*International Journal of Engineering & Technology*, 7 (4.33) (2018) 37-40

International Journal of Engineering & Technology

*Website: www.sciencepubco.com/index.php/IJET*

***Research paper***

# Evaluation of "Instantiation" for Cultural Heritage Information System

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**Abstract**

This paper presents the evaluation of "Instantiation" for cultural heritage information system. Within social-technical concerned, the soft design science was used as an approach to create "Instantiation" as IT artifacts. The evaluation of "Instantiation" was performed based on the "functionalities characteristic" evaluation criteria. Explanation on how the verification study was conducted to evaluate constructed instantiation according to five sub-characteristics of "functionality" named as accuracy, suitability, interoperability, security, and functionality compliance is also presented. Finally, this paper concludes the results of applying information quality by highlighting the feedback that shows the "Instantiation" created has been accepted among the museum and cultural heritage community.

***Keywords***: *Soft design science methodology; IT artifacts evaluation; Community based e-museum; Sustainable cultural heritage information system.*

## 1. Introduction

Information systems (IS) are implemented within an organization for improving the effectiveness and efficiency of the organization. Indeed, there has been an extensive discussion conducted by [1] on acquiring information system knowledge which involves the behavioral science and design science paradigm. Both paradigms are perceived as foundational to the Information Systems discipline which can be positioned as the convergence of people, organizations and technology. To implement this convergence, in [2] highlighted that processes of design science research should connect to IT artifacts. Thus, IT artifacts are defined as "things that serve human purposes" [3] and the design of IT artifact [1] is commonly associated with the process steps of artifact creation and artifact evaluation. In [4] summarized the processes based on their synthesized results from design science and information systems experts [1-2, 5-8]. Their papers mentioned that the core process element of design science across disciplines for IS includes problem identification and motivation, suggestion, design and development, and evaluation. As for our research, these process elements are referred as our basis to correspond to the refinement of soft design science research methodology. Within the soft design science process, the concept of community based e-museum is created to represent the socio-technical views that include the convergence of people, organizations and technology.
Many experts mentioned that the evaluation is a primary concerned with evaluation of design science output [9, 3]. Essentially, IT artifacts resulting from our research include constructs, methods, models and instantiations of community based e-museum framework. Among all IT artifact created, this paper presents the evaluation of "Instantiation" IT artifacts. These IT artifacts will then contribute to the development of cultural heritage information system for museums. The evaluation of "Instantiation" was performed according to evaluation criteria in terms of functionalities of valid online digital artifact workflow instantiation as part of community based e-museum framework. Based on the verification study, this paper concludes with the evaluation feedback that shows the "Instantiation" created has been agreed among the museum and cultural heritage community.

## 2. Research Background

### 2.1. Descriptions of Evaluation

The evaluation activities of this research refer to the evaluation criteria suggested by IT artifact evaluation framework proposed by [10]. The framework consists of two dimensions, the IT artifact (A) and the evaluation element (E). For IT artifact dimension, in [10] follows the four artifacts in IS research: constructs, methods, models and instantiation suggested by [1, 3]. For the evaluation element dimension, in [10] addresses the question of what aspects of IT artifacts quality assessment should be considered. He refers to structure of the artifact, evaluation criteria and the evaluation approach/procedure. Taking into consideration of these two dimensions, we applied the IT artifact evaluation framework as a significant evaluation element in soft design science research.
In [10] concerned with approaches and procedures for evaluating conceptual model using ontology-based approach. For our research, we focus on the "Method" and "Instantiation" as IT artifacts in soft design science research. Findings related to "Methods" has been discussed in [11], while this paper report findings related to "Instantiation" Evaluation.
Other than [10], we also refer to [18, 12-13, 20] to assess the quality of the artifact for a systematic evaluation process and interpretations of soft design science research artifact. In [18] mentioned that the variables and values that are subsequently relevant for the evaluation of design science research artifacts can partly be assigned to the IS discipline.

### 2.2. "Instantiation" as IT Artifacts

In executing the evaluation of "instantiation"; code inspections, testing, code analysis and verification are established through the evaluation techniques performed for facilitating high software quality [23]. For this research, "Instantiation" evaluation work refers to the evaluation criteria that are based on functionality and the evaluation approaches refers to verification method. To describe on the functionality, evaluation criteria details using FURPS model is referred. The FURPS model was introduced by [19] and this model consist of five quality characteristics including Functionality, Usability, Reliability, Performance and Supportability. The functionality characteristic has been defined as the capability of the software to provide functions which meet the stated and implied needs of users under specified conditions of usage [22]. To specify the functionality characteristics, our research used the 5 sub-characteristics namely; accuracy, suitability, interoperability, security, and functionality compliance to verify whether functionalities meet user requirements or not. To evaluate the instantiation of the valid online digital artifact workflow, the evaluation procedure was also prepared. Knowing that the verification is the process of checking, confirming, making sure, and being certain with the results, preparing the right evidence is important. Therefore, we also refer to the system requirements specification document (SRS) that defines functional requirements based on requirement study activities conducted.

## 3. Descriptions of "Instantiation" Evaluation

From the initial model produced from literature study, our research activities continue with empirical work performed within three phases named as awareness of the problem, suggestion of model, development and evaluation. Other than that, we also referred to activities suggested by other design science scholars [12, 20-22]. Each phase represents different research methods. Requirements were collected, analyzed and aligned until the specific requirements are met. Finally, the IT artifacts that represents construct, method, model and instantiation of a solution to problems related to community-based e-museum framework are produced. The community-based e-museum framework that is organized in five basic components named Community Participation, Application, Workflow, Verification tools and Content Repository is considered as our main deliverable. Fig. 1 shows components representing the instantiation of IT artifact for community-based e-museum framework. The framework is organized in five basic components denoted as community participation, application, workflow, verification tools and content repository. These components are evaluated based on the IT evaluation framework suggested by [18, 13, 4, 10]. However, to demonstrate the evaluation of "Instantiation" process, this paper merely concentrates on the evaluation criteria of functionalities for valid online digital artifact workflow component. Advocated by soft design science research [12] and functionalities evaluation criteria from FURPS model [19] we accumulated evidence using verification method to verify the design objectives satisfaction of the instantiation. Thus, the results provide us information to validate the community-based e-museum workflow components.

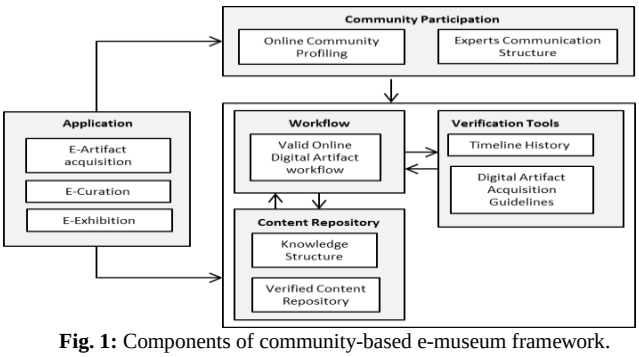


**Fig. 1:** Components of community-based e-museum framework.

### 3.1. Evaluation Methodology

The evaluation method for instantiation in this research concentrates on functionality using verification approach. Requirement specification of community-based e-museum workflow was verified by cultural heritage and museum experts using requirements walkthrough session. Functional requirements model and specification was used as the instrument to verify validity of the functionality. During the walkthrough session, use case diagram that represent system's functionalities was used as the main instrument for us to communicate with experts. We explain each function while experts refer to system requirement specification (SRS) document for reference during the walkthrough session. Other than that, prepared list of questions that refers to the functional sub characteristic was asked to the experts to verify successful and acceptable implementation of the community-based e-museum workflow functional requirements.

Resulting from empirical study, valid online digital artifact workflow describes processes that provide a solution to differentiate between authentic digital contents and the counterfeit. The acceptance of the cultural heritage digital content relies on the assigned validation committee from user profiling sub-component which consists of experts in museum and cultural heritage knowledge. Here, digital artifact uploaded by community is treated as a special and valuable item; therefore, the process for bringing it to the trusted repository of the community-based e-museum is controlled in a systematic manner. The acceptance of the cultural heritage digital content relies on several activities such as: (i) activate digital artifact validation workflow, (ii) assign digital artifact validation team structure, (iii) experts evaluate the digital artifact assigned, (iv) consider comments and dynamic story post from museum community, (v) notify experts and act for validation process. Requirement specification for valid online digital artifact workflow was identified using a qualitative information gathering methods. Expert interviews and document reviews were conducted before it was analyzed to provide requirement specification document. The experts' interview session was setup according to the two different perspectives.

The first session aimed to capture requirements related to collecting, managing museum artifacts from museum curators' and museum inventory officer perspective. The second session aimed to capture requirements of cultural heritage artifacts knowledge. Brief description that represent *evaluation method, evaluation objective, evaluation criteria, evaluation instrument, what is evaluated, how it is evaluated, when it is evaluated* and *who evaluated* of the evaluation procedure is presented in Table 1.

**Table 1:** Summary of evaluation procedure

| Evaluation Method | Evaluation Objective | Evaluation Criteria | Evaluation Instrument |
|---|---|---|---|
| Execute the acceptance from expert's verification | To perceive functionality based on 5 sub characteristics | Functionality | Requirements specification |
| What is evaluated? | How it is evaluated? | When it is evaluated? | Who evaluated? |
| Functionality of community-based e-museum workflow | Conduct a requirement walkthrough session with museum experts. Then, the result is mapped with triangulate for final functionalities list. | After requirement specification of valid online digital artifact workflow has been completed | Museum curators, Museum Inventory staff, Academician |

### 3.2. Verification of Instantiation from Expert Reviews

The museum experts reviewed valid online digital artifact workflow requirements during walkthrough session. Table 2 shows the list of requirements description that represents the summary of requirements specification document. To reassure the processes,

museum experts also refer to museum manuals and operation during the verification process. Feedback notes written by experts were kept for analysis purposes. Other than that, experts also check for museum operations functionality such as suitability, accurateness, interoperability, security and functional compliance characteristic.

**Table 2:** List of Requirements Description

| Actor | Use Case Name | Brief Descriptions |
|---|---|---|
| User | Manage profiles | User should be able to manage profiles |
| System Administrator | Accept user request | Admin should be able to verify user request |
| Contributor | Upload Content | Contributor should be able to fill up artifact registration form and upload digital image of artifacts |
| Contributor | Manage Content | Contributor should be able to manage content before submitting. |
| Experts Evaluation committee | Evaluate Digital Content | Evaluation committee should be able to validate artifact originality and uniqueness. |
| Experts Evaluation committee | Search Historical Evidence | Expert should be able to search for historical evidence |
| System Administrator | Notify Users | Admin should be able activate experts' selection & notification through emails, manage validation process & exhibition |
| Museum Inventory staff | Update Records | Inventory staff should be able to receive approval result and update records based on museum artifact classification |
| Museum Curator | Manage exhibition activities | Museum curator should be able to manage e-museum exhibition process. |
| Online Visitors | Navigate E-museum exhibition | Online user should be able to navigate e-museum exhibition |

In demonstrating the functionalities of community-based e-museum workflow, Unified Modeling Language (UML) diagram is used. Use Case Diagram shown in Figure 2 represents use cases explained in Table 2.

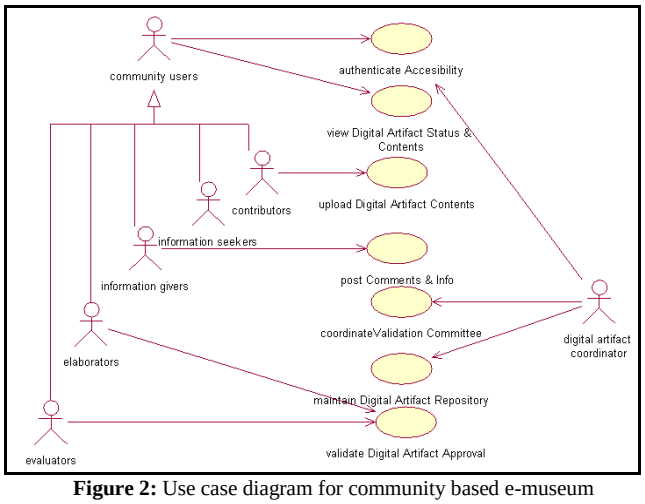


**Figure 2:** Use case diagram for community based e-museum

Based on the experts' reviews, the elements of functionality evaluation criteria were represented with an appropriate comments and suggestions for each function. The museum experts explained and summarized its general practices over the museums' operation environment. All feedbacks certainly to confirm on what kind of functionalities are used for and with whom the information of each functionalities may be shared. Finally, experts were asked questions that directly refer to each "functionality" sub-characteristic presented in Table 3. After consolidating results for suitability, accurateness, interoperability, security and functional compliance from all experts, the final results shows that the functionality evaluation of instantiation is considered as the necessity of verification in order to create a trusted digital artifact repository.

**Table 3:** Summary of the Evaluation Results based on Functionalty Characteristics

| | Sub-Characteristics | Descriptions | Results |
|---|---|---|---|
| Functional Characteristics | Accurateness | Do the functionalities described fulfill the museum operations procedure? | All 4 experts answered yes |
| | Interoperability | Does the constructed model associated to other museum systems | All 4 experts answered yes |
| | Security | Can the uploaded digital cultural heritage artifact be trusted? | 3 experts said that the percentage of trustworthiness is more that 70% if complete guidelines given to the evaluator, while 1 expert said that the percentage of trustworthiness is less than 50% |
| | Functional Compliance | Does the identified functional requirements follow to the Museum operation standards and regulations? | All 4 experts answered yes |

## 4. Conclusion

In summary, we can understand on how evaluation of instantiation based on identified characteristics and criteria that provide an organized evaluation process. Although this paper only focusses on the evaluation for valid online digital artifacts workflow component, the results of functionalities validity appears clearly for accurateness, interoperability, security and functional compliance sub-characteristics. As described, the evaluation results show that experts have accepted the functionalities of selected community-based e-museum component. As a conclusion, evaluation characteristics and criteria are essential when evaluating instantiation to ensure information system quality. Furthermore, we believed that any IT artifacts evaluation must be validated within wider group of stakeholders which requires relationships in different application domain and different purposeful perspectives for more dynamic validation.

## Acknowledgement

We would like to record our sincere thanks to the Faculty of Computer and Mathematical Science and Universiti Teknologi MARA for the financial support of this publication under the funding of 600-IRMI/DANA 5/3/LESTARI (0137/2016).

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