

Study of the Impact of Management Skills on Labour Productivity in the Building Construction Industry in Uganda

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Abstract: The construction industry plays a significant role in integrating the economy of any developing country. It is also noted that the increasing rate of building construction projects has led to the increasing demand of competent first line managers in the building construction industry, who possess the right skills to effectively manage and supervise construction projects. First line managers' incompetence leads to cost and time overruns as well as poor quality work thus affecting labour productivity. This study investigated the impact of management skills on the productivity in the building construction industry in Uganda. Both quantitative and qualitative research approaches were used to collect data from 155 respondents who were purposively selected. Management skills were categorized under three groups: conceptual, interpersonal and technical skills. Their impacts were assessed using Relative Importance Index (RII) as a basis for analysis. Regression analysis in R-Studio software was employed to develop a model, to be used in prediction and to forecast the impact of construction management skills on labour productivity during building construction stages. Findings revealed technical skills as the most significant management skills, followed by interpersonal skills and lastly conceptual skills. Model results showed existence of a fairly strong correlation between construction management skills and productivity. Based on the model results, the study concluded that there is significant impact of construction management skills on labour productivity in the building construction industry. It is recommended that adequate attention should be paid to training, retraining and continuous professional development of people charged with supervisory roles on construction sites so as to achieve higher construction workers productivity.

Keywords: Management Skills, Productivity, Building Construction, First Line Managers

1. Introduction

Construction industry plays a significant role in integrating economies of developing countries. Increase in demand of the building construction projects lead to economic growth and development. However, in developing countries such as Uganda, building construction projects are still executed using labour intensive methods [2, 27]. Low labour productivity is one of the challenges faced in building construction projects. This partially explains the reasons behind the big number of uncompleted and abandoned buildings, poor quality work, cost and time overruns as a result of low labour productivity [1]. This is caused by a number of factors including harsh weather conditions, lack of

tools, poor foundation designs, inaccurate drawings, variation orders from consultants, construction management skills of first line managers (FLMs) among others.

First line managers included project managers, construction managers, site managers, general foremen and health and safety managers.

Previous studies by Long et al. [16] and Ouko [21], indicate that incompetence of FLMs is one of the critical problems leading to low labour productivity of the construction industry in developing countries.

In addition, building construction in Uganda is labour oriented industry. It heavily relies on the construction management skills of its workforce such as construction managers, project managers and other supervisors [1]. These

managers, do not possess the required construction management skills which leads to low productivity. Therefore, the construction management skills competence of FLMs needs to be one of the first priority considerations in executing construction projects.

The main goal of the study was to examine the impact of construction management skills (CMS) on labour productivity (LP) in the building construction industry. It was achieved through, characterisation of CMS that affect LP, establishment of the impact of CMS on LP and determining the relationship between CMS and LP in the building construction industry.

Productivity loss is one of the severe problems faced by building construction practitioners [10]. Less emphasis has been put on labour productivity and most of the building construction companies pay attention to equipment, technology and materials productivity components as the most- risk cause of low productivity [1]. Inadequate CMS of the FLMs contributes to low labour productivity. This study was conducted to suggest strategies towards improving CMS of FLM to enhance labour productivity in the building construction industry.

2. Construction Management Skills in the Building Construction Industry

Construction management skills are obligatory ingredients for efficiency and effectiveness of all managers to become enhanced leaders and motivate employees for increased construction labour productivity. These enable them accomplish the vision and missions of construction companies to meet the stipulated goals and objectives of the projects [13, 25]. Furthermore, Katz [13] and Seyedinejat et al. [26] argued that, what a manager can achieve in production is based on the skills that the manager exhibits through learning and practical experience.

2.1. Conceptual Management Skills

These refer to the ability to co-ordinate and integrate all of the building construction organization's interests and activities. These are skills of an individual's ability to think beyond the obligation at hand. Managers with a high level of conceptual skills have the mental capacity to understand various cause and effect relationships in the building construction organization and to view the organization in a holistic manner [26]. The conceptual skills help mostly top managers like chief executive officers, Managing directors and General managers to look outside their department's goals and make decisions that will satisfy overall building construction company goals. These skills are vital for top managers, less critical for middle managers, and to some extent are required for first line managers. The conceptual management skills include: decision-making, analysis,

communication, creative thinking, leadership, problem solving, planning, motivation and Listening skills [25, 26].

2.2. Interpersonal Management Skills

Interpersonal management skills are the skills that involve the ability to interact, work or relate effectively with people. They enable the managers to make use of human potential in the company and motivate the employees for better results [9]. According to Peterson and Vanfleet [23], defined interpersonal skills as the ability to work cooperatively with others, to communicate effectively, to resolve conflict and to be a team player. Interpersonal skills are essential for all hierarchical levels in the building construction company because one of the most critical role of manager tasks is to work with people. Without people, there will be no need for the existence of management and managers [23]. According to Zadeh et al. [33], interpersonal management skills include: problem-solving, self-confidence and self-control, time management, active listening, negotiation, communication, reliability, leadership, openness to feedback, delegation, public speaking, political awareness, goal orientation, team work, flexibility and dispute resolution skills.

2.3. Technical Management Skills

These are skills necessary to accomplish specialized activities of the first line managers (Operation manager, Project manager, Site manager, Foreman, Construction manager, Supervisor and Health and safety manager). These skills incorporate the ability to use procedures, techniques and knowledge of a specialized field. First line managers have to possess technical skills as they are responsible for the day to day running of the building construction projects [26]. These technical management skills are obtained through formal education training and on-job experience. These skills involve understanding and proficiency in a specific kind of activity, particularly involving methods, process, procedures, techniques and skills in the specific areas of responsibility. They are most important for both middle line and first line managers. For the top managers, these skills have low significance level, as we move through a hierarchy from the bottom to higher levels of management [26, 9]. Project managers, construction managers, site managers all need specific technical skills to perform their building construction tasks. According to Zadeh et al.[33], technical management skills include: planning, scheduling, good communication, problem solving, decision-making, motivation, estimation, time management, teamwork, procurement, contractual, safety management, risk assessment, good knowledge of building methods, knowledge of project close out and regulations skills.

3. Methodology

3.1. Research Method

Research in construction is usually carried out through experiments, surveys or case studies [8]. Experiments on construction management skills that affect labour productivity in the construction building industry would take

a long time to yield results and they are difficult to control and would be expensive. Surveys through questionnaires were found suitable because of the relative easiness of obtaining standard data appropriate for accomplishing the objectives of this study. Surveys are one of the most commonly used methods of data collection in qualitative research. The survey procedure of random sampling processes allows a relatively small number of people to represent a much larger population [4].

3.2. Study Population

The study population comprised of building construction first line managers (project managers, construction managers, site managers, health and safety managers and general foremen) who work with local building construction company grades from A-1 to A-5, registered with Uganda National Association of Building and Civil Engineering Contractors (UNABCEC). It is a voluntary and non-political association established by federation of Uganda employers to defend interests and set standards of building and civil engineering contractors in the Uganda construction industry.

These local construction companies are classified by UNABCEC with respect to their annual contractual capacity and ability to execute the project to completion. Class A-1 are companies with annual contractual capacity above 10 billion, class A-2 companies with annual contractual capacity between 5 billion to 10 billion, class A-3 companies with annual contractual capacity between 2.5 billion to 5 billion, followed by class A-4, companies with annual contractual capacity between 500 million to 5 billion lastly class A-5 companies with annual contractual capacity below 500 million Uganda shillings. Numbers of companies in their respective grades are presented in Table 1 from the list the researcher obtained from UNABCEC.

Purposive, stratified and simple random sampling techniques were employed to limit researcher bias and increase equal chance of companies and participants being chosen. Sample size was determined using equations (1 and 2) [15].

$$\text{Sample size } (n_0) = \frac{Npqz^2}{\varepsilon^2(N-1) + pqz^2} \quad (1)$$

$$n = \frac{n_0}{1 + \frac{n_0 - 1}{N}} \quad (2)$$

Where: N is the population size, n_0 is the sample size of the population, n is the adjusted sample size of the population, Z is the value (1.96 for 95 percent confidence interval), p is the degree of success among the elements of the population (0.5), q is the degree of failure among the elements of the population (1-p) and ε is the desired level of precision (5 percent).

$$\text{Sample size } (n_0) = \frac{89 \times 0.5 \times 0.5 \times 1.96^2}{0.05^2(89-1) + 0.5 \times 0.5 \times 1.96^2} = 73 \text{ companies}$$

$$n = \frac{73}{1 + \frac{73-1}{89}} = 41, \text{ the sample size of 41 companies was}$$

obtained and it was used in this study as shown in Tables 1 and 2.

Table 1. Company study population.

Grades	No. of companies	No. of firms chosen	Sampling technique
A-1	13	6	Stratified and random sampling
A-2	15	7	
A-3	9	4	
A-4	22	10	
A-5	30	14	
Total	89	41	

3.3. Data Collection Method

The method used for data gathering was a questionnaire survey using structured survey approach and the respondents expressed their opinions in answering the questions. This approach is a widely-used research technique for quick and efficient gathering data from a population under study [6].

The questionnaire was designed based on construction management skills from literature review and validated by three respondent experts in the study field. The questionnaire comprised of closed-ended questions, constructed using a five point Likert scale for the purpose of easy statistical analysis.

3.4. Pilot Studies

The validation of the questionnaire was addressed by conducting a pilot study with participation of three respondent experts in the study field. Based on their responses, modifications were made and the second phase of the pilot study was conducted on five building construction project FLMs who were later excluded in the final survey. The questionnaire was then adjusted based on comments received from the second pilot study and the tool was distributed to the respondents in the field for data collection.

3.5. Sample Selection

Simple random sampling was used by the researcher to select the number of local construction companies. Simple random sampling was used because it generalizes findings and reduces bias [5]. FLMs, who participated in this study, were purposively selected because they were thought to have construction skills and specialized knowledge in building construction projects.

3.6. Survey Response

The respondents were requested to rank the construction management skills affecting labour productivity according to the degree of importance (1-strongly disagree, 2-disagree, 3-Neutral, 4-agree and 5-strongly agree). Data was analysed using Relative Importance Index (RII).

Table 2. Respondents from each company grade.

Grades	Desired no. of companies (S)	No. of participants	Sampling Technique
A-1	6	30	Purposive sampling
A-2	7	35	
A-3	4	20	
A-4	10	50	
A-5	14	70	
Total	41	205	

The RII was computed using equation (3).

$$RII = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N} \quad (3)$$

Where: n_1 is the number of participants who answered “strongly disagree”; n_2 is the number of participants who answered is “agree”; n_3 is the number of participants who were “neutral”; n_4 is the number of participants who answered “agree”; n_5 is the number of participants who answered “strongly agree” and N is the total number of respondents.

The Relative importance index (RII) for all construction management skills was computed. In addition, the group RII was computed by taking the average of construction management skills in each category of conceptual, interpersonal and technical construction management skills. The researcher used the average RII for every category of management skills in this study as a baseline to determine significant and insignificant management skills.

All management skills that were considered significant were used as inputs in model development. The cost, time and quality models' coefficient, represents the amount of change in the dependent variable when there is unit change in one of the independent variables while other variables are held constant. These models are useful to building construction practitioners in making predictions of the relationship between construction management skills of FLMS and improved labour productivity.

3.7. Data Reliability

Reliability means low measurement error and indicates the extent to which similar measurements procedure yields repeatable and consistent results [6]. The internal consistency of measuring instrument is considered acceptable when Cronbach's alpha (α) coefficient of test items is greater than 0.7 [6].

In this study, the internal consistency of the survey instrument was determined using Cronbach's alpha equation (4).

$$\text{Cronbach's alpha } (\alpha) = \frac{n}{n-1} \left(1 - \frac{\sum_{i=1}^n V_i}{V_T} \right) \quad (4)$$

Where: n is the number of questions, V_T is the variance of total questions score, and V_i is the variance of scores on each question.

Study findings are presented in the Table 3. The average Cronbach's alpha of 0.89, indicate acceptable strength of internal consistency of the instrument.

Table 3. Reliability test results.

Management skills	n	$\sum_{i=1}^n V_i$	V_T	Cronbach's (α)
Conceptual skills	13	6.706	30.738	0.847
Interpersonal skills	17	11.137	80.224	0.915
Technical skills	13	8.545	52.797	0.908
Average alpha				0.89

3.8. Content Validity

It refers to a degree of the designed measuring instrument procedure accurately cover and capture the specific concept that the researcher is attempting to measure [6]. In this study, the content validity of the questionnaire was addressed by conducting a pilot study with participation of three respondent experts for questionnaires in the same field. Based on their responses, modifications were made and the second phase of the pilot study was conducted on five building project first line managers, none of those participated in the final survey. The questionnaire was then adjusted based on comments received from the second pilot study and the tool was validated and distributed to the respondents in the field for data collection. The content validity index (CVI) of the tool was determined using equation (5) [15].

$$CVI = \frac{NA}{NI} \quad (5)$$

Where: NA is the number agreed of respondents

NI is the number of items of all respondents

According to Creswell and Creswell [6], indicate that, validity index values range from 0 to 1 and a minimum CVI of 0.7 is recommended. The closer CVI of an item to 1 the better results and the more relevant to the indicator of accuracy. The results are presented in Table 4. The average CVI of 0.946, indicate adequate strength of validity of the instrument.

Table 4. Validity test results.

Management skills	N of respondents	Content validity index
Conceptual skills	143	0.923
Interpersonal skills	147	0.948
Technical skills	150	0.968
Average (V)		0.946

4. Results and Discussion

4.1. Response Rate

In this study, a total of 205 questionnaires were distributed to the respondents and total responses received were 155 giving a response rate of 76 percent. The desirable survey response rate for qualitative research lies between 60 percent to 80 percent [4, 6].

4.2. Characterization of Management Skills That Affect Productivity in the Building Construction Industry.

The study undertaken established three categories of construction management skills which include: technical skills rated number one with 36 percent, followed by interpersonal skills rated number two with 32 percent and conceptual skills rated number three with 31 percent as shown in Figure 1. This finding is in line with similar studies by Katz [13]; Robbins et al. [25] and Seyedinejat et al. [26] who emphasized that first line managers require more of technical skills followed by interpersonal skills and less conceptual skills.

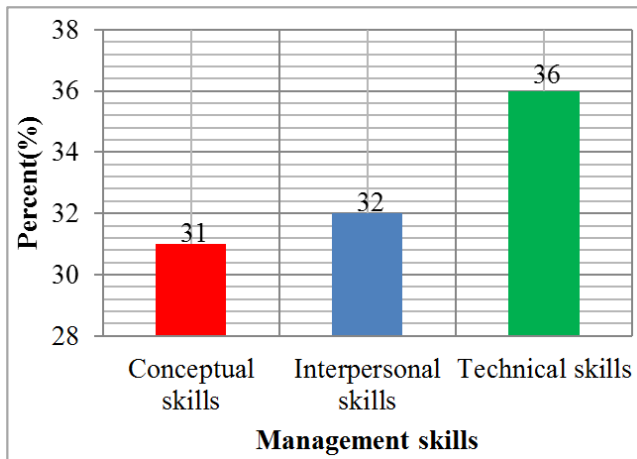


Figure 1. Categories of management skills.

4.2.1. Technical Related Construction Management Skills

Table 5 illustrates the ranking of 13 related construction technical management skills. The researcher computed average RII=0.840 and decided that those technical construction management skills with RII above 0.840 were considered significant and those below were considered insignificant. The results indicate that most significant construction technical skills negatively affecting labour productivity were construction material and equipment utilization (RII=0.906) followed by plan interpretation (RII=0.891), knowledge of green and sustainable construction (RII=0.872), Knowledge of construction operations (RII=0.871), operational planning (RII=0.846), managerial knowledge and experience (RII=0.839) and knowledge of project closure out (RII=0.837).

Research findings from Ghalandari [9] and Zadeh *et al.* [33], highlighted that FLMS require more construction technical skills to be able to manage building construction projects and less significant to middle and top construction managers. However, this was found to disagree with findings by Mostafa *et al.* [19], who ranked managerial knowledge and experience number one followed by performance evaluation in Iran whereas in Uganda are considered insignificant. This may be explained by the level of technology used in that country, unlike Uganda where more manual labour construction methods are commonly used.

Table 5. Technical related construction management skills.

Technical Skills	RII	Ranking
Construction materials & equipment utilization	0.906	1
Plan interpretation	0.891	2
Knowledge of green & sustainable construction	0.872	3
Knowledge of construction operations	0.871	4
Operational planning	0.846	5
Managerial knowledge & experience	0.839	6
Knowledge of project closure out	0.837	7
Computer skills	0.822	8
Estimating skills	0.819	9
Safety and health hazards Identification	0.819	9
Scheduling	0.811	11
Proficiency in construction IT	0.808	12
Evaluation of performance	0.781	13
Average RII	0.84	

4.2.2. Interpersonal Related Construction Management Skills

Table 6 presents the ranking of 17 related construction interpersonal management skills. The researcher computed average RII=0.742 and decided that those interpersonal construction management skills with RII above 0.742 were considered significant and those below were considered insignificant.

Table 6. Interpersonal related construction management skills.

Interpersonal Skills	RII	RANKING
Desire to learn	0.814	1
Supervision	0.777	2
Time management	0.771	3
Problem solving	0.769	4
Report generation	0.766	5
Teamwork	0.761	6
Communication Skills	0.755	7
Controlling conflicts	0.754	8
Conducting a meeting	0.746	9
Delegation of authority	0.746	9
Creativity	0.743	11
Openness to feedback	0.728	12
Motivation	0.719	13
Reliability	0.694	14
Self- confidence	0.693	15
Listening ability	0.689	16
Good temper	0.684	17
Average RII	0.742	

The results show that the most significant construction interpersonal management skills negatively affecting labour productivity were: desire to learn with RII=0.814 followed by supervision with RII=0.777, time management with RII=0.771, problem solving with RII=0.769, report generation with RII=0.766, teamwork with RII=0.761, communication skills with RII=0.755, controlling conflicts with RII=0.754, conducting a meeting with RII=0.746, delegation of authority with RII=0.746 and creativity with RII=0.743. Other interpersonal skills considered insignificant were: openness to feedback with RII=0.728, motivation with RII=0.719, reliability with RII=0.694, self- confidence with RII=0.693, listening ability with RII=0.689 and good temper with RII=0.684.

These findings agree with research findings from Seyedinejat *et al.* [26] and Zadeh *et al.* [33] who emphasized that FLMS require more construction interpersonal skills to easily manage building construction projects and more significant to middle and top construction managers. However, this differ from findings by Ogunsanmi [20] of Nigeria and Mostafa *et al.* [19] of Iran who ranked good-temper number one followed by communication skills whereas in Uganda good-temper was considered insignificant while communication skills are considered significant ranked number seven. This may be explained by level of education of the workers in that country, unlike Uganda where both formal and informal levels of education are still applicable. The next section discusses conceptual construction management skills.

4.2.3. Conceptual Related Construction Management Skills

Table 7 presents the ranking of 13 construction conceptual management related skills. The researcher computed average RII=0.724 and decided that those conceptual construction management skills with RII above 0.724 were considered significant and those below were considered insignificant.

Table 7. Conceptual related construction management skills.

Conceptual skills	RII	RANKING
Strategic Planning	0.872	1
Time Management	0.831	2
Decision Making	0.783	3
Problem Solving	0.774	4
Critical thinking	0.738	5
Discipline	0.726	6
Creativity	0.697	7
Leadership	0.694	8
Mental stability	0.687	9
Prediction Ability	0.680	10
Complex Situation Diagnosis	0.662	11
Goal Making	0.637	12
Delegation	0.632	13
Average RII	0.724	

The results indicate that the most significant construction conceptual management skills negatively affecting labour productivity were: strategic planning with RII=0.872 followed by time management with RII=0.831, decision making with RII=0.783, problem solving with RII=0.774, critical thinking with RII=0.738 and discipline with RII=0.726. Other conceptual skills considered insignificant were: creativity with RII=0.697, leadership with RII=0.694, mental stability with RII=0.687, prediction ability with RII=0.68, complex situation diagnosis with RII=0.662, goal making with RII=0.637 and delegation with RII=0.632.

The study findings are in agreement with similar studies by Robbins et al. [25] and Seyedinejat et al [26] who highlighted that FLMs require some conceptual skills to be able to manage building construction projects and more significant to top managers. However, this was differing from findings by Ogunsanmi [20] and Mostafa et al [19] who ranked discipline as number one followed by creativity in Iran whereas in Uganda discipline was considered significant ranked number six while creativity was considered insignificant. This may be explained by level of education of the workers in that country, unlike Uganda where both formal and informal level of education are still applicable.

4.3. The Impact of Construction Management Skills on Productivity in the Building Construction Industry

Table 8 presents the ranking of 7 related impacts of construction management skills on labour productivity. The researcher computed average RII=0.720 and decided that those impacts of construction management skills on labour productivity with RII above 0.720 were considered significant and those below were considered insignificant.

Table 8. Impacts of construction management skills on productivity.

Impact of management skills on labour productivity	RII	RANKING
Increased contractual dispute	0.754	1
Poor quality work	0.746	2
Time overrun	0.730	3
Cost overrun	0.721	4
Building failure	0.708	5
Projects cancellation	0.705	6
Projects abandonment	0.676	7
Average RII	0.720	

The results in Table 8 show that the most significant impacts negatively affecting labour productivity were increased contractual dispute with RII=0.754 followed by Poor quality work with RII=0.746, time overrun with RII=0.730 and cost overrun with RII=0.721. Other impacts considered insignificant were: building failure with RII=0.708, Projects cancellation with RII=0.705 and Projects abandonment with RII=0.676. These significant impacts should be well managed by construction practitioners. If they are not properly managed contractual dispute as an impact can easily break the relationship among the participants. More so, affect work quality and consequently may lead to project contract termination. Poor quality work suddenly destroys client-contractor relationship, leads to work rejection by the client which may cause increased project cost on the side of the contractor through some rework on the process to meet standards agreed in the contract. Time and cost overruns means the failure to complete building construction project in targeted time and budgeted cost as agreed in contract. The occurrence of these impacts the project may go beyond accomplishment date and budgeted cost that parties agreed upon for delivery of building construction project which leads to productivity loss in terms of profits to the parties.

This implies that FLMs should have control on the level of contractual dispute, quality of work, costs and time to be able improve on the level of labour productivity which is in line with findings from Rahman et al. [24] who stated that contractual disputes, quality work, cost and time are crucial for FLMs to improve on the level of productivity. However, this was differing from findings by Vaardini et al.[31] who ranked cost overrun number one whereas in Uganda it was considered significant ranked number four. This may be explained by technology used in that country, unlike Uganda where intensive labour methods are practiced more than mechanized methods.

4.4. Relationship Between Construction Management Skills and Labour Productivity (Cost, Time and Quality) in the Building Construction Industry

Regression models illustrating the relationship between labour productivity and construction management skills were developed. The data collected from respondents were analysed using R-studio computer package software and the following results in Tables (9, 10 and 11) were obtained. In regression analysis the labour productivity was presented as

(Y) dependent variable. The independent variables were presented as TS, IS and CS for technical, interpersonal and conceptual skills respectively. The estimated labour productivity was found to be statistically significant (significance p-values were less than 0.05). It is supported by R-squared of 0.9076, 0.8792, 0.9366 for cost, time and quality models respectively; they indicate a stronger significant effect of independent variables on productivity. It was established that, technical skills had the most significant positive impact on labour productivity. Equation 6 indicates that, the unit change in technical skills while holding

conceptual and interpersonal skills constant produces an increase of 2.3029 units of productivity in terms of costs, equation 7 indicates that, the unit change in TS while holding IS and CS constant produces an increase of 2.126 units of productivity in terms of time and equation 8 indicates that, the unit change in TS while holding IS and CS constant produces an increase of 3.342 units of productivity in terms of quality. Also a unit change in IS and TS while holding other predictors constant, the effect can be seen in the regression model equations (6, 7 and 8).

Table 9. Model summary of construction management skills and labour productivity in terms of cost.

	Estimate	Std. Error	t-value	Pr (> t)
Intercept	307.2704	200.0338	1.536	0.18511.
Conceptual skills (CS)	-3.8005	0.9331	-4.073	0.00961 *
Interpersonal skills (IS)	2.1813	0.4008	5.443	0.00284**
Technical skills (TS)	2.3029	0.5578	4.129	0.00909**
Significant codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			
Residual standard error: 15.61 on 5 degrees of freedom				
Multiple R-squared: 0.9076			Adjusted R-squared: 0.8522	
F-statistics: 16.37 on 3 and 5 df,			P-value: 0.005108	
t-value critical (t_{crit})=2.571			F-value critical (F_{crit})=5.41 on 3 and 5 df	

Table 10. Model summary of construction management skills and labour productivity in terms of time.

	Estimate	Std. Error	t-value	Pr (> t)
Intercept	208.5462	221.3586	0.942	0.38939.
Conceptual skills (CS)	-2.9707	1.0326	-2.877	0.03471*
Interpersonal skills (IS)	1.6913	0.6172	2.740	0.04078*
Technical skills (TS)	2.1258	0.4435	4.793	0.00491**
Significant codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			
Residual standard error: 17.27 on 5 degrees of freedom				
Multiple R-squared: 0.8792		Adjusted R-squared: 0.8067		
F-statistics: 12.13 on 3 and 5 df,		P-value: 0.009881		
t-value critical (t_{crit})=2.571		F-value critical (F_{crit})=5.41 on 3 and 5 df		

Table 11. Model summary of construction management skills and labour productivity in terms of quality.

	Estimate	Std. Error	t-value	Pr (> t)
Intercept	-22.7241	222.5682	-0.102	0.92359
Conceptual skills (CS)	-4.1558	1.0218	-4.067	0.01526*
Interpersonal skills (IS)	2.0738	0.4461	4.648	0.00967**
Technical skills (TS)	3.3422	0.6206	5.385	0.00575**
Significant codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			
Residual standard error: 16.88 on 4 degrees of freedom				
Multiple R-squared: 0.9366		Adjusted R-squared: 0.889		
F-statistics: 19.68 on 3 and 4 df,		P-value: 0.007385		
t-value critical (t_{crit})=2.776		F-value critical (F_{crit})=6.59 on 3 and 4 df		

Equations of the multiple regression models of labour productivity in terms of cost, time and quality from Table (9, 10 and 11) are given by:

$$\text{Prod}_{(C)} = 307.270 - 3.801 \text{ CS} + 2.18 \text{ IS} + 2.303 \text{ TS} \quad (6)$$

$$\text{Prod}_{(T)} = 208.546 - 2.971 \text{ CS} + 1.691 \text{ IS} + 2.126 \text{ TS} \quad (7)$$

$$\text{Prod}_{(Q)} = -22.724 - 4.156 \text{ CS} + 2.074 \text{ IS} + 3.342 \text{ TS} \quad (8)$$

Where:

$\text{Prod}_{(C)}$ =labour productivity in terms of cost,

$\text{Prod}_{(T)}$ =productivity in terms of time,

$\text{Prod}_{(Q)}$ =the productivity in terms of quality, CS is the conceptual skills, IS is the Interpersonal skills and TS is the Technical skills.

4.4.1. Model Verification

The researcher verified the model using the following approach. The overall fit of the model was checked by looking at model F-value and the associated p-value to confirm model significance. The greater the observed F-value than the F-value critical from F-distribution in Table 12, the more strongly significant and vice versa [4, 14, 6].

It is observed from Tables (9, 10 and 11) that F- ratio statistics computed values are 16.37, 12.13 and 19.68 are greater than critical values of F-distribution of 5.41, 5.41 and 6.59 respectively obtained from Table 12, indicate that, the overall models are relatively strongly significant.

It is supported by low p-values less 5 percent level of significance which shows high significance for the regression models at 95 percent confidence. This explains that there is a

significant relationship between the management skills and labour productivity in building construction industry in Uganda. This finding is in agreement with studies by Ullah et al. [30] and Vaardini et al. [31] who stated that technical skills are highly required by FLMs to improve on the cost variations between actual project cost and predicted project cost.

Model predictors with probability value less than 5 percent indicate that those terms are statistically significant. From the R-studio results, the three variables studied conceptual, interpersonal and technical skills were found to have significant effect on labour productivity. The statistical significance is supported by critical t-values of 2.571 and 2.771 indicated in Table 13 which are less than observed t-values of cost, time and quality model terms in Tables (9, 10 and 11) which fall in the rejection region at 5 percent level of significance, this indicate a significant relationship between construction management skills of FLMs and productivity in the building construction projects.

Table 12. F-Distribution [15].

CRITICAL VALUES FOR THE F-DISTRIBUTION							
F- values for $\alpha=0.05$							
d_1							
d_2	1	2	3	4	5	6	7
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8
2	18.51	19.00	19.16	19.25	19.3	19.33	19.35
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79

4.4.2. Model Goodness-of-fit Test

It refers to measuring how well do the observed data correspond to the fitted (predicted) model. It ascertains whether a model achieved is within acceptable level of significance. The closer R^2 value is to 1, the stronger the model is and the better it predicts the response [4].

In these regression model equations (6, 7 and 8) their average value of R^2 was 0.91 which means that the variation of 91 percent in labour productivity in terms of cost, time and quality is attributed to these construction management skills and only 9 percent of the total variation is not explained by the models and therefore these models would be good labour productivity predictors in building construction projects.

Table 14. Predicted model summary of construction management skills and labour productivity in terms of cost.

	Estimate	Std. Error	t-value	Pr (> t)
Intercept	268.4201	214.4337	1.252	0.27886
Conceptual skills	-3.9187	0.9845	-3.980	0.01640*
Interpersonal skills	2.4113	0.5979	4.033	0.01570*
Technical skills	2.2598	0.4298	5.257	0.00627**
Significant codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			
Residual standard error: 16.27 on 4 degrees of freedom				
Multiple R-squared: 0.9133		Adjusted R-squared: 0.8482		
F- statistics: 14.04 on 3 and 4df,		P-value: 0.01369		

Table 13. T-Distribution [15].

t-DISTRIBUTION: CRITICAL t-VALUES					
Degrees of Freedom	Area in one Tail				
	0.005	0.01	0.025	0.05	0.10
Area in Two Tail					
0.01	0.02	0.05	0.10	0.20	
1	63.657	31.821	12.706	6.314	3.078
2	9.925	6.965	4.303	2.920	1.886
3	5.841	4.541	3.182	2.353	1.638
4	4.604	3.747	2.776	2.132	1.533
5	4.032	3.365	2.571	2.015	1.476
6	3.707	3.143	2.447	1.943	1.440
7	3.499	2.998	2.365	1.895	1.415
8	3.355	2.896	2.306	1.860	1.397
9	3.250	2.821	2.262	1.833	1.383
10	3.169	2.764	2.228	1.812	1.372
11	3.106	2.718	2.201	1.796	1.363

4.4.3. Model Validation

Model validation is directed towards determining if the model will function successfully in its intended operating environment and provides a measure of protection for both the developer and user with greater confidence [18]. To measure the overall predictive fit of a model, predicted R^2 value is calculated [11, 29]. The percentage of variability in the predicted and estimated model are compared and closeness of their values is observed [12, 17, 18, 28, 32]. Research by Palmer and Connell [22] indicate that, there is no rule of thumb for interpreting the closeness between R^2 values. A study by Montgomery et al. [18], indicate that slight difference of 0.063 between predicted R^2 and estimated R^2 of the regression model gives a better predictability and greater confidence for prediction in asample from the the same population. It is supported by Kleinbaum et al. [14], who suggested that decrease in value of R^2 less than 0.1 (10%) indicate a stable model, meaning the model is validated and judged to have very close agreement.

In this study, regression models developed were validated by the split sample technique. The data were split into two parts, with 75 percent of the data randomly chosen for estimating the regression model as indicated in Tables (9, 10 and 11), the remaining subsample used for validating the model accuracy. The summary of results is presented in the Tables (14, 15 and 16).

Table 15. Predicted model summary of construction management skills and labour productivity in terms of time.

	Estimate	Std. Error	t-value	Pr (> t)
Intercept	197.4274	253.4074	0.779	0.4794
Conceptual skills	-3.0045	1.1634	-2.582	0.0612
Interpersonal skills	1.7223	0.7066	2.437	0.0714
Technical skills	2.1483	0.5080	4.229	0.00134**
Significant codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			
Residual standard error: 19.22 on 4 degrees of freedom				
Multiple R-squared: 0.8652		Adjusted R-squared: 0.7641		
F- statistics: 8.556 on 3 and 4df,			P-value: 0.03251	

Table 16. Predicted model summary of construction management skills and labour productivity in terms of quality.

	Estimate	Std. Error	t-value	Pr (> t)
Intercept	41.027	227.0720	0.181	0.86372
Conceptual skills	-3.9618	1.0592	-3.740	0.01343*
Interpersonal skills	1.9450	0.4550	4.275	0.00790**
Technical skills	3.1643	0.6331	4.998	0.00411**
Significant codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1			
Residual standard error: 17.72 on 5 degrees of freedom				
Multiple R-squared: 0.9184		Adjusted R-squared: 0.8695		
F- statistics: 18.76 on 3 and 5 df,		P-value: 0.003759		

It can be observed from both actual and predicted models in Table (9, 10, 11 and 14, 15, 16) respectively that, cost model estimated R^2 is 0.9076 and model predicted R^2 is 0.9133 with a difference of 0.0057, in case of time model estimated R^2 is 0.8792 and model predicted R^2 is 0.8652 with a difference of 0.014 and quality model estimated R^2 is 0.9366 and model predicted R^2 is 0.9184 with a difference of 0.0182. Using Kleinbaum et al. [14] standard, these values have close agreement and Therefore the models developed are validated, can be applied on local construction sites under similar conditions of management skills.

4.5. Strategies for Improving Project Management Skills

Table 17. Strategies for improving construction management skills.

Strategies for improving construction management skills	RII	RANKING
Taking refresher courses	0.778	1
Motivation courses	0.765	2
Responsibility delegation	0.739	3
Transparency	0.735	4
Attend workshops and conferences	0.732	5
Good communication system	0.728	6
Take Leadership course	0.699	7
Trust your people	0.679	8
Read management books	0.637	9
Average RII	0.719	

Table 17 presents the ranking of 9 related strategies for improving construction management skills. The researcher computed average RII=0.719 and decided that those strategies with RII above 0.719 were considered significant and those below were considered insignificant. The results show that the most significant strategies for improving construction management skills positively affecting labour productivity were: taking refresher courses with RII (0.778) followed by motivation courses with RII (0.765), responsibility delegation with RII (0.739), transparency with RII (0.735), attend workshops and conferences with RII (0.732) and good communication system with RII (0.728).

Other strategies considered insignificant were: take leadership course with RII (0.699), trust your people with RII (0.679) and read management books with RII (0.637).

The study findings are in agreement with related studies by Benator and Thumann [3]; Ellis [7] and Ogunsanmi [20] who emphasized that in order for first line construction managers to improve productivity, they require training and re-training in different short courses.

5. Conclusions and Recommendations

The main objective of this investigation was to study the impact of construction management skills of FLMs on labour productivity in the building construction industry in Uganda. Based on study findings, it was concluded that FLMs require more of construction technical skills, followed by interpersonal and less conceptual skills to be able improve labour productivity in the building construction industry in this country. Building projects practitioners should first identify construction FLMs with prerequisite technical and interpersonal skills since they have been identified as the most significant construction management skills.

It was concluded that contractual disputes, poor quality work, time and cost overruns had the most significant impact on labour productivity in the building construction industry, as all these largely depend upon the skills of its workforce. Building construction practitioners to minimize these impacts, they should employ experienced personnel to execute construction projects with most care, with aim of improving quality, minimizing cost and reducing on the project duration.

The study concluded that, there is significant relationship between construction management skills of FLMs on labour productivity in terms of quality, time and cost in the building construction industry in this country. The building FLMs should acquaint themselves with the developed model in order to be in position to predict and forecast their impacts on

building projects so as to increase labour productivity on building construction sites.

The study also sought to find appropriate strategies for improving the labour productivity of construction FLMs with emphasis on the most critical construction management skills taking into account the impact of quality, time and cost. Therefore, based on the findings of the study, it was concluded that, the level of technical skills with RII above 0.84 in Table 5 of FLMs ought to be improved. The local contractors and consultants should emphasize on improving these skills through taking refresher courses, motivational courses, good communication system, attendance of workshops and conferences and re-training of FLMs on the basis of required skills and productivity on the particular building construction project.

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