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Involving Domain Experts in the Construction of Specific Domain Ontology

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Abstract: Most works suggested the involvement of domain experts when handling and dealing with specific-domain knowledge. Therefore, the construction of ontology requires active participation from domain experts especially in preserving the authenticity of digital artifacts, or specifically in this study, the batik artifacts. In this study, two main components of ontology mainly structure and content were identified. For each component, an expert has been chosen to evaluate the ontology syntactically and semantically. Both experts were then being interviewed to gain their rich and contextualised insights. The results show that the participation from domain experts in the early stage of the construction leads to the development of ontology, in this case, Malaysian Batik Heritage Ontology (MBHO) with defined classes and properties. This stage is really crucial in ensuring the interpretation of cultural information can be done properly and accordingly. The developed ontology could later be used by others to further enhance Malaysian textile ontology.

Keywords: domain experts, ontology, batik artifacts

1 Introduction

The work to develop a standard ontology in a particular domain is very challenging effort. The standard ontology must provide comprehensive, rich and wide coverage of descriptions, terminologies and definitions of entities needed for reasoning and decision making. It normally involves tedious and laborious process which requires agreement by everyone involved in the development process. At the same time, the number of ontologies keeps increasing to cater for different group of users. Due to the existence of diverse ontologies in the same domain, it becomes common to integrate these ontologies together. However, the difficulty of finding and relating similarities between these different ontologies creates obstacles in ontology mapping.

This paper presents the role of domain experts in the mapping process between a local ontology known as Traditional Malay Textile (TMT) Knowledge Model and a standard ontology in the cultural heritage domain, CIDOC CRM. The size of this local ontology is considered small since it focuses only on one of the Malay textiles as compared to the standard ontology which covers and represents most of cultural artifacts. The reason is that the process of retrieving and collecting the artifacts of TMT is challenging and complex. Yet, preservation effort of TMT artifacts is very important in conserving the heritage value of the country. The process is time consuming and involves diversified resources. The process requires participation and agreement by many parties involved especially the experts. Furthermore, knowledge on TMT artifacts are scattered, isolated and owned by individuals, institutions or third parties.

This study relies on domain experts to assist in the development of cultural heritage ontology, specifically for TMT domain. Domain expert is the one who must have deep knowledge on the subjects which in this case on cultural knowledge. This study raised several issues that need careful consideration. The first challenge is to get the involvement of experts in the development of cultural

heritage ontology. The role of experts is very crucial in formalizing and conceptualizing the ontology. Their participation contributes directly to the construction of domain ontology in TMT. However, this process is claimed to be laborious, time-consuming and intellectually challenging. Another important challenge is the unavailability of experts in ontology development especially in the area of batik making. To get the right experts who can volunteer in the process is cumbersome.

The aim of this study is to identify the role of experts in the construction of ontology and determine the metadata pertaining to batik making process. The paper is organized as follows: the next section reviews the roles of domain experts in ontology construction. Section 3 discusses the possible scenario of expert's involvement in building the ontology. Chosen experts based on two main principles of ontology: structure and content are identified. Their assistance in the construction of Malaysian Batik Heritage Ontology (MBHO) is then presented in the following section. The final section provides a summary and conclusion of the work.

2 Related Work

Ontology mapping is seen as a key solution to the heterogeneity problem of ontology in the same domain. Many works discussed on how to carry out mapping that eventually falls into two directions namely manual and automation. Findings show that there exists a standard ontology in cultural heritage domain, CIDOC CRM which later used in this study as global ontology in the mapping. Most works in this field are done manually due to the wealth of cultural information that needs to be interpreted properly and accordingly. Manual process normally refers either human experts or upper level ontology in finding similarity between ontologies in the mapping process. The knowledge and expertise of experts in the field are much needed in the ontology construction. Kalfoglou & Schorlemmer [1] believes that "human users have to be domain experts, familiar with the underlying formalisms and technologies and definitely capable of spotting the subtle differences in the semantics of seemingly similar concepts".

Apart from that, involvement of the experts is crucial in the development of ontology such during acquisition [2], creation [3-4] and evaluation [5] process. Albeit, most of the ontologies being developed for specific domains require validation from the experts in the field. Manual mapping requires substantial efforts of experienced domain experts.

Often background knowledge is needed to infer the correct mapping which in this case can be obtained from existing upper ontology and expert knowledge. These approaches can therefore guarantee the semantic nature of the mappings. However, the process is intellectually demanding, time consuming and often constitute a large and tedious portion of the sharing process which leads to excruciating and laborious task [1]. Another issue to consider which is similar to the case of knowledge management is the issue of how to retain knowledge from being lost [6]. When handling cultural knowledge, the background knowledge is important to ensure semantic mapping and chances of data lost during the mapping process is almost zero.

3 Methodology

The approach used in this study is based on the case study carried out in developing MBHO [7]. There are two kinds of scenario that requires involvement of domain experts in the mapping process as follows:

Scenario A: Mapper is the domain expert

Scenario B: Mapper is not the domain expert

Rule:

If mapper \neq domain expert

Get the domain expert as reference

Else

Mapper can play the role of domain experts

The scenario highlights the importance of domain experts and his roles in the mapping process. The involvement of experts in the mapping process is specifically in the acquisition stage. In this stage, the local ontology is transformed into compatible form of global ontology. The process requires the ontology expert to confirm the structure on one hand and the batik expert to verify the semantic of the modified local ontology on the other. After mapping it to the global ontology, the mapped ontology is then validated again by the ontology expert. Figure 1 summarized the involvement of the experts in the process. The steps illustrated are the activities performed manually for cultural heritage ontology development where the role of both experts is shown.

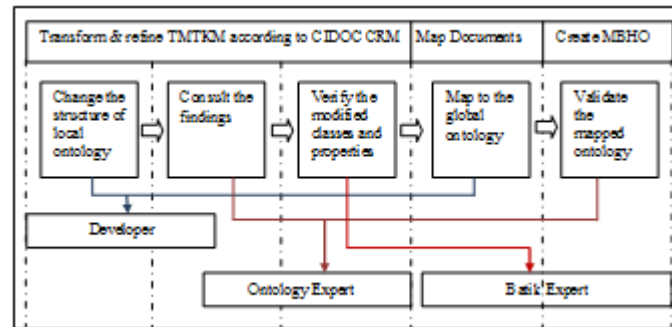


Figure 1: Role of Experts in the Mapping Process

4 Results and Findings

In this study, two experts have been chosen to evaluate the ontology syntactically (structure) and semantically (semantic). Their involvements are described as follows:

A *Ontology Expert*

In terms of structure, the individual chosen for this task is Martin Doerr, the senior researcher in Institute of Computer Science, Foundation for Research and Technology – Hellas (ICS/FORTH), Greece. He has been involved in most of the harmonization projects involving CIDOC CRM and his suggestions and recommendations are the valuable asset for this study.

The discussion on ontology construction is done through email with Martin Doerr before an interview is arranged to finalize the findings. According to Martin Doerr, this task is intellectual demanding due to the specification of CIDOC CRM. The comments made by the expert assists in revising the TMT Knowledge Model from one structure (taxonomy) into another structure (ontology). Each of the concepts and properties defined are validated by Martin Doerr. However, he suggested that the meaning of the concepts especially should be verified by the batik expert himself. This brings to the next expert chosen for the research as explained in the following section. The guidelines given by the expert in developing the ontology which include the role of experts are summarized as follow:

1. Define the classes. Make sure the classes defined are well distinguished. Do not need to describe more because the process is expensive.
2. Identify the relationship by associating the relevant parameters, the features which allows for throwing the conclusions/inferences.
3. Each class must have identity criteria with well-defined substance and instance of the class. When does it come into existence? When does it go out of existence?
4. Test the behavior of the concepts. If the properties are too contradicting, split the concept into two.

5. Validate the classes by the experts.

In particular, this research uses advice from Martin Doerr through two phases of validation. His extensive knowledge in building ontology helped solve the problem of ontology mapping from local to global ontology. In the first phase, the consultation carried out repeatedly in the production of local ontology to ensure consistent results (see Figure 2). In the second phase, the assistance of Martin Doerr once again needed in confirming the final ontology, MBHO which is the result of ontology mapping of local to the global ontology as shown in Figure 3. At this stage, face to face interview is conducted to clarify the ontology to ensure that all classes and properties are reviewed comprehensively.

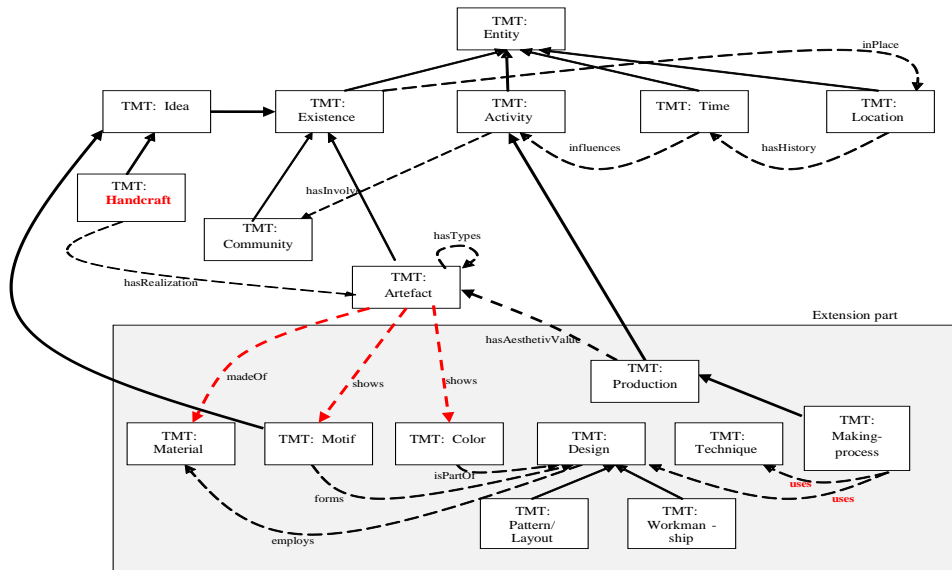


Figure 2: First Phase of Validation - Revised TMT Knowledge Model

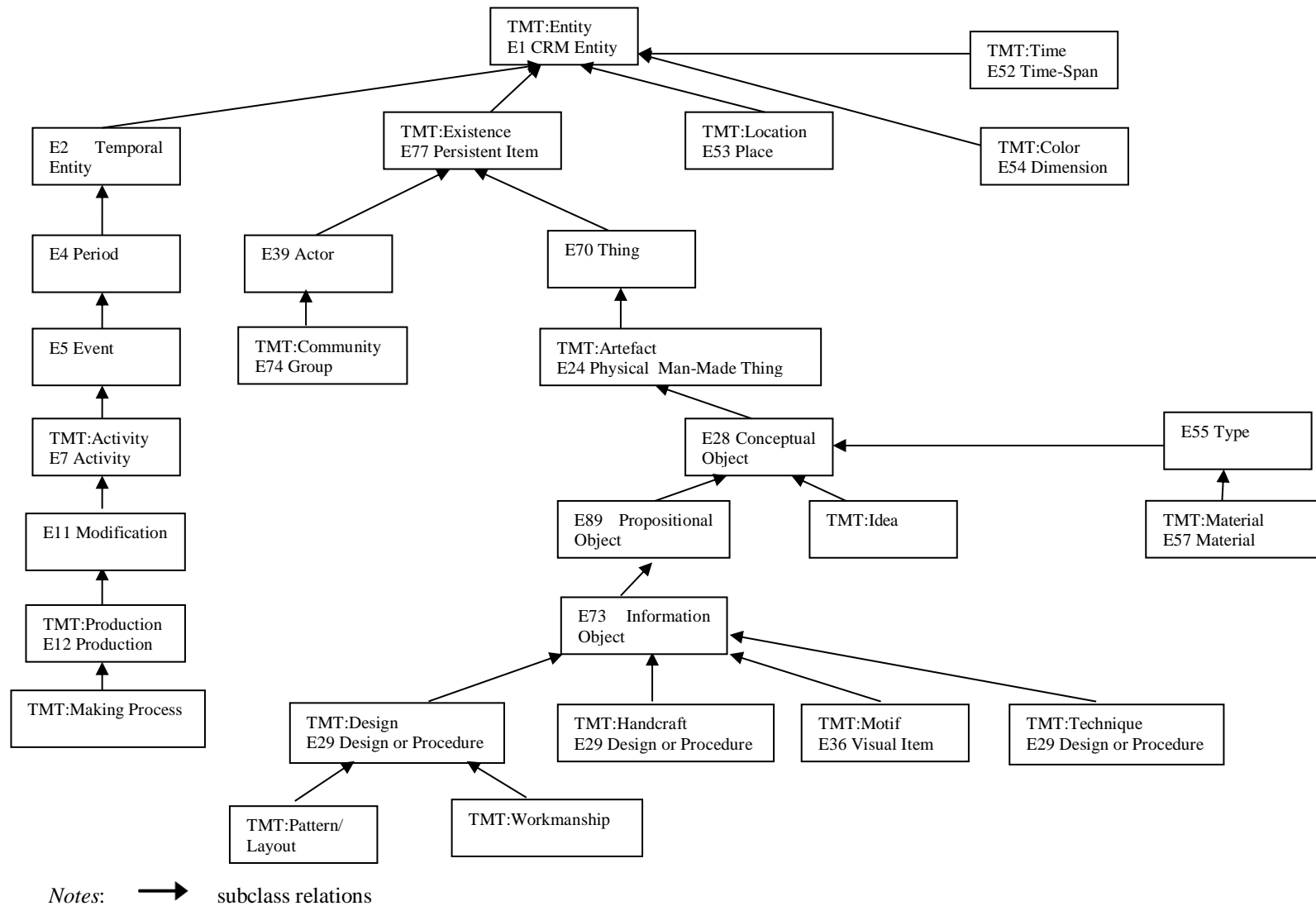


Figure 2: Second Phase of Validation - MBHO

B Batik Expert

In term of content, a senior lecturer from Faculty of Art & Design, Universiti Teknologi MARA, Shah Alam, Encik Danuri Sakijan has collaborated in helping to define concepts related to batik making. He was chosen because his invaluable expertise and vast knowledge in batik design could help realize the aim of digitizing the batik artifacts through the development of local ontology. His experience and expertise help to clarify many aspects of batik including the origins, making process, techniques, design and also the current trends in Malaysia. His involvement gave clear indications towards the meaning of the batik related information and indirectly helps to build the local ontology.

Several series of discussion are arranged which focused on the classes and properties of Revised TMT Knowledge Model by defining and revising the meanings of terms. The chosen expert does not have any knowledge on ontology. During the sessions, the chosen expert is asked with methodology questions to identify the behavior of each class and property. In other words, the batik expert is needed in confirming the description of content for all classes and properties of local ontology. His active participation helped in developing the important part of ontology construction. Thus, all the classes in the model were given a name and an identifier consists of the word TMT which is constructed according to the conventions used in the CIDOC CRM model. As a result, a number of classes to represent TMT knowledge are created and part of them is shown in Table 1.

Table 1: Part of Classes Definition

No.	Class	Subclass of	Superclass of	Description	Examples
1	TMT: Entity	TMT: Existence, TMT: Activity, TMT: Time, TMT: Location		This primitive category comprises all thing related to Revised TMT Reference Model.	
2	TMT: Idea	TMT: Existence	TMT: Handcraft	This class comprises non-material products of minds and information produced by humans. Instances of this class are created, invented or thought by someone and then may be communicated or documented between persons. They cannot be destroyed as long as they exist in the memory. It is used to express the notion of Handcraft which exists through sensible way such as when it is told, demonstrated and shown in some way.	a) The knowledge about using 'block' to make Batik. b) The Batik-motif inspired by elements of surrounding.
3	TMT: Existence	TMT: Entity	TMT: Community, TMT: Artifact	The Existence is similar to entity Persistent Item (E77) which stands in contrast to the Idea category. This class comprises artifacts that have a persistent identity. It expresses tangible cultural heritage which refers to something that remains intact to see, hold and is movable and normally preserved in its original form. TMT expresses this notion through the in Place that associates Existence with Location.	a) Batik Kelantan b) Batik Pekalongan Indonesia
4	TMT: Activity	TMT: Entity		The Activity is equivalent to entity Activity (E7) which involves Community in the context of Production. This class comprises actions carried out by instances of TMT: Community that results in changes of Batik artifacts. This notion includes all related batik making actions such as the production of masterpiece or as well as simple actions such as the drawing of a Batik-motif. TMT expresses this notion through has Involve that associates Activity with Community.	a) Batik coloring process b) Batik canting process c) Design tracing.

5 Conclusion

In summary, the help of experts is much needed in the building ontology from scratch through mapping process. The active involvement of domain experts in the early stages of construction process is needed and still required until the end. For this research, individual interviews are conducted to gain rich and contextualised insights from both experts. Interview allows for more focused discussion and follow-up questions. This is important in the research to comprehend both aspects of ontology, namely structure and content. The findings could be adopted by others to extend the ontology to cover other types of Malaysian textiles.

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