An Alternative Model to Measure Smart Space Implementing Success

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Submission date: 13-Aug-2021 01:51AM (UTC-0500)
Submission ID: 1630912594
File name: 111_SPIS_Dwi_Yuniarto_CITSM_2021_Revisi.pdf (477.08K)
Word count: 4747
Character count: 26993

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***Abstract*—Simultaneously when the government began to implement several technologies in rural areas, especially Smart Space, problems emerged from the community who were considered not ready to use them. The government needs some input as material for policymakers when it has implemented Smart Space, namely through the formation of a new alternative model to measure Smart Space Implementing Success. This model is adopted from the Smart Space model and the Information Project Success model. The purpose of this research is to build an alternative model in measuring Smart Space Implementing Success. The result of this research is to produce a Smart Space Implementing Success measurement model which consists of six variables and 17 indicators and their measuring tools. This research contributes to providing input to Policymakers regarding Smart Space Implementing Success, participating in maintaining the sustainability of Smart Space Implementing Success, material for other researchers in applying it to different research objects, and developing the next Smart Space Implementing Success model into a framework.**

***Keywords*—smart space, model success, measuring tool**

I. Introduction

In everyday life, we can feel the growth and development of technology. Of course, this will have an impact on everything. Autonomous Things, Augmented Analytics, Digital Twins, Blockchain, and Smart Space are the current Information Technology trends [1-3] and have become an integrated part of everyday life. These terms may be a scary thing for some people, especially in rural areas [4-6]. Of course, this will be a big problem if it is not followed up by providing input to policymakers so that it is appropriate, effective, efficient, and wise in the application of the technology. Moreover, some villages still respect their ancestral culture and reject the application of technology [7-9].

The government has now started implementing policies to implement Smart Space in Rural Areas. One of the most widespread examples of Smart Space is Smart City [10-12], an area that combines business, residential and industrial communities designed using a smart urban ecosystem framework, with all sectors connected by social and community collaboration [10-12]. Artificial Intelligence Technology, Edge Computing, Blockchain, and Digital Twins are some of the supports for the creation of Smart Space [2, 3, 13-15]. Based on the pervasive goal of Smart Space, it is possible that natural technology and computer technology can co-exist, collaborate and interact with each other [1-3]. Smart Space is not only related to smart computing machines but also related to local culture and nature [1-3]. Smart Spaces develops based on five dimensions, namely: Openness, Connectedness, Coordination, Intelligence, and Scope [1-3].

The purpose of this research is to build an alternative model in measuring Smart Space Implementing Success. This alternative model consists of five exogenous constructs, namely: Openness, Connectedness, Coordination, Intelligence, and Scope [1-3], and one Smart Space Implementing Success [16-29] construct as an endogenous construct. As for the problem, questions are:

RQ1: How to understand the constructs, indicators, and their relationship in making alternative measurement models for Smart Space Implementing Success?

RQ2: What is the relationship between the constructs to produce measuring tools in making alternative measurement models for Smart Space Implementing Success?

In answering research questions, reporting is done by presenting problems in the introduction, followed by a literature review, research methods, results and discussion, and finally conclusions which are answers to research questions.

II. Literature Review

Humans are always interacting and reacting to the surrounding environment, be it fellow humans or other objects [1-3]. Smart Space is a space, be it physical or digital, that provides an environment where technology and humans interact together [1-3]. Other researchers argue about the definition of Smart Space [7-9], Smart Space is a physical or digital environment where humans and technology-supported systems interact in an increasingly open, connected, coordinated, and intelligent ecosystem. They appear in an environment that works together to get the best results [1-3]. Trends follow the pattern that determines what will happen, namely the day where all things digital-based and artificial intelligence will go hand in hand and give each other reciprocity [30].

According to Gartner, Smart Spaces develop based on five dimensions, namely: Openness, Connectedness, Coordination, Intelligence, and Scope [1-3]. The level of accessibility to elements in a smart area is referred to as Openness [31, 32]. Individual apps or systems in a smart environment, for example, will be segregated from one another in a closed paradigm and will not share data. If data must be shared, it will be done so in a regulated and exclusive manner. In an open paradigm, on the other hand, systems will watch out for one another, with data public and available to a broad audience via standard procedures. This component of Smart Spaces is being driven by trends in open data formats, identities, and protocols, as well as the activity of the open-source community [31, 32].

The depth, breadth, and toughness of the connections between pieces in a Smart Spaces are referred to as Connectedness [25, 33, 34]. Openness and connectedness are inextricably linked. Other than the specified user interface, there is no access to any of the functionality or application data in the Smart Space if there is no connectivity. A system like this will be shut down [25, 33, 34]. The degree of openness rises as the means for accessing application properties, data, and operations get more sophisticated. Connectivity is also improved by increasing the split of available properties, data, and functions. IoT (Internet of Things), IoT platforms, twins' edge digital computing, APIs and API gateways, and mesh service and application architectures are all contributing to enhanced connection in the smart sector [25, 33, 34].

The depth and strength of coordination between elements in a Smart Space is referred to as coordination [24, 35, 36]. Smart environments that are built on connectivity have a more active coordination component. While connectivity considers the possibility of connecting the various pieces, coordination considers the actual amount of interaction and collaboration between them [24, 35, 36]. Two apps operating in a smart area with common login credentials, for example, will have a poor coordination score. They will have a considerably higher coordination score if they also share data and conduct tightly connected procedures. Similarly, blockchain, which uses shared ledgers and smart contracts to drastically minimize business friction between parts in the Smart Space [24, 35, 36].

Intelligence is the application of machine learning and other AI (Artificial Intelligence) techniques to automate smart environments and deliver services to supplement people's activities [16, 30, 37]. Intelligence can take the shape of self-driving cars or enhanced intelligence, such as augmented analytics. The use of AI to aid users in the smart environment, as well as to give an immersive experience to improve how users perceive and interact with other aspects in the Smart Space, is an important consideration [16, 30, 37].

The scope of the Smart Space and its participants refers to the size of the Smart Space and its participants. A Smart Space with limited scope will focus on a single team in a single department inside a large corporation [26, 38]. A smart space with a broader scope might be more focused on the entire organization, but only within a limited problem space. A broader variety of Smart Spaces could include elements from outside the business as well as ecosystems that participate. The foundation for expanding the breadth of smart environments is openness, connectivity, and coordination. As the scope of Smart Space expands, intelligence supports streamlined access and automated management [26, 38].

Measurement of the success of the implementation of Information Systems has become an interesting research material at this time, when Information System builders are incessantly fulfilling consumer demand, on the other hand, researchers regarding the success of Information Systems provide input with the aim that the Information System has a high sustainability value. citation). Some researchers adapt, combine, or integrate models that measure the impact of using or implementing Information Systems in building their new models [17, 22, 23, 33, 39-46]. The emergence of new models such as TRAM (Technology Readiness Acceptance Model) which adopts and combines the TR (Technology Readiness) model from Parasuraman with TAM (Technology Acceptance Model) from Davis [47, 48]. Several other studies tried to integrate the Usability model from Nielsen with TR [45]. In this study, researchers tried to integrate the Smart Space model with the Information Project Success model to measure Smart Space Implementing Success.

III. RESEARCH METHOD

The research on the formation of this new model went through several stages as illustrated in Figure 1.

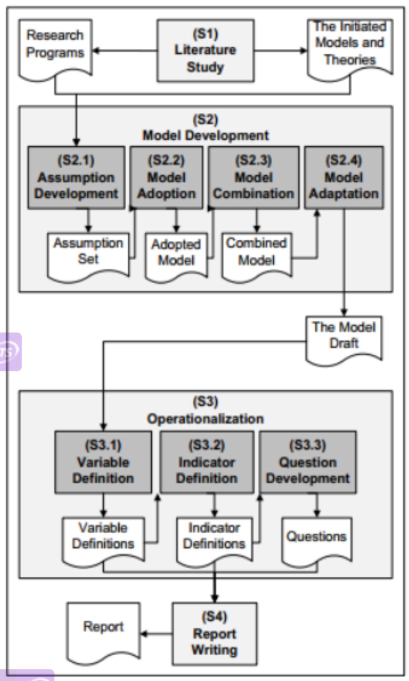

Fig. 1. The research procedure [45, 46]

To support the study agenda and establish supporting models and ideas, the researcher conducts a literature study (S1). The following step is to create a draft model, the researcher started working on a new model (S2) that included creating assumptions, model adoption, model combination, and model adaptation. The following step is operationalization (S3), which involves determining the definition of variables, indicators, and the construction of questions. Reporting is the final stage.

IV. RESULTS AND DISCUSSION

An alternative model is proposed as shown in Figure 2. The Smart Space Implementing Success measurement model consists of the Openness, Connectedness, Coordination, Intelligence, and Scope [1-3] constructs, and the Smart Space Implementing Success [16-29] constructs.

Variable Openness is defined as the level of accessibility to elements in the smart space [1-3]. From the Openness variable, it is translated into four indicators based on a literature review of several research sources [31, 32]. The first indicator is a joint monitoring system. The joint monitoring system has the meaning as a level to find out how far the Smart Space has carried out the joint monitoring function [31, 32]. The second indicator is the exposed data. The definition is as a level to determine the extent to which Smart Space provides exposed data facilities which is one of the concepts of Openness [31, 32]. The third indicator of the Openness variable is accessibility, with the definition of the level of measurement to find out that Smart Space provides convenience in accessibility [31, 32]. And the fourth indicator of the Openness variable is a standard mechanism, with a definition of the level of a standard mechanism that makes it easier for Smart Space to be implemented [31, 32].

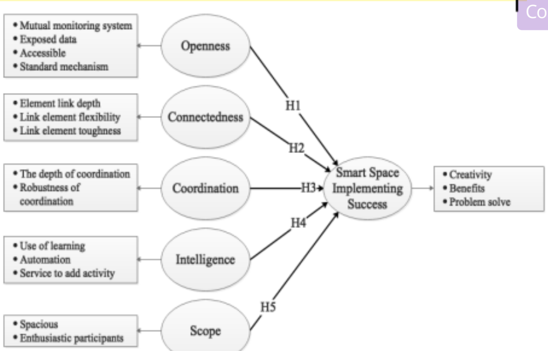

Fig. 2. Proposed an Alternative Model for Measure Smart Space Implementing Success

Connectedness variable is defined as the level of depth, breadth, and toughness of the link between elements in the smart space [1-3] as the second variable of the Smart Space model and when described and studied from several sources, produces three indicators. The first indicator is the link depth of the element. Element link depth is the degree to which the links between elements function in Smart Space [25, 33, 34]. The second indicator of the Connectedness variable is the flexibility of the link element, with a level definition to determine the flexibility of the interlinked elements in the application of Smart Space [25, 33, 34]. And the third indicator of the Connectedness variable is the toughness of the link elements, with the definition of the toughness level of each element involved in the implementation of Smart Space [25, 33, 34].

The third variable of the Smart Space model is Coordination and is defined as the level of depth and robustness of coordination between elements in a smart space [1-3]. From the Coordination variable, two indicators are produced. The first indicator is the depth of coordination between elements. The depth of coordination between elements is the level of measurement regarding the depth of coordination between elements in the implementation of Smart Space [24, 35, 36]. And the second indicator of the Coordination variable is the robustness of coordination between elements, with the definition being the level of knowing the robustness of coordination between elements in the implementation of Smart Space [24, 35, 36].

The next variable of the Smart Space model is the Intelligence variable, by definition as the degree to which machine learning and other AI techniques are used to drive automation into smart spaces and provide services to augment the activities of the people in them [1-3]. The indicator of the result of the translation of the Intelligence variable consists of three indicators. The first indicator is the use of learning, with the definition being the level that states the use of learning in the application of Smart Space [16, 30, 37]. Automation is the second indicator of the Intelligence variable, with the definition being the level that states one of the facilities provided by Smart Space regarding automation [16, 30, 37]. And the service to add activity as the third indicator of the Intelligence variable by definition is the level of measurement of the addition or increase in activity when already implementing and using Smart Space [16, 30, 37].

Variable Scope is defined as the extent of the smart space and its participants [1-3], which is the fifth variable of the Smart Space model. Consists of two indicators of results from the elaboration of several sources. The first is the indicator of a spacious smart room, with the definition being the level of measurement stating that the implementation of Smart Space provides and creates a spacious smart room [26, 38]. And the second indicator of the Scope variable is enthusiastic participants. It can be expressed as a level to find out how far the implementation of Smart Space can have an impact on enthusiastic participants [26, 38].

Next is the Smart Space Implementing Success variable which is defined as the success rate of Smart Space implementation [16-29]. The indicators consist of the Creativity Indicator which is the level of creativity growth [16-29], the Benefits Indicator which is the level of usefulness [16-29], and the Problem solves Indicator which is the level of problem-solving [16-29].

TABLE I. PROPOSED HYPOTHESIS

H	Variables Relationship	Previous Research That Supports Hypothesis Forming	Ref.
1	Openness > Smart Space Implementing Success	In the study entitled "The effects of openness, altruism and instructional self-efficacy on work engagement of MOOC instructors", "the variable studied in this study, Openness, was found to significantly affect the work engagement of MOOC instructors. As the number of MOOC and MOOC students increases, the importance of MOOC instructors and their work engagement will be critical to the success of this course".	[31, 32]
2	Connectedness > Smart Space Implementing Success	In the research entitled "Work in Progress: Openness, Conscientiousness, Self-Direction, and Mindset in First-Year Engineering Students", it was found that "Openness will likely provide a more robust view of factors that influence engineering student retention and success".	[25, 33, 34]

H	Variables Relationship	Previous Research That Supports Hypothesis Forming	Ref.
3	Coordination > Smart Space Implementing Success	In the research entitled "The role of organizational motivation and coordination in continuous improvement implementations: an empirical research of process improvement project success", "central coordination is found to affect the alignment of the organization to the CI implementation activities and objectives and affects PI project success".	[24, 35, 36]
4	Intelligence > Smart Space Implementing Success	In the research entitled "Analyzing the Impact of Coordination Factors on Construction Project Success	[16, 30, 37]
5	Scope > Smart Space Implementing Success	In a study entitled "The contribution of contextual factors to the success or failure of behavior modification interventions for medically unexplained symptoms: realist synthesis". In the research entitled "Ontology-Based Coalition Creation by Autonomous Agents in Smart Space: An Approach and Case Study", "It is proposed to describe every agent with an ontology and support the ontology matching between ontologies of different agents in smart space to enrich the semantic interoperability between them".	[26, 38]

From several studies on the Smart Space model and the Success model, several proposed hypotheses are obtained as shown in Table I. Previous research was involved in the formation of the model, and the most important is those who have conducted studies on the relationship between variables [45, 46].

TABLE II. PROPOSED QUESTIONNAIRE STATEMENTS

Variables	Indicators	Proposed Statements of the Questionnaire
Openness	Mutual monitoring system	With Smart Space, every existing system can carry out a joint monitoring system.
	Exposed data	Smart Space provides facilities for openly exposed data.
	Accessible	Smart Space provides convenience inaccessibility.
	Standard mechanism	Smart Space has implemented the standard mechanism.
Connectedness	Element link depth	The links between elements in Smart Space are declared to meet the depth of function.
	Link element flexibility	The linking between elements in Smart Space is flexible.
	Link element toughness	The linkage of the elements on Smart Space is solid.
Coordination	The depth of coordination	The depth of coordination on the Smart Space is reassuring.
	Robustness of coordination	Smart Space provides robustness in terms of coordination.
Intelligence	Use of learning	Smart Space is easy to learn.
	Automation	Smart Space is automatic.
	Service to add activity	Smart Space provides services to involve several activities.
Scope	Spacious	Smart Space provides flexibility in the smart space.
	Enthusiastic participants	Smart Space makes the participants or users involved enthusiastic.
Smart Space Implementing Success	Creativity	Smart Space as a solution for the development of creativity
	Benefits	Smart Space is beneficial for all people
	Problem solves	Smart Space is the answer to all problems

We propose the Statements of the Questionnaire according to Table II, the development and addition of indicators will affect the reliability of the relationship between variables so that in the future it is hoped that there will be changes both from the results of the pre-test and pilot study. Measuring tools in the form of questionnaires can be used and distributed for Smart Space Implementing Success research [16-29], of course with different research objects and the results will be able to develop the Smart Space Implementing Success model that has been formed to be more perfect.

V. Conclusion

From the stages that the researchers did in reporting this research, it was concluded that the constructs, indicators, and their relationship in making alternative models for the Smart Space Implementing Success measurement have been understood. Likewise with the relationship between the constructs to produce a measuring tool in making alternative measurement models for Smart Space Implementing Success. The formation of this model is to produce a Smart Space Implementing Success measurement model consisting of six variables and 17 indicators and their measuring tools. This research contributes to making it easier for researchers in terms of providing input to Policymakers regarding Smart Space Implementing Success, participating in maintaining the sustainability of Smart Space Implementing Success, materials for other researchers in applying to different research objects, and developing the Smart Space Implementing Success model which then becomes a framework.

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P/V You have used the passive voice in this sentence. You may want to revise it using the active voice.

Article Error You may need to remove this article.

P/V You have used the passive voice in this sentence. You may want to revise it using the active voice.

Confused You have used either an imprecise word or an incorrect word.

Article Error You may need to use an article before this word. Consider using the article **the**.

PAGE 2

Missing "," Review the rules for using punctuation marks.

P/V You have used the passive voice in this sentence. You may want to revise it using the active voice.

Wrong Article You may have used the wrong article or pronoun. Proofread the sentence to make sure that the article or pronoun agrees with the word it describes.

P/V You have used the passive voice in this sentence. You may want to revise it using the active voice.

Article Error You may need to use an article before this word. Consider using the article **the**.

Article Error You may need to use an article before this word. Consider using the article **the**.

Wrong Form You may have used the wrong form of this word.

Article Error You may need to remove this article.

Sp. This word is misspelled. Use a dictionary or spellchecker when you proofread your work.

Prep. You may be using the wrong preposition.

Prep. You may be using the wrong preposition.

Frag. This sentence may be a fragment or may have incorrect punctuation. Proofread the sentence to be sure that it has correct punctuation and that it has an independent clause with a complete subject and predicate.

Article Error You may need to remove this article.

Dup. Did you mean to repeat this word?

Article Error You may need to use an article before this word. Consider using the article **a**.

Sp. This word is misspelled. Use a dictionary or spellchecker when you proofread your work.

PAGE 3

Coord. Conjunction Review the rules for combining sentences.

Confused You have used either an imprecise word or an incorrect word.

Coord. Conjunction Review the rules for combining sentences.

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Missing "," Review the rules for using punctuation marks.

Missing "," Review the rules for using punctuation marks.

Article Error You may need to remove this article.

Article Error You may need to use an article before this word. Consider using the article **the**.

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Article Error You may need to remove this article.

Coord. Conjunction Review the rules for combining sentences.

PAGE 4

Missing "," Review the rules for using punctuation marks.

Article Error You may need to remove this article.

Missing "," Review the rules for using punctuation marks.

Article Error You may need to use an article before this word.

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