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ORIGINAL RESEARCH ARTICLE

Integrate between information systems engineering and software engineering theories for successful quality engineering measurement of software: Valid instrument pre-results

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ABSTRACT

An extensive number of instruments and systems assessment tools are weak and not good enough in the appraisal of systems' quality engineer success measurement. Thus, the comprehension of systems' success is very serious. One of the purposes of this research topic is to develop a successful, novel, validated instrument for measuring system quality success based on the integration between theories of information systems (Seddon and DeLone & McLean) and software engineering theory (ISO 25010). To ensure the quality of the instrument before use, eight academic experts have validated. The reason for expanding the number of experts to eight is to accurately build and evaluate the instrument because this instrument is the first one erring. After expert validation done successfully, researchers started the process of instrument pre-test. Pre-test verification and validation results done by test the instrument of 74 users. The results of the statistical testing were perfect. The Composite reliability proposed value is 0.7, The average variance extracted value is 0.5. Cronbach's alpha is higher than 0.7. The value of Spearman's reliable rhea is >0.6. Results approved that this instrument is strong and perfect to be used as a valid tool for system success measurement.

Keywords: information systems; systems success measurement; software engineering; quality engineering; ISO 25010

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1. Introduction

The high degree of system failure, the absence of theoretical background, and the restricted engineered frameworks could assist companies in identifying the advantages and quality of their systems concerning the loyalty and satisfaction of their users, the absence of empirical data as well as the collection of data. Due to the absence of knowledge about the quality of systems in the Middle East and the lack of studies in Yemen, a large number of users and organizations are not satisfied with such systems[1–3]. Due to the difficulty in finding an engineered framework that can identify the factors in the field of education and the ambiguity of the association between the satisfaction of the users and their loyalty, it is vitally significant that these issues are investigated. It is usually proposed that engineers should use a framework to integrate information systems with soft engineering, like DM 2003 as well as ISO 20510. It is vitally significant to carry out a comprehensive study that establishes a fresh framework able to deal with all or part of the issues discussed above[1–3].

2. Background

Measuring system success involves evaluating various aspects of a system's performance, usability, and impact on achieving organizational goals. This evaluation is crucial to determine the effectiveness and value of the system in meeting its intended objectives. Various models and frameworks have been used to measure system success, and research in this field has evolved over time. Several notable models for measuring system success include: DeLone and McLean Information Systems Success Model: This model, proposed by DeLone and McLean in 1992 and later revised in 2003, focuses on six dimensions of information system success: system quality, information quality, service quality, use, user satisfaction, and net benefits. Technology Acceptance Model (TAM): Developed by Davis in 1989, TAM assesses user acceptance and adoption of technology based on perceived ease of use and perceived usefulness. Unified Theory of Acceptance and Use of Technology (UTAUT): Venkatesh et al. proposed this model in 2003, which integrates various models to predict and explain technology usage intentions and behaviors[4,5].

ISO/IEC 25010 Quality Model: This standard defines a comprehensive set of quality characteristics and sub-characteristics to evaluate software product quality, including functionality, reliability, usability, efficiency, maintainability, and more. Recent research in system success measurement emphasizes the need for comprehensive evaluation frameworks that consider not only traditional metrics like user satisfaction and system performance but also broader organizational impacts such as business value, innovation, and agility. Furthermore, emerging technologies like artificial intelligence, machine learning, and blockchain have prompted researchers to explore new evaluation methods specific to these technologies' unique characteristics and impacts. System success measurement is a crucial aspect of assessing the effectiveness and impact of information systems within organizations. It involves evaluating various dimensions to determine how well a system meets its intended goals and contributes to overall organizational objectives[6]. One of the seminal models used for assessing system success is the DeLone and McLean Information Systems Success Model. Initially proposed in 1992 and revised in 2003, this model highlights multiple dimensions of success, including system quality, information quality, service quality, user satisfaction, usage, and net benefits[7] Another influential model is the Technology Acceptance Model (TAM)[8] which focuses on users' acceptance and adoption of technology. TAM emphasizes perceived ease of use and perceived usefulness as crucial factors influencing technology adoption. Recent research in 2024 might explore advancements in system success measurement, considering emerging technologies and novel evaluation methodologies[6,9].

3. Literature review

The users of the system are increasingly expanding that ever before. This led to the difficulty of measuring the success of systems. Currently, scholars encounter obstacles due to the system sophistication besides their big number of users. Such phenomena could lead to the loss of sight of the main elements like (timeliness, accuracy, relevance) of quality which has a role in the system success. The system success measures are developing continuously resulting in more difficulty that must be urgently investigated[3,10]. ICT has a leading role in many companies and thus substantial budgets are spent on communication and information technology so as to achieve a sustainable competitive benefit. Nevertheless, the system measurement success has triggered many researchers and scholars so far[11]. The system of universities is considered as one of the main systems which facilitate the development as well as management of institutions. It's utilization for decision-making aims and other academic duties.

Scholars focused on improving the system qualities, trying to establish a framework and identifying a possible research domain which placed the emphasis on the importance of the measure of system success. The system quality definitely affects the satisfaction of users[3,12]. Success of systems has been a trend of argument, this is Because of the effect of noncontrollable variables, it actually very hard task to determine the value of systems to organizational effectiveness or on overall organizational performance[11]. A university system is one of the key systems for facilitating the management and development of institutions. The works of researchers aimed to improve quality of systems. For this purpose, authors trying to develop a framework and identified a potential study area that emphasized the significance of systems success measure. Quality of the system positively influences users' satisfaction[3,12].

Studies on the definitions of systems and its success could be traced a few years ago. However, there is still a lack of conceptualization particularly with regard to its definition and what could be possibly led to the success of system though notable researchers in this domain have presented some remarkable explanations. Besides, researchers have stressed the need for urgent investigation for refining theories and explaining the notion[13]. In addition, there has been no accepted definition and dependable instrument of measurement[3,13–15]. Thus, the essential concern is still existent in terms of explaining the quality criterion which might be possibly used to investigate the effectives and quality of the system[3,15].

4. Problem statement

Currently noticed that systems, high rate of failure is strongly related to the weak instruments and frameworks that being used for a successful evaluation. There is a dire need for a strong validated instrument for systems success measurement, especially in the least developed countries. The goal behind this study is to provide a strong validated instrument for systems quality measurement and success evaluation[3,4,6,16–18].

5. Methodology

Research can be of any of the types qualitative, quantitative or mixed methods. The best method depends on the research objective and purpose of which research is going to be conducted, as each of them has their own merits and demerits. With an adapted and validated instrument this study will be conducted under quantitative research method approach best suited under the current circumstances. Hence the data from the users were collected by the questionnaire survey. The study aims to comprehensively explain the phenomenon by utilized a quantitative method to achieve the maximum benefits and to measure the success. Smart PLS used to perform the results as it's categorized as one of the best tools used for predicating the results of the models in fields of software engineering and information systems. Before made the quantitative process, validation of the instrument has been done through consulting 8 academic experts[3,16,19–22].

6. Discussion

In this research the instrument was validated by eight experts with an experience more than ten years in the position of systems director and academic field with minimum PhD qualification from academies in Yemen, Malaysia and India. All suggestions and notes of the experts were considered. The instrument validation results are provided below and with all needed statically findings required for the approval.

Table 1. Instrument illustration.

Factor	Items load	Items	Cronbach's Alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Information quality	0.7138	The information outputs of my university web system (including on-screen and printed outputs) are complete.	0.8	0.8	0.8	0.5
	0.7419	The information outputs of my university web system (including on-screen and printed outputs) are concise and are easy to understand.				
	0.7276	It is easy to find what I'm looking for when using my university web system.				
	0.7048	The information outputs of my university web system (including on-screen and printed outputs) are accurate and is free from errors.				
	0.7037	My university web system provides the precise information I need.				
System quality	0.6723	It is easy forme to become skilful by using my university web system.	0.8	0.8	0.8	0.5
	0.7661	In general, I find my university web system is easy to use.				
	0.686	My university web system is well integrated.				
	0.7542	My university web system has a short time lag between input and output of data as example (registration process).				
	0.7354	My university web system has a short response time for on-line enquiry.				
Efficiency	0.7287	It is possible to find in my university web system what I want in a reasonable time.	0.7	0.7	0.8	0.5
	0.6874	My university web system enables me to get on to it quickly.				
	0.7525	My university web system does not use advertises or unwanted plug-ins.				
	0.6104	I can access my university web system from my favourite browser.				
	0.6704	It is easy to get and browse any part on my university web system.				
Functionality	0.7575	It is easy to go to the homepage while I'm browsing any other page in my university web system.	0.7	0.7	0.8	0.6
	0.7347	While using my university web system, I can easily navigate backwards through previously visited pages.				
	0.7610	My university web system provides varied search options (e.g., By faculty, courses, etc).				
	0.7742	Search hints are provided when wrong search keywords are used.				
Reliability	0.6747	My university web system never stops unexpectedly.	0.7	0.7	0.8	0.5
	0.7059	When there is a problem in some part or parts in my university web system I still can browse and perform some of process.				
	0.7055	In case of interruption of fault, my university web system recovers properly.				
	0.7213	In general, my university web system is available 24/7.				
	0.7035	I believe that my university web system is reliable.				
Usability	0.7582	The interface design of my university web system is attractive.	0.8	0.8	0.8	0.6
	0.7960	All interface elements are well combined and harmonious in my university web system.				
	0.7839	My university web system protects me from making errors when interring data.				
	0.8075	My university web system errors messages clearly indicate tome how to correct the problem.				
	0.7002	In my university web system, it is easy to recover from the error quickly.				
Security	0.7468	I believe my university web system is secure.	0.7	0.7	0.8	0.5

Table 1. (*Continued*).

Factor	Items load	Items	Cronbach's Alpha	rho_A	Composite reliability	Average variance extracted (AVE)
	0.7982	Overall, Itrust my university web system.				
	0.7174	My university web system has adequate security features that make you feel secure while using.				
	0.6505	I believe that the information offered by my university on the university web system is sincere and honest.				
	0.6763	The output information of my university web system is secure.				
Ease of use	0.8021	I find my university web system flexible to interact with.	0.7	0.8	0.8	0.6
	0.6987	My interactions with my university web system during doing online process were clear and understandable.				
	0.7923	My university web system is convenient forme.				
	0.7079	My university web system is laid out in a modern and fashionable.				
	0.7094	My university web system is of high quality.				
Satisfaction	0.7601	My university web system has met my expectations.	0.8	0.8	0.8	0.5
	0.7438	My interaction with my university web system is very satisfying.				
	0.7350	Overall, I am satisfied by using my university web system.				
	0.7256	Overall, I'm happy with my university web system.				
	0.7540	My university web system helps me to retrieve my information easier and quickly.				
	0.6136	My university web system saves my time.				
Benefit	0.7504	Overall, I obtained benefits from using my university web system.	0.8	0.8	0.8	0.5
	0.7363	My university web system is an important and valuable aid tome.				
	0.7253	My university web system has a large, positive impact on me as a user.				
	0.7045	I will be using more of my university web system in the future.				
	0.7614	I will recommend my university web system to others.				
	0.7911	I will say positive things about my university web system to others.				
Loyalty	0.7891	I like using my university web system.	0.8	0.8	0.8	0.6
	0.7700	I use my university web system frequently.				

The items of construct should be 0.6 and above to provide dependable analysis[23]. Average Variance Extracted of 0.5 is encouraged by Hair et al.[24]. Composite reliability proposed value is 0.7[24]. If the Average Variance Extracted value is lower than 0.5, scholars could still accept the values of Average Variance Extracted until 0.4 as long as composite reliability CR is >0.6 in case of Average Variance Extracted = 0.4 and value of CR is >0.6, no worry about the factor convergent validity[25,26]. Cronbach's Alpha as proposed by Pallant[27] could be higher than 0.7. The value of spearman's reliable rho_A should be >0.6[28].See the appendix for table of validation results.

7. Conclusion

The validation results of the instrument pre-test showed very good and perfect results. All items relate to their construct; the reliability of constructs is of high, excellent value, and the loading of the items is perfect.

Cronbach's alpha values within the perfect range, AVE values are also within the good range, rhea values are all above 0.6, so, it's justifiable now to use the current instrument in a large sample with a

big system that large number of users. Based on the results that come out of surveying, users of the big system researcher can produce the new validated system quality engineering success measurement framework, and this new framework will be published in the next article.

Author contributions

The work is done as apart of full project research of engineer IEIF and supervised by his supervisor AAI. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

There is no conflict.

References

1. Fadhel IEI, Idrus SZS, Ibrahim AAEA, et al. An integration between information systems engineering and software engineering theories towards engineering a novel framework of web-based systems success for institutions based on students' perceptions. *Journal of Physics: Conference Series* 2018; 1019: 012081. doi: 10.1088/1742-6596/1019/1/012081
2. Fadhel IEI, Idrus SZS, Ibrahim AAAE, et al. Measuring system success in new context by adapting DM 2003 framework with the external factor management support. *Journal of Physics: Conference Series* 2018; 1019: 012003. doi: 10.1088/1742-6596/1019/1/012003
3. Jami Pour M, Mesrabadi J, Asarian M. Meta-analysis of the DeLone and McLean models in e-learning success: The moderating role of user type. *Online Information Review* 2022; 46(3): 590–615. doi: 10.1108/OIR-01-2021-0011
4. Bao Z, Zhu Y. Understanding customers' stickiness of live streaming commerce platforms: An empirical study based on modified e-commerce system success model. *Asia Pacific Journal of Marketing and Logistics* 2022; 35(3): 775–793. doi: 10.1108/apjml-09-2021-0707
5. Zhang J, Zhong S, Wang T, et al. Blockchain-based systems and applications: A survey. *Journal of Internet Technology* 2020; 21(1): 1–14.
6. König CM, Karrenbauer C, Breitner MH. Critical success factors and challenges for individual digital study assistants in higher education: A mixed methods analysis. *Education and Information Technologies* 2023; 28(4): 4475–4503. doi: 10.1007/s10639-022-11394-w
7. DeLone WH, McLean ER. The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems* 2003; 19(4): 9–30. doi: 10.1080/07421222.2003.11045748
8. Davis RB, Anderson JR. Exponential survival trees. *Statistics in Medicine* 1989; 8(8): 947–961. doi: 10.1002/sim.4780080806
9. Hsu L. What makes good LMOOCs for EFL learners? Learners' personal characteristics and Information System Success Model. *Computer Assisted Language Learning* 2023; 36(1–2): 1–25. doi: 10.1080/09588221.2021.1899243
10. DeLone WH, McLean ER. Information systems success measurement. *Foundations and Trends® in Information Systems* 2016; 2(1): 1–116. doi: 10.1561/2900000005
11. Gelderman CJ, Kusters RJ. Measuring information systems success: A comment on the use of perceptions. In: *Measuring Organizational Information Systems Success: New Technologies and Practices*. IGI Global; 2012. pp. 23–38. doi: 10.4018/978-1-4666-0170-3.ch002
12. Gürkut C, Nat M. Important factors affecting student information system quality and satisfaction. *Eurasia Journal of Mathematics, Science and Technology Education* 2017; 14(3): 923–932. doi: 10.12973/ejmste/81147
13. Mardiana S, Tjakraatmadja JH, Aprianingsih A. Validating the conceptual model for predicting intention to use as part of information system success model: The case of an Indonesian government agency. *Procedia Computer Science* 2015; 72: 353–360. doi: 10.1016/j.procs.2015.12.150
14. McNab AL, Ladd DA. Information quality: The importance of context and trade-offs. In: Proceedings of 2014 47th Hawaii International Conference on System Sciences; 6–9 January 2014; Waikoloa, HI, USA. pp. 3525–3532. doi: 10.1109/hicss.2014.439
15. Mwangi EW. *Information Quality Assessment Framework: Case of the National Safety Net Program Single Registry System* [PhD thesis]. Strathmore University; 2016.
16. Fadhel IEI. *The Development of Web-Based Systems Quality Engineering Framework in the Universities Domain* [PhD thesis]. University Malaysia Perlis; 2019.
17. Fadhel IEI. *An Evaluation of Information System Success Based on Students' Perspective* [Master's thesis]. Universiti Utara Malaysia; 2015.

18. Fadhel IEI, Idrus SZBS, Abdullah MSY, et al. Nias-mukalla web based systems success measurement and students satisfaction evaluation based on security factor of systems quality engineering theory (ISO 25010) and other factors. *Independent Journal of Management & Production* 2019; 10(6): 2102–2123. doi: 10.14807/ijmp.v10i6.967
19. Fadhel IEI, Idrus SZBS, Abdullah MSY, et al. A new perspective of web-based systems quality engineering measure by using software engineering theory (ISO 25010): An initial study. *Journal of Physics: Conference Series* 2020; 1529(2): 022004. doi: 10.1088/1742-6596/1529/2/022004
20. Fadhel IEI, Idrus SZBS, Abdullah MSY, et al. Towards development a novel framework of web-based systems quality engineering by the integration between information systems and software engineering theories: Context of higher education. *Journal of Physics: Conference Series* 2020; 1529(2): 022005. doi: 10.1088/1742-6596/1529/2/022005
21. Fadhel IEI, Idrus SZBS, Abdullah MSY, et al. Systems success measurement: Instrument & framework a new perspective. *Independent Journal of Management & Production* 2019; 10(5): 1572–1606. doi: 10.14807/ijmp.v10i5.872
22. Fadhel IEI, Idrus SZBS, Ibrahim AAEA, et al. Ibrahim's triangle model (satisfaction–benefit–loyalty) for systems success measurement. *Independent Journal of Management & Production* 2019; 10(2): 499–511. doi: 10.14807/ijmp.v10i2.867
23. MacCallum RC, Widaman KF, Preacher KJ, et al. Sample size in factor analysis: The role of model error. *Multivariate Behavioral Research* 2001; 36(4): 611–637. doi: 10.1207/S15327906MBR3604_06
24. Hair JF Jr, Hult GTM, Ringle C, Sarstedt M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Sage Publications; 2017.
25. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* 1981; 18(1): 39–50. doi: 10.1177/002224378101800104
26. Huang CC, Wang YM, Wu TW, et al. An empirical analysis of the antecedents and performance consequences of using the moodle platform. *International Journal of Information and Education Technology* 2013; 3(2): 217–221. doi: 10.7763/ijiet.2013.v3.267
27. Pallant J. *SPSS Survival Manual*. McGraw-Hill Education; 2013.
28. Garson GD. Reliability analysis. Available online: http://faculty.chass.ncsu.edu/garson/pa765/statnote.htm (accessed on 18 January 2024).