RESEARCH MANAGEMENT AND RESEARCH OUTPUT

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Synopsis

Purpose: A study was conducted at two merged South African higher education institutions to determine which management factors, as identified in a literature study as well as through a factor analysis of survey data, were predictive of the dependent variable 'research output'.

Problem investigated: Research output contributes to creating sustainability of knowledge of management sciences and therefore the active management of research is in the interest of progressive universities. Research management related activities are usually associated with measurable targets, detailed plans, rigorous evaluation and decisive action – all of which are observable (perhaps programmable) behaviour also referred to as tangible factors. Authors argue that the tangible factors of any successful institution can be copied, technology can be bought, and in theory you should have an instantly thriving research institution. It is, however, clear that although many institutions have exactly the same technology and structure as their successful competitors, they still fail to succeed in increasing research output.

Design and Research methodology or approach: A survey was distributed to n=411 and yielded a 49.6% response rate. A confirmatory reliability analysis as well as a factor analysis was conducted.

Findings / implications: The empirical model that was derived through a factor analysis strengthens the argument that both tangible and intangible factors exist in a research environment. Tangible and intangible factors play a different role in predicting research output. The tangible factors are predictors of research output for non-research-active academics. The theoretical research output prediction model highlights predictors such as 'professional activities' and 'individual skills and competence' for specific groupings. The theoretical model indicates that the factors that predict research output are largely intrinsic to a researcher but could also be supported by institutional research management.

Value of research: Findings provide direction on the differences in managing research active and research non-active academics. Findings could influence institutional research management practices and policies.

Conclusion: A large percentage of the knowledge capital of the global economy is managed and retained in a university setting through the management of tangibles and intangibles. Research management, of which impact is measured through research output, can only be optimised through a balanced combination of tangibles and intangibles.

Keywords: Research management, research output, predictors research

INTRODUCTION AND THEORETICAL BACKGROUND

In a globalised world, given the rapid growth of both technology and the world population, the spread of knowledge and its application in particular contexts is exponentially mushrooming. Ultimately, knowledge drives and sustains power and the notion of the knowledge economy, where economic growth and prosperity are determined by the exploitable knowledge that a nation produces, is elevated in importance. Howells and Roberts (2000, p. 17) state that "…for the advanced industrialised countries, knowledge is becoming the only resource capable of offering competitive advantage and continued growth and prosperity." Universities have a proud history of research and are therefore well positioned to generate knowledge. They furthermore have the human competence and mandate to sustain knowledge generation. University research is regarded as a competitive strength by developed countries (Paterson, 1999, p. 10; Larédo & Mustar, 2001, p.497). However,

"...important questions remain about ... which institutional factors are influential in shaping cutting-edge research environments" (Heinze, Shapira, Rogers & Senkerd, 2009, p.610).

Research and knowledge management has in recent years become a highly professional and strategic function within universities. Di Sarli (2002, pp. 18-19) describes research management as: "Planning the physical and material conditions under which research may flourish; improving the dissemination of results; and activity comprehensive [sic] reporting". Research management is usually associated with measurable targets, detailed plans, rigorous evaluation and decisive action – all of which are observable (perhaps programmable) behaviour also referred to as tangible factors. These tangible and technical factors of research management include organisational structures for research management, and types of research offices ACU (2003) as well as categories of research funding (Bushaway, 2003, p.20), all measured and tracked through research output. Becker, Huselid and Ulrich (2001, p.13) argue that the tangible factors of any successful organisation can be copied, technology can be bought, and in theory you should have an instantly thriving organisation – not unlike cloning. It is, however, clear that although many organisations have exactly the same technology and structure as their successful competitors, they still fail to succeed. This raises the proposition that the intangible factors of an institution are what create success or failure. Intangibles are difficult to quantify, are based on people's assumptions, cannot be bought or imitated, and appreciate in value with purposeful use (Becker et al., 2001, p.15). Intangibles, such as people management and the management of relationships such as power relations and participation, become part of the competitive advantage of an institution.

"Little is known about the variety of factors influencing faculty publication productivity in different nations, and especially those from the developing world." (Teodorescu, 2000, p. 202)

In this regard an investigation was conducted at two South African higher education institutions that were busy merging, to determine which factors, as identified in a literature study as well as through a factor analysis of survey data, were predictive of the dependent variable 'research output'.

Research productivity and output

The overall aim of research management is to increase the research productivity and research quality of an institution. Publication productivity, as a consequence of its measurability (namely, number of publications), is usually used as an indicator of research productivity. Publication productivity is not strictly equal to research productivity (Fox, 1992, p.103). The reason is that there is no guarantee that large numbers of publications make for significant, quality contributions. An all-inclusive equation to calculate research productivity in this broad sense is not available. For the purposes of this study, publication productivity is used as an indicator of research productivity and is measured as self-reported number of publications published over a three-year period. According to the South African government's research funding framework, research output is defined as 'textual output'. Of the textual output there are three publication output types that are formally recognized: journals, books and proceedings (DoE, 2003, p.5).

Related studies

Research regarding research productivity is predominantly delineated into two main groups – namely, single-nation and cross-national studies (Theodorescu, 2000, p.203-206). Of these two groups of studies, the majority refer to research productivity but most are more descriptive than quantitative in nature.

Single nation studies

Single-nation studies are usually based on single disciplines and single or multiple institutional settings, therefore in a specific nation. Single-nation studies cover psychological-individual factors attributable to researchers, and include studies in the USA, UK and Australia. Other studies cover the Matthew-effect with reinforcement, and disciplinary norms (Wanner, Lewis & Gregorio 1981; Finkelstein 1984; Fox 1985; Cresswell 1985; Waworuntu 1986; McGee & Ford 1987; cited in Theodoresu, 2000, p. 204). The Matthew-effect and reinforcement postulates that researchers that have early success in their career are able to accumulate greater research funding and other forms of support based on their reputation over time than those who do not have a well-established research reputation. This effect is also referred to as the accumulative advantage (Theodorescu, 2000, p.204).

Similar to the Matthew effect, Simonton (1999, 2004, cited in Heinze et al., 2009, p.611) investigated creativity in scientific research and found that scientists increase their likelihood of being cited by increasing the number of textual outputs available thereby broadening the potential sources for subsequent referencing. Psychological-individual factors maintain that intrinsic rewards are more motivating than institutional incentive structures (Theodorescu, 2000, p.204).

Another approach to investigating research output at universities is exemplified by the multi-institutional study by Long and McGinnis (Fox, 1992, p.105). The study investigated the effect of the prestige of organisational setting on publication productivity. Organisational settings were classified into research universities, non-research universities, non-academic and industrial settings. It was found that publication productivity was not a prerequisite to gain employment at any of the organisational settings but that "… once on the job … publication comes to conform to the context … after three years in the location" (Fox, 1992, p.105). This means that the institutional prestige was reinforced through the organisational climate and norms at research universities. Other single-nation studies focused on university and industry collaboration (Landry, Traore & Godin, 1996, p.283-301) and university and industry collaboration through entrepreneurial activity (Van Looy, Rnaga, Callaert, Debackere & Zimmerman, 2004, p.425-441).

Cross-national studies

Cross-national studies, according to Teodorescu (2000, p.204-206), show that academics who emphasise a primary commitment to research publish more than those who place emphasis on teaching (Altbach & Lewis cited in Theodorescu, 2000, p.213-216). This study also indicated a high level of correlation between internationalism and research productivity. The research and teaching nexus was strongly supported by Gottlieb and Keith (cited in Theodorescu, 2000, p.205). The Teodorescu (2000) study, which used the Carnegie Foundation's 'International Survey of the Academic Profession' questionnaire, analysed data from 10 countries – namely, Australia, Brazil, Chile, Hong Kong, Israel, Japan, Korea, Mexico, the UK and the USA. The study indicated that publication productivity predictors differed between nations and especially between developed and developing nations. Age and gender, the *individual ascriptive* variables, did not predict research output. The *individual achievement* variables indicated that a strong affiliation with the subject discipline – i.e. membership of societies, academic rank, as well as access to professional international networks, was a very strong indicator of research output overall. Access to international networks, through the attendance of international conferences, was a very strong indicator of publication productivity in Brazil, Israel, Korea and Mexico. This suggests that, for developing nations, due to their poor national research dissemination mechanisms and systems, international networking and dissemination is of prime importance in motivating publication productivity. *Institutional characteristics* did not seem to influence research productivity in the ten countries studied. The only institutional characteristic that was significant for Australia, Japan, the UK and the USA, was time spent on research.

In contrast to the Teodorescu study, Wissing, Du Toit and Rothmann (2002) state that the research productivity of academics at South African historically advantaged universities is influenced by time and work overload, a lack of support from the institution, role overload with conflicting expectations and the conflict between teaching, research and service delivery. The need for academics to supplement their income externally is also cited as a fundamental strain on time available for research. Researchers at the lower levels of the hierarchy are furthermore hampered by a lack of mentorship and research skills and, most importantly, South African academics are not convinced that increased research output will lead to desired outcomes such as recognition and support. The South African-based study therefore posits that institutional characteristics are a strong influence on research productivity. It could be that the South African context is influenced more by institutional characteristics than other contexts as a result of the country's unique higher education history and the associated consequences of teaching massification and poorly prepared students. Whatever the reasons for the differences, the Teodorescu (2000) and Wissing *et al* (2002), studies clearly indicate that the factors motivating publication productivity differ markedly across national academic settings. Publication productivity is therefore one of the most prevalent indicators of research productivity. Other indicators could be the number and size of research grants and contracts and other forms of peer recognition.

PURPOSE/PROBLEM STATEMENT AND OBJECTIVES

The purpose of the study was to determine which management factors, as identified in a literature study as well as through a confirmatory reliability analysis and a factor analysis of survey data, were predictive of the dependent variable 'research output', at two merged South African higher education institutions.

The study aimed to answer the following research question: Which factors are predictors of research output?

METHODOLOGY

Sampling

The study was undertaken during a merger at two South African higher education institutions with combined locations on five campuses. The full population of academic staff members at each institution was targeted for the questionnaire i.e. those staff members who had teaching or research tasks as part of their normal job duties and were permanently employed by the institution or were employed on full-time contracts (948 academics in total). The study was a census survey with a self-selected sample. The generalisability of the results of questionnaires is directly influenced by the choice of a census (Babbie & Mouton, 2003, p.166) and, strictly speaking, only probability (or random) samples can be statistically generalised to the population (Williams, 1997, p.68). I was aware of this fact but felt that the opportunity for all academics to participate carried greater priority and decided to employ alternative strategies in order to increase the response rate. The response rate is indicated in table 1. Non-respondents were not used to control the responses as the survey was anonymous and the control group would lose their anonymity if requested to serve as control for the data.

Table 1: Response rate

	Campus A	Campus B		Campus C	
		Main campus	Business campus	Campus 1	Campus 2
Number of respondents	204	76	17	44	20
Number of academic personnel	411	284	127	88	38
Response rate per campus sub-sections	49.6%	26.7%	13.4%	50%	52.6%
Combined response rate per main campus	49.6%	22.6%		50.7%	

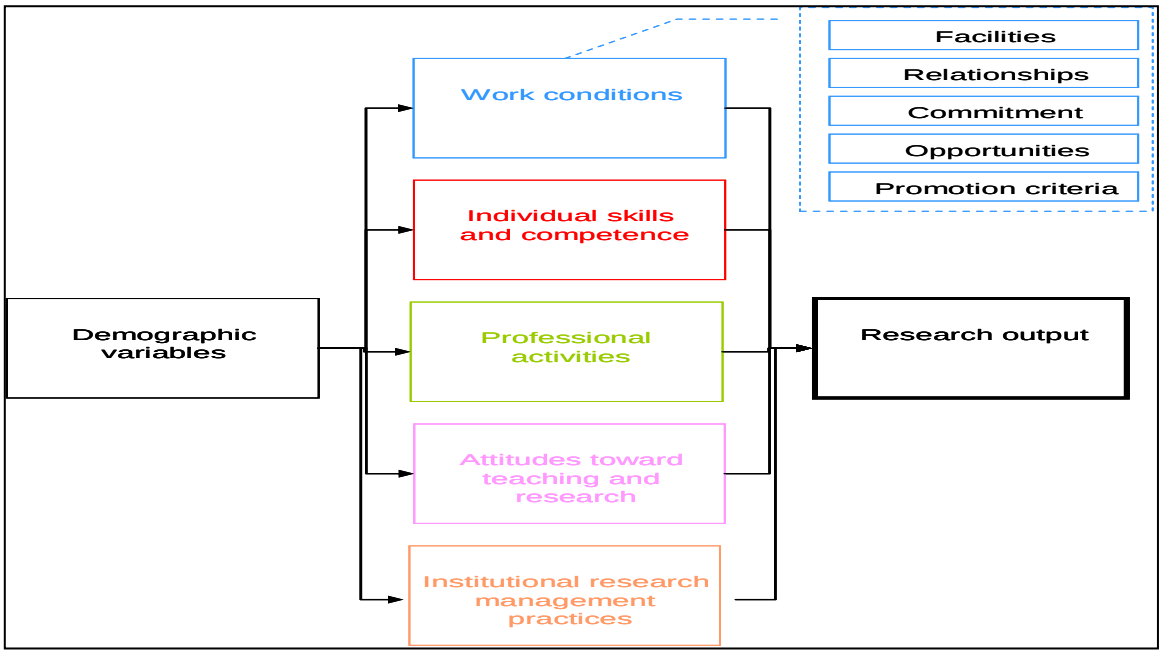
Babbie and Mouton (2003, p.261) indicate that an acceptable response rate for a self-completion mail survey is 50%. Nevertheless the response rate for campus B was above 20% and the demographic groupings that responded were proportionate to the demographics of the academics of campus B. Furthermore, 51% of respondents on campus B indicated that they had 'some to full-time' research responsibilities, on the basis of which the assumption could be made that 51% of the respondents were knowledgeable about research, and could therefore comment authoritatively on the topic of research. Based on the aforementioned, the data was used for comparison purposes.

Data collection

I compiled a self-completion questionnaire called the "Survey on the State of Research at [institution's name]". Certain questions of the questionnaire were based on the Carnegie Foundation for the Advancement of Teaching's 1998 survey called the "International Survey of the Academic Profession" (Theodorescu, 2000, p.201-222). The questionnaire was based on a theoretical model presented in

figure 1. The factors that influence research productivity have been identified from the literature and range from extra- to intra-institutional. These factors suggest different organisational levels of research activity within institutions, and include research management practices and work conditions. Factors are furthermore linked to researchers as individuals, with their unique skills and competence, professional activities as well as attitudes toward teaching and research. Permission to adapt the questionnaire was obtained from the Carnegie Foundation. The self-completion questionnaire was adapted to reflect national jargon, institutional-specific imperatives as well as a literature study's findings. Furthermore, the Carnegie survey focused on the whole academic profession, with equal emphasis on the different elements of the profession. The present study focused on research as a subsection of the duties of an academic.

Figure 1: Theoretical model



The tangible elements of the theoretical model in figure 1 include certain work conditions such as facilities and promotion criteria, as well as institutional research management practices. Intangible factors are professional activities, attitudes towards teaching and research as well as individual skills and competence.

Method

Instructions on the questionnaire were clearly stated and the clarity thereof verified by a language specialist. This was followed up by pre-testing the questionnaire and adapting questions that were unclear. The questionnaire was compiled in a self-completion format which means that the paper-based questionnaire had sufficient instructions for the respondents to follow on their own. Eleven academics, representing different faculties/divisions, job levels and the two main language groups at the institution, were purposively selected to complete the questionnaire as part of a pre-test study. Certain questions in the questionnaire were adjusted to ensure clarity and correct interpretation. I made use of a strategy of telephoning individual academics to solicit their participation. Academics were given a maximum of three weeks in which to complete the questionnaires. Questionnaires were returned via the internal postal system.

ANALYSIS

Inter method triangulation was by done by initially conducting a confirmatory analysis based on the parcels of the theoretical model, depicted in figure 1, followed by a factor analysis. A second model, namely an empirical model, was derived from the factor analysis. Both models were tested for reliability. Both the theoretical and empirical models were thereafter used to determine which parcels/factors have the highest prediction rate for the dependent variable 'research output'. This was done via one-way ANOVAs, CHAID and regression analyses. Furthermore, Chi-square tests were conducted. Data was managed on the SPSS statistical package and calculations done by statistical consultation services.

RESULTS

The confirmatory or theoretical model was tested for reliability in order to determine how strong the model's theoretical arguments were. The theoretical model was adapted according to reliability scores. In order to determine whether there was a secondary model which could be derived from the data, a factor analysis was conducted which resulted in two factors.

Theoretical (confirmatory) model

Theoretical parcels, as illustrated in the theoretical model in figure 1, were grouped according to the commonality of issues that were probed in questions (or items) on the questionnaire. Table 2 provides the reliability calculations of each theoretical parcel. Reliability calculations were not conducted on the parcels 'professional activities' and 'research output' since the data used in these parcels is based on actual research output/professional activity data.

Table 2: Reliability of theoretical parcels

Theoretical parcel	Reliability per campus (Cronbach alpha)			Reliability combined across campuses (Cronbach alpha)	Number of valid cases per parcel	Number of items per parcel
	Campus A	Campus B	Campus C			
Facilities **(d)**	0.800	0.640	0.751	0.804	**(a)** 92 (25.4%)	9
Relationships **(f)**	0.855	0.812	0.867	0.860	335 (92.5%)	6
Commitment **(f)**	0.806	0.807	0.722	0.822	297 (82%)	9
Opportunities **(f)**	0.650	0.672	0.826	0.711	342 (94.5%)	3
Promotion criteria **(d)**	0.223	0.001	0.013	0.167 **(b**)	324 (89.5%)	4
Individual skills and competence **(f)**	0.771	0.803	0.712	0.786	353 (97.5%)	2
Attitudes toward teaching and research **(d)**	0.127	0.152	0.499	0.190 **(c)**	302 (83.4%)	8
Institutional research management practices **(e) (f)**	0.602	0.666	0.730	0.630	318 (87.8%)	8

Notes:

a. Although reliability was good at 0.804 for the parcel 'Facilities', there were too few valid cases (number of respondents that responded to all the items), namely 92 or 25.4% – to render the data usable for further regression analyses. When the parcel was excluded during regression analysis, the total number of valid items increased from 62 to 216.

b. Questions in the parcel 'Promotion criteria' contained one question that probed opinion and three questions

that focused on actual fact. The differences in the purposes of these questions and the small number of items (namely 4) influenced reliability negatively.

c. The parcel 'Attitudes toward teaching and research' covered too many varied issues. Furthermore, the items had variance in interpretation and were therefore not unidirectional in meaning. This rendered a poor reliability.

d. Parcels 'Facilities', 'Promotion criteria' and 'Attitudes toward teaching and research', based on the above, were excluded from the calculations of the CHAID and regression analyses.

e. The Cronbach alpha coefficient of 0.630 for 'Institutional research management practices' is deemed reliable, since the parcel measured four different sub-constructs, each with two items. Items should contain proper variance to contribute to the reliability of a test (Schepers, 1992, p. 28) and the fact that there were only two items per sub-construct contributed to low, but acceptable, reliability. Further testing of this parcel should be done.

f. These theoretical parcels were deemed reliable.

The theoretical model was therefore adapted to exclude parcels: 'Attitudes towards reaching and research', 'Facilities' as well as 'Promotion criteria'.

Empirical model

A factor analysis was conducted to determine whether an empirical model could be derived from the data. 42 items were inter-correlated. Items Q11 and Q25 were discarded since their MSA values were < 0.5. The KMO and Bartlett tests indicated that the item inter-correlation matrix would allow for a factor analysis – refer to table 3.

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure (KMO) Measure of Sampling Adequacy (MSA)		0.767
Bartlett's Test of Sphericity	Approx. Chi-Square	3257.946
	Df	861
	Sig. p-value	0.000

A first level factor analysis, using the Principal Axis Factoring Extraction method utilising the Varimax Rotation with Kaiser Normalisation, was conducted. The number of postulated factors, based on the number of Eigen values larger than unity, was 14. For the second-order factor analysis, sub-scores were calculated for the 14 first level factors and were inter-correlated. An Anti-image correlation indicated that first level factors 5, 6 and 10 lacked measures of sampling adequacy (KMO<0.4). These factors were discarded. The KMO and Bartlett's tests were conducted on the sub-scores matrix and this was deemed suitable for further analysis (KMO=0.703). For the second level factor analysis, a Principal Axis Factoring Extraction method utilizing the Oblimin with Kaiser Normalization was conducted. The number of second level postulated factors, based on the number of Eigen values larger than unity, was 3. These 3 postulated factors are presented in table 4.

Table 4: Second level analysis: Pattern Matrix(a)

Pattern Matrix(a)			
	Factor		
	1	2	3
FACTOR 1.1 (Q8 - A, B, C, G, H, I)	0.758	0.127	
FACTOR 1.9 (Q8D, Q8E, Q2)	0.694	-0.177	-0.133
FACTOR 1.2 (Q4 – A, B, C, D, E, G)	0.543	0.297	0.382
FACTOR 1.13 (Q8F)	0.453		
FACTOR 1.11 (Q9, Q10)	0.202		0.138
FACTOR 1.7 (Q12, Q26, Q27)		-0.588	
FACTOR 1.12 (Q6, Q7)		0.556	
FACTOR 1.8 (Q22, Q23)	-0.138	-0.105	0.623
FACTOR 1.4 (Q13, Q14, Q17, Q18E, Q18G)	0.165		0.478
FACTOR 1.3 (Q19, Q20, Q21, Q24)			0.436
FACTOR 1.14 (Q18F)			0.262
Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization.			
(a) Rotation converged in 7 iterations.			

The three factors that are presented in table 4 were labelled as follows:

- Factor 1: Intangible factors (cannot be bought, copied or imitated);
- Factor 2: Alienation factors (factors that do not aid or hinder research output); and
- Factor 3: Tangible factors (measurable or can be seen).

Table 5: Second level analysis: Factor Correlation Matrix

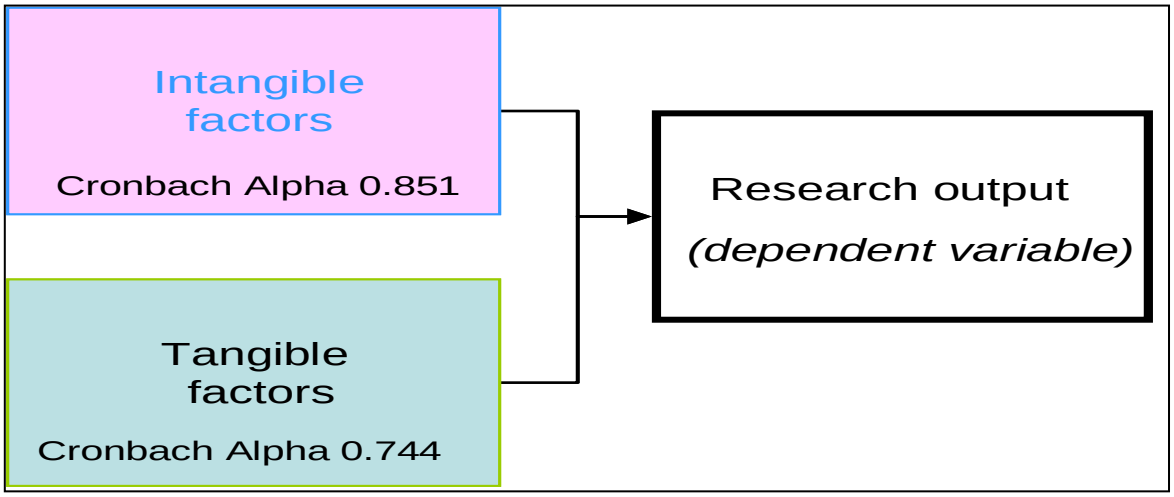
Factor Correlation Matrix			
Factor	1	2	3
1 – Intangible factors	1.000	-0.116	0.431
2 – Alienation factors	-0.116	1.000	-0.226
3 – Tangible factors	0.431	-0.226	1.000
Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization.			

From the correlation matrix presented in table 5 it can be deduced that Intangible factors (Factor 1) and Tangible factors (Factor 3) are strongly correlated. Alienation factors (Factor 2) correlates negatively with both Factors 1 and 3.

Reliability of the factors ‘Intangible factors’ (Cronbach alpha=0.851) and ‘Tangible factors’ (Cronbach alpha=0.744) was acceptable. The reliability of the factor ‘Alienation factors’ was low due to the low number of items measuring the construct (Cronbach alpha=0.553). The low score was largely due to a

mixture of opinion and factual information questions as well as a low number of items. The factor 'Alienation factors' was therefore not taken into consideration in the final empirical model. Based on the factor analysis and the reliability calculations, the empirical model can therefore be illustrated as depicted in figure 2.

Figure 2: Empirical model



Prediction value – Theoretical model

For the theoretical (confirmatory) model, a CHAID analysis indicated that 'Professional activities' (83.46%) and 'Individual skills and competence' (94.52%) had the highest prediction values for predicting high 'Research output'. Due to the low n-count (157 valid items), and in order to verify the CHAID analysis, a binary logistic regression analysis using 'Research output' as the dependent variable, based on the theoretical model, was conducted. Two categories of research output were used, namely 0–2 outputs and 3–12 outputs. The analysis was conducted using a Forward Stepwise (Wald) regression analysis. Block 1 of the Forward Stepwise (Wald) calculation selected two parcels. In the first step 'Professional activities' was selected and in the second step 'Individual skills and competence' was selected. The overall variance explained for research output is 83.4%. This means that both 'Professional activities' and 'Individual skills and competence' have high prediction value of the dependent variable 'Research output'. The regression analysis therefore confirmed the findings of the CHAID analysis. Furthermore, 'Individual skills and competence' is relatively uncorrelated with 'Professional activities', which mean that both independently predict research output.

Prediction value – Empirical model

A binary logistic regression analysis using 'Research output' as the dependent variable was conducted, in which the two factors of the empirical model were entered. The analysis was conducted using a Forward Stepwise (Wald) statistical analysis. Block 1 of the Forward Stepwise (Wald) calculation selected one factor. 'Tangible factors' was selected (refer to table 6).

Table 6: Stepwise calculation: Empirical model

Variables in the Equation							
		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1(a)	FACTOR 3 Tangible factors	1.620	0.658	6.059	1	0.014	5.052
	Constant	-5.746	2.061	7.773	1	0.005	0.003
(a) Variable(s) entered on step 1: FACTOR3.							

Block 1 of the Forward Stepwise (Wald) calculation selected one factor. 'Tangible factors' was selected with an overall prediction percentage of research output of 74% (table 7).

Table 7: Prediction values: Empirical model

			Predicted		
			Number of different research outputs		Percentage Correct
	Observed		0	7-12	
Step 1	Number of different research outputs	0	32	3	91.4
		7-12	10	5	33.3
	Overall Percentage				74.0
(a) The cut value is 0.500					

The factor 'Tangible factors' predicts research output better for non-research-active academics (91.4% correct prediction rate – 0 research outputs category) than for the research-active academics (33.3% correct prediction rate for the 7–12 research outputs category). Therefore, the research output of the active researchers is predicted by factors, not reflected in the equation, other than the 'Tangible factors'.

DISCUSSION

Although the theory on tangible and intangible factors is well established, the empirical model that is derived from this study (figure 2) strengthens the argument that both types of factors exist in a research environment. Furthermore, the tangible and intangible factors play a different role in predicting research output.

The tangible factors are predictors of research output for non-research-active academics, which means that the research-active academics are motivated to produce research output by factors other than tangible factors. Teodorescu's study (2000) indicated that time spent on research, and therefore time made available for research by the institution correlated positively with high research output. In

support of time as a tangible factor, the South African study of Wissing et al. (2002) indicated that a lack of time, high workload and academic staff's opinion that research output might not be rewarded, had a negative correlation. Tangible factors such as time, workload and reward mechanisms are therefore important in stimulating research by providing structure to non-research-active academics. Time spent on research, as confirmed by the Teodorescu study (2000), is a significant tangible indicator of publication productivity for developed and developing nations.

One could argue that tangible factors have to be in place before non-research-active academics can begin to produce research output. However, at an institution where there are many research-active academics, an over-emphasis on the tangible factors can lead to frustration on their part and will not increase research output. Institutions should, whilst providing for tangible research management factors, at the same time, also focus on putting in place the unique combination of intangible factors that will ensure competitive advantage, to ensure that the academics that are already research active are encouraged to produce more research output. Of the intangible factors the theoretical research output prediction model highlights the fact that factors associated directly with researchers, namely their 'professional activities' (83.46%) and 'individual skills and competence' (94.52%) individually predict of research output. The high prediction rate of participation in 'professional activities', which includes international conferences, supports the Teodorescu (2000) study which indicated that international networking stimulates research for academics in developing countries. Furthermore, professional society memberships and the affiliation with a subject discipline as well as internationalism had a high correlation with research productivity (Teodorescu, 2000). Apart from the institution's provision of opportunities for participation in professional activities or opportunities for the development of skills and competence, the theoretical model indicates that the factors that predict research output are up to an individual researcher and not institutional management. Once again, intangible factors are at play and other than adjusting staff selection criteria, there is little an institution can do to impose pressure on individuals to do research if they do not wish to become involved in research or do not identify with their subject discipline. However, the very high prediction rate of 94.52% of 'individual skills and competence' indicates that staff development in research skills should be very high on a university's priority list when stimulating research. Research managers should also focus on the institutional prestige attached to research since academics conform to a research intensive environment within three years of joining a research prestige institution (Fox, 1992). The institutional research culture is therefore a very strong mechanism through which research output can be supported for research-active academics. A research culture where the commitment is to research (Altbach & Lewis cited in Theodorescu, 2000) and where academics are encouraged to have a very high affiliation with their subject discipline (Theodorescu, 2000), should lead to increased research output.

SUMMARY AND CONCLUSIONS

Research management mechanisms include the material conditions under which research can flourish such as opportunities for staff development, time and work allocation, reward and prestige mechanisms as well as funding opportunities. These tangible management mechanisms can enhance the institutional environment in which researchers operate thereby creating intangible institutional and individual outcomes. The tangible management mechanisms are important in assisting non-research-active academics to increase their research output, however, output of research-active academics is not predicted by tangible management mechanisms. Institutional managers should be cognisant of the fact that factors other than tangible management mechanisms, such as collegial networking (especially internationally for developing nations), identification with subject discipline and prestige of the research setting, placing an emphasis on research instead of teaching, all of which are more intrinsic to the researcher, are positively correlated with publication productivity.

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