Measurement Tool for Assessing Research Information Management System Success

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***Abstract*—Research Information Management System (RIMS) has become necessary for any research affiliated institutions including "Research University" to improve research efficiency, management and overall performance to gain competitive advantages. Despite other challenges, there is still a lack of effective tools in research affiliated institutions for managing research information. The success or failure of RIMS implementation largely relies on the level of systems success and user acceptance. Therefore, the measurement of Information Systems success remains a top concern for researchers, practitioners, and managers. As such, prior studies of this research have extended DeLone and McLean success model into three dimensions (technological, organization and human). This paper presents a pilot study to validate the relevancy of items thus ensuring the reliability of the proposed measurement tool for RIMS success. As a result, this study proposes RIMS success model measurement tools. The findings of this study indicate that the survey instruments used in this study are reliable and feasible to be used for further related studies.**

***Index Terms*—Research Management System; Information System Success; Instrument Development**

I. INTRODUCTION

Research information act as a vital enabler in the knowledge-based economy. Research affiliated institutions must collect, analyze and report their research output and outcomes with other stakeholders (e.g. funders). The management of research information can become more effective and efficient with the assistance of ICT. As such, Research Information Management System (RIMS) is a necessity for any research affiliated institutions. Universities around the world are encouraged to implement and use RIMS to maximize their research performance and gain competitive advantages. Research information is a collection of administrative information and research outputs of an institution [1].

RIMS is an integrated online application that offers researchers, administrative and executive staff a single point of reference relating to research projects, grants, publications and other academic activities [2-3]. Research information management is one of the emerging areas of importance for universities in the recent years [4]. Research information system derives information from different institutional systems such as finance, human resources etc. RIMS offer a systematic way to locate research area and topic by the user.

It provides a centralized and integrated expertise database which can facilitate cross-collaborations among researchers, minimize duplicate efforts to maintain publication records and grant-related information as well as simplify data collection/reporting. Implementation of such Information Systems (IS) in research affiliated institutions relies on several factors that might affect its success.

Several studies have evaluated IS success by adopting original DeLone and McLean (DandM) model [5], updated DandM model [6] and also considering technology acceptance related theories such as Unified Theory of Acceptance and Use of Technology (UTAUT) [7] or Technology Acceptance Model (TAM) [8].

However, very few literatures have studied three important aspects of IS success such as Human, Organization, and Technology in higher education or research institution perspective. Hence, recently a study has been done by Hasan et al. [1] to fill this gap by identifying factors in these dimensions that affect the success of RIMS. As the success or failure of IS implementation highly depends on the level of systems success and user acceptance, therefore, the measurement of IS success remains a top concern for researchers, practitioners, and managers [9-10]. As such, development of success measures of RIMS is necessary.

The initial study was conducted to propose a conceptual RIMS success model [1]. The main aim of this pilot study is to develop RIMS success measurement tools which can be used to validate the RIMS success model quantitatively in the later study. A pilot study is conducted as a small-scale trial run of all the procedures as it is an essential component in the data collection process [11]. It also helps to determine reliability and validity of the measures which will be used in the main study. Based on the overview, this study aims at identifying relevant items which can be used to measure RIMS success thus examining reliability and validity of the identified items.

II. LITERATURE REVIEW

A. DeLone and McLean IS Success Model

Initially, a taxonomy of IS success was developed by DeLone and McLean in 1992 [5]. Six (6) different and interrelated variables were identified namely system quality, information quality, use, user satisfaction, individual impact, and organizational impact. Many scholars criticized that the original DandM is incomplete. As a result, ten years later in 2003, DeLone and McLean [6] improved their original model and published an updated model of IS success. A new variable called "service quality" was added.

The factors "individual impact", and "organizational impact" were combined into "net benefits", "Use" was added as an alternative to "Intention to use". The updated DandM model is one of the most widely used models for IS success and several researchers used it to understand and measure the success of various ISs [12-14]. Figure 1 [5] shows the original

DandM model and Figure 2 [6] shows the updated DandM IS success model.

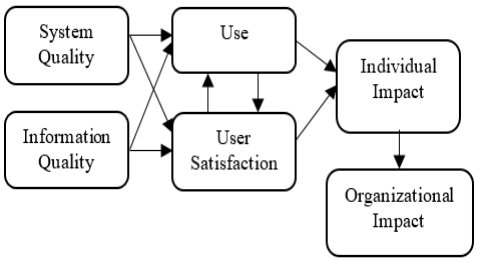

Figure 1: Original DandM IS Success Model

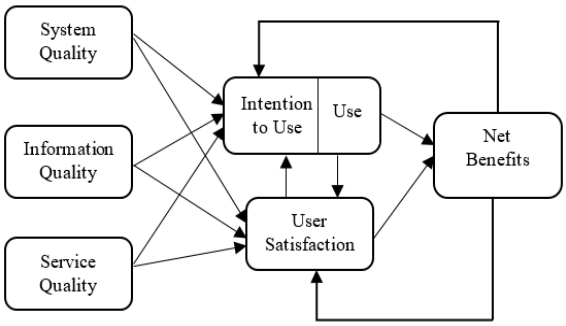

Figure 2: Updated DandM IS Success Model

B. *RIMS Success Model*

In the initial study, Hasan et al. [1] reviewed other researchers of IS success in different contexts such as construction project management, education, e-governance, healthcare, e-commerce, human resource, geographic information management etc. in order to identify the measurement factors of RIMS success. After synthesizing from the literature Hasan et al. [1] proposed a theoretical RIMS success model that takes into consideration the HOT dimensions that might affect RIMS success in higher education institutions. To propose RIMS success model DandM IS success model was adopted as a base model followed by prior models in a similar context [13, 15]. The modification has been done to evaluate the success of RIMS at higher education research institutes.

Each dimension has its own variables to measure RIMS success. System quality, information quality, and service quality were suggested under technological dimension. In organizational dimension, two variables were recommended namely the Top Management Support and Operations Enablement. Computer Self-efficacy, User Experience, and Performance Expectancy were suggested under human factor dimension.

The RIMS success model also considered other mediating factors such as "Perceived Usefulness" and "User Satisfaction" that has an overall impact on net benefits. It also adopted "Perceived Usefulness" and "User Satisfaction" due to its environment and user experience. Impacts resulting from the use of RIMS among researchers in institutions were considered as net benefits.

In RIMS success model, "impact of efficient research management" was considered of in terms of the job performance of researchers (such as publication history, grants usage, awards and recognition history etc.). And the "impact of effective research management" was considered in terms of research project performance (such as project timeline, cost estimation, and KPI monitoring).

A prior study by Hasan et al. [1] stated a positive relationship between technological factors (System Quality, Information Quality and Service Quality) and mediating factors (User Satisfaction and Perceived Usefulness). A study by Lee and Yu [16] found that mediating factors (User Satisfaction and Intention to Use) were a more significant determinant of net benefits (Efficient/Effective Project Management).

Hasan et al. [1] also found a significant relationship between organizational factors (Top Management Support and Operations Enablement) and editing factors (User Satisfaction and Perceived Usefulness) as well as human factors (Computer Self-efficacy, User Experience, and Performance Expectancy) and mediating factors (User Satisfaction and Perceived Usefulness). Figure 3 [1] shows RIMS success model.

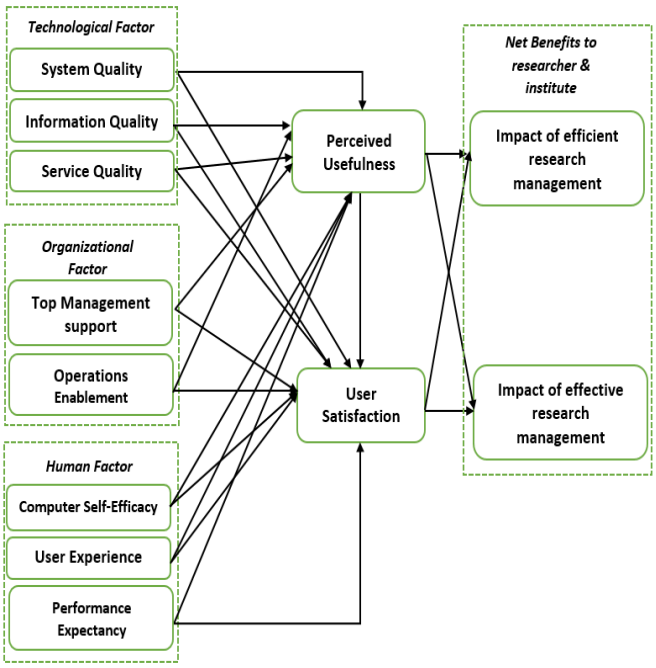

Figure 3: RIMS Success Model

III. RESEARCH METHODOLOGY

In this pilot study, the quantitative research method was used to test the validity and reliability of the RIMS success measures. At an early stage, construct questionnaire was designed by considering existing literature review. Then, the questionnaire was converted in survey form which provides the quantitative data collection through an online survey. Finally, analysis and finding are presented. This would help to evaluate the proposed model later as the results of the pilot study is used to assess reliability during coder training, with a final test to establish reliability levels for the coding of the full sample (or census) of units.

The instrument of this study was an online survey questionnaire. All the items that used to measure each of the latent variables were adopted and adapted on the basis of a review of prior studies as shown in Table 1. The questionnaire was divided into two main sections. Section A consists of the respondent's demographic profile and Section B covered questions on RIMS success measures. PLS algorithm with SmartPLS 3.0 was used to perform inferential analysis and SPSS version 24 was used for descriptive analysis.

The available target population for this study was small.

The respondents for this pilot study consisting of 32 researchers and management staffs from one Research University. According to Nunnally and Bernstein [17], a minimum of 30 respondents are required for the pilot study.

Content validity was confirmed through expert reviews. Experts were asked to give their feedback to establish the content validity of the measurement tool. Items were refined based on their feedback. Section 3.3.1 describes expert review results in details. Prior to the pilot test, three Information Systems expert was involved in validating the item instruments to ensure content validity. As proposed by Lynn [18] a minimum of three experts is adequate for content validity requirement. The items were scaled as "1" as not relevant, "2" as somewhat relevant, "3" as quite relevant and "4" as highly relevant. In obtaining content validity index for each item (I-CVI), each item rated as quite relevant or highly relevant was then divided by the number of experts [19].

Based on a set of 43 items, content validity analysis was executed on twelve factors namely system quality (five items), information quality (six items), service quality (five items), top management support (three items), operation enablement (three items), computer self-efficacy (three items), user experience (three items), performance expectancy (three items), perceived usefulness (three items), user satisfaction (three items), impact of effective research management (three items) and impact of efficient research management (three items).

In total, the study revealed that these instruments are very much at the appropriate level of content validity with the full score (1.00) for both the Item-level Content Validity (I-CVI) and Scale-level Content Validity (S-CVI). The result satisfied the Polit and Beck [20] recommendation that for items to be judged excellent the I-CVI must be at 1.00 score with the involvement of 3 to 5 experts.

Table 1
Survey instrument development

Factor	Items	Reference
System Quality	SQ1: RIMS is user-friendly	[21-25]
	SQ2: RIMS is reliable	[22,23,26]
	SQ3: RIMS has flexible features and functions necessary to perform the required tasks.	[21,23,25]
	SQ4: RIMS is easy to use and do what I would like it to do	[24, 26]
	SQ5: RIMS optimizes response time	[21,22,23,25]
Information Quality	IQ1: The information in RIMS is easily accessible from anywhere, any time and any device (such as PC or Smart Phone)	[22, 28]
	IQ2: RIMS provides me with accurate information	[22, 24]
	IQ3: RIMS provides information that is relevant to my needs.	[22, 23, 26]
	IQ4: I can find complete information when I need it in RIMS	[22, 23, 26]
	IQ5: RIMS provides my up-to-date information in a timely manner	[21, 26]
	IQ6: RIMS provides information that is easy to understand.	
Service Quality	SV1: RIMS is available at all times	[24,26]
	SV2: RIMS technical support staff responds quickly in a cooperative manner	[16,23]
	SV3: RIMS technical support gives users individual attention	[16,23,24]
	SV4: RIMS is secure as well as protects information privacy and confidentiality that prevent the data from being released publicly	[16]
	SV5: In RIMS, data presented with accuracy, current, clear and easy to use.	[14]
Top Management Support	TMS1: Management encourages the optimal use of RIMS	[15,26]
	TMS2: Management through RMC discusses problems regarding the system with users and provides all necessary resources (including hardware and software, IT support) to improve it.	[22,26,30]
	TMS3: Management is aware of the benefits that can be achieved with the use of the system.	[29]
Operations Enablement	OE1: RIMS helps to meet overall organizational objectives.	[28]
	OE2: RIMS ensures that data are correctly provided and received by its stakeholders (Top Management, Research Management Centre, and Researchers)	[28]
	OE3: RIMS helps to continue required operations.	[28]
Computer Self-Efficacy	CSE1: I can understand how the RIMS works	[29]
	CSE2: I am confident to learn how to use RIMS.	[29]
	CSE3: It is easy for me to become skillful at using the RIMS.	[26]
User Experience	UX1: I have experience in using information systems	[29]
	UX2: I frequently use the RIMS	[21,23,24]
	UX3: I depend upon the RIMS.	[21,24]
Performance Expectancy	PE1: RIMS allows users to improve the competence	[15]
	PE2: I believe, knowledge gained from using RIMS can improve performance.	[15]
	PE3: I cannot complete my job without using RIMS.	[25]
Perceived Usefulness	PU1: RIMS is useful for my overall job performance	[22,23,27]
	PU2: RIMS makes it easier to do my job	[22,27]
	PU3: RIMS helps to enhance effectiveness (useful in monitoring KPI, time and cost)	[27]
User Satisfaction	US1: The RIMS has met my expectations and I actively utilized information provided by it.	[16]
	US2: RIMS give me the self-confidence to fulfill my research needs.	[23]
	US3: Overall, I am satisfied with the RIMS.	[16,23]
Impact of Effective Research Management	EFE1: Project and grant activity is effectively conducted	[16]
	EFE2: Project cost or budget monitoring is effectively conducted	[16]
	EFE3: Key Performance Index of the academics are effectively monitored.	[16]
Impact of Efficient Research	EFI1: RIMS helps to reduce repetitive activities (such as tracking publication history, grants usage, awards etc.) and enables me to accomplish tasks more quickly	[16,22]
	EFI2: RIMS helps to reduce error and improve overall research performance in an organization	[16,22]
	EFI3: Research Management among stakeholders (Top Management, Research Management Centre, and Researchers) is improved	[16]

IV. FINDING

A. Descriptive Analysis

In this pilot study, selected profiles such as gender, age, grade designation and research experience were reported. A sample of 32 researchers and management staffs completed the survey. The majority of the respondents were female (n=22, 68.8%) and only 31.3% (n=10) were male. The majority of respondents (81.2%) were between 30-49 years of age. The majority of respondents have excellent research experience (0-3 years (9.4%), 3-6 years (37.5%), 6-10 years (12.5%) and 10 years above (40.6%)).

B. Inferential Analysis

Inferential statistic test was performed to infer relevant information with regard to the results in order to test the reliability and validity of the identified items. This includes item analysis, reliability, and validity measurement. Item analysis was done through factor loadings to measure indicator reliability. High loadings on a construct indicate more reliability [30]. According to Hair et al. [31] factor loadings, more than 0.50 are considered to be significant. One item (UX1=0.488) was dropped because of low corrected-item total correlation which was less than 0.50 minimum threshold. Table 2 shows factor loadings of each item.

Table 2
Descriptive statistics of the items and factor loadings

Item	Mean	Standard Deviation	Factor Loading
SQ1	3.25	.916	0.909
SQ 2	3.22	.906	0.799
SQ 3	3.38	.9942	0.853
SQ 4	2.97	.967	0.838
SQ 5	2.97	.897	0.874
IQ1	3.09	1.027	0.633
IQ2	3.41	.946	0.861
IQ3	3.56	.840	0.842
IQ4	3.25	.916	0.844
IQ5	3.22	.941	0.891
IQ6	3.34	.865	0.644
SV1	2.88	.833	0.581
SV 2	3.41	.911	0.739
SV 3	3.34	.745	0.806
SV 4	3.47	.842	0.56
SV 5	3.38	.793	0.744
TMS1	3.84	.723	0.75
TMS2	3.16	.884	0.79
TMS3	3.53	.761	0.865
OE1	3.56	.801	0.924
OE2	3.63	.833	0.893
OE3	3.66	.865	0.945
CSE1	3.50	.880	0.966
CSE2	3.50	.803	0.94
CSE3	3.25	.880	0.928
UX1	4.09	.856	0.488
UX2	3.97	.782	0.876
UX3	3.63	.976	0.909
PE1	3.53	.915	0.892
PE2	3.50	.880	0.934
PE3	3.38	.976	0.704
PU1	3.86	.677	0.869
PU2	3.53	.803	0.884
PU3	3.59	.911	0.897
US1	3.19	.821	0.909
US2	3.31	.821	0.84
US3	3.28	.958	0.854
EFE1	3.66	.827	0.932
EFE2	3.56	.878	0.896
EFE3	3.41	.911	0.886
EFI1	3.28	.991	0.913
EFI2	3.47	.915	0.955
EFI3	3.56	.840	0.94

The reliability test was performed after item analysis. Subsequently, Cronbach's alpha (CA) was used to measure internal consistency. CA coefficient is widely used to measure the reliability of the construct. CA assumes that all indicators are equally reliable such as all indicators have equal outer loadings on the construct. It is calculated based on indicator inter-correlations. Higher coefficients indicate reliable measuring instruments [32]. The minimum adequate value recommended for CA is above 0.70 to achieve reliability by ensuring internal consistency of the survey instruments [17].

However, in exploratory research, the minimum threshold for CA may be decreased to 0.60 [31]. Additionally, the composite reliability (CR) test was performed considering different outer loadings of the indicator variables. In general, both CA and CR are used to estimate the internal consistency of a measure. However, CA calculates the score by assuming equal weights of all the items and is influenced by the number of items. In contrary, CR provides a better indicator for measuring internal consistency as CR relies on standardized regression weights and measurement correlation errors for each item and therefore may yield consistent results [31]. Internal consistency reliability is considered satisfactory when the value of CR is at least 0.7 [17, 31] and all the constructs used in this study have met the condition.

Table 3
Reliability Analysis of Measures

Construct	Cronbach's Alpha	Composite Reliability	No. of Items
System Quality	0.908	0.932	5
Information Quality	0.881	0.911	6
Service Quality	0.721	0.819	5
Top Management Support	0.727	0.845	3
Operations Enablement	0.910	0.944	3
Computer Self-Efficacy	0.940	0.961	3
User Experience	0.648* (0.854)**	0.815* (0.931)**	3* (2)**
Performance Expectancy	0.803	0.884	3
Perceived Usefulness	0.859	0.914	3
User Satisfaction	0.837	0.902	3
Impact of Effective Research Management	0.889	0.931	3
Impact of Efficient Research Management	0.930	0.955	3

** Before item (UX1) dropped*
*** After item (UX1) dropped.*

The result shown in Table 4 indicates that all the constructs have met the acceptable CA and CR values which are above the recommended threshold value. Therefore, the instruments are sufficiently error-free and reliable which can be used for further studies.

V. CONCLUSION

The purpose of this pilot study is to find relevant items and ensure their reliability in order to measure RIMS success model. Data were collected using an online survey questionnaire provided by Google forms. Thirty-two responses were analyzed using statistical software. The prior study argued that RIMS should have some success components of its strategic information access and display. The initially proposed model of RIMS was developed based on an extensive literature review considering the interrelationship among three success dimensions namely

human, organizational and technological was then piloted and analyzed in this study involving relevant reliability analysis of measures. Each dimension consists of several factors as mentioned in previous sections. As a result, this study has proposed significant measurement tools for managing related research information system in the domain of research institutions. Furthermore, the revised survey instruments developed for this pilot study could further be used to measure RIMS success with the context of higher education and research management in research affiliated institutions.

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