

# SumutSiana: A Framework for Applying ICT to Preserve the Cultural Heritage of Sumatera Utara Indonesia

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**Abstract**—Preservation of cultural heritage is a task given by UNESCO charter. In the information age, this task becomes a challenge due to the high level of growth and rapid changes of ICT. Additionally, complex cultural heritage has been neglected because of the stream of information global and the high cost of the legal application of ICT. In this context, SumutSiana, has been proposed as an ICT-based preservation of heritage cultural of “Sumatera Utara”. It involves people, content, processes, management, budget, facilities and infrastructure, evaluation, and result as a resource. This was the basis of the proposed framework for developing information system for preserving the cultural heritage.

**Index Terms**—Batak; Sumatera Utara; Information and Communication Technology (ICT); DBMS, XML.

## I. INTRODUCTION

Cultural heritage is a hidden knowledge in a particular community [1], such as Batak alphabet from Sumatera Utara (North Sumatra) Indonesia (<http://www.omniglot.com/writing/batak.html>). The cultural heritage is taught in each generation. It may also be neglected little by little as time passes, which eventually will no longer be recognized by the people who came later, or lost swallowed by time [3]. However, at this time, dealing with cultural heritage becomes an integral part of almost every aspect of human life in order to build the interactions between one another [4], whether it is to know the national origin or to identify wisdom that may be used as an example (local wisdom) or learning for the next generation. Therefore, in an effort to protect cultural heritage in the information age, information technology (IT) can be served as the infrastructures or facilities to enable the cultural heritage to be studied, observed, recorded, preserved, assessed, explored and transmitted to the subsequent generations.

Information and Communication Technology (ICT) is not only important for the welfare of the community, but also more importantly to establish a tie between different generations [5] that are separated by time. Thus, the ties must be built by conducting the communication between generations through virtualization of cultural heritage. In the application of ICT (in system) that enables to conduct communication and interaction, the user is allowed to control what and when data or information to be delivered and retrieved. Through different communication technologies, the flow of data is captured, recorded,

processed, and presented from or to a system [6]. Meanwhile, to support and represent human activities such that there is a flow of information as a form of interaction between them, the processing and manipulation of data is required. The processing data or data manipulation does not only involve coding software, but organizing hardware. Therefore, there should be a woven of digital multimedia comprises a combination of several different elements as resource [7] that functions as an information system. The problem in the existing application or the appropriateness of the current situation, either the availability of technology or related to social and natural constraints.

## II. METHODOLOGY

In this paper, we first defined Sumut-Siana, reviewed some of papers related to the cultural heritage and ICT, and then proposed a conceptual framework.

### A. Related Work

The culture of every tribe is distinctive to the individual tribe. Thus, cultural heritage is treated as such by any person and every nation. Indonesia consists of many tribes and provinces. Sumatera Utara (North Sumatra, <http://www.sumutprov.go.id/>), abbreviated as Sumut, is one of the provinces of Indonesia. It has an area of 72.981.23 km<sup>2</sup>, with more than 13.5 million inhabitants. Its area stretches across the Sumatra Island between the Indian Ocean and the Strait of Malacca. It is at the border of Aceh province on the Northwest and Riau and West Sumatra provinces in the Southeast. Medan is the capital city of Sumut. In the south and west, the land rises to the mountain range that runs the length of Sumatra. Many of the mountains are dominated by Toba Lake, formed from the caldera of an ancient volcano. Sumut has 419 islands, with several large islands in the Indian Ocean off the west coast of Sumatra, i.e. Nias Islands and the Batu Islands ([http://en.wikipedia.org/wiki/North\\_Sumatra](http://en.wikipedia.org/wiki/North_Sumatra)).

The term Sumut, in this case, is referred to an area on Sumatra Island that has its own cultural heritage, while the term “Siana” means treasure/treasury or scientific wealth. Thus, the combination of two words, “Su-mut” and “Siana” creates a terminology of “SumutSiana” [8], refers especially to the treasury of Sumatera Utara, which is owned as cultural or natural wealth that exists in that provincial. Therefore, SumutSiana implicates the regional assets consisting of 8 indigenous tribes (Mela-yu, Mandailing,

Toba, Karo, Angkola, Simalungun, Pakpak, and Nias) or something unique (does not exist elsewhere) [9]. The cultural heritage is manipulated digitally as a combination of text, photography, graphics, sound, animation, and video over the function and use of ICT as a product of the development of current culture [10]. SumutSiana as a framework helps in selecting and enclosing the ICT in order to preserve the cultural heritage of Sumatera Utara. It serves not only to deliver to all stakeholders to always open their eyes toward the wealth of scientific and the cultural heritage in Sumatera Utara, but also to mobilize resources so that cultural heritage can be explored legally. Therefore, all community members can participate in the management of the resources either tangible or intangible of the cultural heritage.

The relationship between cultural heritage and information technology has been discussed at the International Cultural Heritage Informatics Meeting (ICHIM), which ran from 1991 to 2007, (<http://www.archimuse.com/conferences/conferences/ichim.html>). Table 1 shows the themes of the conference from 1991 to 2007 that relate to the relationship of ICT with the cultural heritage. Although the annual meeting is no longer continued, discussion on the relationship between cultures and ICT continues to be disclosed in a variety of occasions. Thus, the research culture in this body of knowledge has already existed with several different frameworks to help the application of ICT for various obstacles. However, the work does not exactly meet the legal requirements of Indonesia. In this context, consideration of human capabilities, including intelligence, wisdom, policy, and social results are related to the application of technology, where technology is considered as a means of achieving prosperity.

Table 1  
ICHIM

Year	Venue	Theme & Description
1991	Pittsburgh, Pennsylvania	Hypermedia & Interactivity in Museums.
1993	Cambridge, England	Planning for Museum Automation Student Workbook. The profound technological, cultural and California and intellectual issues raised by the use of multimedia technologies to represent cultural heritage.
1995	San Diego, California	Issues of systems design and user interface.
1997	Paris, France	Interactive experience of the presentations and some technical features being describe.
1999	Washington, USA	Cultural heritage and technologies in the third millennium.
2001	Milan, Italy	Where culture, technology, heritage and communications network meet.
2003	Paris, France	Digitization of cultural heritage and on the emergence of new digital art and cultural forms.
2004	Berlin, Germany	Website & HTML5
2005	Paris	In memoriam: It dedicated to Xavier Perrot.
2007	Toronto, Canada	

The preservation of cultural heritage, especially those in a vulnerable position, does not only require resource management in the area [11, 12], but also the management of ICT as a resource that is used for the preservation [13]. In general, there are two directions of ICT engagement to address the challenges of managing cultural heritage [14].

Firstly, the relationship is related to the exploration of ICT to be used in the field of cultural heritage [15]. This is conducted by researchers in the field of ICT to stimulate other stakeholders in society to establish the multimedia database [7] as accentuation to the importance of everyone's role. In this regard, the work involved are processing the real time visualization [16], supporting to interactive process and learning [17], getting the ICT (as infrastructure) to increase the presentation (in the form of results) by using laser scan [18] and photogrammetry [19], and the involvement of mobile technology (as a support facility) [20] specially to increase the user engagement for collecting the cultural heritage (as the content of system) digitally [21]. Secondly, the relationships that relate to exploration of resource of digital cultural heritage [3] or multimedia content [6]. In this case, some researchers have revealed the involvement of the Semantic Web to disclose information of cultural heritage [22] or to search the cultural heritage in website [23], especially for evaluating the information retrieval, or access the multimedia for exchanging of information [5].

In the application of ICT to support the UNESCO charter [24], the researchers have presented the possibility of developing a collaborative working environment to preserve the cultural heritage into the teaching system, such as e-Learning [25], and the use of games [26] by introducing an avatar [27]. These are used to optimize resources, especially budget involved to preserve the cultural heritage. This is supported by the possibility of integrating ontology-based metadata in the domain of cultural heritage [28].

Thus, based on the literature review, there are things that need to be considered in establishing the system of cultural heritage preservation, namely people, content, processes, management, budget, facilities and infrastructure, evaluation, and results.

### B. Some of the Frameworks

Frameworks of preservating the cultural heritage have been proposed by researchers. Among them is a model that does not depend on the specification of devices [5]. However, there are also frameworks that have been proposed to include some factors, such as social characteristics, behavioral patterns, economic factors, technology, climate, and local materials [29]. Other than that, in the study of cultural heritage and implementation of ICT, researchers have proposed a model of managing the cultural heritage tourism [30, 31], a framework for effective accessing to multimedia data by involving an ontology [6], a framework for identifying and documenting the resources of cultural heritage [32], a framework for exploring the potential of cultural heritage in tourism [33] and the development of city as a living culture [34].

## III. A PROPOSED FRAMEWORK

SumutSiana, the framework for implementing ICT, is specially proposed to preserve the cultural heritage of Sumatera Utara Indonesia. Its implementation is subject to the culture itself as a key. The framework that includes the following items: executor (stake-holder), content, processes, management, budget, facilities and infrastructure, test and evaluation, and result or product. This framework describes the relationship between ICT and the resources of the

cultural heritage. Thus, it is possible to apply ICT to build a system capable of preserving the cultural heritage.

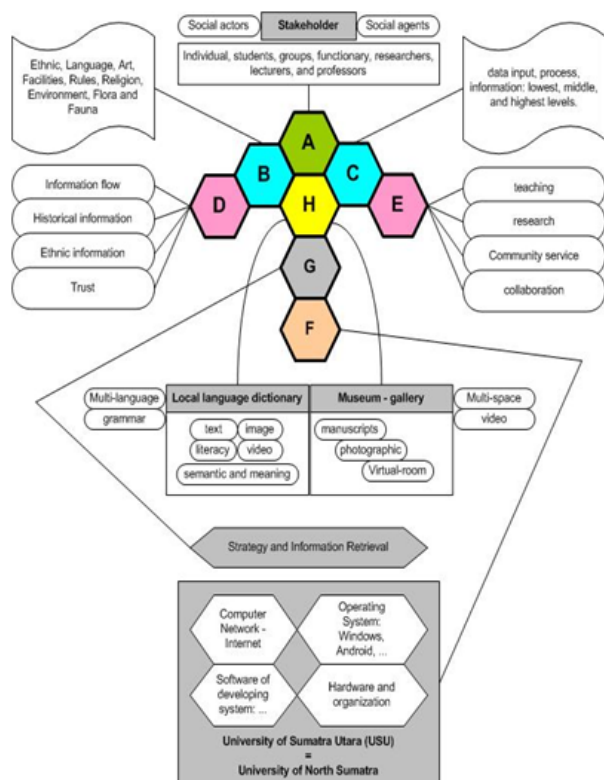


Figure 1: A framework of ICT implementation

In this framework, everyone involved is expected to master the methodology of ICT applications in accordance with the areas of expertise, type of activity, complexity, and depth of the target activity. While the content is based on the depth and breadth of material derived from the research and development of cultural heritage evidence. Thus, the goal of this framework is to evaluate problems existing in a society with regard to cultural heritage by utilizing appropriate technology (mainly ICT), in which cultural heritage is made possible as the material of science and technology development or enriching learning resources. In particular, the framework of the implementation of ICT involves a standard process: planning, execution and reporting, taking into account the quality and trust. Moreover, the framework is intended to meet minimally the educational principle, objective, accountable, and transparent. In other words, the ICT implementation considers the suitability between the results, contents and process research. Specifically, it takes into consideration the level of satisfaction of the people, the change of attitudes, knowledge and skills, ability to solve problems, the creation and innovation.

#### A. Eight Components

The implementation of ICT that comprises 8 hexagons, as shown in Figure 1 is described below.

##### a. Stakeholder

Executors are those who become stakeholders or social actors [35], either authors or receivers, either individually or in groups, both of which become members of the ethnic communities directly or not, but more importantly, they are able to use ICT. Therefore, the flow of data or information about cultural heritage supplied and collected by the

stakeholders voluntarily on various occasions, involves ICT. Most of data are placed specifically to be processed or filtered based on the Law on the Electronic Transactions and Internet in Indonesia [36] and the data are recognized as a raw input. Stakeholders can be categorized as follows: (a) Individual, a community member; (b) Students of higher education; (c) Groups of community members; (d) Functionary of the royal or the custom; (e) Researchers of any institution; (f) Lecturer of any college; and (g) Professor of any university.

##### b. Content

SumutSiana contents namely all records of cultural heritage or the unique results drawn from new developments, in which the contents are originally from Sumatera Utara. Therefore, the cultural heritage (tangible or intangible) of Sumatera Utara includes the following content: (a) Actors or agents of history, it includes kinship and ethnic development; (b) Local language, it includes narrative, script, and lettering: symbols and characters, dialects and oral traditions; (c) Art: it includes voice, dance, sculpture, fine, martial, crafts, clothing, food, music and musical instruments; (d) Traditional houses, transportation, lighting and irrigation; (e) Customs, which includes the legal, ethical and social order; (f) Religion, including ordinances, acts of worship and houses of worship; (g) Environment from where the culture has grown; and (h) Flora and fauna, which includes plants and animals originated (there is) from Sumatera only.

Obviously, collecting the cultural heritage is done with the available ICT capabilities, and it is easily gathered by the executors, and SumutSiana customized ICT to serve the executor and keep records of cultural heritage perfectly. The contents are recorded into an information system (SumutSiana) as the first step to maintain the cultural heritage by way of involving one or more types of multimedia, accumulated in layers in accordance with the trust level of information. The first layer contains information about the inherited culture discussed in blogs; the second layer is dedicated for records of evidence, such as photographs, manuscripts, and notes that can be saved as official documents that must be protected; while the third layer contains papers of research reports. Thus, SumutSiana consists of three layers: Blog and Discussion; Gallery, Repository and Database; and Journal or Research Reports.

##### c. Processing

Processing converts the raw input into a meaningful form. The level of meaning is carried out in accordance with the level of confidence of the information presented. The highest level is the meaning of scientific papers presented in the journal of cultural heritage, which is provided as part of the system. The lowest level is the meaning derived from the blog of cultural heritage that is provided as part of the system. Therefore, in addition to research on cultural heritage carried out continuously, the information is collected and processed through data mining, semantic technology or knowledge technology.

##### d. Management

The management of cultural heritage is organized through the application of ICT with the main objective to preserve cultural heritage. The cultural heritage is one of fields that has been, is and will be the focus of research. It is expected

that technological developments will increasingly be able to support the transaction of information on cultural heritage, mainly in Information Systems (IS) specifically developed to manage and organize communication among stakeholders. For this purpose, IS should encompass: (a) Information flows to/from the system in the forms of texts, graphics, audio, and video; (b) Historical information is recorded into and out of the system presented in the forms of manuscripts, paintings, drawings, narratives, investigative reports; (c) The information collected is not only associated with a particular object, but it includes the cultural environment (place), the history of characters or actors, descent and family as well as the possibility of the formation of ethnic (tribal) intended; (d) Information that is mined and researched should be recorded into the system in the forms of scientific papers, imagery, dialogue, and journey.

#### *e. Cost of programs*

IS of SumutSiana has been gradually built and developed based on resources that fulfill the function of collecting, processing, and presenting the cultural heritage. It is also supported by academics on campus such as the students, the lecturers and the researchers through the triplet of activities i.e. teaching, research and community services. Three last phrases are a triplet that has been recognized as “Tri Dharma Perguruan Tinggi” and has become the duty of every college in Indonesia.

In order to maintain its continuity in performing its duties, supported by the activities of triplet at the university, the budget for this program supports all the activities mainly related to the data management and the server, or the use of ICT. In this case, the cost of developing and managing the work programs is based on the cooperation with the local governments and the stakeholders in Sumatera Utara voluntarily [37].

#### *f. Facilities and infrastructures*

SumutSiana as IS is placed in a network server that is accompanied with adequate storage space and connected to Internet globally. Obviously, this system is located in the higher education institution located in Sumatera Utara, namely the University of Sumatera Utara (USU). This information system has some facilities for delivering and retrieving information relating to cultural heritage. In this case, IS is developed gradually in accordance with the needs and interests based on the principle of the development of information systems. Hence, the conveniences provided include the operating system platform that supports the devices in the field work and in the office such as, Windows desktop, the Mac desktop, Windows Phone 8, iPhone, iPad, iPod touch, and Android. In addition, the flow of information can be obtained from ICT devices including cameras, scanners, and video, as well as a computer connected to the network. The information system is equipped with a file system and database. Therefore, in addition to being equipped with a Database Management System (DBMS), IS possesses a repository for storing information or documents. IS also accompanied the implementation of XML to support the database and repository to provide better facilities.

SumutSiana as a virtual museum is not just a regular IS. It is expected to be E-SumutSiana based on its features to deliver a museum facilities that demonstrate the cultural richness to the stakeholders. Furthermore, by applying cloud

computing technology, E-SumutSiana can be enhanced to be M-SumutSiana, a system that brings all mobile facilities to users so as to reach difficult areas as time goes by.

#### *g. Test and evaluation*

The development of IS as SumutSiana, E-SumutSiana, or M-SumutSiana is to describe the level of testing and the presence of feedback. When a new software system is completed, it is very important to evaluate it to ensure that it meets the user's original specifications and is at a satisfactory level in all respects [38]. Likewise, when the methods for collecting, processing, and presenting are implemented in the SumutSiana, the evaluation is done to maintain the level of truth and the trustworthiness of information presented by the SumutSiana, mainly when it involves the strategies of information retrieval [39].

#### *h. Result or product*

Recognized as the unique area, Sumatera Utara consists of a variety of its own regional language dialects. The regional languages are the languages spoken in the region, other than the national language itself (“Bahasa Indonesia”), whether it is in a small area, a state/district, or a wider area. The language is written in the text, perhaps with the letters original characters (e.g. Batak characters), Arabic script or Latin script, also expressed in the national or international languages, while the oral presentation with a particular dialect and may be explained through pictures. As a system of writing, literacy is a visual symbol that is stamped on paper or other media, to express expressive elements in a language. The writing is the result of activities in creating records or information on a medium by using a script, and is generally expressed in the form of manuscripts written in a certain media such as a rock or any media, like papyrus, tree bark or bamboo. Therefore, SumutSiana is equipped with digital multi-language dictionary involving database management system and repository system (file) for other data. In addition, the grammar of local language will become an integral part of SumutSiana consisting of all literatures about treasures of Sumatera Utara and the presence of every ethnicity as examples for cases of regional languages. Further the local language dictionary based on semantic derived from several studies is developed at a later stage of IS development.

In different presentations, cultural heritage like painting, sculpture, or inscribed stone, are recorded in the form of two-dimensional as digital images or video. These presentations involve a variety of ICT equipment. Such heritage is the historical evidence about the reality of certain culture. Therefore, it must be structured such that it illustrates the course of history. Display showrooms should look like the actual room in a museum, by involving the augmented reality. In addition, the historical evidence of activities or a specific event is obtained from the possibility of the presence of pictures in black-white saved by members of ethnic communities as a proof of existence of a particular ethnic. In addition to digitizing the existing manuscripts, this heritage can also be expressed in narrative or investigative report.

#### *B. An Approach*

Obviously the implementation of this framework is by developing an IS (E-SumutSiana and then M-SumutSiana)

as a facility (with infrastructures of ICT) to preserve the cultural heritage by adjusting the needs related to eight components: people, content, processes, management, budget, facilities and infrastructure, evaluation, and results. Further, the architecture of IS based on the pattern of letters (A-H) listed in Figure 1 can be used to cope with the changes and demands for continuous development of the cultural heritage of Sumut.

#### IV. CONCLUSION

The framework for preserving cultural heritage for the area of Sumatera Utara Indonesia were coined by the name of SumutSiana, which involves the application of ICT based on several studies of literatures. A framework has been formulated related to resources such as executor (stakeholder), content, processes, management, budget, facilities and infrastructure, test and evaluation, and result or product. The future work is to examine the resources one by one and implement it into an information system.

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