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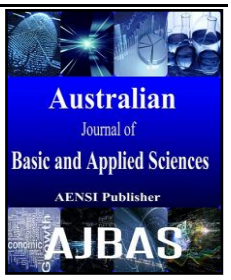

The Role of Measurement, Analysis and Knowledge Management Criterion in MBNQA Model to Manage Institutions of Higher Education

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ABSTRACT

The purpose of this research is to empirically test the role of measurement, analysis and knowledge management criterion on Malcolm Baldrige National Quality Award (MBNQA) criteria model for higher education institutions (HEIs). The paper identifies five (5) causal hypotheses from literatures that are related to the measurement, analysis and knowledge management criterion. Structural equation model (SEM) is used to analyse the empirical data that were collected from 118 Malaysian HEIs. The results indicate that there are three (3) significant relations and two (2) insignificant relations within the model. Measurement, analysis and knowledge management have causal positive effect on strategic planning and student, stakeholder and market focus. In addition, leadership has causal positive effect on measurement, analysis and knowledge management. However, measurement, analysis and knowledge management do not have causal positive effect on faculty and staff focus and process management. The comprehensiveness of these relationships provides a guide to implement, develop, assess and improve higher education institutions.

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INTRODUCTION

Globalization has led increasingly competitive environment in higher education institutions (HEI). To succeed in today's great competition, there is an important and immediate required improvement to the performance of HEI to meet international academic trend and raise overall academic standards and institution's performance.

In response to growing concerns from stakeholders about inconsistent performance, HEIs are increasingly seeking ways to improve education quality (Lawrence & McCollough 2001). Thus, many higher education institutions have looked up methods from industry to create competitiveness (Vazzana *et al*. 1997; Chen *et al*. 2009).

In the recent years, Information Technology and Quality Management have significantly impacted most organizations and each has been widely researched. Manufacturing and industrial firms can rely on Information Technology (IT), which plays the role of a feedback system, acts as a tool to obtain more precise information, serves as an instrument that facilitates communications, and helps to apply advanced tools, implement systems, and employ modelling methods more effectively. Subsequently, it is obvious that using IT tools influences all components, functions and activities of an organization.

Information flows, including information transfer and feedback among all the different levels in an organization, will form the necessary foundation for an effective quality management (Zeng *et al*. 2007). The importance of information systems criterion in supporting quality management system is advocated by the TQM theory and frequently considered in different quality models. Moreover, the positive influence of this criterion on quality enablers and its contribution to organizational results have been examined and approved by several researchers.

According to Tannock *et al*. (2002), without sufficient information and data of excellence parameters, the organization cannot identify the weaknesses in their policy and strategy, people management, and processes. As a result, improvement areas are not distinguished and corrective actions are not performed. Thus examining the information systems role in an organization view is necessary to weave the information systems function into an organizational context.

This paper is organized in the following manner.

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After the discussion of the relevant literature, the research hypotheses and methodologies are presented. Next, the research results and a discussion are provided. The article ends by summarizing key findings and proposing future directions for research.

Materials:

The MBNQA Model:

MBNQA was created in 1987 by the National Institute of Standard and Technology (NIST), an agency under the US Department of Commerce (NIST, 2012). The MBNQA criteria represent a comprehensive framework of seven categories that are used to evaluate an organization's performance. The categories cover: (1) leadership, (2) strategic planning, (3) student, stakeholder and market focus, (4) measurement, analysis and knowledge management, (5) workforce focus, (6) process management, and (7) results.

MBNQA was launched to enhance competitiveness among American companies in 1987. Over the years, the award has proved to be effective in improving companies' market share, customer satisfaction, employee morale, and also profitability. MBNQA model has been a 'role model' in developing a national quality award for many other countries in the world. The objectives of launching the award are as follows: (1) to recognize the companies who are doing an excellent job in quality management, (2) to increase awareness of quality as an important element in competitiveness, (3) to share information on successful quality strategies and on the benefits derived from implementation of these strategies, and (4) to promote understanding of the requirements for quality excellence (Badri *et al*., 2006).

During the period 1988–1998, MBNQA was awarded to only three types of business companies, namely Manufacturing, Service, and Small Business. In 1999, the Health Care and Education sectors were added to the categories of award. This inclusion of the educational sector was in response to several national reports that indicated concern over the lack of progress in improving the quality of education. It was not until 2001 that a university won the Baldrige Award (Thompson, 2004).

The role of measurement, analysis and knowledge management in quality management model:

Quality management had been widely studied up to the 1990s, however very little attention had been paid to the contribution of information systems to quality management practices (Sadeh *et al*. 2013). According to NIST (2012) information and analysis is a core fundamental concept which retains effect upon other categories in Baldrige model. Meanwhile, information technology helps organisations to share information with partners and enhances the trust between partners (Hemsworth *et al*. 2008).

Several authors studied and examined supportive effects of information criterion on MBNQA model, Xiang *et al*. (2010) investigated the relationships between the categories of China Quality Award model based on the criteria of MBNQA model. In their study, they found that information and analysis dimension had positive impacts on Strategic planning, Customer and market focus, Human resource focus and Process Management.

Sohn *et al*. (2007) suggested an SEM model formed by the MBNQA criteria, for the assessment of national funding on the R&D programme of SMEs in Korea. In their study, the results indicated that information and analysis criterion had direct positive effects on Strategy, People and Processes.

Badri *et al*. (2006) attempted to test the causal relationships among excellence criteria using the dimensions of MBNQA model in United Arab Emirates (UAE) universities and colleges. They found that, Information and Analysis criterion has a positive influence on Strategy, Faculty and Staff (People) and Processes. In addition, they also found that, Leadership had a positive influence on Information and analysis criterion.

Flynn and Saladin (2001) examined the causal relationships among MBNQA model of the manufacturing sector in US. The findings indicated that Information and Analysis criterion was directly affected by Leadership. In addition, Information criterion was also found to have significant influence on Policy and Strategy, and People as well as Processes.

Meyer and Collier (2001) tested the causal relationships among MBNQA model criteria in American hospitals. They found that, Information and Analysis criterion has positive effects on Strategy, People, and Processes. In addition, it was revealed that Leadership has positive influence on Information and Analysis criterion.

Wilson and Collier (2000) examined the assumptions of the theory and the relationship among the MBNQA model categories. The results indicated that Information and Analysis criterion had positive significant effects on the Strategy, People and Processes.

Methods:

Research hypotheses:

This study attempts to verify the causal relationships of measurement, analysis and knowledge management criteria on MBNQA model as shown in Figure 1.

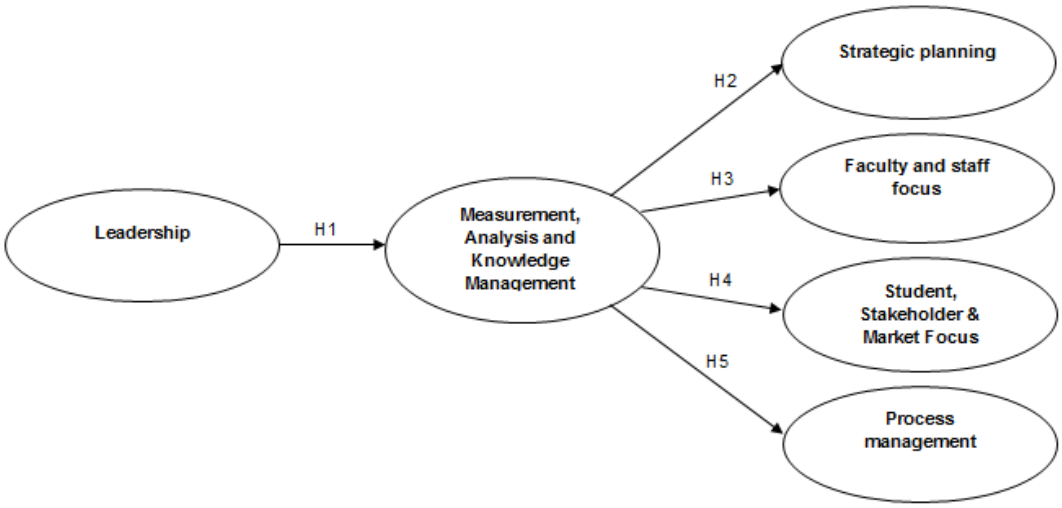

Fig. 1: Research model and hypotheses.

H1: Leadership has causal positive effect on Measurement, Analysis and Knowledge Management.
H2: Measurement, Analysis and Knowledge Management have causal positive effect on Strategic Planning.
H3: Measurement, Analysis and Knowledge Management have causal positive effect on Faculty and Staff focus.
H4: Measurement, Analysis and Knowledge Management have causal positive effect on Student, Stakeholder and Market focus.
H5: Measurement, Analysis and Knowledge Management have causal positive effect on Process management.

Sample and instrument:

The questionnaire comprised of 48 items of the MBNQA standard questionnaire which were used to determine six (6) criteria (leadership, strategic planning, faculty and staff focus, student, stakeholder and market focus, process management and measurement, analysis and knowledge management) of MBNQA model adapted from Badri *et al*. 2006 and Lau *et al*. 2004. Since the focus of our study is on the HEIs, the authors chose those items that are applicable and useful for them from previous studies. As in some previous studies, the degree of each indictor is determined using a five-point Likert scale.

A link of online survey was emailed to 230 Malaysian HEIs. They represented the various types of HEIs in Malaysia: universities and colleges, and public and private HEIs. For each HEI, the quality manager in charge of quality management in HEI was asked to complete the survey. These individuals typically have significant knowledge of the institutions' performance and quality management, thus providing some legitimacy and reliability to the responses. Sampling and data collection took about three months, which was conducted between 15 January 2015 and 15 April 2015. Finally, a total of 118 completed questionnaires (response rate 51%) were received from Malaysian HEIs.

Results:

Convergent validity:

In this paper, we use multiple questions to get at the unobservable criteria which are difficult to capture and to model the relationships among the criteria. We originally set 48 questions to capture the response. To verify feasibility of model, we used Confirmatory Factor Analysis (CFA) via the AMOS 21 program. The validity of the model is evaluated by investigating convergent and discriminant validity. Using CFA, we can assess the adequacy of the instruments used to measure the six (6) constructs.

The convergent validity is evaluated by investigating the value of standardized factor loadings (FL) and reliability. The survey questions should load at least 0.60 on their respective hypothesized component and all loadings need to be significant ($p < 0.05$, $t > 2.0$) (Bagozzi & Yi, 1988; Harish, 1994). Reliability for all the survey questions of a construct should be evaluated jointly by investigating composite factor reliability (CFR) and the average variance extracted (AVE). For a construct to possess good reliability, CFR should be at least 0.70 and the AVE should be at least 0.50 (Bagozzi & Yi, 1988; Baumgartner & Homburg, 1996; Hair *et al*., 2010; Steenkamp & van Trijp, 1991). Thus, the survey questions which load on multiple constructs or have low item-to-construct loadings are deleted from the model. After 11 items are deleted, 37 questions remain in this model. The results are summarized in Table 1. See the Appendix 1 for the measures for each of the six (6) constructs in the model.

Discriminant validity:

The purpose of discriminant validity is to identify whether the correlation between constructs is

not equal to 1.0 and whether the constructs differ from each other (Bollen, 1989; Chin *et al*., 1997). The coefficient of the correlations should be under 0.9 (Bollen, 1989; Chin *et al*. 1997). The results of correlations in Table 2 show that all of the correlations among 6 constructs are not unduly vast, that is, the constructs in our model exhibit discriminant validity.

Structural equation model:

We use structural equation model (SEM) to examine the dependence relationships among the six (6) constructs. In this section, the model parameters are estimated and the hypotheses are tested. To test the research hypotheses and identify the casual relationships between the constructs, we use SEM via the AMOS 21 program. The fit statistics of the model are shown in Table 3. The fit statistics of the model indicate that the chi-square model was 1007.522 with degree of freedom (df) of 373. The minimum chi square/degree of freedom (CMIN/DF) is 2.701. The Comparative Fit Index (CFI) is 0.921, the Tucker Lewis Index (TLI) is 0.907 and Incremental Fit Index (IFI) is 0.921, these indicate a good fit to the data. The Root Mean Square Error of Approximation (RMSEA) is 0.068 this indicating a reasonable model fit (Badri *et al*., 2006; Browne & Cudeck 1992; Browne & Mels, 1994). Thus, the structural model in this article is satisfactory and can be tested (Hair *et al*., 2010).

Table 1: Fitness indices of measurement constructs

Construct	Items	Cronbach's alpha	Final Items	CFI	NFI	TLI	IFI
Leadership	1-8 (8)	0.966	8	0.998	0.991	0.996	0.998
Strategic planning	9-18 (10)	0.966	8	0.997	0.991	0.992	0.997
Faculty and staff focus	19-26 (8)	0.965	6	1	0.995	1	1
Student, stakeholder and market focus	27-33 (7)	0.930	4	0.998	0.996	0.993	0.998
Measurement, analysis and knowledge management	34-38 (5)	0.923	5	1	1	1	1
Process management	39-48 (10)	0.967	6	1	0.999	1	1
Total	1-48		37				

Notes: CFI, Comparative fit index; NFI, Normed fit index; TLI, Tucker Lewis index; IFI, Incremental fit index.

Table 2: Square of correlation values between any pair of constructs.

	LD	SP	FSF	SSMF	MAKM	PM
LD	0.876					
SP	0.784	0.873				
FSF	0.728	0.701	0.877			
SSMF	0.613	0.697	0.693	0.863		
MAKM	0.659	0.776	0.709	0.619	0.842	
PM	0.477	0.712	0.659	0.627	0.692	0.860

Notes: LD, Leadership; SP, Strategic planning; FSF, Faculty and staff focus; SSMF, Student stakeholder and market focus; MAKM, Measurement, analysis and knowledge management; PM, Process management;

Table 3: Overall model fit statistics

Overall model fit statistic	Statistic value
p (x^2=1007.522; df = 373)	0
CMIN/DF	2.701
CFI	0.921
TLI	0.907
IFI	0.921
RMSEA	0.068

Notes: CMIN/DF, Minimum chi square/degree of freedom; CFI, Comparative fit index; NFI, Normed fit index; TLI, Tucker Lewis index; IFI, Incremental fit index; RMSEA, Root mean square error of approximation.

Table 4: Results of hypotheses testing extracted from output of AMOS software.

Hypothesis	Path	Estimate	SE	CR	Hypothesis supported
H1	Leadership → Measurement, analysis and knowledge management	.826	.093	8.873	**
H2	Measurement, analysis and knowledge management → Strategic planning	.404	.060	6.716	**
H3	Measurement, analysis and knowledge management → Faculty and staff focus	.117	.064	1.830	ns
H4	Measurement, analysis and knowledge management → Student, stakeholder and market focus	.226	.078	2.900	**
H5	Measurement, analysis and knowledge management → Process management	-.109	.056	-1.940	ns

Notes: * p< 0.05, ** p < 0.01, ns, not significant

Discussions:

This study attempted to empirically test the relationships between the measurement, analysis and knowledge management criterion in MBNQA model for higher education institutions. The results indicate that there are three (3) significant relations and two

(2) insignificant relations within the model. The results are shown in Table 4.

First, the finding shows that leadership has a positive significant effect on measurement, analysis and knowledge management (H1). This result has been confirmed by other empirical studies such as those in Badri *et al*. (2006), Flynn & Saladin (2001), Wilson & Collier (2000), Winn & Cameron (1998), Su *et al*. (2003). In order to have competitive advantage to higher education institution, HEIs must concentrate on using information systems well in order to respond to the needs quickly and rationally (Su *et al*. 2003).

Secondly, the finding shows that, measurement, analysis and knowledge management have a positive significant effect on strategic planning (H2). This result is in line with the findings of other researchers such as in Sohn *et al*. (2007), Badri *et al*. (2006), Flynn & Saladin (2001), Wilson & Collier (2000), Winn & Cameron (1998), which indicate that the strategic planning of organizations are strongly affected by feedback and information. Thus, organisations must establish appropriate strategy planning, and quality information is crucial for such strategy planning.

Thirdly, measurement, analysis and knowledge management do not have a positive significant effect on faculty and staff focus (H3). However, in MBNQA theory support the causal relationships between the dimensions of Quality Information Systems and enablers criteria. Besides, there are empirical research's evidences such as in Xiang *et al*. (2010), Sohn *et al*. (2007), Badri *et al*. (2006), Wilson & Collier (2000), Meyer & Collier (2001), indicating that the management of staff is directly affected by information flows. Thus, HEIs should empower its people by giving performance information, such as waste reduction information, and providing operational information, such as written operating procedures.

Fourthly, measurement, analysis and knowledge management have a positive significant effect on student, stakeholder and market focus (H4). This result is also confirmed by empirical research's findings, such as in Sohn *et al*. (2007), Badri *et al*. (2006), Wilson & Collier (2000), Xiang *et al*. (2010), which indicate that the information and feedback received from customers can assist organizations to fulfil their customers' expectations.

Lastly, measurement, analysis and knowledge management do not have a positive significant effect on process management (H5). In this respect, the research does not coincide when verifying this hypothesis. However, according to MBNQA theory support the causal relationships between the dimensions of Quality Information Systems and enablers criteria. Besides, there are empirical research's evidences such as in Xiang *et al*. (2010), Sohn *et al*. (2007), Badri *et al*. (2006), Flynn & Saladin (2001), Meyer & Collier (2001), Wilson & Collier (2000) indicating that processes could be planned and managed effectively through appropriate management of information flows.

Conclusions and Limitations:

The result of this study shows that using measurement, analysis and knowledge management criterion in MBNQA model is necessary for the implementation, evaluation and improvement of quality in the field of higher education institutions.

The analysis of the structural model has allowed us to study the causal structure of the model in depth and knowledge of this structure may help HEIs to lead their management towards excellent results.

Based on the results, the following points are suggested to the HEIs. First, leadership of senior management of HEIs must support and facilitate the process of measurement, analysis and knowledge management through providing necessary devices and systems.

Subsequently, measurement, analysis and knowledge management must be put into practice through providing appropriate devices and systems to help senior management of HEI to implement, improve and correct their planning based on accurate information.

The study has certain limitations that must be considered when it comes to interpreting the results and conclusions from it. A first limitation is this study was conducted in the higher education institutions; the results of this study merely specific to higher education institutions. As a result, more research are needed to study the contributions of proposed quality management model in other sectors, such as servicing companies, public organizations, manufacturing firms, and health care organizations. Secondly, this study just focuses on measurement, analysis and knowledge management criterion in MBNQA model. Lastly, the current study was a cross-sectional research. Future longitudinal studies may be useful to obtain more appropriate results.

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Appendix 1: Survey questions and results of confirmatory factor analysis

Categories/Items	FL	CR	AVE
Leadership		0.967	0.767
LD1. Leader develop the organization's mission, vision and values	0.853		
LD2. Leader communicate the mission, vision and values to all levels of the organization	0.885		
LD3. Leader improve their actions, making them fit in with the organization's present and future needs	0.825		
LD4. Leader design an university structure suitable for the university's policies and strategies	0.809		
LD5. Leader implement a system of key processes or activities supporting the university's policy and strategy, and its goals	0.780		
LD6. Leader keep in touch with the different stakeholders in order to know their expectations and opinions	0.720		
LD7. Leader encourage student's and staff's involvement in the improvement actions	0.736		
LD8. Leader publicly acknowledge the successes of people and groups in quality improvement actions	0.648		
Strategic planning		0.962	0.762

PS3. All the areas in the University are involved in the process of formulating and communicating the policies and strategies	0.566		
PS4. There is a formal process of reviewing and updating policies and strategies	0.707		
PS5. The organization's policies and strategies are structured in a Strategic Plan	0.639		
PS6. The organization's goals are set out in writing and in a clear and quantifiable manner	0.722		
PS7. The goals are communicated at all levels of the organization	0.558		
PS8. The principles of quality are incorporated into all of the University's policies, strategies and goals	0.850		
PS9. There is a procedure allowing for the deployment of the policies and strategies and for their being turned into short term plans	0.672		
SP10. The formulation and revision of policies and strategies include the needs and expectations of the stakeholders	0.744		
Faculty and staff focus		0.952	0.769
FSF3. Promoting actions which support the staff's commitment and involvement in the improvement actions	0.787		
FSF4. Encouraging the staff's assumption of responsibilities and empowerment to carry out improvement actions	0.699		
FSF5. Developing suitable channels for sharing and communicating 'better practices', knowledge and experiences	0.846		
FSF6. Recognizing quality improvement related efforts, either at a personal or group level	0.843		
FSF7. Establishing social benefits and improvement of the staff's services and facilities	0.748		
FSF8. Encouraging the staff's involvement in topics related to health and safety, the environment, and social and ethic responsibility	0.750		
Student, stakeholder, and market focus		0.921	0.744
SSMF2: Organization takes students' opinions and suggestions seriously.	0.629		
SSMF3: Organization study students' requirements and disseminate student knowledge in a timely manner.	0.740		
SSMF4: Organization established communication channel with students, allowing students to seek help and information, or to make a complaint.	0.869		
SSMF5: Organization solves student complaints or problems in a timely manner.	0.941		
Measurement, analysis and knowledge management		0.924	0.709
MAKM1. Organization has an effective system to assess organizational performance	0.809		
MAKM2. Organization has a clear appraisal system for every department, unit, and staff	0.946		
MAKM3. All staff understand their performance indicators well and take them seriously	0.912		
MAKM4. Management adjust policy and strategy by analysing information and facts	0.703		
MAKM5. The knowledge management system is actively used within the organization.	0.605		
Process management		0.958	0.740
PM1: The teaching activity envisages the students' needs and expectations	0.858		
PM2: The teaching activity envisages the companies' needs and expectations	0.955		
PM4: The research activity envisages the students' needs and expectations	0.607		
PM5: The research activity envisages the companies' needs and expectations	0.526		
PM6: The research activity envisages the needs and expectations of the community or the society as a whole	0.742		
PM9: Data are collected about claims and suggestions of the stakeholders, then used to improve the processes	0.514		