AN OVERVIEW OF THE APPROPRIATENESS OF TERTIARY BUILT ENVIRONMENT EDUCATION IN SOUTH AFRICA

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Construction is a complex process which requires the co-ordination of and co-operation of the skills and services of various built environment disciplines. The effective integration of these skills determines the success of the project. However, built environment students continue to receive discipline-based education. Furthermore, an outdated tertiary built environment education system is challenged by academics, built environment practitioners and the public in the form of media reports. A homogenous, internationally acceptable tertiary built environment education program, directed at commonality, consistency, coordination, cooperation and standardization using cost effective high-technology methods of delivery to enhance the interest, retention, empowerment and control of large groups is the overall aim of the study. A questionnaire developed from literature related to the diverse content, interconnectedness, cohesion, appropriateness, empowering effect, delivery methods and quality assurance of built environment education was used to obtain data from a sample of nine stakeholder groups within the built environment arena. An analysis of the data indicates that there is a perceived need for both universities and universities of technology programs; built environment tertiary education is relatively diverse in terms of content; there is a perceived need for a common first year and common subjects at other levels, and there is a trend towards perpetuation of traditional technologies, practices and systems within built environment education. The culmination of the study is the development of a template which comprises five components directed towards the advancement of tertiary built environment education. The template takes cognizance of the hypotheses, the findings and comments and is validated by a group selected in their capacity as subject specialists or representatives of primary built environment stakeholders.

Keywords: appropriateness, built environment, tertiary education.

INTRODUCTION

A recent graduate and member of the design build foundation graduate board, De La Mare (2002) is of the opinion that the current education system for construction in South Africa does not fully prepare students for the real life, commercial environment, nor does it provide enough exposure to the various sectors of the industry, all of which are vital to the construction process. Professional concern regarding the appropriateness of tertiary built environment education is expressed by Poole (1994), who states that the Australian Institute of Quantity Surveyors (AIQS) has set up a

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competency standards task force, which provides a framework that will better allow for the preparation of graduates.

Deficiencies within built environment education are deduced from the results of a study conducted by Nkado (2001) to determine the competencies required of quantity surveyors. The study discloses that all the competencies listed in a questionnaire rated at above average importance, however respondents contend that practitioners display above average proficiency levels relative to only thirty-nine percent of these.

The concerns of the built environment stakeholders are addressed to an extent by Smallwood's (2000) survey conducted to determine knowledge areas and skills required, and their frequency of use by construction managers. It was determined that all construction managers need technical expertise to be able to work with people and integrate the efforts of people. The top four subject areas arising from the study are programming, quality management, productivity, and industrial relations. The conclusion reached by Smallwood (2000) is that construction management undergraduate programs need to focus on management, and more specifically, the management of resources within defined parameters, along with the requisite technical expertise.

All tertiary built environment education programs should be aimed at producing people who have the basic capacity for inquiring, innovation and creativity (Daily Dispatch, 2003). Furthermore they should be capable of meeting the client's requirements of quality, price and delivery, and be aware of the complementary role of health and safety (H&S) in overall project performance, as H&S enhances productivity, quality, time, and ultimately cost (Smallwood, 2002). However, a report, although it did not directly refer to built environment education, indicates that current tertiary education is not fulfilling the aim of producing competent people. The Daily Dispatch (2004) reports: "the skills produced by the system, do not match the skills required. Our system is producing job-seekers instead of job-makers."

The aforementioned sentiments are corroborated by Sunter (2000), with the suggestion that current education is aimed at the job market of the 1960's. He suggests the creation of a society of foxes by creating an encouraging atmosphere and education system with a bias towards shaping entrepreneurs.

The outcome of a questionnaire survey of nine built environment stakeholder groups effectively constitutes a template for the development of appropriate built environment education.

SURVEY OF THE BUILT ENVIRONMENT POPULATION

A pilot study to pre-test the questionnaire consisted of a sample of built environment educationalists, postgraduate students registered for a built environment coursework program and final year architecture, quantity surveying and construction management students at a geographical spread of universities and universities of technology within South Africa.

The population selected for the primary survey consisted of registered members of the architecture, civil engineering, construction management, project management, and quantity surveying professions. They were selected in the capacity as the primary employers and prospective employers of built environment graduates. The survey instrument used was a questionnaire consisting of 14 questions directed to tertiary education in the disciplines of architecture, civil engineering, construction

management, project management, and quantity surveying. Each question related to all the abovementioned disciplines given that they are often all involved on a project.

Although researchers should endeavour to maximize sample size, it would have been a formidable and prohibitively expensive task to survey the entire population selected for the survey. Leedy and Ormrod (2005) cite that beyond a certain point, about 500 units or more, the population size is almost irrelevant, and a sample size of 400 should be adequate. Krejcie and Morgan (1970) developed a more scientific method of calculating the sample size and state that, using this calculation, as the population increases the sample size increases at a diminishing rate and eventually remains constant at slightly more than 380 cases. There is little to gain to warrant the expense and energy to sample beyond 380 cases, therefore this is the number of questionnaires distributed to randomly selected samples from each population group.

To ensure the relevance of the questions in the questionnaire a matrix of keywords was compiled to illustrate the relationship between the question, related literature and each sub-problem. Table 1 indicates how this was done.

Table 1: The relationship between questions, literature and the sub-problems

Question	**Salient literature**	**Sub-problem**
Standardization Merging Common year(s) of study	Opinions on career orientated training	Interconnectedness between various disciplines Cohesion between various disciplines
Subject areas	A diverse range of skills is necessary and diversifying the content is encouraged	Diverse content
Appropriateness in terms of trends, technologies, practices and systems Perpetuation of trends, technologies, practices and systems	Major weaknesses are identified and a worldwide paradigm shift is taking place in engineering education and common modules are proposed	Appropriateness Empowering effect
Performance of industry and the built environment disciplines	Fatalities, unambitious targets, rework, and disputes	Overall performance
Delivery methods	Learning approaches and webucation	Delivery methods
Policing	Education quality management, performance management and appraisal are prepared	Quality assurance
Comments re appropriateness	To assist in the investigation of the appropriateness of tertiary built environment education	All

Haksever and Manesali (2000) used questionnaires for the acquisition of qualitative data using quantitative scales. Similarly the questionnaire used in this study incorporated a five-point Likert type scale to facilitate an evaluation of responses between the ranges of minor to major; most inappropriate to most appropriate; very poor to excellent, and most inadequate to most adequate. A yes, no or unsure option was provided relative to certain questions and space was allocated for comments and the substantiation of particular responses. The questionnaires were designed such that the organized and systematically presented data resulting from the analysis could be compared to related literature, performance standards, competency norms and industry expectations in order to draw valid and accurate conclusions.

DATA CAPTURE AND ANALYSIS

The respondents that participated in the primary survey collectively represent thousands of years of construction industry experience, which makes their comments sound and therefore defensible.

Table 2 indicates the number of members in each of the associations, the number surveyed, the responses received, the responses discarded and the number of responses resulting from the primary survey.

Table 2: Response to primary survey

Association	Population	Sample size	Responses	Discarded	Usable	Percentage
ACPM	162	162	18	3	15	9.3
ASAQS	1 920	380	42	6	36	9.5
SACPCMP	4 765	380	26	3	23	6.0
SAIA	2 207	380	34	4	30	7.9
SAICE	8 72	380	27	3	24	6.3

The captured data was analysed using Microsoft Excel to produce descriptive statistics in the form of frequencies and a measure of central tendency in the form of mean scores. Inferences were in turn made from the collated and presented data. However, in order to further investigate the response data, further tests were conducted on the captured data. The first test conducted checked for discrepancies, omissions or errors in the captured data prior to further tests for consistency, practical significance, reliability and association being conducted.

INTERPRETATION OF THE DATA

The inferential statistical analysis entailed combining the responses from the primary survey respondents to enable the calculation of summated scores to reflect the actual support for topics.

Figure 1 shows how the responses to range type questions were scored prior to collation, summation and interpretation.

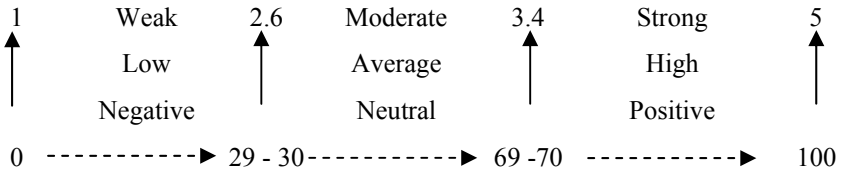

Figure 1: Scoring of responses on the Likert scale

Although the validity of the data obtained is not questionable, because it is face validity; a test of the internal consistency of the data is required. Cronbach's alpha is not only a test, but an investigation of the reliability of the data. Nunnaly (1978) explains Cronbach's alpha tests for association and reliability and provides values to engender an interpretation of the test results.

Table 3 contains values to compare the significance of the Cohen's d values and Cronbach alpha values resulting from the inferential statistical analysis of the primary survey responses.

Cronbach's alpha coefficient greater than .70, the recommended minimum value for reliability (Nunally 1978), were observed for most indices. Nunally (1978) argues that in the early stages of basic research, reliabilities of .50 to .60 are sufficient. For the purpose of this basic exploratory study the cut-off value of .60 was used to indicate

the reliability of the individual measuring instruments. Thus the internal reliability of the measures relating to the indices all exceeded this cut-off point and are regarded as acceptable.

Table3: Cohen's d values and Cronbach's alpha values

Cohen		Cronbach	
Value	**Effect**	**Value**	**Reliability**
.20 - .49	Weak	< .5	Poor
.50-.79	Medium	.5 to .7	Sufficient
.80 >	strong	> .7	Good

Table 4: Summary of the inferential statistical analysis relative to the primary survey response

Topic	**No.**	**MS or M%**	**Cohen's d**	**Cronbach's alpha**	**Support**
Standardization of programs in terms of subjects	127	79.21	0.97	.90	Strong
Merger	128	36.25	-0.37	.93	Weak
Common subjects at 1st yr level	128	3.69	0.50	.71	Strong
At least a common 1st year	128	3.63	0.44		Strong
Extent to which subject areas are included					
Accountancy	128	62.81	0.37	.81	
Price analysis & estimating	128	65.31	0.49	.71	
Quantities/Materials	128	56.41	0.20	.72	
Management Theory	128	71.41	0.65	.79	
Information technology	128	77.50	0.78	.89	Above average
Law	128	72.66	0.66	.83	
Structures	128	60.31	0.35	.67	
Design	128	55.94	0.19	.75	
Construction science & technology	128	76.25	0.88	.76	
Property development	128	51.25	na	.61	
Construction economics	128	66.88	0.52	.74	
Project management	128	71.72	0.69	.75	
Appropriateness of programs in terms of current trends technologies and practices	111	60.95 or 3.44	0.58	.90	Above average
Perpetuation of traditional technologies, practices and systems	113	55.49 or 3.22	0.32	.84	Moderate
Performance of construction industry wrt project parameters	123	44.67 or 2.79	-0.41	.84	Below average
Disciplines performance	118	55.25 or 3.21	0.42	.66	Moderate
Delivery methods	118	55.30 or 3.21	0.43	.79	Moderate
Policing	115	50.83 or 3.03	na	.82	Average

FINDINGS

Table 4 summarizes the results of the inferential statistical analysis of the primary survey responses. A comment relative to the extent of support for various topics is

inferred from a comparison of the findings to the tables containing values and the significance of the values.

A TERTIARY BUILT ENVIRONMENT EDUCATION TEMPLATE

In order to validate elements of the findings a template directed towards an appropriate tertiary built environment education was designed. The first component includes quantitative entrance criteria to determine the compatibility of the candidate before a contract is entered into between the tertiary education institution and the student, given that the throughput rate relative to the national civil engineering diploma had dropped from 67% in 1992, to 27% in 2002 (Capazorio, 2007). Furthermore, the first component should take cognizance of the three limits to education, namely, the definite limit, the objective limit and the absolute limit.

The second component proposes a common 1st year given that most construction projects require the services of the five built environment disciplines surveyed. The notion of team working has a long history and in the second half of the twentieth century, its theoretical and practical contribution to workplace engineering and re-design has been extensively reviewed and comprehensively documented.

The quantity of team management literature, team-building seminars and conferences act as a tangible testimony to the enduring appeal of team working philosophies. Tennant and Langford (2005) reason that the professional construction teams require a multi-functional, inter-disciplinary representation, engaging a cross-section of industry professionals responsible for carrying out duties particular to their specialist education and training.

The third component presents five subjects most frequently cited by built environment stakeholders for inclusion in the five disciplines' programs. The subject areas are design principles, information technology, law, management and quantities.

The fourth component espouses that a series of lectures and short courses relevant to specific subject areas be recorded and made available from a website. It is envisaged that these lectures be presented professionally and feature domain champions and subject experts. Computer-assisted instruction has the attendant advantages of flexibility, accessibility and feedback.

Standardization relates to order and control. However, standards are invented and only give an illusion of control. They should be adapted and not elevated to the status of truth (Amod, 2006). Most importantly these standard lectures and short courses will update and refresh the educators whilst ensuring a broad and equitable transmission of knowledge.

The fifth component of the template provides for quality assurance given that the evaluation of the students and the accreditation of the programs are on a national basis. Furthermore, the availability of the lectures will encourage feedback thereby ensuring that they are regularly updated. Quality may be further enhanced by recognising and adopting standard procedures and policies. Quality is conformance to requirements – nothing more, nothing less. Given that the importance of testing is attested to by Suppes (1992) declaring that it is the fifth educational innovation, it is included in this component of the template.

CONCLUSIONS

Strong support may be deemed to exist for standardization of programs in terms of subjects given that only 79.2% of the respondents indicate that programs should be standardized. However, weak support may be deemed to exist with respect to the merging of universities and universities of technology built environment programs given that two thirds of the respondents are opposed to the merge. A mean score of 3.69 for a common 1st year is an indication of moderate to strong support for the inclusion of a common 1st year in the five disciplines' programs. This is confirmed by a mean score of 3.63 relative to common subjects between programs at 1st year level. Generally there is above average to strong support regarding the inclusion of the twelve subjects listed in all five of the built environment disciplines' programs. Similarly above average support may be deemed to exist with respect to the appropriateness of the disciplines' programs in terms of current trends, technologies and practices.

The values in Table 4 postulate that since traditional technologies, practices and systems are perpetuated, change is not taking place. Furthermore, it is disturbing that the performance of the disciplines and the delivery methods employed by educationalists is moderate. Generally unpoliced built environment tertiary education program are attested to by the average values attributed to this topic. A template comprising quantitative entrance criteria, a common 1st year, common subjects, standardized lectures and short courses, and quality assurance is proposed as an aid to the enhancement of tertiary built environment education.

RECOMMENDATIONS

A realization that evolved during the study was the significance and similarity the investigated problem has to the human resources component of other industries. In order for a company to progress and produce quality goods and services and make a meaningful contribution, its people should have a diverse knowledge and undergo standardized training programs that take cognisance of the collaboration required for a production process. Furthermore, unless feedback is obtained regarding the products and services supplied by a company perpetuation of traditional technologies, practices and systems will continue resulting in the products and services becoming redundant. It is therefore, strongly recommended that appropriate methods of instruction be employed in standardized training programs that are regularly policed. Universities should consider adopting a unified approach towards tertiary built environment education in South Africa.

Ceric and Radujkovic (2007) inform that the Bologna Declaration is an obligation undertaken by twenty countries to reform the structures of their higher education system in a convergent way. A commitment is freely taken by each country to reform its own education system. A set of specified objectives of the Declaration are: the adoption of the common framework of readable and comparable degrees; the establishment of a system of credits ECTS – European Credit Transfer System; students, 'teachers' and researchers' mobility; and quality assurance. The recommendation that consensus is reached regarding the naming of degrees, subjects and subject content is thus indirectly aligned with the Bologna Declaration.

REFERENCES

Amod, S (2006) The ecology of construction. A perspective of sustainable development. *In:* Haupt, TC (Ed.), *The First Built Environment Conference*, 18-20 June, Sandton, 28-38.

Capazorio, B (2007) Graduates fail to bring skills. *The Herald*, 15 June, 15.

Ceric, A and Rodujkovic, M (2007) *An overview of construction management education and research at Central and South-Eastern European universities*. 7th Senet Conference, Zadar, Croatio.

Daily Dispatch (2003) Full Ft Hare campus for East London. *Daily Dispatch*, 4 February, 3.

Daily Dispatch (2004) Graduates 'need to be employable.' *Daily Dispatch*, 4 March, 12.

De la Mare, R (2002) The curse of the course. *Construction Manager*, May 2002, 22.

Haksever, A and Manesali, E (2000) Assessing supervision requirements of PhD students: The case of construction management and engineering in the UK, *European Journal of Engineering Education*, May, **25**, 19-32.

Krejcie, R V and Morgan, DW (1970) *Educational and psychological measurement*, **30**, 607-610.

Leedy, P and Ormrod, J (2005) *Practical research, planning and design*, 7ed, Merrill, Prentice Hall.

Nkado, R (2001) How can quantity surveyors chart the future of their profession? *Project Pro*, February, 22-24.

Nunally, J (1978) *Psychometric theory*, 2ed, New York: McGraw-Hill.

Poole, M (1994) Standards for quantity surveying, *The Building Economist*, December, 32.

Smallwood, J J (2000) Practicing the discipline of construction management: knowledge and skills. *In:* Ngowi, AB and Ssegawa, J (Eds.), *2nd International conference on the CIB Task Group on Construction in Developing Countries Challenges facing the Construction Industry in Developing Countries*, 16 November, Gaberone, Botswana, Botswana National Construction Industry Council / Faculty of Engineering and Technology, University of Botswana / Council for Research and Innovation in Building and Construction, 60-70.

Smallwood, J J (2002) Construction health and safety: Motivation for the inclusion of client and designer responsibility. *Construction World*, October, 8.

Sunter, C (2000) SA needs foxes not hedgehogs! *Engineering News*, October, 76.

Suppes, P (1992) Instructional computers, past present and future. *International Journal of Educational Research*, **17**, 7-17.

Tennant, S and Langford, B (2005) Teams and project performance in the UK Construction Industry. *In:* Haupt, TC (Ed.), *4th Triennial International Conference Rethinking and Revitalizing Construction Safety, Health, Environment and Quality*, 17-20 May, Port Elizabeth, South Africa, Construction Research Education and Training Enterprises, 200-210.