JurnalMantik
Volume 4, Number 4, Feb 2021, pp. 2427-2435 E-ISSN 2685-4236
https://iocscience.org/ejournal/index.php/mantik

Measuring the Effectiveness of Public Organizational Information System Functions

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ARTICLEINFO

Article history:
Received: 01/12/2020
Revised: 10/12/2020
Accepted: 03/01/2021

Keywords: Effectiveness Measurement, Information Systems Functions, Public Organizations

ABSTRACT

This study aims to identify validated constructs and their attributes that are used to assess the effectiveness of the public organization's information system functions. In this study, the function of information systems can be in the form of work units, groups of people, or individuals, who are given responsibility for an organization's information system. This study uses literature studies and in-depth interviews with individuals who are responsible for the development, management and operation of information systems in 5 public organizations in Semarang City, to identify 98 items measuring the effectiveness of information system functions. A total of 192 sample items were obtained from a survey of end users of information systems in 5 public organizations in Semarang City. Using principal component analysis and second-order confirmatory factor analysis methods, this study has succeeded in validating 4 main dimensions, namely: Institutional (3 factors), Service Quality (3 factors), System Quality (4 factors), and Individual and Organizational Benefits (4 factors). The final instrument can be used to evaluate the effectiveness of existing information system functions, and the results obtained can be used to determine the initial status of effectiveness and for benchmarking.

1. Introduction

Assessing the effectiveness of information system functions has long been an important issue for information systems executives. Decision makers routinely seek evidence whether the information technology investments they have made provide returns on more substantial effectiveness and the organization's competitive needs. The function of information systems is defined as parties both individuals, groups, and departments in an organization who are daily responsible for developing and supporting the operationalization of the organization's information system (Usman & Pakarti, 2016). This function holds the main responsibility in supporting organizational decision making, so that it becomes an inseparable part of achieving the success of an organization. But on the other hand, the overall effectiveness of the information system function turns out to be more difficult to conceptualize and measure.

It can be argued that there is a growing need for a formal assessment of the effectiveness of information systems, which allows for the establishment of a baseline to be used in assessing the success of information systems functions. Thus, the issue of overall information systems functional metrics is becoming increasingly important and has become a top priority for information systems executives.

Although there is a great deal of research on the efficiency, effectiveness, and success of information systems at various levels of analysis, the overall functional level performance is one of the least discussed and studied. While there are metrics and instruments for assessing specific information system sub-functions and specific information system sub-areas, for example data center performance, productivity, and data quality, these measures usually cannot be combined in any way. This of course will limit its use as a basis for identifying sources of increase or decrease in its effectiveness or overall performance.

On the other hand, of the few studies on the efficiency, effectiveness, and success of information systems, the whole is in the context of profit-oriented organizations, where they always pay attention to the material benefits of their information systems spending. Taking into account that non-profit organizations, including public organizations, have very different organizational visions and goals, including organizational structures and mechanisms that are also very different from profit-oriented organizations, therefore a separate

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measurement metric is needed to be able to assess the effectiveness of the organization. information system function.

Public organization is a type of organization that aims to provide services to the wider community. With the structure and foundation of a public organization very different from a profit organization, the organization's mission, decision-making, performance measures, value creation, and organizational accountability are also different. The results of research by Olson and Rosacker (2013) state that the critical success factor in information technology projects between the public and private sectors is significantly different. Thus the measurement of the functional effectiveness of the information system of public organizations must be carried out with specific benchmarks.

There are many public organizations in Semarang City which are dominated by government institutions, both at the provincial and city levels. Most of these public organizations are in the form of official offices. Like any other organization, this public organization must also pay special attention to the functional effectiveness of its information system. This functional effectiveness assessment can be used as a method for periodic evaluation of strengths and weaknesses, determining baseline status and determining development targets, for benchmarking intra and between agencies, and for knowledge transfer. The functional effectiveness of information systems which is getting better over time will support efforts to create good governance (good government governance). In addition, this effectiveness assessment is also part of the assurance of service quality and accountability to stakeholders, both internal and external to the organization.

2. Research Methodology

There are many studies that have been carried out related to the development of models for effectiveness assessment that are implemented in various fields or aspects, such as effectiveness in an individual context, organizational effectiveness, namely both for-profit and non-profit organizations, and organizations in their overall, sub-structural or sub-functional sense. In addition, there are a number of studies that focus on marketing effectiveness, financial effectiveness, information system effectiveness, and project effectiveness. Studies on the development of effectiveness measurement models to be implemented in certain fields or aspects have also been widely carried out.

Previous studies related to measuring and evaluating effectiveness or performance in public organizations have also been carried out by many researchers, such as Tonelli et al. (2017) and Biswan and Andika (2020). Some researchers have linked the measurement of effectiveness or performance with information systems, as was done by Wang et al. (2018), Gupta et al. (2018), Salleh et al. (2010), as well as Marchand and Raymond (2008).

On the other hand, studies on information system performance measurement have also been carried out, namely those related to pre-implementation, during implementation, and post-implementation. Some studies discuss information systems in a broad sense, and some others in terms of certain applications or technologies such as Enterprise Resource Planning (Chofreh et al., 2020; Rodríguez et al., 2020), e-Commerce (Kim & Peterson, 2017; Lim et al., 2018), e-Government (Twizeyimana & Andersson, 2019; Wirtz & Daiser, 2018), and other internet-based applications, and information systems projects (Patalas-Maliszewska & Krebs, 2018; Roberts, 2018). There are many different perspectives used, such as a strategic perspective and a senior management perspective (Al Shobaki et al., 2018; Zhang et al., 2018), as well as a technology perspective (Jameel et al., 2019; Wang et al., 2018) .

It can be said that, although there have been quite a variety of studies on how to develop an effectiveness measurement and evaluation system, measuring the functional effectiveness of information systems has become one of the main issues in the socio-technical problems of information systems to date. DeLone and McLean (2016) and Dwivedi et al. (2015) have developed a performance measurement model for the information system function that also presents validated measurement metrics. However, overall studies on the functional performance measurement of information systems exist only in the context of profit organizations. Usman and Pakarti (2016) conducted the same study in the context of local government, by including aspects of the capabilities of the information system function in assimilating new technology as a new construct.

On the other hand, research that focuses on public organization information systems, such as ¬ e-Government, is still dominated at the level of technical system design and development (Gottschalk, 2020; Sulehat & Taib, 2016), and the level of application users (Ganapati, 2011; Kinder, 2010). Studies of information systems for public organizations in the post-implementation stage have so far been rarely carried out, and have only been limited to special cases such as effectiveness for evaluation design frameworks (Valle-Cruz, 2019), HR information systems (Mbugua, 2015), and user acceptance (Krishnaraju et al., 2016),

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2006). Some other examples are related to the critical success factor of public organization information systems (Napitupulu & Sensuse, 2014; Othman & Razali, 2018), as well as successful models from a technology perspective (Ziemba et al., 2016). It can be said that there is no study that specifically addresses the functional level, in the sense of specifically considering information systems technically with the managerial aspects of public organizations.

According to Rosacker and Olson (2008), the critical success factors in information technology projects in profit-oriented organizations are very different from those in non-profit organizations or public organizations. Thus the information system functional performance measurement model that has been developed in previous research (DeLone & McLean, 2016) cannot necessarily be implemented to measure the functional effectiveness of the information system for non-profit organizations including public organizations. Therefore, the development of a model for measuring the effectiveness of the information system functions of public organizations and its validated measures needs to be done specifically.

3. Literature Review

To carry out this research, it first begins with a literature review in the areas of organizational effectiveness of information systems, information system success, information system function performance, e-Government, and information system resources and capabilities. From the literature review, the dimensions and initial measures were identified to assess the effectiveness of the information system function.

In the next stage, in-depth interviews are conducted with individuals who are responsible for and / or directly involved in the development, management and operation of information systems in each public organization that is the object of study. This in-depth interview is intended to confirm the results of the identification of the dimensions and initial measurements carried out through a literature review. In-depth interviews are also intended to find out in more detail the organizational structure, governance and management of information systems in each selected organization.

As the object of the study, 5 public organizations in Semarang were selected, consisting of 1 regional government commission and 4 offices belonging to the Central Java Provincial Government. The five public organizations were selected by considering convenience (convenience) considering the homogeneity of public organizations in Semarang City, both those owned by the Semarang City Government, the Central Java Provincial Government, and regional government-owned institutions in the regions. Furthermore, 192 complete data samples obtained from information system end users in the five public organizations were used for model validation process.

For analysis, we use the Principal component analysis method, especially to factors extraction. The criteria used to determine the number of extracted factors is the eigenvalue or latent root criterion, which is a account that represents the amount of variance that can be explained by a factor. To clarify the variables that fall into certain factors, orthogonal rotation with the Varimax method is used. In addition, second order confirmatory factor analysis using structural equation modeling (SEM) was used to validate the effectiveness measurement model.

4. Discussion

4.1 Information Systems In Public Organizations

Through a preliminary study conducted on 5 sample public organizations, it is known that the conditions of the existing information systems in public organizations in Semarang City appear to vary in general. Although some of the existing systems appear to be mature and well-established as the information system owned by the Health Office, others appear to be modest. It can be said that the information system development policy has not become a top priority by some existing public organizations. Whereas with a good information system, which is well managed and operated, it becomes very effective to support organizational success.

There are several types of information systems contained in each public organization, namely: 1) Specific information systems in accordance with the unique functions of each organization. This information system is developed and managed by each of these public organizations; 2) Information systems to support daily office work, such as for archiving, correspondence, employee attendance, and others; 3) An information system that is part of the parent organization's information system, where the public organization that becomes the object of study only acts as a user.

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The results of the preliminary study also show that in general the users of the information system are: the relevant public organization internal, including institutions or organizational units under the structure, as well as similar public organizations located at the district / city level; other organizations directly related to their function; Other organizations, both for-profit and non-profit, which are not directly related, which are more like partners or users; parent organizations whose structures are above it, including public organizations at the provincial and national levels.

There are many main problems that have been identified through this research, particularly those related to planning, development, operation and management of information systems in each public organization. Some of the problems include: 1) An unsupportive organizational culture, especially related to reluctance to change and adapt to new things. For example, there is an assumption that the old system or manual method is sufficient to help complete their daily work, while others feel that they do not need technology support; 2) organizational structure and work procedures that do not accommodate the development of information systems; 3) Lack of top management commitment, which is largely due to the age factor or the unfamiliarity of the leadership towards the latest information technology; 4) Improvement and development plans, which are generally not preceded by a comprehensive needs analysis, have resulted in several systems that have been built not being optimal for use or even partially wasted; 5) Human resources are very limited both in terms of number and technical capabilities. This is driven by recruitment and placement mechanisms that are not good enough to accommodate the needs of each organization, so that it makes it difficult for each organization to get human resources according to their expectations; 6) Existing information technology equipment and / or infrastructure, especially in the regions, which do not support the development of a reliable information system. Several obstacles are related to the main infrastructure, such as limited fiber optic network, as well as limited main network capacity; 7) There is no budget for system development. In general, public organizations' budgets for information technology spending are limited to routine operational and maintenance activities.

Apart from that, public organizations also experience other obstacles that are more technical in nature. Some of them are:

a. Almost every public organization has many applications that are used separately or not integrated. As a result, the operational effectiveness of the organization becomes very difficult to fulfill.
b. Although some public organizations already have a special unit to manage their information systems, some others do not have them. Management of information systems by some organizations is carried out by combining it with other units (sections, subsections). There are even organizations whose management of information systems is left to units that are actually completely unrelated to information systems management.
c. In the case of information exchange, particularly regarding data updating, data contributors generally use non-standard file formats with transfer media using email, social media, and flash disk copy. Information system that is not integrated

4.2 The Conceptual Framework

The development of the conceptual framework in this study begins with the formulation of the initial domains for this study. This initial domain refers to the results of the study of Govindaraju and Usman (2007). In this study, the initial domain is a slice of the measurement domain of the information system success model and the organizational effectiveness measurement domain as can be seen in Fig 1. In the next stage, the identification of dimensions from previous studies related to the performance of information systems functions is carried out (Chen et al., 2018; Govindaraju & Usman, 2007; Tan et al., 2013), successful information systems (DeLone & McLean, 2016; Jaafreh, 2017; Myers et al., 1997), organizational effectiveness (Cameron, 2015; Liket & Maas, 2015; Zoogah et al. al., 2015), as well as resources and capabilities (Gupta et al., 2018).

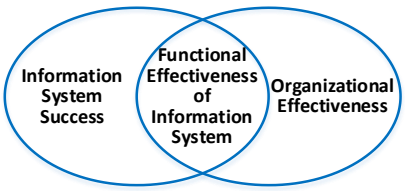

Fig 1. Initial domain

Measurement dimensions were also identified from recent studies relating to critical success factors (CSF) in public organization information systems. In addition, through a review of the Indonesian e-Government Ranking form from the Ministry of Communication and Information (2012).

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This study as a whole succeeded in identifying 32 candidate dimensions, which were then extracted into 4 main dimensions using an input-output logical model framework. This framework has been used in a number of previous studies such as Alrubaiee et al. (2015), Czohara and Melkers (2004), and Iqbal et al. (2019). The four main dimensions are:

a. Institutional
b. Service Quality
c. System Quality
d. Individual and Organizational Benefits

Through literature review, content analysis, and verification of key people in each public organization that is the object of the sample, the overall attributes of measuring the effectiveness of information systems are obtained as follows.

For the Institutional dimension, there are 9 measures, namely:

a. Completeness of work units and personnel
b. Completenes of job description
c. Completeness of work instructions
d. Internal evaluation frequency
e. Master plan
f. Documentation of system development planning
g. Documentation of HR development planning
h. Documentationof IT Asset
i. Monitoring mechanism

For the dimensions of Service Quality, 14 measures are identified as follows:

a. Operational capability
b. System development capability
c. Introduction of the problem
d. Delivery of ideas
e. Adaptation to change
f. Service reliability
g. Service flexibility
h. Emergency services
i. Attitude and empathy
j. Understand the needs of the relationship
k. Service exceeds expectations
l. Timeliness
m. Improvement suggestions
n. Transfer of knowledge

For the dimensions of System Quality identified the following 20 measures:

a. Completeness of information
b. The validity of the information
c. Clarity of information
d. Relevance of information
e. Ease of verification
f. Internet access
g. Integration
h. Completeness
i. Up-to-date
j. Easy to use
k. Flexibility
l. Reliability
m. Easy maintenance
n. Ease of data exchange
o. Ease of data management
p. Physical securitymeasure
q. Electronic security
r. Convenience
s. Meeting needs
t. Backup system

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For the dimensions of Individual and Organizational Profits, 17 measure items were identified as follows:

a. Organizational image
b. Achievement of the organization's vision and mission
c. Improvement of habits / culture
d. Stakeholder satisfaction
e. Cost efficiency
f. Effectiveness of planning
g. Effectiveness of supervision
h. Effectiveness of decision making
i. Increased employee productivity
j. Regularity of work processes
k. Effectiveness of information exchange
l. Effectiveness of information delivery
m. Improved communication between personnel / units
n. Collaboration between personnel / units
o. Encouraging innovation
p. Increased use of knowledge
q. Ease of learning

4.3 Instruments Validation

To produce a valid instrument, it begins with a factor extraction step against a collection of measurement attributes in each of the four main dimensions. The extraction method used is principal component analysis with the varimax rotation method.

The results for this factor extraction are, for the Institutional dimension, 2 factors are obtained, namely: quality management and governance. From the dimension of Service Quality, 3 factors were successfully extracted, namely: assurance, reliability, and empathy. Meanwhile, for the dimensions of System Quality, 4 factors were extracted, namely: convenience, security, reliability, and quality of information. For the dimensions of Individual and Organizational Benefits, 4 factors were successfully extracted, namely: information & communication, knowledge management, business processes, and organizational profits. Thus a total of 13 factors were successfully extracted.

Furthermore, to ensure the validity and reliability of the instrument, a series of tests was carried out using second-order confirmatory factor analysis through structural equation modeling (SEM) analysis techniques.

The validity of the content (content validity) has been guaranteed through adequate literature surveys and confirmation of results to users, namely when identifying the measurement attributes. For measurement items that are not suitable, necessary corrections or deletions have been made in accordance with the feedback we received from key people in each of the sample public organizations.

To evaluate the convergent validity, SEM analysis technique is used. Convergent validity is the degree that indicates that the measurement attributes of a certain factor or dimension share the variance together in a large proportion. According to Hair et al. (2014), convergent validity can be shown by estimating standardized factor loading of at least 0.5 and ideally at least 0.7. In addition, all loading factors must also be statistically significant.

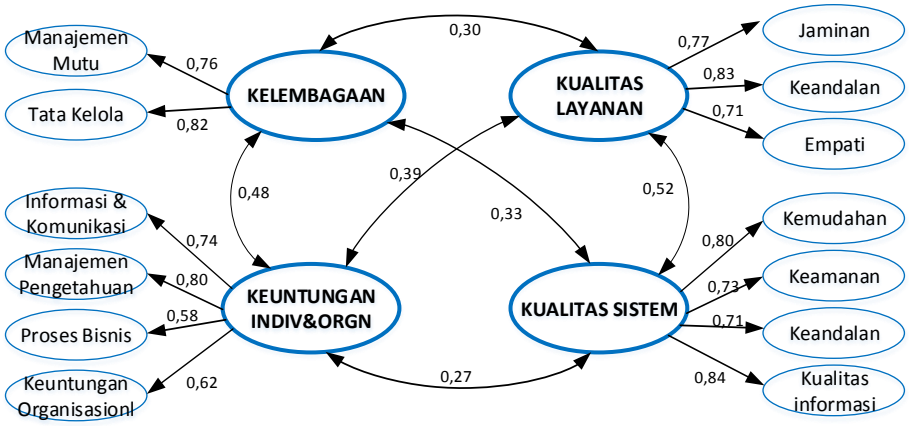

Fig 2. Second-order confirmatory model - a measure of the effectiveness of the public organization's information system functions

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Fig 2 is a complete second-order confirmatory model. It can be seen that some loading factors are greater than 0.7, and some are greater than 0.5. The results of the analysis also show that all loading is statistically significant. Thus the convergent validity of the measurement model has been fulfilled.

Table 1.
Reliability of the measurement construct

Faktor	Alfa Cronbach	Reliabilitas Komposit	AVE
Institutional Dimensions	–	0.70	0.53
Quality management	0.89	0.90	0.65
Governance	0.91	0.91	0.69
Service Quality Dimensions	–	0.63	0.48
Assurance	0.84	0.84	0.62
Reliability	0.86	0.85	0.62
Empathy	0.79	0.80	0.58
System QualityDimensions	–	0.68	0.51
Convenience	0.88	0.87	0.62
Security	0.84	0.84	0.59
Reliability	0.85	0.85	0,59
Information quality	0,91	0,90	0,64
Dimensions of Individual and Organizational Benefits	–	0,61	0,47
Information & communication	0.78	0.78	0.53
Knowledge management	0.85	0.84	0.61
Business process	0.74	0.74	0.49
Organizational benefits	0.76	0.76	0.50

5. Conclusion

Stakeholders and related parties should give greater attention to the implementation of information and communication technology in order to achieve the vision and mission of every public organization. Greater attention is still needed, especially in the framework of planning, development and operational activities. as well as control of information systems, especially in public organizations to institutions in the structure below.

There are many problems that have been identified in the planning, development and operation of information systems in each of these public organizations. There are 2 things that need serious attention from stakeholders. First, improving the organizational culture so that it becomes more friendly and adaptive to technological developments. Second, the availability of skilled human resources in the field of information and communication technology. One thing that needs to be underlined in the recruitment or fulfillment of human resources is the mismatch between the criteria for expertise requested and the realization of its fulfillment.

In order to be the main supporter of organizational decision making and also to support the organization's operational activities optimally, the information system in every public organization needs to be managed properly by paying attention to continuous improvement efforts. Therefore, how well the effectiveness of the information system of public organizations needs to be assessed and evaluated periodically.

This research has succeeded in developing a validated measurement framework to evaluate the effectiveness of the information function in public organizations, particularly those in the city of Semarang. The framework and the validated factors and measures generated through this study can be used to periodically measure the strengths and weaknesses of the information system function, and the results can be used to establish initial status, as a benchmark for internal and inter-organizational measures (agencies or institutions), and also for knowledge transfer in the context of developing knowledge management.

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