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Challenges Facing Graduate Structural Engineers in the Building Construction Industry in Kenya

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Authors' contributions

This work was carried out in collaboration among all authors. Author BB designed the study, wrote the protocol and wrote the first draft of the manuscript. Authors BB, SJ and DH reviewed the study design and all drafts of the manuscript. Author BB managed the analyses of the study. Author BB managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Despite a number of challenges, training institution Kenya has produced structural engineers in the building and construction field. As a result, there have been problems facing these apprentices that have led to questions concerning their competencies in the Kenyan building and construction industry. Mitigating such foreseeable problems, require proper policy planning, which can only be enacted after findings of facts have been adduced. The purpose of this study was therefore to determine the challenges facing university trained structural engineers in the construction industry in Kenya. The research design in the study was cross-sectional survey research design. Purposive sampling was employed in collecting the data. The study population comprised practicing structural engineers trained at the universities offering building construction, civil engineering and structural engineering. Questionnaires were used to collected data from the sampled respondents in the building industry. Proportional analysis techniques and statistical chi-square test was used to analyze the data. Information on problems facing the engineers and perception of the engineering graduates concerning university training were collected from 89 Kenyan university trained practicing Structural engineers. The data collected was analyzed using the Statistical Package for Social Science (SPSS 23.0) presented inform of descriptive statistics, bivariate correlations,

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frequency distribution, cross-tabulation and Chi-square (χ^2) tests. The results obtained revealed that, graduates had problems related to initial choice of the course, for which they did not have interest in and hence poor content coverage. These results demonstrate the need for establishment of a clear policy aimed at regulating the learning resources for structural engineers at the universities appropriately. Moreover, there is need for standard resources for the teaching of the programme and the need for higher educational funding scheme for research in the universities.

Keywords: Structural; engineers; mitigating; policy; planning; building; construction; challenges.

1. INTRODUCTION

Education is universally regarded as an indispensable tool for social, economic and personal developments [1,2], which help in improving the welfare of people as a society, community or individuals [3,4]. Education plays an important role of developing a country's human resource base and prepares student in the future professional careers and aspirations [5]. As a result, good outcomes in education may immeasurably contribute to the country's economic development by producing appropriate human resource who are integral in supporting the country's productivity [6,7]. One of the Sustainable Development Goals (SDGs) is achievement of quality education at all levels, alleviation of poverty and economic development among developing nations of the world [8]. This noble idea is also contained in documents of many governments in an endeavour to reduce the illiteracy gap [9]. More recently, the agenda 2063 recognize Science, Technology and Innovation (STI) as a major driver enabling the achievement of development goals in Africa (https://au.int/en/agenda2063). In line with this breakthrough, STISA (Science, Technology and Innovation Strategy for Africa 2024) identified technology as one of the key factors that would enhance the competitiveness of Africa (Union, 2014).

In Kenya, a major factor sustaining employment in all sectors of the economy is training in entrepreneurial, managerial, and technical fields [10]. It has been established that most entrepreneurs in less developed countries acquire their skills through on-the-job training and apprenticeship [11] though a number also attain their training through formal education system. The duration of the formal training vary depending on the kind of skill one train for but, normally short term apprenticeship training may range from six months to five years (Union, 2007) [12] (Hicks JH, Kremer M, Mbiti I, Miguel, E ks, 2011). This training is important as it seeks to develop essential work skills and attitudes required for effective performance at the industrial sector. According to the Education, Science and Technology under the department of Research, Technical Training, and Applied Technology (RTT and T), the objectives of formal training are categorized under three main areas namely: (i) Technical skills acquisition and up-grading which seek to: equip the employees with technical skills to produce quality goods; up-grade technical skills to keep up with changing technological challenges; train in product design and diversification (ii) Basic business management and book-keeping focusing on: enabling the trainee to do proper costing and pricing, facilitating proper accounting and book keeping including cash flow, performing proper financial management and store-keeping, management, and procurement training in personnel management (iii) Basic entrepreneurship training whose central concern is to: promote marketing and sales skills, train in customer relations, train in identification of business ventures [13]. However, in technologically advanced countries, technical skills acquisition is mainly acquired from the universities.

At present the university education and training in Kenya appears to be in a flux. For a number of years, efforts at sector planning have been underway [14], but the national policy on university practical and technical training in aviation engineering has not yet emerged. Since the expanded education opportunities after independence did not result in the expected automatic employment of the primary school leavers, in 1984 a fundamental restructuring of Kenya's education system was changed to "8-4-4" where 8 years were spend in primary, 4 years in secondary school and 4 years in the university. It places emphasis on attitudinal and skills preparation for the world-of-work. The introduction of this system of education brought with it many hue and cries from the industrial players arguing that the education system was

implemented hurriedly without giving much afterthought about the availability of facilities for the students to master the practical skills in engineering and technology courses required of them in the industrial job market. According to Shiundu (2001), the curriculum has a number of useful elements however, the students have been accused on many occasions that they cannot link what they learn directly with the practicum in the industrial job market.

To work in this industry, one needs effective training and exposure to technological skills. University is one of the supreme institutions which equip one with the skills which are required in this industry. Therefore, engineers trained in these institutions are expected to perform immensely excellent work in the construction industry but due to challenges faced by these engineers they at times fail to meet the expectation of their employers. Continuous expansion of major towns has been witnessed in various parts of the country, where public and private institution structures are put up in large numbers. High-rise buildings are constructed in major town-centers like Nairobi, Mombasa, Eldoret, Kisumu and Nakuru this has led to great demand for qualified personnel to work in the building industry.

Architects and engineers, among others in the building and construction industry, are trained at the university level where they acquire degrees [15]. Moi University, Jomo Kenyatta University of Agriculture and Technology, Masinde Muliro University of science & technology and University of Eldoret in Kenya offer degrees in such fields as Building and Construction Technology, Civil Engineering, Structural Engineering and Architectural Engineering. Moreover private universities have joined public universities in training engineers for the labour market which has become more competitive. Despite such glaring information being in the domain of educational planners, no concrete research has been done in Kenyan Universities, among the employers and graduate students to determine challenges faced by the structural engineers in the job market, where the input of graduates are expected to be felt. It is within the basis of this argument that this study was contrived and is aimed at exploring the challenges facing university training of structural engineers to work in the construction industry.

There are several challenges facing university trained structural engineers in the construction industry that are motivated by the adoption of new technologies such as 3D rendering and simulation, model-driven design including building information modeling (BIM), standards for interoperability for example LandXML.org, International Alliance for Interoperability (IAI), and Open Geospatial Consortium (OGC) standards. All these challenges may not be wished away because of lack of knowledge or skills being offered our own institutions of learning; Therefore, more research should be done to determine challenges encountered by the structural engineers in the building construction industry so as to advise the authorities concerned to take necessary measures in improving the welfare of structural engineers in the country at large.

2. METHODOLOGY

2.1 Research Area

The study was carried out in universities and building firms in Uasin Gishu and counties. The study specifically looked at university trained structural engineers who design most building in these towns. The universities known for offering building construction related engineering courses, for example, Moi University, Masinde Muliro University of science & technology and University of Eldoret. Eldoret like all these other towns, is a fast growing agricultural town, with the present international airport which makes the town cosmopolitan in nature where foreign residents have settled in the town. Building structures in these towns should be modern and standardized in all aspect, in order to encourage investment in the counties hence improving economy of the country.

The universities mentioned above are known for expertise and professionals working in the building construction industry. The rationale of choosing these areas were because these areas are currently leading in the number of building firms and institutions that are undergoing a major phase of development regarding the engineering technologies and as a result it is the most suitable area to carry out the study since the study is about challenges facing structural engineers in the building construction industry.

2.2 Research Design

This study was conducted using survey approach. Surveys are normally used to systematically gather factual quantifiable information necessary for decision-making [16].

According to Kothari, [16], surveys are efficient methods of collecting descriptive data regarding the characteristics of populations, current practices and conditions or needs. They also help gather information from large populations by employing use of samples hence cutting down on costs. Given the above stated attributes, case study research design was adopted in this study in order to capture descriptive data from selected samples.

2.3 Population

The targeted population were practicing structural engineers who are involved in building industries in Uasin Gishu and Kakamega counties of Kenya. A group of practicing structural engineers was chosen according to their experiences and the number of contracts they have accomplished. Structural engineers were selected from different firms within Eldoret and Kakamega. A population of 114 respondents were targeted the entire respondents are registered practicing professional in the construction industry.

2.4 Sampling

A sample is the smallest representation of the population with all the characteristic of the said population. According to Cooper and Schindler (1997) a sample size is determined by the number of factors. Some of these are the fact that, the greater the variance within the population, the larger the sample should be to provide increased estimation precision: the greater the desired precision of the estimate, the larger the sample; the higher the confidence level in the estimate, the large the sample must be and thereafter the number of the sub-groups of interest within a sample. The sample size was determined using Slovin's Formula [17] n = N / (1 + Ne2) where n, N and e are the number of samples, the total population and error tolerance respectively. When using Slovin's formula, the error of tolerance is first determined which can range between 95% and 99% confidence level (giving a margin error of 0.05 and 0.01 respectively)? In this study a confidence level of 95.0% was utilized thus the margin of error was 5% or 0.05. Thus the sample size was given as $114/ ((1+114(0.05)^2)$, equating to 89 respondents.

According to Mugenda and Mugenda [18], a sample size of 10% of the target populations is considered adequate for descriptive study; however the researcher used Slovin's formula where a sample of 89 respondents was used. The researcher used different respondents from the ones used in the actual research but with similar characteristics, in order to avoid bias when analyzing data. Once the respondents had filled in the questionnaires, the researcher analyzed the questionnaires and determined from the responses given whether there were any corrections or adjustments to be made in the questionnaires, such as spelling mistakes and unfinished sentences, also this was to help the researcher in knowing whether the respondents understood the concepts given in the questionnaires.

2.5 Content Validity

The researcher requested his supervisors and colleagues to check whether the items in the questionnaires will elicit the expected response for the study. Criticism from these experts enabled the researcher to make some adjustments accordingly. Piloting was done in some selected firms and universities before administering the tools. During this try out, items that were found ambiguous and not exhaustively framed were adjusted accordingly.

2.6 Reliability of Instruments

A test re-test method was applied to the questionnaire to ensure consistency of the question items. The instruments were administered to few chosen respondents within the firms. The researcher then checked for the responses together with those obtained earlier to ensure similarities in response for specific items. Where question items varied greatly in response, they were adjusted to elicit reliable response in line with the expected outcomes.

2.7 Data Collection and Analysis

The data was collected through self-administered questionnaires. This method was appropriate as it reaches a large number of respondents who are literate.

2.8 Statistical Analysis

The data was analyzed using both quantitative and qualitative techniques. The use of frequencies, percentages and graphical presentation to illustrate the trends was utilized in descriptive statistics and Chi-square was used for inferential statistics. Data processing exercise commenced with the coding of all the responses

obtained to facilitate easy analysis using computer Statistical Programme for Social Sciences (SPSS 23.0) package. A master codebook was designed to ensure that all the questionnaires are coded uniformly. All data was analyzed at a level of 95% confidence level and degree of freedom of 1 depending on the particular case as was determined. The value $\alpha = 0.05$ was chosen because the sample size was adopted from figures calculated based on 95% level of confidence.

3. RESULTS AND DISCUSSION

3.1 Perceptions of the Structural Engineers

The problems facing the structural engineers in the industrial job markets were determined as the first objective. To determine this, the researcher first determined the perception of the structural engineers whether they feel adequate to handle the challenges of the industrial job market. All (100%) of the sampled engineers believed that they are indeed adequately trained to handle the challenges of the industrial job market. The engineers were then asked why they opted to do the course in structural engineering. The results are as shown in Fig. 1. For a number of the engineers, they opted for structural engineering since they liked the course (82.1%), others enjoyed the prospect of being an engineer (90.0%) while the highest number of graduates in structural engineering (98.0%) decided to take a course in structural engineering because they believed that it was prestigious to do an engineering course. On the other hand a moderate proportion of the students opted for structural engineering because they passed their exams (35.2%) and persuasion from the parents (44.2%). On the contrary, lower proportion of the graduate chose structural engineering because of: lack of alternatives (2.0%), peer pressure (3.1%), their role models are engineers (8.8%) as well as a bridge to further pursue other courses (5.8%).

The researcher went further to determine whether Structural engineering course has actually equipped the graduates with practical skills to adequately handle the challenges in the industrial job market. The results indicated that 64% of the university trained engineers were actually equipped to handle the challenges of the industrial job market. The graduates' adequacy to handle the challenges of the courses is as shown in Fig. 2. Most of the graduates believed that the syllabus was adequate in terms of content, coverage, time allocation and that most graduates believed that the most emphasized content was theoretical, but practically of the content was not highly emphasized. When the comparison was made among the graduates from the three universities, through cross-tabulation, the differences were found to be statistically similar among the students in Moi University, Masinde Muliro University of Science & Technology and University of Eldoret in Kenya ($\chi^2 = 1.334$, df = 4, P = 0.422).

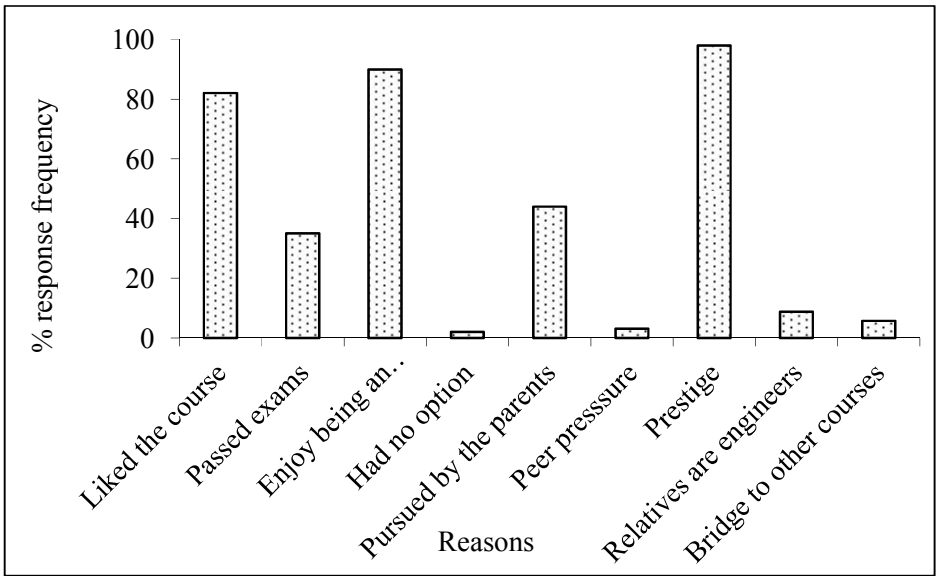

Fig. 1. Reasons why the graduates preferred the courses in Structural engineering Structural engineering course

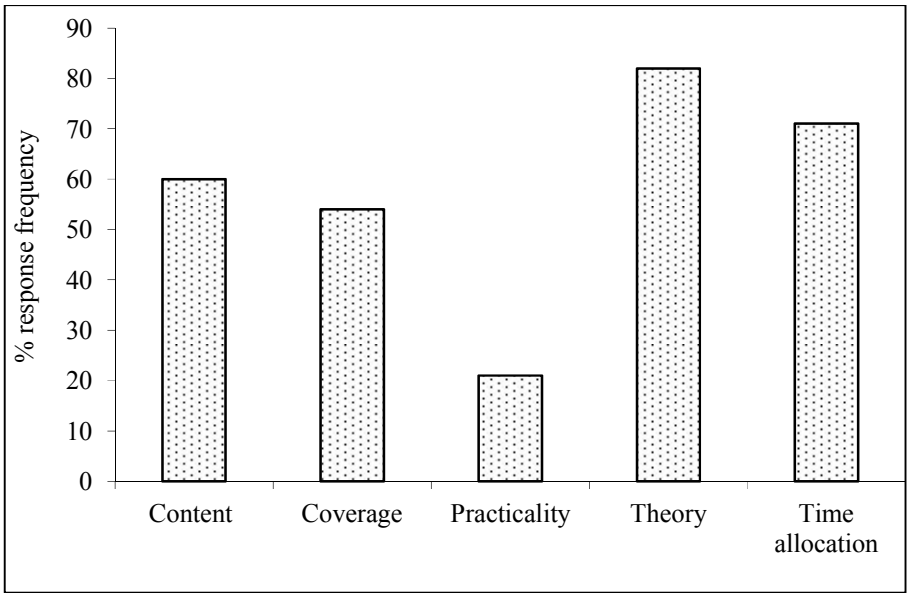

Fig. 2. Adequacy of syllabus in terms of coverage, content and practicality to the industrial job market

All structural engineers of the sampled engineers believed that they are indeed adequately trained to handle the challenges of the industrial job market. Yet results from their employers state otherwise. Probably it is a time to examine reasons why the students chose structural engineering because, some chose the course for which they had little, knowledge about as summarized in Fig.1.

Because of the haphazard nature of choosing the course and sometimes inadequate syllabus contents coverage, most students who had never had any opportunity to work in an industrial firm, hopefully believed that they could handle the training in the job market based on their training in Structural engineering.

4. CONCLUSION

The main problems that affected the locally trained engineers in the industrial job market were haphazard nature of choosing the course and sometimes inadequate syllabus contents coverage that may hinder the development of education system that would eventually affect the performance of university trained graduates in Structural engineering. When designing the content of structural engineering, the universities must strive to include the content suggested by the employers in the industrial job market to enhance local ownership of the contents by the employers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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