently hampered by health and safety hazards, including injuries and fatalities. Such incidents induce workers anxiety, trigger accident investigations and ultimately diminish labour productivity, leading to project delays. Nevertheless, knowledge regarding the labour productivity factors specifically linked to health and safety hazards in building construction in Uganda remains poorly documented. This study therefore assessed the effect of labour productivity factors on health and safety hazards among construction workers across four region cities in Uganda. Employing a quantitative approach, data was collected from 262 randomly selected respondents. The study examined two categories of labour productivity factors; psychophysical and technological that contribute to health and safety hazards for construction workers. Analysis was conducted using SPS, and R-Studio by employing relative importance index (RII), weighted mean (mean), correlation and regression. Findings revealed psychophysical factors as most significant (RII= 0.774, SD=0.712, Mean =3.876) which was attributed to falls from a height factors, followed by technological with (RII =0.767, SD=0.729, Mean=3.837) mainly attributed to inappropriate trench strutting and improper use of tools and equipment. Correlation analysis showed strong positive relationships, particularly for technological (r =+0.750) and psychophysical (r = +0.375) factors. Regression (adjusted R^2= 0.685 and p-value =1.43e-13) confirmed both as statistically significant contributors to health and safety hazards. The study recommended routine training programmes for project managers to raise awareness of psychophysical strains and proper safety technology use, thereby enhance overall site safety performance. health and safety performance on construction project sites.

Keywords Health, Safety, Labour, Productivity, Psychophysical, Technological, Factors, Building, Construction

1. Introduction

In developing countries, building construction industry has been known as a significant contributor of economic development. In Uganda, this industry has experienced rapid growth in recent years, largely driven by population increases that resulted in demand for housing services [19]. Building construction industry is comparatively labour intensive and creates employment opportunities for skilled and unskilled workers to meet the rising need for housing services [30,25].

However, despite its economic importance, the construction industry in Uganda continues to face significant health and safety hazards, including injuries and fatal accidents [19]. The occurrence of these incidents not only cause fear and anxiety among workers but also prompt accident investigations [22]. These investigations often lead to project delays, which in turn collectively reduce labour productivity and ultimately postpone the completion of construction projects.

Nevertheless, knowledge regarding the labour productivity factors particularly linked to health and safety hazards in building construction in Uganda remains scarcely addressed in literature. There is a need to establish labour productivity factors that cause health and safety of construction workers particularly those related to hazards arising from or in connection with construction work activities. Addressing these factors would help reduce the number of incidents on construction sites, thereby improving productivity, construction projects completed on schedule and meet the demand of housing services in Uganda.

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natukundan@kyu.ac.ug (Nathan Natukunda)
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Health and safety hazards are persistent obstacles and risk factors that hinder the effective protection of workers from physical harm, injury, illness and fatalities from construction activities [7]. Building construction H&S hazards is a worldwide issue especially common in developing countries. The study by [8] highlighted that construction is one of the most dangerous industries faced with challenges of H&S hazards for construction workers. It is estimated that at least 108,000 construction workers are killed on site globally each year accounting for about 30% of all occupational fatalities. The findings of [28] indicate that construction accidents in Kampala, Uganda, the estimated annual fatality rate among construction workers is 84 deaths per 100,000 workers.

Health and safety hazards in construction ranges from physical and psychosocial hazards that workers face during construction activities [25]. These are commonly attributed to falls from heights, struck by moving objects, electrocution and collapsing structures [17]. Subsequently result in injuries, illnesses and fatalities of workers. Such consequences result in increased absenteeism, medical leave and decreased workforce morale among affected workers [14]. In turn, these outcomes hinder overall productivity and subsequently lead to delayed construction project completion. This pattern has been linked to several labour productivity factors [18].

2. Labour Productivity Factors

According to [19] and [3] indicate that labour productivity factors are the primary cause of H&S hazards in building construction industry in Uganda. Poor safety management characterized by inadequate training, lack of management commitment, insufficient safety equipment among others contributes to workplace accidents and injuries, this declines the productivity of workforce [3].

According to [27] and [26], labour productivity refers to the quantity of work produced per person within a given period. They further argued that construction productivity depends on the collective effort of the entire construction team working together. However, [24] indicate that labour productivity is the units of work produced per man-hour, emphasizing that productivity measures how an individual utilize resources to transform inputs into outputs. Therefore, construction productivity relies on both workforce effort and individual performance on the construction project. Also [3] argue that the disruptions of work force due to safety related incidents reduce overall project efficiency and work stoppages, which in turn affect project completion time line.

Over time, a significant number of studies have examined the labour productivity factors linked to H&S hazards in the construction industry [8]. These factors are inherently unstable and erratic, which persistently result in occurrence of physical and psychosocial hazards to construction workers [25]. Such health and safety hazards result in decline in construction project completion time line and significant financial losses of the construction projects.

Researchers have identified a range of specific causes and broader groups of factors that collectively influence the H&S hazards of construction workers [34]. For instance, human factors such as fatigue, cognitive overload, miscommunication may trigger absenteeism, rework and subsequently delay the scheduled completion of construction projects [30].

Literature reviewed indicates categorization of the various labour productivity factors influence the health and safety of construction workers into groups of up to eleven (11) groups. These include external related, supervision related, psychophysical related, manpower related, technological related, material related, leadership related, project related, management related, motivation related and work condition related factors, among others [8, 34]. This study re-classified these factors into four (4) overarching groups: Management, Technological, worksite condition and Psychophysical related factors. However, among these factors, the study focused on psychophysical and technological labour productivity factors as they were established through the findings as the most significant contributor to project H&S hazards for construction workers.

2.1. Technological Labour Productivity Related Factors

Various studies have consistently highlighted in the literature that, technological related factors are significantly contributors to H&S hazards for construction workers. In the study by [15] in U.S assert that technological factors such as poor strutting of trench excavation sides, attributed to skills of supervision team, depth of trench to be excavated, bearing capacity of soil to be excavated, poor design of strutting system greatly influence H&S hazards for construction workers. Collectively, these technological deficiencies expose workers to fatal risks including cave-in and crush injuries. The study by [14] indicates that, inappropriate use of tools and equipment which are attributed to skills of equipment operator, training on the usage of equipment, skills of site supervisor are the main cause of H&S hazards of construction workers. The studies by [1] and [11] in Indonesia identified technological factors especially the ineffective support of scaffold work platforms stand out as the primary contributor to H&S hazards among construction workers. It is driven by poor design of scaffold supports such as inadequate load bearing capacity and missing bracing which creates inherent instability. This make platforms prone to swaying and collapse under normal use. Subsequently result in injuries and fatal accidents. Additionally, [1] in Malaysia indicates that poor methods of handling material, improper assembly of scaffold platforms and non-adherence to scaffold safety standards together create an unpredictable working environment, ultimately lead to scaffold support failure and a decline in worker safety. However, most evidences on technological labour productivity factors and H&S hazards for construction workers come from several countries other than Uganda. Therefore, a research gap exits in understanding which specific technological labour productivity factors most influence H&S hazards for construction workers in Uganda.

2.2. Psychophysical Labour Productivity Related Factors

Psychophysical related factors especially fall from height risks, individual poor attitude, mental fatigue, cognitive overload, salary increment stagnation, demotivation and health corporate policies have been identified in the literature as primary causes that influence H&S hazards for workers on construction projects. In the study by [35] indicates that falls from height risks pose the most significant threat to construction workers, leading to severe physical consequences such as spinal cord fractures, traumatic brain injuries and death. These fall related incidents create labour shortage when skilled workers are impacted and cause unplanned work stoppages, consequently lead to construction project delays. These incidents are primarily attributed to poor fall protection systems, inadequate installation of guardrails, unsafe working environment on elevated platform and unstable scaffolding systems [11].

Similarly, [18] and [33] in their studies contend that, individual poor attitude, mental fatigue, cognitive overload, salary increment stagnation, demotivation and health corporate policies significantly undermine the H&S hazards for construction workers. Poor attitude characterized by overconfidence create workers to ignore required protective equipment and result in safety incidents ranging from minor to serious injuries. Although studies have persistently indicated that psychophysical labour productivity factors such as cognitive overload, mental fatigue, poor communication and falls from a height significantly contribute to H&S hazards for construction workers, limited research has been conducted to validate these findings within construction industry in Uganda.

2.3. Objectives of the Study

The main objective of the study was to examine labour productivity factors that influence health and safety hazards for construction workers in the building construction industry in Uganda. The study was informed by the following specific objectives.

- To establish the psychophysical labour productivity factors that affect health and safety hazards for construction workers,
- To determine the technological labour productivity factors that influence health and safety hazards for construction workers.

2.3.1. Research Hypotheses

- H_o: Psychophysical labour productivity factors do not significantly contribute to H&S hazards for construction workers in the building construction industry?
- H_a : Psychophysical labour productivity factors significantly contribute to H&S hazards for construction workers in the building construction industry?
- H_o: Technological labour productivity factors do not significantly contribute to H&S hazards for construction workers in the building construction industry?
- H_a : Technological labour productivity factors significantly contribute to H&S hazards for construction workers in the building construction industry?

3. Methodologies

3.1. Research Approach and Design

The research employed a cross-sectional design that utilized quantitative research approach. Data was collected using a five-point Likert scale questionnaire from respondents, focused on running building construction projects being managed by local construction companies.

3.2. Study Population and Sample

Local construction companies were registered with the Uganda National Association of Builders, Suppliers and Engineering Contractors (UNABSEC), ranked from A-1 through A-5 in descending order based on their annual financial capacity for contracts. A list of local construction companies including contractors' contact details, was obtained from UNABSEC, which facilitated the identification of five categories of local companies under the association. Category A-1 was made up of 28 companies, A-2 consisted of 15 companies, A-3 had16 companies, while A-4 composed of 90 firms and the last category A-5 comprised of 59 local companies, giving a total of 208. Regarding geographical distribution, 81%were located in the central region (Kampala metropolitan), 7.7% in northern (Gulu city), 8.3% in the western region (Mbarara city) and 3% in the eastern region (Mbale city). To minimize researcher bias and enhance equal participation opportunities, the researcher contacted contractors within each category to identify ongoing building construction projects.

Table 1. Study Population

UNABSEC local companies' Ranking	No. of companies	Running projects	Population sample (running proj.x 6 no. of respondents per project)	Sample size (using Stratified sampling)	No. project sampled	Sampling criteria
A-1	28	48	288	54	9	Stratified and Simple random sampling
A-2	15	26	156	30	5	
A-3	16	26	156	30	5	
A-4	90	110	660	126	21	
A-5	59	74	444	84	14	
Total	**208**	**284**	**1704**	**324**	**54**	

As presented in Table 1, a total of 284 active projects were identified. For each running project, 6 respondents participated including; Architect, construction manager, site engineer, quantity surveyor, H&S manager and general foreman. This yielded a total target population of 1,704 (284projects x 6 participants per project). The Krejcie and Morgan (1970) sample size estimation Table was used to determine the appropriate sample size of 324 respondents from the target population of 1,704. And a total of 54 running construction projects were sampled.

3.3. Study Location

The study was conducted in four regional cities of Uganda. The selection of these locations was based on the following factors: first, these cities host a high number of construction projects undertaken by local construction companies for both government and private developers in compared to other parts of the country; secondly, construction projects managed by local companies in these cities frequently experience health and safety hazards of construction workers; Third, these cities offer diverse geographical representation of Uganda broader context of construction projects, thereby enhancing the generalizability of the study findings [19,7].

3.4. Sample Selection Criterion

Simple random sampling was used to select the number of local construction companies with running projects, as this technique helps generalize findings and reduce bias [10,32]. Stratified sampling was employed to draw respondents from different strata of local construction companies, which were grouped as A-1 through A-5. Finally, within each stratum, respondents were randomly selected based on the assumption that they possessed the construction knowledge and skills relevant to study in the building construction projects.

3.5. Pilot of the Tools for Validity and Reliability

The validity test was conducted to assess the clarity and precision of the questions, this strengthens the credibility of the data collected. To establish content validity of the questionnaire items. The content validity index (CVI) was computed by dividing the number questionnaire items declared valid by the experts and the total number of items on the questionnaire. The overall CVI of 0.88 was obtained, which exceeded the recommended threshold of 0.70 [13].

Before performing a reliability test, a pilot study of the questionnaire was first conducted on a small sample drawn from the target population, excluding those who would later participate in the main survey. The purpose was to identify ambiguous and redundant items before full deployment. The reliability of the instrument was performed using Cronbach's Alpha coefficient using SPSS to assess internal consistency of responses across items. The instrument achieved an overall internal consistency reliability coefficient of 0.872 which was above the acceptable threshold of 0.7 [4].

3.6. Data Management and Data Analysis

The effect of labour productivity factors on H&S hazards among construction workers in building construction projects was established through a series of steps; a literature review was conducted to identify labour productivity factors influence H&S hazards. From this review, the following labour productivity factors were identified: technological, and psychophysical factors. Prior to data collection, these factors were validated previous using questionnaires administered to various experts in the study area. Based on their feedback, appropriate modifications were made to the factors.

Thereafter, a questionnaire constructed on a five-point Likert scale was administered to respondents. They were asked to assess each labour productivity factor based on its degree of importance in causing H&S hazards to construction workers. The scale used for this assessment was as follows: 5-strongly agree, 4-agree, 3-neutral, 2-disagree and 1-strongly disagree. Inaddition, the impact of labour Productivity factors on H&S hazards was evaluated using a separate questionnaire scale, where: 5- very severe impact on H&S ,4-severe impact, 3-moderate impact, 2-minor impact and 1-insignificant impact.

3.7. Data Analysis

All collected data were analyzed using Statistical Package for Social Science (SPSS). The relative importance index (RII) and weighted average index (Mean) for each factor were determined using equation 1 &2 from [20], after which the factors were ranked. An average relative importance index (ARII) of 0.763, Weighted mean score (mean) of 3.816 and standard deviation (SD) of 0.744 were computed and adopted as the threshold. Factors with RII and Mean values above this average were considered significant and most influential on the H&S hazards of workers in the building construction projects, as presented in tables 5&6. To validate these findings, correlation coefficients were employed to test the strength of the relationship between H&S and labour productivity factors. Finally, regression analysis focusing on the significant factors, was conducted using R-studio software to evaluate the effect of LP group factors on H&S hazards faced by workers in the building construction industry.

$$\text{RII} = \frac{\sum W}{A*N} \quad (0 \leq \text{RII} \leq 1) \tag{1}$$

Where:

$\sum W$ is the sum of weights given to each factor by the respondents and ranges from 1 to 5, (where 1 is strongly disagree and 5 is strongly agree);

A-is the highest weight (in this case 5) and;

N-is the total number of respondents.

$$\text{Weighted mean score (mean)} = \frac{\sum W}{N} \quad (1 \leq \text{M} \leq 5) \tag{2}$$

$\sum W$ is the sum of weights given to each factor by the respondents and ranges from 1 to 5, (where 1 is strongly disagree and 5 is strongly agree) and;

N-is the total number of respondents.

$$\text{Standard deviation (SD)} = \sqrt{\frac{\sum_{i=1}^{n}(w_1 - \bar{w})^2}{n-1}} \quad (3)$$

n = number of data point
w_1 = Weight for each of the values of the data point
$\bar{w}$ = the mean of w_1

4. Results and Discussion

4.1. Respondents Demographic

The study presented various demographic attributes of the respondents, such as their education level, professional title, years of experience in construction industry and the response rate achieved. A total of 324 questionnaires were distributed, 262 participants responded representing an 81% response rate. According to [4,5,16], a response rate exceeding 70 percent is deemed statistically significant, as it indicates low nonresponse bias and strengthens the generalizability of the sample to the target population [13].

4.2. Level of Education

Table 2 presents the respondents' level of education, which was analyzed to determine the extent to which education influence H&S hazards on construction projects. The findings indicate that the majority of respondents had attained a significant level of education, with only 1.91% possessed no formal qualifications. This distribution suggests that the project site personnel were generally qualified to provide reliable information regarding to the labour productivity factors that contribute to H&S hazards. This finding aligns with the argument by [3], who assert that workers with low level of education tend not to understand safety signs and safety operating procedures which significantly influence the H&S hazards of workers on construction projects.

Table 2. Respondents level of Education

Level of education	Frequency	Percentage
On-job training	5	1.91
Craft certificate	20	7.63
Diploma	35	13.36
Bachelors	154	58.78
Masters	42	16.03
PhD	6	2.29
Total	**262**	**100**

4.3. Respondents Designation

Table 3 presents designation held by respondents. The findings indicate that the majority held critical roles on the project sites such as site engineers, general foremen, construction managers, health and safety engineers among others. This level of responsibility enabled them to understand and offer informed opinions on the ground challenges that influence H&S hazards in the building construction projects across regional cities of Uganda. These findings are in line with the study by [8], which note that effective site management is a core role of site engineers who are positioned to recognize the supervisory lapses that contribute to H&S hazards.

Table 3. Respondents Designation

Respondents designation	Frequency	Percentage
Health & Safety Engineers	31	11.83
Construction managers	34	12.98
Architects	16	6.10
Site engineers	100	38.17
Quantity surveyors	11	4.20
General foremen	45	17.18
Craftsmen	20	7.63
Artisans	5	1.91
Total	**262**	**100**

4.4. Respondents Work Experience

Table 4 represents findings on respondents years of experience in the construction industry. Findings indicate that, the majority 95respondents (36.26%) had between 11 to 15years of experience, closely followed by 71respondents (27.10%) with 16 to 20 years in the field. This distribution suggests that most respondents possessed a substantial level of industry exposure, which likely enhanced their understanding of the factors influence H&S hazards for construction workers in the building construction industry.

Table 4. Respondents years of experience

Respondents years of experience in construction industry	Frequency	Percentage
Above 20 years	13	4.96
16-20 years	71	27.10
11-15 years	95	36.26
6-10 years	58	22.14
1-5 years	18	6.87
Below 1 year	7	2.67
Total	**262**	**100**

In addition, the concentration of respondents in the 11 through 20-year range suggests that respondents were well positioned to contribute informed opinions on H&S hazards for construction workers in the building construction industry in Uganda. This finding aligns with the study by [23] highlights that work experience is among the primary factors that influence the perception of H&S hazards among construction workers.

4.5. Ranking of Labour Productivity Factors that Influence H&S Hazards

The study identified various labour productivity factors that influence H&S hazards on the building construction projects in Uganda as presented in Table 5. To determine their relative significance, the analysis employed the Relative Importance Index (RII), supported by the Weighted mean score (Mean) and Standard Deviation (SD). Factors with a relative importance index (RII) above the overall average RII of 0.765 and a mean score above 3.816 were considered significant, while those falling below these thresholds were deemed less significant. The average standard deviation (SD) across all factors was 0.744; factors with values below this indicate strong consensus among respondents' perceptions, while values above it suggests divergence in opinion.

Table 5. Ranking of labour productivity related factors that influence H&S hazards

Labour Productivity Factors	Mean	SD	RII	Rank
Technological related factors				
Poor strutting of trench excavation	**4.013**	**0.626**	**0.803**	
Skills of site supervisors	4.124	0.747	0.825	1
Depth of trench to be excavated	4.045	0.364	0.809	2
Bearing capacity of the soil to be excavated	4.034	0.694	0.807	3
Design of strutting systems	4.000	0.581	0.800	4
Supervision of construction team	3.955	0.616	0.791	5
Assessment of soil type and its stability	3.920	0.754	0.786	6
Inappropriate method of trench excavation	**3.859**	**0.748**	**0.772**	
Planning and monitoring of excavation process	4.180	0.696	0.836	1
Skills of the supervisor	4.090	0.713	0.818	2
Change in trench excavation scope	3.775	0.858	0.755	3
Experience of contractor's team on construction site	3.753	0.768	0.751	4
Regulatory compliance	3.719	0.764	0.744	5
Construction team opinions on trench excavation	3.637	0.689	0.728	6
Inappropriate use of tools and equipment	**3.908**	**0.696**	**0.782**	
Skills of equipment operators	4.292	0.722	0.858	1
Training on the usage of equipment	3.966	0.626	0.793	2
Equipment maintenance and repair	3.955	0.718	0.791	3
Skills of construction project supervisor	3.865	0.722	0.773	4
Matching of equipment to different tasks	3.708	0.640	0.742	5
Manufacturer's instructions adherence	3.662	0.748	0.735	6
Ineffective support of scaffold work platform	**3.568**	**0.804**	**0.710**	
Design of scaffold supports	3.933	0.897	0.787	1
Material handling methods	3.730	0.825	0.746	2
Assembly of scaffold platform	3.697	0.756	0.739	3
Adherence to safety standards	3.629	0.784	0.726	4
Regular monitoring & repair of scaffold support	3.618	0.772	0.724	5
Loading of scaffold work platform	2.801	0.79	0.538	6
Improper use of electric cords	**3.837**	**0.771**	**0.768**	
Adequate cord design selection	4.169	0.782	0.834	1
Work practice of the contractor's team	3.888	0.841	0.778	2
Safety standards compliance	3.854	0.743	0.771	3
Use of adequate insulation material and tools	3.787	0.711	0.757	4
Competence of construction project supervisor	3.742	0.787	0.748	5
Technical skills of construction team	3.582	0.762	0.720	6
Psychophysical related factors				
Falls from a height	**3.895**	**0.729**	**0.779**	
Fall protection systems	4.326	0.731	0.865	1
Installation of guardrails	3.966	0.756	0.793	2
Working environment of workers on platform	3.831	0.707	0.766	3

Labour Productivity Factors	Mean	SD	RII	Rank
Stability of scaffolding system	3.798	0.657	0.760	4
Warning systems adherence	3.775	0.775	0.755	5
Concentration and focus	3.674	0.748	0.735	6
Individual poor attitude and mental fatigue	**3.857**	**0.695**	**0.769**	
Unsafe working conditions	4.241	0.738	0.876	1
Inadequate training	3.982	0.713	0.813	2
Personal issues	3.859	0.757	0.757	3
Long working hours	3.769	0.799	0.739	4
Poor leadership	3.701	0.677	0.726	5
Lack of recognition	3.590	0.486	0.703	6
Total Average	**3.816**	**0.744**	**0.763**	

Table 6. Ranking summary labour productivity group factors that contribute to H&S

Group factors	Mean	SD	RII	Rank
Psychophysical	3.876	0.712	0.774	1
Technological	3.837	0.729	0.767	2
Average	**3.816**	**0.744**	**0.763**	

As indicated in Tables 5 & 6, the Psychophysical related labour productivity group factor with (Mean =3.876, SD=0.712 & RII=0.774) ranked first as the most influential factor that contribute to H&S hazards. This was attributed to falls from a height with (Mean=3.895, SD=0.729& RII= 0.779), this suggest that fall protection systems, installation of guardrails on platform, working environment of workers on platform and stability of scaffolding system were perceived as the main drivers of H&S hazards. Additional contributing factor was individual poor attitude and mental fatigue with (Mean =3.857, SD=0.695 &RII=0.769), this also suggest that, unsafe working conditions, inadequate training of workforce and personal issues are the contributors of H&S hazards to construction workers in the industry. The relatively low SD of 0.712 indicates a strong consensus among the respondents. This finding aligns with the study [33] in Iran contend that, individual poor attitude, mental fatigue and cognitive overload significantly undermine the H&S of construction workers.

Also, technological related labour productivity factor (Mean=3.837, SD = 0.729 & RII =0.767) was ranked second most significant factor, that influence H&S hazards to construction workers and mainly attributed to poor strutting of trench excavation with (Mean =4.013, SD =0.626 &RII=0.803), this suggest that skills of site supervisors, Depth of trench to be excavated, design of strutting systems and assessment of soil type and its stability are the main contributors of H&S of workers on the construction projects. Its supported by relatively low SD of 0.729 indicates a strong consensus among the respondent's opinion. Additional contributing factors include inappropriate method of trench excavation triggered by planning and monitoring of excavation process and skills of the supervisors. Another contributing factor include, inappropriate use of tools and equipment attributed by skills of equipment operators, training on the usage of equipment, skills of construction supervisor and equipment maintenance and repair. These findings are consistent with [15] in U.S contend that technological factors including poor strutting of trench excavation sides, inappropriate use of tools and equipment expose workers to H&S hazards including cave-in and crush injuries.

4.6. Relationships Between Labour Productivity Factors and H&S Hazards

4.6.1. Correlation Analysis

The results presented in Table 7 examines the relationship between identified labour productivity group factors and Health & Safety (H&S) hazards using Spearman's rank correlation coefficient. The results reveal that technological factors have a strong, positive and statistically significant correlation with H&S hazards (r=0.750, p=0.000) for the construction workers. This suggests that technological group factors including Poor strutting of trench excavation, inappropriate use of tools and equipment, ineffective support of scaffold work platform among others, increase H&S hazards trend of the construction workers.

Psychophysical group factors yielded a weak positive and statistically significant correlation (r =0.375, p=0.000). This indicate that psychophysical factors including, individual poor attitude and mental fatigue, falls from a height are drivers of H&S hazards in the building construction projects in Uganda. These findings align with the studies by [2] and [3], contend that labour productivity factors particularly technological, and psychophysical related factors are the main drivers of H&S hazards of construction workers in the building construction projects.

Table 7. Labour productivity factors Rank correlation coefficient and H&S hazards

Labour productivity Factors	Correlation coefficient(r)	P-values
Technological	0.750	.000
Psychophysical	0.375	.000

4.6.2. Regression Analysis

Regression analysis was conducted to determine the effect of labour productivity factors on H&S hazards in building construction projects. The results of analysis are presented in Table 8. The significant labour productivity factors identified were considered in the analysis and a multiple linear regression analysis was performed in R-studio. Health and safety (H&S) was treated as dependent variable (Y), whereas Psychophysical and, technological group factors that influence H&S hazards of construction workers were taken as independent variables (x).

Equation of the multiple regression analysis for the health and safety (H&S) from Table 8 is given by,

$$HS = -2.263 + 0.940\ PH + 0.579\ TH \quad (4)$$

Where:

HS = Health and safety

PH = Psychophysical labour productivity factors

TH = Technological labour productivity factors

Model coefficients indicated that the psychophysical factor had a greater influence on the H&S hazards for constructionworkers, followed by technological factors as independent variables. The model's adjusted R^2 value was 0.684, which indicate that the variation of 68 percent is attributed to these labour productivity factors included in the model. This demonstrates strong model generalizability and only 32 percent of the total variation remains unexplained. Therefore, the model would serve as a good predictor of H&S hazards in building construction projects in Uganda.

(i). Model Verification

The verification of the model was conducted using both the F-statistic and p-value criterion. As shown in Table 8, the observed F- statistic value of 29.19 exceeded the critical F-statistic value of 2.525 obtained from F-distribution Table 9, which indicate that the model explains a substantial amount of variation in the dependent variable relative to error. This finding is supported by the associated p-value of 1.434e-13. Considering the large F-statistic (29.19) with the small p-value (less than 0.05), it was concluded that the regression model is statistically significant at the 95% confidence level. This suggest a significant relationship between labour productivity factors (Psychophysical and technological) and H&S hazards in the building construction projects in Uganda. This finding a aligns with the study by [29], who argued that labour productivity factors ought to be accorded high priority by those working in construction to minimise H&S hazards of construction workers and execute projects in line with the predefined plan.

(ii). Model validity

Validation of the regression model was conducted using a data-split technique. The study randomly split the dataset with 75 percent for training and the remaining 25 percent for validation. Evaluation of predictive fit involved the R squared value, alongside a comparison of the adjusted R-squared derived from both the training and validation datasets. Adjusted R-squared values were 0.684 for the training model and 0.634 for the validation model. The proximity of these values supports the model validity. [31] and [6] note that, no strict rule governs the interpretation of R squared closeness, [21,12] maintain that a difference of less than 10 percent between training and validation R-squared signifies a stable model with close agreement and thus confirming model validation. Regression model is shown in equation 4.

Table 8. Summary of regression model coefficients for H&S

Coefficients	Estimate	Std. Error	t-value	**Pr(>|t|)**
(Intercept)	-2.26348	0.53964	-4.194	9.01e-05***
Psychophysical	0.94012	0.19447	4.832	9.49e-06***
Technological	0.57926	0.15494	3.739	0.000411***
Residual standard error: 0.2409 on 61 degrees of freedom				
Multiple R-squared: 0.7418		Adjusted R-squared: 0.6845		
F-statistics: 29.19 on 4 and 61 df,		p-value: 1.434e-13		
F- value critical = 2.5252 on 4 and 61 df		t-value critical = 1.9995		

Table 9. F-Distribution [9]

CRITICAL VALUES FOR THE F-DISTRIBUTION WITH $\propto$ =0.05							
Denominator df2	1	2	3	4	5	6	7
1	161.447	199.500	215.707	224.583	230.161	233.986	236.768
2	18.512	19.000	19.164	19.246	19.296	19.329	19.353
3	10.128	9.552	9.276	9.117	9.013	8.94	8.886
30	4.170	3.315	2.922	2.689	2.533	2.420	2.334
40	4.084	3.231	2.838	2.608	2.449	2.335	2.249
60	4.001	3.150	2.758	2.525	2.368	2.254	2.166
120	3.920	3.071	2.680	2.447	2.289	2.175	2.086

5. Conclusions

The main objective of this investigation was to assess the influence of labour productivity factors on H&S hazards for construction workers in the building construction industry in Uganda. The relative importance index (RII) was computed for each factor and the resulting values were ranked to identify those with the greatest significance. Psychophysical factors emerged as the most influential, ranked first, followed by technological factors. These findings are supported by correlation coefficient analysis for each factor which revealed that Psychophysical and technological factors, had a strong positive correlation with H&S hazards on the construction workers in the building construction projects.

Additionally, the regression analysis considered only the significant factors, from which a multiple linear regression was developed. Results found out that psychophysical and technological factors had a statistically significant impact on H&S hazards for construction workers. The effect of these factors is reflected in the adjusted R-squared value of 0.684, which indicates that 68 % of the variation in H&S model is attributed to labour productivity factors. The study concluded that, there is significant relationship between H&S risks and labour productivity factors in the building construction industry in Uganda.

This study focused on technological and psychophysical labour productivity related factors that influence H&S hazards among construction workers. Regarding psychophysical aspects, the research concentrated on falls from a height, poor individual attitudes and mental fatigue. However, the findings suggest that future research should place emphasis on psychophysical labour productivity factors that contribute to H&S hazards such as salary increments, worker motivation and health corporate policies.

REFERENCES

[1] Abas, N.H., Noridan, M.R., Hanafi, M., Abas, N.A., & Ibrahim, N.Q. (2020). Causes of Accidents Involving Scaffolding at Construction Sites. Journal of Technology Management, 7(1), 75-86.

[2] Abhyankar, V.E., & Narayanan, S. (2021). Foundation Stability of Existing Buildings near Upcoming Structures, 26(8).

[3] Adebowale, O. J., & Agumba, J. N. (2024). A Systematic Review of Challenges Undermining the Efficacy of Construction Health and Safety Regulations in Major African Countries. Construction Economics and Building, 24(No.4/5), 1-24.

[4] Amin, M. E. (2005). Social Science Research: Conception, Methodology and Analysis. Makerere University Press, Kampala.

[5] Anas, N., & Ishaq, K. (2022). Qualitative Research Methods in Social and Behavioural Science Research. International Journal of Management, Social Science, Peace and Conflicts Studies, 5(1), 89-93.

[6] Arkes, J. (2026). Regression Analysis; A practical Introduction; Third Edition (3rd ed.). Routledge, Taylor and Francis.

[7] Bohara, B.K. (2020). Work Place Health and Safety Concern of Workers in Nepal: A Review. Journal of Advanced Research in Civil and Environment Engineering, 7(2), 20-27.

[8] Canton, H. (2021). International Labour Organization (ILO). In the Europa Directory of International Organizations. Routledge.

[9] Chattamvelli, R., & Shanmugam, R. (2022). F Distribution. In Continuous Distributions in Engineering and the Applied Sciences-Part II. Cham: Springer International Publishing., 227-234.

[10] Cresswell, J.W., & Cresswell, D. J. (2018). Research Design; Qualitative, Quantitative and Mixed Methods Approaches (5th ed.). SAGE Publications Ltd.

[11] Dinata, E., Pramayogi, K. S., Asnaning, A.R., & Agustina, R. (2025). Comparative Analysis of HIRARC and HIRADC Methods in Occupational Safety Risk Management for Girder Erection Projects. Indonesian Journal of Environment and Sustainability, 2(1), 20-30.

[12] Dobson, A.J., & Barnett, A.G. (2018). An Introduction to Generalized linear Models (2nd ed.). Chapman and Hall/CRC.

[13] Dubey, U.K. B., & Kothari, D. P. (2022). Research Methodology; Techniques and Trends (1st ed.). Chapman and Hall/CRC Press.

[14] Giri, O.P. (2020). Factors Causing Health and safety Hazards at Construction Sites. Technical Journal, 2(1), 68-74.

[15] Hameen, E.C., Singh, S., Priyadarshini, S., & Shi, Z. (2024). SETU: Safety in Excavation and Trenching, for you; A Training and Decision-making Tool for Workers Safety in Excavation and Trenching Operations in Construction.

[16] Holtom, B., Baruch, Y., Aguinis, H., & Ballinger, G. (2022). Survey response rates: Trends and a validity assessment framework. Human Relations, 75(8), 1560-1584.

[17] Hughes, P., Ferrett, E., & MBE, P.H. (2021). International health and safety at work: For the NEBOSH international general certificate in occupational health and safety. Routledge.

[18] Jagtap, D., & Tidke, A. (2019). Factors affecting labour productivity in building construction. JETIR, 6(3), 162-166.

[19] Kiconco, A., Ruhinda, N., Halage, A. A., Watya, S., Bazeyo, W., Ssempebwa, J.C., & Byonanebye, J. (2019). Determinants of occupational injuries among building construction workers in Kampala City, Uganda. BMC public Health, 19(1), 1444-1456.

[20] Kishan, P., Bhatt, R., & Bhavsar, J.J. (2015). Developing ranking of risk factors and risk management actions, Affecting building construction projects in Gujarat. International Journal of advance engineering and research, 2(5), 1472-1482.

[21] Kleinbaum, D. G., Kupper, L. L., Muller, K. E., & Nizam, A. (2008). Applied regression analysis and other multivariable methods (4th ed.). Cole Publishing Company.

[22] Mayanja, L. N., Ddamulira, C., Katamba, P., & Mutekanga, D. R. (2022). Determinants of compliance to occupational health and safety measures in construction sites in Kampala central division, Kampala city, Uganda. World journal of advanced

research and reviews, 14(02), 475-491.

[23] Meng, Q., Liu, W., Li, Z., & Hu, X. (2021). Influencing factors, mechanism and prevention of construction workers' unsafe behaviors: Asystematic literature review. International journal of Environmental research and public health, 15(5), 2644-2654.

[24] Momade, M.H., Shahid, S., Rosli, M., Nashwan, M. S., & Umar, A.T. (2022). Modelling labour productivity using SVM and RF: a comparative study on classifiers performance. International Journal of construction management, 22(10), 1924-1934.

[25] Moyo, T., Crafford, G., & Emuze, F. (2022). Sustainability learning for improved safe work environments for construction semi-skilled workers in Zimbabwe. Built Environment project and Asset management. 12(6), 940-955.

[26] Mudiyanselage, R., & Gayan, A. (2024). Aproductivity measurement framework for construction projects. University of Cambridge.

[27] Murianka, S., Njuguna, M., & Wachira-Towey, N. (2024). Predictive Model for project Construction labour productivity versus flow of project materials and components. 1-11.

[28] Musa, B. (2022). Investigating health and safety problems in relation to training and recruitment of workers on construction sites (Doctoral dissertation, Makerere University).

[29] Mutekanga, D. (2022). Determinants of compliance to occupational health and safety measures in construction sites Kampala Central Division, Kampala city, Uganda. CERN European organization for nuclear research-zenodo.

[30] Olutende, M., Edwin, P., Wamukoya, K., Wanzala, M., & Wabuyabo, I. K. (2021). Predictors of occupational health and safety management practices in the building construction industry, Kakamega Kenya. IOSR-JNHS, 10(2), 43-57.

[31] Palmer, P., & Connell, D.O. (2009). Regression Analysis for prediction: Understanding the process. Journal of cardiopulmonary physical therapy, 20(3), 21-26.

[32] Rahman, M.M., Tabash, M. I., Salamzadeh, A., Abduli, S., & Rahaman, M.S. (2022). Sampling Techniques (Probability) for quantitative social science researchers: A conceptual guidelines with examples. Seeu Review, 17(1), 42-51.

[33] Taherpour, F., Ghiasvand, E., & Namian, M. (2021). The effect of fatigue on safety attitude, hazard recognition and safety risk perception among construction workers. Amirkabir Journal of civil engineering, 53(8), 3299-3316.

[34] Van Tam, N., Quoc Toaan, N., Tuan Hai, D., & Le Dinh, N. (2021). Critical factors affecting construction labour productivity: A comparison between perceptions of project managers and contractors. Cogent business & management, 8(1), 1-17.

[35] World health organization, (2021). Step safety: Strategies for preventing and managing falls across the life-course. World health organization.