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The threat of technology to the way quantity surveying is practised in KwaZulu-Natal

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ABSTRACT AND KEYWORDS

Purpose: The rapid growth and development of comprehensive user-friendly estimating software has threatened the traditional roles of quantity surveyors in the construction sector resulting in them having to develop alternative services that they render clients. Consequently quantity surveying has experienced significant changes in terms of scope and types of services provided. This study examines the perceived threat of new technological developments on the way that quantity surveyors conduct themselves.

Design/methodology/approach: A sample of 22 quantity surveyors in Durban was surveyed using an quantitative survey instrument developed from published literature on responses of quantity surveying to technology to measure the responses of this sample to the same issues. Knowledge and experience of technology, benefits, barriers and readiness for technological change was examined.

Research limitations: The sample of quantity surveyors was drawn from the Durban area using the Association of Quantity Surveyors (ASAQS) and South African Council for the Quantity Surveying Professions (SACQSP) database.

Findings: Preliminary findings suggest that quantity surveyors are lagging behind with respect to their adoption of technology due to high cost of hardware and software.

Response to conference theme: This study identifies the reasons why the adoption of technology by quantity surveyors is not pervasive throughout the discipline.

Practical implications: The findings provide the opportunity to improve the services currently offered by quantity surveyors but also new and innovative services driven by technological developments

Keywords: Quantity surveying, computer technology, computer hardware, computer software

Conference sub-theme: *Construction Education*

1. INTRODUCTION

The rapid growth and development of comprehensive user-friendly estimating software has threatened the traditional roles of quantity surveyors in the construction sector (Ashworth, Hogg and Higgs, 2013). Consequently quantity surveying has experienced significant changes in terms of scope and types of services provided. Rapid technological innovative practices are being developing to achieve competitive advantage (Kulasekara, Jayasena, and Ranadewa, 2013). Technology has the potential to remove many mundane elements of traditional quantity surveying by automating or assisting in these tasks while removing human error, increasing efficiency and promoting collaboration (Zhou, Perera, Udeaja and Charlotte, 2012). This study examines the perceived threat of new technological developments on the quantity surveying discipline.

2. ROLE OF QUANTITY SURVEYORS

Quantity surveyors are regarded as the cost managers of construction works in all sectors of the construction industry particularly in regions where there has been a historic relationship with the United Kingdom. According to Ashworth (2010) and Ashworth, Hogg and Higgs (2013), the traditional quantity surveying roles are, namely

- Single rate approximate estimation;
- Cost planning;
- Procurement advice;
- Measurement and quantification;
- Document preparation, especially bills of quantities;

- Cost control during construction;
- Interim valuations and payments;
- Financial statements;
- Final account preparation and agreement;
- Settlement of contractual claims.

Following the potential demise of bills of quantities additional and potential new roles evolved and include the following, namely:

- Investment appraisal;
- Advice on cost limits and budgets;
- Whole life costing;
- Value management;
- Risk analysis;
- Insolvency services;
- Cost engineering services;
- Subcontract administration;
- Environmental services measurement and costing;
- Technical auditing;
- Planning and supervision;
- Valuation for insurance purposes;
- Project management;
- Facilities management;
- Administering maintenance programs; and
- Advice on contractual disputes (Ibid).

Other classifications have referred to the roles as being traditional (six roles) (Ashworth, 2010), evolved (ten roles) (Frei and Mbachu, 2009) and emerging (five roles) (Fanous, 2012) with the traditional roles being regarded as the most important (Sonson and Kulatunga, 2014). The list under each classification in order of importance is:

Traditional role

- Quantification and costing of construction works
- Project financial control and reporting
- Procurement and tendering
- Contract practice
- Cost planning
- Construction technology and environmental services

Evolved role

- Valuation (property, rental, etc.)
- Contract administration
- Consultancy services
- Project management

- Insurance
- Facilities management
- Risk management
- Management and dispute resolution procedures
- Development/investment appraisal
- Research methodologies and techniques

Emerging role

- Whole life costing assessment
- Strategic management and leadership
- Value management studies
- Sustainability
- BIM management [ICT] (Ibid).

From this particular study it is evident that quantity surveyors have not embraced the potential of new technologies. Some of the issues predicted by Harris (2000) that will affect the discipline of quantity surveying include the following, namely:

- Blurring of professional disciplines;
- Wider range of services offered to present clients;
- Application of quantity surveying to new markets;
- More extensive and intensive use of information and communications technology to improve efficiency and effectiveness;
- Changes in professional structure;
- Multi-discipline working and development;
- Increased emphasis on continuing professional development;
- Geographical dispersion of work to allow for the most economical methods of working; and
- Forecasted shift between professional and technical activities.

In this list of issues the increased use of technologies to improve efficiency and effectiveness of quantity surveyors stands out.

3. ADOPTION OF TECHNOLOGY

Ashworth and Hogg (2000) claim that the five most dominant problems of using computers in quantity surveying are maintaining programs, integration of processes, cost containment, recruitment, and meeting project deadlines. Further, benefits of technological advancements for quantity surveyors include:

- Reduction in the amount of time spent on repetitive processes;
- Improvement in methods of communications;
- Enhancement in the quality of the services provided;

- Development of a broader range of services; and
- Speed in the execution of tasks (Ibid).

Technology enables collaboration between users through better visual understanding of the building artifact (Matipa, Cunningham and Naik, 2010). Ashworth, Hogg and Higgs (2013) predicted that the broadening range of quantity surveying functions will include automated measurement and quantification, environmental and sustainability analysis, facilities management, legal services, investment advices and quality management. It has been found that the emergence of new and updated technologies make the achievement of these functions more efficient (Wu, Wood, Ginige and Jong, 2014).

Several studies have found that the level of the adoption of information technologies was positively associated with improved performance (Kang, O'Brien, Thomas, and Chapman, 2008). Usman, Said and Yahaya (2012) argue that despite these benefits quantity surveyors have not been taking serious action towards adopting new technologies. Where they have been used they have been at the basic stages only with no advancement into the usage of sophisticated software because of the negative perceptions and fraudulent activities. The construction industry, and by inference quantity surveying, has been found repeatedly to be reluctant to apply new technologies and employs lower levels of technology than other industries (Yang, 2007). Further, organizations tended to resist giving up and changing established ways of doing things and familiar technology products (Lawrence and Scanlan, 2007). This tendency is referred to as organizational inertia.

According to Venkatesh, Morris, Davis and Davis (2003) direct determinants of user acceptance of technology and usage behavior were likely to be

- performance expectancy - degree to which a particular technology will help individuals attain gains in job performance;
- effort expectancy - degree of ease associated with use of the system;
- facilitating conditions - degree to which an individual believes that organizational and technical infrastructure exists to support use of the system;
- social influence - degree to which an individual perceives that important others believe he or she should use the new system;
- top management support; and
- individual resistance to change.

A study in Nigeria found that the greatest challenges reported as deterrents to the increased uptake of technology by quantity surveyors were the high cost of hardware and the fear of virus attacks (Oyewobi, Ibironke and Oladosu, 2015).

It is therefore important that quantity surveyors to appreciate technology, understand their potential and develop and employ effective processes and tools to integrate technologies into their current practices (Cartlidge, 2011).

4. RESEARCH APPROACH

A convenience sample of 22 quantity surveyors who were either employed in quantity surveying practices or practicing for themselves in the Durban area of the KwaZulu-Natal province of South Africa were surveyed about their views of the threat of technology to the discipline and practice of quantity surveying. The data were collected via a quantitative questionnaire survey comprising of several sections such as knowledge and experience of technology, benefits, barriers and readiness. Almost all questions took the form of statements around the various themes which required a scaled response of agreement. Descriptive statistics were derived using SPSS v23 and presented including measures of central tendency and dispersion. The internal validity of scaled responses was determined by the Cronbach's alpha co-efficient for validity.

5. RESEARCH FINDINGS

Profile of respondents

Most respondents had been in business for between 1 to 10 years (63.6%) and between 11 to 20 years (31.8%). Just more than half of the respondents (57.1%) considered their practices or firms ready for technology. They rated their knowledge and experience of technology, software and innovation as shown in Table 1 with 1=very low and 5=very high.

Table 1. Knowledge and experience of technology, software and innovation (n=22)

	1	2	3	4	5	Mean	SD
Knowledge	4.5	18.2	40.9	31.8	4.5	3.14	0.94
Experience	4.5	31.8	36.4	23.4	-	2.86	0.89

Respondents tended to have average knowledge (mean 3.14) and experience (mean=2.86) of technology, software and innovation. Almost all respondents (95.5%) expressed that they were open to the introduction and adoption of new technology to quantity surveying despite the threats that it might present.

Reliability

Table 2 shows the Cronbach's alpha co-efficient for the scaled responses of each of the four constructs. There is an acceptable degree of internal consistency for the scales used for all the constructs, namely a Cronbach Alpha statistic which is greater than the rule-of-thumb 0.70 for acceptable internal scale consistency. There is therefore between 71.2% and 90.1% probability that the constructs each measure a single underlying concept with an error of at most 5%. The scales used to measure the perceptions of technology in quantity surveying are therefore acceptable in their measure of the reliability of the constructs.

Table 2. Reliability statistics

Construct	Cronbach's alpha co-efficient (n=22)
Technology and quantity surveying	0.712 (25 items)
Benefits of technology	0.857 (8 items)
Barriers of technology	0.863 (8 items)
Knowledge and experience	0.901 (2 items)

Technology and quantity surveying

Respondents were presented with 25 statements about technology and quantity surveying and were asked to indicate their level of agreement on a 5-point Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. The findings are shown in Table 3 ranked by the means of their responses.

Table 3. Technology and quantity surveying (n=22)

Factor/Influence	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	SD	Rank
Software reduces the time to produce BoQs	-	-	4.5	36.4	59.1	4.55	0.60	1
Technology increases efficiency of quantity surveying	-	-	13.6	54.5	31.8	4.18	0.66	2
Technological advances require new skills and knowledge	-	9.1	9.1	40.9	40.9	4.14	0.94	3
Cost estimation can be improved	-	13.6	-	50.0	36.4	4.09	0.97	4
Technology allows the quantity surveyor to focus on strategic activities	-	4.5	13.6	54.5	27.3	4.05	0.79	5
Technological innovations promote collaboration between stakeholders	-	4.5	18.2	54.5	22.7	3.95	0.79	6
Technology enhances life cycle costing data provision to clients	-	4.8	23.8	47.6	23.8	3.90	0.83	7
Technology automates taking off	4.8	4.8	9.5	57.1	23.8	3.90	1.00	8

and BoQ production								
Technological developments can streamline the procurement process	-	-	27.3	59.1	13.6	3.86	0.64	9
Technology potentially removes many mundane elements of traditional quantity surveying	4.5	9.1	13.6	45.5	27.3	3.82	1.10	10
Upfront costs are too high	-	9.1	22.7	59.1	9.1	3.68	0.78	11
Technology increases program certainty at the tender stage	-	13.6	36.4	27.3	22.7	3.59	1.01	12

Table 2 continued

Factor/Influence	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	SD	Rank
Financial and time commitment from small practices is too large	4.5	13.6	27.3	45.5	9.1	3.41	1.01	13
Information and Communication Technologies (ICT) are too expensive	4.5	4.5	50.0	36.4	4.5	3.32	0.84	14
Additional costs of training make technology prohibitive	9.1	13.6	36.4	31.8	9.1	3.18	1.10	15
Roles and responsibilities of quantity surveyors will change	-	40.9	13.6	31.8	13.6	3.18	1.14	16
There is a scarcity of available training	4.8	19.0	38.1	33.3	4.8	3.14	0.96	17
Technology removes human errors from quantity surveying	4.5	27.3	31.8	22.7	13.6	3.14	1.13	18
Organizational inertia prevents the adoption of new technology	9.1	22.7	22.7	36.4	9.1	3.14	1.17	19
Quantity surveyors resist the introduction and adoption of new technology	13.6	27.3	13.6	31.8	13.6	3.05	1.32	20
There are problems with legal ownership of information	-	27.3	54.5	18.2	-	2.91	0.68	21
Technology reduces the amount of variations during the construction phase	13.6	27.3	31.8	18.2	9.1	2.82	1.18	22
There is no client demand	18.2	31.8	31.8	18.2	-	2.50	1.01	23
QS practices are too small to embrace technology	36.4	22.7	27.3	13.6	-	2.18	1.10	24
Technological developments are only for architects and designers	68.2	22.7	-	9.1	-	1.50	0.91	25

Respondents tended to agree strongly that software would reduce the time to produce Bills of Quantity (mean=4.55). They tended to agree that technology

would increase the efficiency of quantity surveying (mean=4.18) but would require new skills and knowledge (mean=4.14). They also tended to agree that cost estimation could be improved (mean=4.09), technology would allow the quantity surveyor to focus on strategic activities (mean=4.05) and promote collaboration between stakeholders (mean=3.95). Respondents tended to disagree strongly that technological developments were for architects and designers only (mean=1.50). They tended to disagree that quantity surveying practices were too small to embrace technology (mean=2.18). What was noticeable were the large proportions of respondents who had neutral views about several of the issues such as there being problems with legal ownership of information (54.5%) and information and communication technologies being too expensive (50.0%). This finding might be indicative of their lack of knowledge and experience with new technological advances.

Benefits of technology

Respondents were presented with eight benefits of technology to quantity surveying and were asked to indicate their level of agreement on a 5-point Likert scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. Their responses ranked by the means are shown in Table 4.

Table 4. Benefits of technology to quantity surveying (n=22)

Benefit	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	SD	Rank
Improved efficiency	-	-	4.5	31.8	63.6	4.39	0.59	1
Standardization of routine tasks	-	4.5	4.5	45.5	45.5	4.31	0.78	2
Cost plan production	-	-	9.1	54.5	36.4	4.27	0.63	3
Visual aid	-	-	13.6	54.5	31.8	4.18	0.66	4
Automatic schedule/program production	-	4.5	13.6	54.5	27.3	4.05	0.79	5
Co-ordination of all design information	-	4.5	13.6	59.1	22.7	4.00	0.76	6
Accurate measurement	-	4.5	22.7	45.5	27.3	3.95	0.84	7
Cost effective	-	4.8	42.9	28.6	23.8	3.71	0.90	8

The findings suggest that respondents tended to either agree or strongly agree that technology would benefit quantity surveying in all the ways indicated in Table 4 with means ranging from 3.71 to 4.39. Improved efficiency (mean=4.39) was the most dominant benefit derived from technology and cost effectiveness and efficiency was the least dominant benefit (Mean=3.71).

Barriers of technology

Respondents were presented with eight barriers of technology to quantity surveying and were asked to indicate their level of agreement on a 5-point Likert

scale where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree. Their responses ranked by the means are shown in Table 5.

Table 5. Barriers of technology to quantity surveying (n=22)

Barriers	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean	SD	Rank
High cost/extra capital investment	-	14.3	19.0	47.6	19.0	3.71	0.96	1
Lack of software application interfaces	-	19.0	47.6	19.0	14.3	3.29	0.96	2
Less familiarity with project	9.5	14.3	23.8	42.9	9.5	3.29	1.15	3
Software complexity	-	31.8	18.2	40.9	9.1	3.27	1.03	4
Liability concerns	9.1	18.2	50.0	13.6	9.1	2.95	1.05	5
Lack of standards	4.5	31.8	36.4	22.7	4.5	2.91	0.97	6
Threat to services conventionally provided by quantity surveyors	13.6	40.9	31.8	9.1	4.5	2.50	1.01	7
Removed need for a quantity surveyor	36.4	31.8	18.2	9.1	4.5	2.14	1.17	8

From the findings in Table 5 it is evident that respondents tended to agree that the high cost and extra capital investment involved would be the largest barrier to adopting technology by quantity surveyors (mean=3.71). They tended to disagree with the perceptions that technology would remove the need for a quantity surveyor (mean=2.14) or present as a threat to services conventionally provided by quantity surveyors (mean=2.50). They were somewhat neutral about the other barriers (means from 2.91-3.29).

Determinants of technology usage

Respondents were asked to rank the significance of six determinants of the use of technology in quantity practices in ascending order from 1 to 6 with 1 being most significant. The rankings are shown in Table 6.

Table 6. Determinants of technology usage (n=22)

Determinants of technology usage	Mean	SD	Rank
Performance expectancy	3.18	1.89	1
Top management support	3.32	1.67	2
Effort expectancy	3.45	1.44	3
Facilitating conditions	4.05	1.21	4
Social influence	4.09	1.44	5
Individual resistance to change	4.32	1.78	6

From Table 6 it is evident that respondents regarded the degree to which a particular technology would help individuals attain gains in their employment (Performance expectancy) as the most significant determinant of technology usage in quantity surveying practices. Top management support was the

next most significant determinant. Of the six determinants Individual resistance to change was the weakest.

6. CONCLUSIONS

The study found that the knowledge that quantity surveyors had about technology, software and innovation was at best rather average. They recognized the most obvious benefits of embracing technology such as the time taken to produce Bills of Quantities which intuitively they still regard as one of their core services to the construction industry. Similarly, more accurate cost estimation was attractive. Largely because of their lack of knowledge of available technologies they could not comment assertively on many of the issues surrounding the relationship between technology and quantity surveying. They, however, recognized the potential that technology might have on various somewhat routine activities that quantity surveyors get involved with. The greatest inhibitor to technology uptake was the perceived high cost and extra capital needed. They denied that technological advancements presented threats to their existence or the services that they traditionally offered. What would enhance the uptake of technology was the individual gains that could possibly be achieved through mundane and tedious tasks becoming easier and quicker. In the main the findings of the study resonated with those of other studies done particular in developing countries.

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