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Innovation Barriers and Enablers that Affect Productivity in Uganda Building Industry

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Abstract: The construction industry has of recent been blamed for lack of innovation. Lack of innovation in the industry is believed to be responsible for the decreasing or stagnant levels of productivity in comparison with other industries. This paper reviews the major barriers and enablers to innovation in general. Propositions were made about the factors that affect innovation in the construction industry which were then formulated into a questionnaire. A survey was made on building contractors in Uganda, a developing country, targeting those with financial strength, large in size, and with high capacity to carry out big projects. The identified factors were then ranked and correlated. The level of training in science, engineering and technical education, and the level of research and development at the industry level are looked at as the greatest innovation enablers in building that will drive forward labour productivity. The size of the domestic market and the level of security are the worst innovation barriers that lead to low productivity in the building industry in Uganda. Contractors, policy makers and the government should address the identified factors in order to improve productivity.

Keywords: Construction industry, Productivity, Innovation barriers, Enablers, Uganda

INTRODUCTION

The performance of the construction industry in terms of productivity, quality and product functionality is considered low in comparison with other industries, and a low rate of innovation has been provided as the major explanation to this situation (Winch, 1998; Gann, 2000).

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Construction is commonly characterised as a backward industry, one that fails to innovate in comparison to other sectors (Winch, 2003). Innovation, which according to Firth and Mellor (1999) means the application of new knowledge to industry including new products, new process, social and organisational change, is therefore desirable.

Changes in building production are essential, especially if the world of construction is to respond effectively to the migration into cities and the increasing world population. The earth's population is anticipated to

reach nine billion by 2054 and it is forecasted that by 2015, 55% of the world's population will live in urban areas compared to 45% in 1995 (Diczfalusy, 2001; Maas and van Gassel, 2005). The fastest rates of population growth are in the developing world. For example, the population of Uganda has been growing at a rate of more than 3% per annum on average for the last ten years. Yet by the year 2004, more than 25% of the population still needed adequate shelter (Uganda Bureau of Statistics, 2005). The rate of providing shelter is therefore much lower than the rate of population growth and the situation can be partly improved by increasing productivity.

As researchers have become aware of the effect such demographic changes will have on housing, there have been several calls to develop the construction industry (CIB Task Group 29, 1999). Productivity is the key to greater competitiveness, as it is critical to the profitability of projects. Increasing productivity is one of the tasks being addressed by the Uganda National Association of Building and Civil Engineering Contractors (UNABCEC, 2004). Productivity is one of the basic variables governing economic production activities, and perhaps the most important one. The expansionary effects on any national economy or business depend on rapid increases in labour productivity, which basically is the ratio of the outputs to labour input (Alby, 1994). It is the fundamental controllable factoring wealth production, while many other economic variables depend on it (Freeman and Soete, 1997). At the same time, it has been relegated by those who influence production process (Alby, 1994).

The construction sector represents one of the most dynamic and complex industrial developments. A good number of construction workers in Uganda are employed by small building firms. Construction is a project-based sector within which individual projects are usually custom-built to client specifications. Fluctuations in the economic markets are reflected in considerable variations in the number, size and type of projects undertaken by construction organisations over time. Construction is by nature project driven and undertaken by an amalgam of firms, which change from project to project. The firms involved in each project are independent companies, which are organisationally interdependent. The finished products largely must be assembled at a point of use, subject to environmental factors in different geographical areas. These industry characteristics present a challenging context for innovation in the industry (Egan, 1998).

Research has indicated that theories of innovation have room for improving the construction process (Widén, 2002). Sexton and Barrett (2003) acknowledge that although construction firms have always demonstrated an ability to innovate, construction practitioners are now very much getting to grips with the need for and management

of innovation as an explicit endeavour. The construction industry in United Kingdom by way of example is increasingly being challenged to successfully innovate in order to satisfy better aspirations and needs of society and clients, and improve competitiveness (Latham, 1994; Egan, 1998). The construction industries in Uganda and other developing countries should similarly aim at being more innovative in order to satisfy the clients. It follows that productivity can be increased, especially in the context of developing countries, with increase in activities that support innovation.

Technological innovation plays a central role in improving productivity and developing new products and services, and in providing comparative and absolute advantages (Dodgson, 2000). According to Freeman and Soete (1997), intangible investment in new knowledge and its dissemination are the critical elements rather than tangible investments in bricks and machines. It is widely acknowledged that technological innovation in manufacturing firms is one of the main reasons for industrial competitiveness and national development (Freeman and Soete, 1997; Porter, 1987).

Innovation in the construction industry has of recent been a subject of discussion in driving the performance of the construction industry (Egan, 1998; Lindsay, 2004). The fragmentation and low level of investment in research and development (R&D) have been highlighted in some studies (Egan, 1998). Dulaimi et al. (2002) investigated integration and level of R&D on innovation using data from Singapore. Fragmentation and low level of investment in R&D are some of the key barriers to innovation but there are other important factors. However, the barriers and enablers of activities that support innovation in the construction industry have not been sufficiently studied and quantified. So far, there has been very little in-depth analysis of various innovation framework factors related to the construction industry (Seadan and Manseau, 2001). There is therefore need to take the research further by identifying the key enablers and barriers to innovation in the construction industry to enable a closer analysis of why the construction industry in Uganda is less innovative and has contributed to its low productivity.

The objectives of this research were to identify and rank the main innovation enablers and barriers in the construction industry in Uganda. The main barriers and enablers of innovation were identified through a literature search. Questions were then formulated according to the factors, which were then taken to the major contractors in Uganda to give their perception in the form of a questionnaire. The major innovation enablers and barriers that affect productivity in the building industry in Uganda have been ranked. The data used tend to reveal the existence of problems similar to those in other countries,

especially the developing ones, thus making them generally applicable for contractors, researchers and policy makers in many countries.

BARRIERS AND ENABLERS TO INNOVATION AT INDUSTRY LEVEL

This section includes literature review on barriers and enablers to innovation at national level. The identified factors are formulated into numbered propositions for example NE1 and NB1. The factors are from the general literature but the intention was to capture those that affect labour productivity in the construction industry.

Enablers at National Level

The incentive structures of national institutions and competencies determine the rate of technological learning (Freeman and Soete, 1997). The overall performance of an economy depends on how institutions interact with each other as elements of a collaborative system of knowledge. A national system is a useful unit of analysis because of common culture, legal framework, education, customer preference, institutions and many other variables that impact innovation (Seaden and Manseau, 2001).

NE1 – Innovation at the national level is positively associated with incentive structures of national institutions.

NE2 – Innovation at the national level is positively associated with competencies of national institutions and legal frameworks.

R&D at the national level increases the knowledge intensity of the processes of generating, producing and commercialising new goods and services and fosters innovation in different fields (Freeman and Soete, 1997). Training in science and engineering education and a highly trained workforce in the relevant fields of science, engineering and management is associated with innovation at the national level.

NE3 – Innovation at the national level is positively associated with R&D.

NE4 – Innovation at the national level is positively associated with level of training in science, engineering and technical education.

Controlled migration can help in importing technology and science and to ease pressure on the labour market. Roads and other transport infrastructure provide the means by which new products and services can be delivered. Local demand and export potential influence the degree of innovation in the industry. Literature indicates that innovation has been achieved in some cases due to market demand-pull. Globalisation in many cases means that innovations have a wider market where they can be used. Globalisation encourages greater participation and integration of world trade, liberal government policies, changing corporate strategies and creation of global capital markets. Multinationals play a key role in disseminating technology around the globe (Freeman and Soete, 1997).

NE5 – Innovation at the national level is positively associated with controlled migration of skilled labour.

Social institutions and legal framework are closely associated with innovation at the national level. Creation, use and interplay with values, norms and legal framework enhance innovation. There is a need for intellectual property protection and regulations to develop and protect the innovations (OECD/Eurostat, 1997).

NE6 – Innovation at the national level is positively associated with strong social institutions and legal framework.

Geographical proximity of firms developing and using similar and related products and technologies produces positive sum gains and business innovation. Increased capacity of information and communications technologies is associated with increase in storage, processing and transfer of vast amounts of information. Distribution will lead to diffusion of the technological innovation. Having a good number of entrepreneurs will help in funding R&D activities and use of the innovations. Many governments around the world are looking for increased contributions to national R&D efforts from the private sector and multinationals (Dodgson, 2000).

Tax relief for R&D expenditure encourages companies to venture more into R&D. Awarding of financial support to inventors and immigrant entrepreneurs, bestowed gifts of machinery, allowed rebates and exemptions of duties on imports of industrial equipment aids innovation by encouraging companies to venture more into R&D. Decrease in depreciation rates will help to increase investment in high technology plant and machinery (Knight,1996).

NE7 – Innovation at the national level is positively associated with tax relief for R&D expenditure.

Barriers at National Level

According to Knight (1996), taxation of new products, processes and services, which are undergoing the transition to full commercialisation, acts as a barrier. Inappropriate government tax is seen as a barrier as it restrains innovation (Pihkala et al., 2002).

NB1 – Innovation at the national level is negatively associated with high government tax on new products, processes or services.

The size of domestic market and access to international markets matters. A small market means that producers will be limited in selling their products, processes or services. Government interference and mismanagement scares away investors in the country, nurtures insecurity and increases risk. Changes in the structure of world economies increases speculation in businesses and stifles investment in R&D necessary for innovation. Hostility towards business from the public, judiciary and government that may stem from a lack of mutual trust and communication (Knight, 1996).

NB2 – Innovation at the national level is negatively associated with government interference.

NB3 – Innovation at the national level is negatively associated with small size of domestic markets.

NB4 – Innovation at the national level is negatively associated with lack of access to international markets.

Differences in the type and level of government support, source of science, technology, finance, and industrial structures lead to differences in level of activities that support innovation. High level of insecurity reduces the rate of invention and diffusion of innovations. Policies that discourage movement of labour act as deterrents to innovation such as disciplines of factory hours (Dodgson, 2000).

NB5 – Innovation at the national level is negatively associated with policies that discourage movement of labour.

NB6 – Innovation at the national level is negatively associated with insecurity that leads to low rates of invention and diffusion.

RESEARCH METHODS

There are five research styles: experiment, survey, action research, ethnographic research and case study. Research in construction is usually carried out through experiments, surveys or case studies. Experiments on barriers and enablers in the construction industry would take a long time to yield results and at the same time would be expensive (Fellows and Liu, 2003). Case studies would not provide results that are easy to generalise as different companies face different problems. Surveys through questionnaires were found appropriate because of the relative ease of obtaining standard data appropriate for achieving the objectives of this study (Ferber, 1980).

Surveys are one of the most frequently used methods of data gathering in social research. The survey protocol of random sampling procedures allows a relatively small number of people to represent a much larger population (Ferber, 1980). The opinions and characteristics of a population can be explained through the use of a representative sample. Surveys are an effective means to gain a lot of data on attitudes, on issues and causal relationships and they are inexpensive to administer. However, they can only show the strength of statistical association between variables. Cross sectional surveys like the one that was used do not explain changes in attitudes and views over time. Surveys also provide no basis to expect that the questions are correctly interpreted by the respondents (Fellows and Liu, 2003).

Questionnaire Design

A set of questions was formulated and a questionnaire was designed to find out the extent to which the identified factors enable or act as barriers to innovation in the building industry. The main innovation barriers and enablers that affect productivity were identified through a literature search. The search identified seven enablers and six barriers at national level. Respondents were asked to rate each of the listed factors for either enabling or acting as barriers to innovation in order to achieve greater productivity in the building industry. A five-point Likert scale (Kothari, 2003) was used, where 1 was for "no effect", 3 for "fairly significant effect", and 5, "very big effect".

Pilot Studies

Pilot studies were carried out to ensure the clarity and relevance of the questionnaire to the contractors. The questionnaire was shown to two senior researchers in the field of construction management. Based on their feedback, amendments were made to the questionnaire and the second phase of the pilot study was conducted on four building contractors who were not eligible to participate in the main survey but eligible for the pilot

studies only. The intention was to keep the sample size for the main survey since the number of contractors in the category was not large. At the same time there was need for feedback from a set of contractors of medium size in Uganda. Based on the feedback from the contractors, minor amendments were again made to the questionnaire to remove any ambiguities and discrepancies. This pilot study was conducted to validate and improve the questionnaire, in terms of its format and layout, the wording of statements and the overall content. The draft questionnaire was revised to include the suggestions of these participants. In short, the questionnaire was validated through this process and provided the research with improvement opportunities before launching the main survey.

Sample Selection

The survey gathered data from chief executives of building contractors. For this purpose, it was determined that the largest contractors who are registered with the contractor's association (UNABCEC) are targeted. It was decided that all those in categories A and B be the source of potential participants. At the national level, one recognised way of categorising construction companies is by the UNABCEC class. The classification from A to E takes into account the financial strength, size and ability to carry out jobs. Those in class A are the biggest and undertake works of the biggest magnitude and include some multinational companies. For the purposes of this survey, the 2005 mailing list of contractors was reduced to those in classes A and B that deal in building. Owing to the relatively small number of firms within the two categories A and B, all the 57 building contractors in the two categories were targeted. A total of 54 questionnaires were sent out. Three companies did not participate for various reasons.

Survey Response

As a result of mailing, telephone and physical explanation and follow up, a total of 44 questionnaires were completed out of the 54 that were sent to contractors, making the total response rate 82% as summarised in Table 1. The survey package comprised a covering letter, the questionnaire and a pre-stamped self-addressed envelope.

A review of the responses indicated no measurable differences in the respondents' answers to the questions. As the number of contractors in group B is small and less than 30, the two groups were combined for the analysis of the results from the survey.

Table 1. Response on Questionnaire from the Contractors

UNABCEC class	Number of questionnaires sent	Number of responses	Percentage response (%)
A	38	34	89
B	16	10	63
Total	54	44	82

RESULTS AND DISCUSSION

This section contains a summary of the statistical analysis and results of the survey and the ensuing discussion is presented.

The mean ratings, standard deviations, correlation were determined for enablers and barriers at the national level as perceived by the contractors. Statistical analysis of the Likert scale ratings given through the questionnaires was conducted using the Statistical Package for Social Sciences (SPSS 10.0 for windows) software. The ranking according to the mean rating of the enablers and barriers to innovation in the building industry as perceived by building contractors is summarised in Tables 2 and 3. Table 2 gives the ranking for enablers at national level starting with the highest rated while Table 3 gives the ranking for barriers. The bivariate correlation analysis based on mean rating and standard deviations was performed on the identified enablers and barriers. The correlation analysis indicated significance for a number of factors at the levels of 0.05 and 0.01, respectively. Table 4 provides the results of the correlation analysis.

At the national level, the level of training in science, engineering and technical education (NE4) is the greatest enabler with average rating of 4.18. This is in line with what the contractors perceive to be the greatest enabler at firm level. This might imply that there should be focus on training the workforce if the building contractors are to be more innovative. However, research elsewhere has shown that many contractors are not keen on freely participating in training their workforce (Sha and Jiang, 2003). It is in industries where the firms are required to pay training levy that they participate.

The level of R&D at the national level (NE3) is looked at as the second most important enabler to innovation with a mean rating of 3.91. This is in agreement with what was found by Dulaimi, et al. (2002). Although contractors would like to see higher levels of R&D, many might not be willing to pay for it. The implication is that the construction firms would like to see more government involvement in R&D while for them they use the products of innovations.

Correlation analysis indicates that some of the enablers at firm level are highly correlated. The level of

Table 2. Ranking of Enablers in the Construction Industry

Rank	Factor	Mean	Standard deviation
1	Level of training in science, engineering and technical education (NE4)	4.18	0.84
2	Level of research and development at the national level (NE3)	3.91	1.01
3	Level of competence of national institutions (NE2)	3.80	0.98
4	Level of incentive structures of national institutions (NE1)	3.61	1.10
5	Level of immigration of skilled labour (NE5)	3.50	1.15
6	Level of tax relief for R&D expenditure (NE7)	3.36	1.26
7	Strength of social institutions and legal framework (NE6)	3.00	0.89

Table 3. Ranking of Barriers in the Construction Industry

Rank	Factor	Mean	Standard deviation
1	Size of the domestic market (NB3)	3.73	0.97
2	Level of security (NB6)	3.64	1.20
3	Level of government interference and management (NB2)	3.57	0.90
4	Level of government tax on new products processes or service (NB1)	3.57	1.09
5	Lack of access to international markets (NB4)	3.36	1.10
6	Policies that discourage movement of labour (NB5)	3.16	1.10

Table 4. Results of Correlation Analysis for Factors that Affect Innovation in the Construction Industry (2 Tailed)

Correlations

	NE1	NE2	NE3	NE4	NE5	NE6	NE7	NB1	NB2	NB3	NB4	NB5	NB6
NE1 Pearson Correlation	1.000	0.506 **	0.365 *	0.202	0.229	0.261	0.338 *	0.226	0.132	0.311 *	–0.035	0.263	0.032
Sig. (2-tailed)		0.000	0.015	0.188	0.135	0.088	0.025	0.140	0.391	0.040	0.823	0.085	0.837
NE2 Pearson Correlation	0.506 **	1.000	0.594 **	0.526 **	0.217	0.214	0.420 **	0.396 **	0.320*	0.404 **	0.243	0.269	0.311 *
Sig. (2-tailed)	0.000	-	0.000	0.000	0.158	0.163	0.004	0.008 **	0.034	0.007	0.112	0.077	0.040
NE3 Pearson Correlation	0.365 *	0.594 **	1.000	0.321 *	0.120	0.156	0.522 **	0.261	0.238	0.045	0.303 *	0.371 *	0.394 **
Sig. (2-tailed)	0.015	0.000	-	0.033	0.437	0.313	0.000	0.087	0.120	0.770	0.046	0.013	0.008
NE4 Pearson Correlation	0.202	0.526 **	0.321 *	1.000	0.120	0.093	0.418 **	0.265	0.259	0.345 *	0.328 *	0.244	0.296
Sig. (2-tailed)	0.188	0.000	0.033	-	0.438	0.548	0.005	0.082	0.089	0.022	0.030	0.110	0.051
NE5 Pearson Correlation	0.229	0.217	0.120	0.120	1.000	0.636**	0.273	0.084	0.348*	0.145	0.183	0.469 **	0.336
Sig. (2-tailed)	0.135	0.158	0.437	0.438	-	0.000	0.073	0.589	0.021	0.347	0.234	0.001	0.026
NE6 Pearson Correlation	0.261	0.214	0.156	0.093	0.636**	1.000	0.332 *	0.096	0.174	0.081	0.190	0.262	0.326 *
Sig. (2-tailed)	0.088	0.163	0.313	0.548	0.000	-	0.028	0.534	0.257	0.603	0.217	0.086	0.031
NE7 Pearson Correlation	0.338 *	0.420 **	0.522 **	0.418 **	0.273	0.332 *	1.000	0.423 *	0.470**	0.140	0.338*	0.428 **	0.427 *
Sig. (2-tailed)	0.025	0.004	0.000	0.005	0.073	0.028	-	0.004	0.001	0.366	0.025	0.004	0.004
NB1 Pearson Correlation	0.226 *	0.396 **	0.261	0.265	0.084	0.096	0.423 **	1.000	0.400**	0.436 **	0.581**	0.507 **	0.180
Sig. (2-tailed)	0.140	0.008	0.087	0.082	0.589	0.534	0.004	-	0.007	0.003	0.000	0.000	0.244
NB2 Pearson Correlation	0.132	0.320 **	0.238	0.259	0.348 *	0.174	0.470 **	0.400 **	1.000	0.314 *	0.279	0.377 *	0.367 *
Sig. (2-tailed)	0.391	0.034	0.120	0.089	0.021	0.257	0.001	0.007	-	0.038	0.066	0.012	0.014
NB3 Pearson Correlation	0.311 *	0.404 **	0.045	0.345 *	0.145	0.081	0.140	0.436 **	0.314*	1.000	0.377 *	0.020	0.331 *
Sig. (2-tailed)	0.040	0.007	0.770	0.022	0.347	0.603	0.366	0.003	0.038	-	0.012	0.899	0.028
NB4 Pearson Correlation	–0.035	0.243	0.303 *	0.328 *	0.183	0.190	0.338 *	0.581 **	0.279	0.377 *	1.000	0.470 **	0.401 *
Sig. (2-tailed)	0.823	0.112	0.046	0.030	0.234	0.217	0.025	0.000	0.066	0.012	-	0.001	0.007
NB5 Pearson Correlation	0.263	0.269	0.371 *	0.244	0.469**	0.262	0.428 **	0.507 **	0.377*	0.020	0.470**	1.000	0.432 *
Sig. (2-tailed)	0.085	0.077	0.013	0.110	0.001	0.086	0.004	0.000	0.012	0.899	0.001	-	0.003
NB6 Pearson Correlation	0.032	0.311 *	0.394 **	0.296	0.336 *	0.326 *	0.427 **	0.180	0.367*	0.331 *	0.401**	0.432 **	1.000
Sig. (2-tailed)	0.837	0.040	0.008	0.051	0.031	0.031	0.004	0.244	0.014	0.028	0.007	0.003	-

*Notes: ** Correlation is significant at the 0.01 level (2-tailed)* * *Correlation is significant at the 0.05 level (2-tailed)* a. *Listwise N = 14*

incentive structures of national institutions (NE1) is strongly correlated with the level of competence of national institutions (NE2). This might be because the contractors look to the government to do most of the work in R&D and innovations and therefore the contractors would like to rely more on government.

The level of security at the national level (NB6) is rated second highest barrier with a mean rating of 3.64. This might be due to the level of security that some parts of Uganda have been exposed to over the last 25 years. The level of security is associated with the level of risk and many entrepreneurs are risk averse. This factor possibly would not be rated high in other countries that have continuously enjoyed peace.

The level of government tax on new products, processes or services (NB1) is strongly correlated to the level of government management (NB2), the size of the domestic market (NB3), lack of access to international markets (NB4), and policies that discourage movement of labour (NB5). All these factors have something to do with the way governments conduct business in the construction industry. Lack of access to international markets (NB4) is correlated with policies that discourage movement of labour (NB5). This might indicate that contractors would like to venture onto the international markets together with some of their domestic labour in order to be more innovative. The other implication is that contractors would like foreign contractors to come in with some expatriate staff who would bring along innovation. Although lack of access to international markets (NB4) is not rated very high, it is strongly correlated with the level of government tax (NB1), policies that discourage movement of labour (NB5) and level of security (NB6).

All the identified enablers and barriers have got mean ratings of more than 3.0 which implies that all are taken as having at least fairly significant effect on innovation in the building industry. Among the enablers, the level of training in science, engineering and technical education (NE4), which has a mean rating of 4.18, is highly regarded by contractors as having a big effect on innovation. The construction industry does not have graduates working at the lower levels unlike some other industries. For example, university graduates in the construction industry in Uganda start at the level of site engineer and above.

From Tables 2 and 3, the standard deviations of the factors that are ranked highest are generally the smallest. This suggests that there is a closer agreement in the rating by the contractors towards those factors with high mean rating.

Reliability of Ratings

To test the consistence of the ratings, a null hypothesis H_o was set as "there was no significant agreement among the respondents on the rating of the factors". The alternative H_1 was set as "there was significant agreement among the respondents on the rating of the factors". The analysis aimed at establishing that the ratings had not been arrived at by chance but rather that there was true agreement in the ratings and therefore the results are reliable.

To test the hypotheses, non-parametric tests using the Kappa Coefficient of Agreement (*K*) were used (Siegel and Castellan, 1988). These tests do not rely on the distribution of data, unlike most other parametric tests. The statistic is used in a typical situation where a group of *N* objects, each of which is to be assigned *M* categories by a group of *I* raters. There were *N* = 13 factors at national level to be rated, evaluated by *I* = 44 raters each assigning each of the factors *M* = 5 rating scales. The value of *K* is the ratio of the proportion of times that the raters agree (corrected for chance agreement) to the maximum proportion of the times the raters could agree (Siegel and Castellan, 1988).

$$K = \frac{P(A) - P(E)}{1 - P(E)} \qquad (1)$$

Where $P(A)$ is the proportion of time that the raters agree; and $P(E)$ is the proportion of time that the raters would be expected to agree by chance.

If there was a complete agreement among the raters, then $K = 1$; and if there is no agreement, other than that which would be expected to occur by chance, then $K = 0$.

$$P(E) = \sum_{j=1}^{m} p_j^2 \text{ ; Where } p_j = \frac{C_j}{NI} \qquad (2)$$

Cj is the number of times a factor is assigned to category *j*. It is the sum of the column frequencies under the rating scales.

$$P(A) = \left[\frac{1}{NI(I-1)} \sum_{i=1}^{N} \sum_{j=1}^{M} n_{ij}^2 \right] - \frac{1}{I-1} \qquad (3)$$

Where *N* is the number of factors being rated = 13;
M is the number of rating scales = 5;
I is the number of raters = 44;
nij are the scores in the rating matrix.

From Equations (2) and (3) above, the computed values, for $P(A)$ and $P(E)$ for the rating matrix are 0.2715 and 0.2505 respectively.

The computed value of K from Equation (1) is equal to 0.02805.

According to Siegel and Castellan (1988), K is normally distributed with zero mean and variance, $var(K)$ given by the equation

$$var(K) \approx \frac{2}{NI(I-1)} \times \frac{P(E) - (2I-3)[P(E)]^2 + 2(I-2)\Sigma p_j^3}{[1-P(E)]^2} \quad (4)$$

$$z = \frac{K}{\sqrt{var(K)}} \quad (5)$$

Hence

The z statistic was used to test the null hypothesis, H_0: $K = 0$ against the alternative hypothesis, H_1: $K \neq 0$.

The computed value var(K) is 8.8589E-05 and z is equal to 2.9803. At 5% level of significance, z = 1.645. Since the computed value is greater than $z_{0.05}$, it can be concluded that there was significant agreement in rating the factors and the degree of agreement is beyond that which could have occurred by chance. The null hypothesis is therefore rejected and the ranking given has significant agreement among the respondents.

This survey was however carried out with building contractors in focus because they are the ones who carry out the building work. The survey did not include the informal contractors who also carry out a significant amount of construction work. The authors believed they would not get representative samples from the informal contractors because of the difficulties in getting working lists with their addresses where they could be approached.

The survey could as well have included consultants, clients and other stakeholders in the construction industry. However, each of these categories requires a different set of questions that are relevant for their situation. It is also important to note that barriers and enablers to innovation are related. Lack of an enabler can be regarded as a barrier and the converse is true.

CONCLUSIONS

The enablers and barriers to innovation at national level from the view of the building contractors have been

identified. The level of training in science, engineering andtechnical education and level of research and development at the national level are looked at as the greatest enablers to innovation in building that will drive forward productivity. The policy makers for the construction industry in Uganda should therefore focus on the level of training of the workforce in the relevant fields. This can be done partly by improving on-the-job training that is one of the most common forms of training in the industry. The contractors and researchers in the industry should also be more involved in R&D to improve innovation activities that will lead to greater productivity. The contractors should consider providing some of the funding for R&D since the government has many areas of commitment.

The size of the domestic market and the level of security are the worst barriers to innovation that lead to low productivity in the building industry in Uganda. The contractors should consider widening the market by venturing in areas they have not been engaged before and possibly by going outside the country. There is a need for contractors to study the conditions of working in construction that are applicable in other countries in order to venture out there. Entry into a foreign market can easily be done by forming joint ventures with contractors in those other markets.

Some of the identified enablers and barriers are closely correlated and all are regarded as having significant effect on innovation. This suggests that if the level of innovation in the building industry is to be improved significantly, the identified factors have to be handled in a systematic approach rather than as isolated factors.

The limitation of the research is that some of the respondents who were from the chief executives of registered companies may not be having the competence to gauge the effect of the identified factors on innovation in construction. The survey obtained data from contractors only. The other limitation is that a big part of building construction work is done informally which makes it difficult to capture and analyse.

Further research is required to find the interaction of the identified factors on the innovation process in the building industry and the effect on productivity. More research could also include the informal contractors who carry out a substantial volume of construction work.

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