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# The 5R adaptation framework for cultural heritage management information system of the Dayak tribe Borneo

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**Abstract.** The Dayak tribe Borneo is divided into 405 sub-tribes which are formed based on clumps, habitats and their origins, despite being Dayak ethnic groups, but each has a wealth of cultural heritage and local wisdom that is diverse and different according to the nature they live in. This paper proposes a framework for cultural heritage management information system of The Dayak Tribe Borneo. The development method approach refers to the 5R Adaptation Framework concept; Right Time (timing), Right Location (location), Right Device (device), Right Learner (user), and The Right Contents (cultural information). The development results have provided a framework called "e-Dayaknese", a framework that integrates information content: location, time, devices, users, and content (cultural heritage information of the Borneo Dayak tribe referring to the UNESCO cultural heritage domain).

## 1. Introduction

Cultural diversity in Indonesia is one of the points of pride of cultural heritage handed down from generation to generation by various tribes and ethnicities. This is a wealth that cannot be underestimated because culture can be created from cultural backgrounds that exist in the community. Culture can be inherited if it is learned and socialized well to the community, whether it is directly related to the culture or the community outside the local culture. Inheriting and decreasing culture to the younger generation is very important because they will deliver to the next generation. What will happen if one day our culture is destroyed? Diverse culture just disappeared? So that it becomes a nation without identity. Indonesia is a country that has a variety of arts and cultures. In preserving culture, society participation already should be developed and not only rely on the government. The young generation who are still aware and understand the rich culture should have made various efforts to inherit to the recipient generation. Indonesian cultural diversity is a priceless wealth, therefore all components of the nation are obliged to preserve and utilize the culture for the nation's prosperity, especially to show the existence of the Indonesian nation amid the current of globalization and modernization which has swept across the Indonesian archipelago.

Efforts to develop Indonesian culture are a very important mandate of the nation's and state's ancestors and founding fathers, as reflected in Article 32 of the 1945 Constitution [1], [2], that 1) advancing Indonesian national culture amid world civilization by guaranteeing people's freedom in



maintaining and develop cultural values. 2) The state respects and maintains regional languages as national cultural wealth. On the basis of these regulations derivative regulations on culture have been made in the form of laws and regulations from the central to regional levels. With the enactment of various regulations, cultural and national preservation and development have been carried out nationally and locally so that the benefits are felt by all components, but in the development process it seems done partially and unsustainably so that the threat of cultural degradation has occurred and is occurring throughout the archipelago due to the wave of globalization and modernization.

On the other hand, globalization and modernization provide opportunities for Indonesian people to manage and utilize cultural resources based on information and communication technology (ICT). The benefits of ICTs enable effectiveness and efficiency in the management, storage and dissemination of information about cultural resources. Concern for the preservation of Indonesian tribal culture has not been too visible compared to other countries, for example in Europe since the 1990s began to electronic the elements of culture since then the term e-Culture (Electronic Culture) was popularized. The term e-Culture is related to the management, documentation, dissemination of information and knowledge about elements of electronic or internet-based culture [3].

The development of e-Culture is a must for the entire component of the Indonesian people to save, preserve and utilize cultural resources by utilizing the opportunities for advancing information technology that is increasingly sophisticated over time.

One of the efforts made in the development of local culture-based e-Culture, as was done in this study, by highlighting the topic of the development of the Culture Heritage Knowledge Management Information System Framework for Digital Literation of Dayak Tribe Borneo.

Dayak is a term for the native inhabitants of the island of Borneo [4]. The island of Borneo is divided according to the administrative region which regulates its territory, each consisting of: East Kalimantan, the capital of Samarinda, South Kalimantan with its capital Banjarmasin, Central Kalimantan, the capital of Palangka Raya, and West Kalimantan, Pontianak, North Kalimantan, the capital of Tanjung Selor. The Dayak tribe, divided into 405 sub-tribes [5], [6]. Each Dayak sub-tribe has similar customs and cultures, in accordance with its social, customs, culture, and language that are typical of each sub-tribe, both Dayaks in Indonesia and Dayaks in Sabah and Sarawak Malaysia. They call themselves by groups originating from an area based on river names, hero names, natural names and so on.

For this reason, the title selection is based on the degradation of the Indonesian Dayak culture which is quite alarming, both tangible (physical) and Intangible (in human memory). Especially the degeneration of the culture of the sub-tribes in Kalimantan which is increasingly on the verge of extinction. Incessant development every time more and more developed, both social, political, economic, education, and health aspects were increasingly advanced, but on the other hand, tribal culture was increasingly integrated. The noble and sacred cultural values possessed by the Dayak indigenous community that were inherited and brought to life by the ancestors gradually changed with the development of science and information technology. The impact also influences the behavior of Dayak people today, so that culture which is self-esteem and identity is now increasingly abandoned and begins to follow outside cultures that are synonymous with westernization.

Knowledge management as exploitation and development of the knowledge assets of an organization with a view to furthering the knowledge objectives [7]. The aim of knowledge management is to improve organizational performance by explicitly designing and implementing tools, processes, systems, structures and cultures to improve the creation, sharing and use of various types of knowledge that are very important for decision making. In this context, we can see the Borneo Dayak tribe cultural heritage as an organization. Management systems are increasingly important and many of them make significant information technology investments in implementing knowledge management systems.

The Knowledge Management Systems as a tool for influencing knowledge management and manifested in various implementations, including data storage and document repositories connected to search engines to support documented capture, storage, digital retrieval and organizational knowledge distribution explicitly. In a digital device and cultural heritage can be framed well in traditional

knowledge management systems as informal learning tools in supporting cultural digital literacy to build national character.

## 2. Background and related work

The development of the digital world (modern globalization) raises two opposing sides in relation to cultural digital literacy. The development of digital technology and access to information have challenges and opportunities. One concern that arises is the tendency that leads to waning the value of cultural preservation. Cultural globalization is so rapid by strengthening and developing national cultural identity. Rebuilding cultural values (revitalization) through the role and influence of technological and communication developments by exploring the local wisdom through digital-based information, promotion and traditional knowledge information approach [8].

The management of information about cultural heritage is a complex process [9], methods, techniques and technology, cultural diversity, file form and format, properties, data classification and resources, database integration, accessibility, knowledge exchange, and other processes. In the [9] study, it has proposed a framework, which is named e-Cultural Heritage and Natural History (e-CHNH) in the public and non-public domains using the Zachman architecture framework [10], which is integrated into an e-CHNH portal [11]. Furthermore, the classification of the cultural heritage, according to the Indonesian Archipelago Culture Initiative (IACI) organization [12], classifies in 15 categories, i.e. Musical instruments, Folklore, Beverage foods, Cloth motives, Music and songs, Ancient manuscripts and historical inscriptions, Ornaments, Traditional clothing, Traditional games, Architectural products, Rituals, Performing arts, Traditional weapons and tools of warfare, Dance, and Medical treatment and maintenance [12].

Nowadays, the question is not if the information, data, and documents about cultural heritage should be digitized, but how should be thinking in content development, release or showing; data visualization, accessibility and knowledge exchange, and others. Not just information. In building a knowledge-based traditional knowledge information system framework, we refer to the 5R Adaptation framework concept architecture: concepts, systems, and learning scenario [13], [14]. The basic concept of the proposed framework for an adaptive cultural heritage management information system and application. This framework enriches the traditional knowledge management information system that integrates learning context information including users, locations, devices, and information content into the adaptation process. In this study, a prototype of a cultural heritage application is able presented to demonstrate the use of a framework that offers insight into how 5R adaptation features, and the e-CHNH framework with cultural content based on 15 IACI classification categories in complementing the traditional heritage cultural pedagogy.

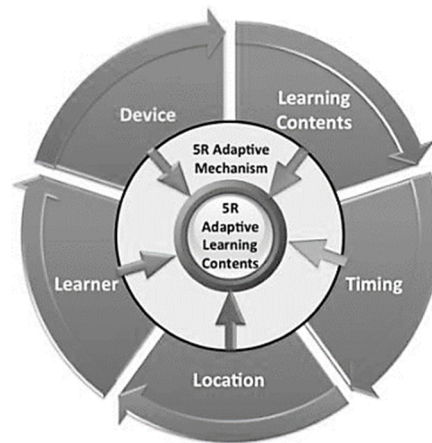
The case study used as an object is the culture of the Dayak tribe Borneo. The Dayak tribe is a native of the island of Borneo, has many sub-tribes with widespread population and distinctive cultures that inhabit four countries on land and in the Borneo archipelago. i.e. the Dayak sub-tribe inhabiting the Indonesian mainland of Kalimantan, the Dayak sub-tribe on the mainland Sabah and Sarawak Malaysia, the Dayak sub-tribe in Brunei, and the Dayak sub-tribe in the archipelago of North Borneo, the Philippines [4].

## 3. Methodology

The proposed study is the development of cultural heritage framework for a traditional knowledge management information system with digitalization and visual cultural contents. The building the framework refers to the 5R concept architecture adaptation framework; Concepts, Systems, and Learning Scenario [13]. This framework enriches the knowledge management information system by integrating cultural heritage context information including users, locations, devices, and information content into the adaptation process.

### 3.1. The 5R adaptation framework

The concept of the 5R adaptation framework was proposed by [13], aimed at enriching adaptive and personalized device learning through the integration of context information to build context-aware mobile-web based computing architectures. The 5R concept presented in 'Figure 1', is stated as: at the right time, in the right location, through the right device, providing the right content for the right learner [15].



**Figure 1.** The 5R Adaptation Framework

The 5R adaptation framework has been used in a location-based mobile learning management system to produce and deliver learning content for ubiquitous learning applications [16 - 19]. By adapting the framework into the digital heritage management information system for digital literacy of Dayak Tribe's Borneo, and has developed a further 5R adaptation framework. The 5R adaptation framework focuses on each of the five systems practice concepts. This framework identifies key aspects of a system that are important for understanding how the system functions and is important as a lever point to introduce change. Thus, the five "R" that make up the framework: Right Time (timing), The Right Location (location), The Right Device (device), The Right Learner (user), and The Right Contents (information culture contents).

### 3.2. The domain of the cultural heritage frameworks Dayak tribe Borneo

Refer to [2] the National Cultural Development Blueprint, and Culture Domains from UNESCO [20], which consists of five tangible culture heritage elements, i.e.: Arts (performing arts, fine arts, cosmetology and literature; and creative services), Science and knowledge systems (education, writing and publishing), Life and technology equipment (audio-visual and interactive media; cultural and natural heritage), Livelihood (food and trade), and Health (medicinal treatment). For intangible cultural elements consists of three fields, i.e. Religious System, Language, Social System and Society. These two cultural elements do not stand alone but are interrelated and influence between all elements of culture, both tangible and intangible cultural heritage.

In the process of cultural development, there are three inseparable things, i.e. 1) education and training, aimed at building national identity and character and strengthening cultural diplomacy; 2) Institutional Management and Support, aimed at preserving works and cultural heritage and building solid institutions from the grassroots level to the central level; 3) Building cultural facilities and infrastructure, aiming for accessibility or ease of obtaining access to cultural wealth. Then as stated earlier that Culture does not stand alone, so that in the mapping of e-Culture domains also included fields other than cultural elements that are directly or indirectly related, i.e. Tourism (e-Tourism), Sports and Recreation (e-Sport), Business (e-Business), Government (e-Government), Environment (e-Environment) and Education (e-Learning). These fields are included in the ecosystem of developing e-

Culture so that it cannot be separated for example in the field of tourism, cultural tourism object services are promoted or marketed through e-Tourism content, or buying and selling cultural products through e-Business systems, etc. The general description of the domain for the development of Borneo Dayak tribe cultural heritage frameworks is shown in ‘Figure 2’.

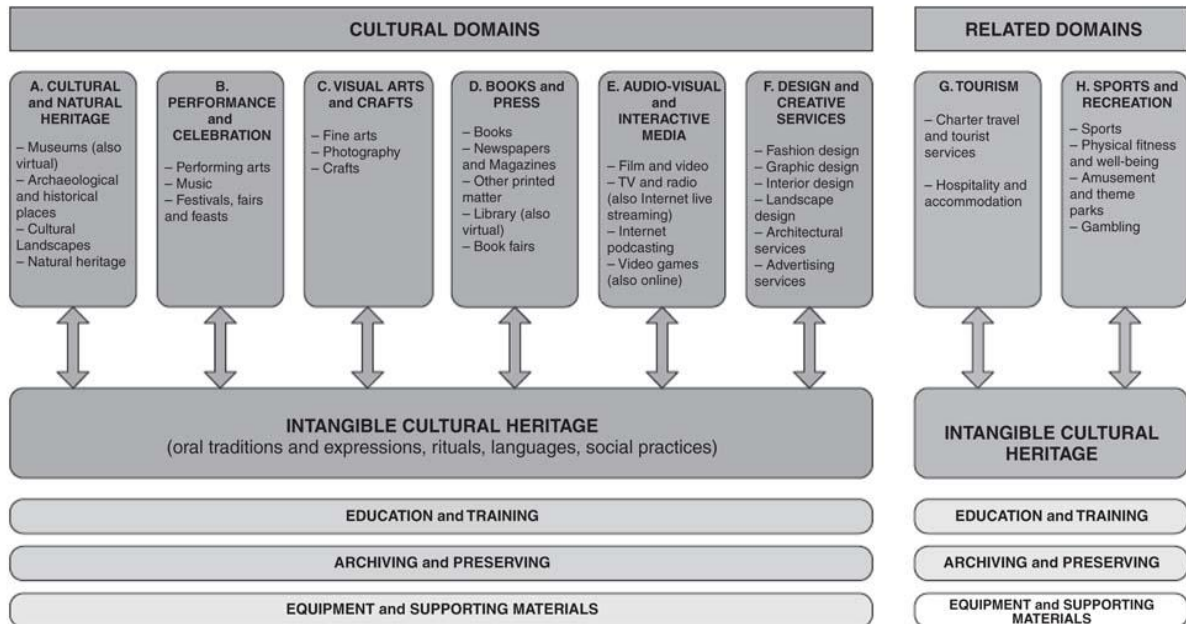


Figure 2. Domain of the cultural heritage frameworks

‘Figure 2’ contains all the elements of Tangible and Intangible Culture, as well as several fields related to the development and use of e-Culture. From a number of cultural elements, it has information technology-based terms or names, such as e-Museum, e-Art, e-Language, e-Music, e-Library, e-Learning, e-lifestyle, e-culinary or other terms which essentially relate to electronic or digitization of cultural elements. The naming of e-Culture can also be contextualized with local culture or ethnic cultures such as e-Melanesia, e-Malay, e-Borneo, e-Sundanese and others, of course, this becomes a very interesting field to be developed further.

### 3.3. Dayak tribe Borneo

Dayak is a term for the native inhabitants of the island of Borneo. The island of Borneo is divided according to the Administrative region, which regulates its territory, each consisting of: East Kalimantan, the capital of Samarinda, South Kalimantan with its capital Banjarmasin, Central Kalimantan, the capital of Palangka Raya, and West Kalimantan, Pontianak, North Kalimantan, the capital of Tanjung Selor. The Dayak tribe, divided into 405 sub-tribes [6]. Each Dayak sub-tribe has similar customs and cultures, in accordance with its social, customs, culture, and language that are typical of each sub-tribe, both Dayaks in Indonesia and Dayaks in Sabah and Sarawak Malaysia [5]. Dayak the term came from word "Daya" which means upstream, to refer to people who live in the inland or in the upstream [21], [22]. The Dayak tribe has the same cultural characteristics such as; mandau, chopsticks, beliong, longhouse (radank), and cultural arts [23]. The original religion of the Kaharingan Dayak tribe, which is an indigenous religion born from the culture of the ancestors of the Dayaks. Some Dayak people still adhere to the belief in the existence of occult objects in certain places such as rocks, large trees, gardens in forests, lakes, pools, and others, according to their belief they have "magical powers". The daily lives of Dayaks are generally of farming, i.e. cultivate an unirrigated field with rituals [23]. The Dayak tribe is divided into seven clusters, namely shown in Table 1.

**Table 1.** The 7<sup>th</sup> clusters of Dayak tribe Borneo [6]

Group name	Description group
DANUN (Ot Danum)	Ot Danum clump or Barito clump is one of the Dayak clusters which is divided into sixty one (61) small tribes, the distribution of which covers the entire Dayak tribe in Central Kalimantan, South Kalimantan, Southern East Kalimantan and Southeastern West Kalimantan. Some argue that the Ot Danum Rumpun Dayak group is the parent of the Dayak Ngaju family, but sometimes the two clusters are separated. The sub-tribes of the Ot Danum Dayak are Ma'anyan, Tunjung, Benuaq, Lebang, Undan, etc.
Dayak NGAJU (Biaju)	The grouping of the names of the Ngaju clumps consists of 53 tribes. Based on the watershed, Biaju is divided into Batang Biaju Basar (Big Biaju River) and Small Biaju Batang (Little Biaju River). Based on the language family, the Dayak Ngaju tribe is divided into 10, that are: Dayak Ngaju (Ngaju Kapuas), Kahayan, Mendawai (Central Kalimantan), Bakumpai Dayak Tribe (South Kalimantan), Mengatip (Central Kalimantan), Berangas (South Kalimantan), in 2010 was declared extinct and the language because it merged into the mainstream of the Banjar Kuala People and Dayak Tribe Beraki (Bara-ki) (extinct).
APO KAYAN	Apo Kayan clump is a Dayak tribe spread in Sarawak, East Kalimantan and West Kalimantan. The Apokayan tribe starts from the outskirts of Sungai Kayan, Bulungan Regency, East Kalimantan. The Dayak tribes included in the Apokayan family are the Dayak Kayan (10 small tribe), the Dayak Kenyah (24 small tribe), and the Dayak Bahau (26 small tribe). The 3 <sup>rd</sup> Dayak tribe is still divided into 60 sub-tribes spread over 60 residential locations in Kalimantan and become the smallest sub-tribe (Sedatuk), which still has a family tree.
IBAN or HEBAN (Dayak Sea)	The Iban Dayak tribe is a group of Dayak tribes found in West Kalimantan, Sarawak, Brunei and Tawau Sabah Malaysia. The Iban Dayak group was previously known as the Dayak Sea. Iban clumps (divided into 11 sub-tribes sedatuk).
KLEMANTAN (Dayak Land)	Klemantan or Land Dayak, is one of the groups of Dayak tribes found in West Kalimantan and Sarawak, East Malaysia. Clumps of Klemantan consist of 2 small tribes and 87 tribes of sedatuk, namely Dayak Klemantan (divided into 47 tribe sedatuk) and Dayak Ketungau (divided into 40 tribe sedatuk).
PUNAN	Punan Dayak is one of the Dayak tribes in West Kalimantan, Central Kalimantan and East Kalimantan. The Punan family consists of 4 small tribes and 52 sedatuk tribes, namely Dayak Basap (divided into 20 sedatuk tribes). Punan Dayak (divided into 24 tribe sedatuk). Punan Ot Dayak (divided into 5 tribe sedatuk) and Dayak Bukat (divided into 3 tribe sedatuk).
MURUT	Murut is a group of Dayak tribes found in northern East Kalimantan, Brunei and Sabah-Sarawak, East Malaysia. Murut Clump (consisting of 3 small tribes and 44 tribes). Dayak Murut (divided into 28 tribes sedatuk); Dayak Idaan (divided into 6 tribes sedatuk) and Dayak Tidung (divided into 10 tribes sedatuk)

#### 4. Result and Discussion

In the domain of knowledge heritage management information systems, we believe that adaptive cultural heritage information content from this approach will explain more about tangible and intangible cultural heritage as a domain feature of this approach because detailed methods depend on specific application domains and specific requirements fields other than cultural elements that are directly or indirectly related.

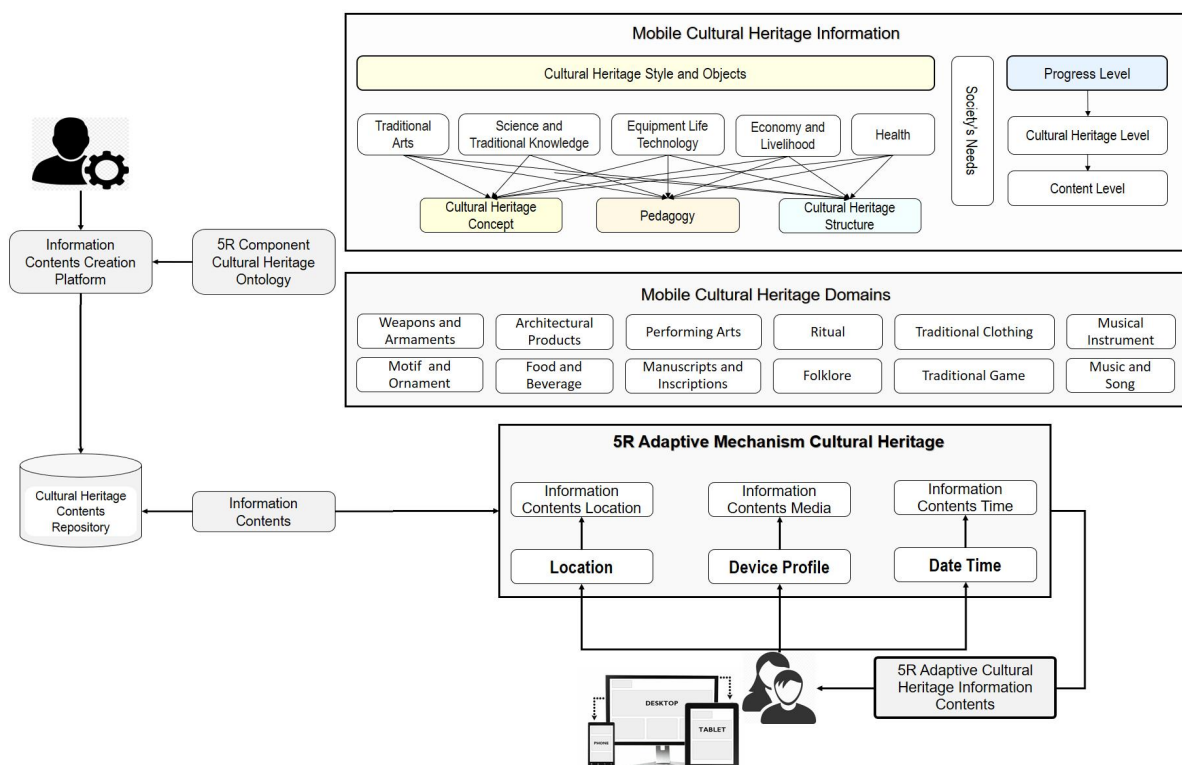


The first approach is to manually create information on Borneo Dayak tribal cultural heritage semantically. The second approach is to take advantage of the pre-existing object information of the Borneo Dayak tribe culture, develop a system that can be shared, publish cultural object standards, and appreciate the service system to make information objects of Borneo Dayak tribal cultural heritage widely accessible. The third approach is to develop software and knowledge search mechanisms that automatically identify appropriate cultural heritage information components and extract structural knowledge from unstructured (intangible) information content and structured (tangible) cultural heritage information content distributed on the web.

In our study, we used all three approaches, the first approach was to create informative content on Borneo Dayak tribes' cultural heritage manually. The second approach was to carry out the bottom-up development of ontologies for the purpose of personalized information on cultural heritage literacy and cultural heritage context information. We also use the third approach to build an information system framework with tangible and intangible cultural heritage domains. The development results have provided a framework called "e-Dayaknese".

#### 4.1. The culture heritage management information system framework of Dayak tribe Borneo

The concept of 5R adaptation applied to the cultural heritage knowledge management system of the Dayak tribe Borneo is stated as: at the right time, in the right location, through the right device, providing the right content for the right user. It aims to enrich the knowledge of the adaptive and personalized cultural heritage Borneo Dayak tribe through the integration of cultural heritage information domains to build a computational architecture based on cultural heritage domains.



**Figure 3.** Culture heritage management information system framework for Dayak tribe Borneo

The five main concepts of the 5R framework are used as guidelines for the content creation of cultural heritage knowledge management information systems, in order to be able to use the user context to adapt cultural heritage information content to meet user requirements and the devices used. The content is made in accordance with the 5R input scheme presented in 'Figure 3'.



The main input of the framework - user, location/environment of cultural heritage, object/information content, type/device, and time - blocks the reusable building framework used to knowledge management information content by the admin. The cultural heritage knowledge management information systems provide domains of cultural information objects and different locations connected to them as needed. This means that information objects with the purpose of certain information can be connected to similar locations. Cultural heritage information and material can be added in various formats, including video, audio, flash, or text, to support adaptation functions for different devices.

- The Right Time: "right time" shows two factors, time-date and progress of information. Date-Time limits are usually related to the time availability of objects of real-life cultural heritage information, while the progress of information is considered as a reference to provide the latest information content to users.
- The Right Location: the "right location" indicates the user's current geographic location. The location constraint is assigned to a real-life information object with positioning description to provide geo-referenced for information content delivery. It enables the application to provide the information contents in the right place where the user is taking place. When a user device is physically at or near a particular location, the user can be informed to visit, observe, and experience the object at the location. In the framework, the location attributes include geographical coordinates in latitudes and longitudes.
- The Right Device: the "right device" refers to the user's device that is used to access cultural heritage information. The device constraint is associated with information contents to provide users with the best possible knowledge, information or experience through their devices. The devices are heterogeneous with multiple operating platforms and they have different and limited user/device interaction capabilities.
- The Right User: the "right user" is the person who uses the device to access information through the cultural heritage application. The right user means that the learning objects provided, the information activities assigned, and the pedagogy used by the knowledge management system to the user matches the user's profile and style.
- The Right Contents: the "right contents" include information objects, information activities, and information instructions that suit the particular user, at a particular time and location as well as the device. The knowledge management system has to be able to generate the 5R sensible information contents to the repository then secondly it has to be able to deliver the 5R adaptive information contents to users. In the App, the information contents attributes contain all the attributes of time, location, device and user.

#### 4.2. *The 5R adaptation framework enabled cultural heritage management information system*

The 5R adaptation framework enabled cultural heritage information application system should be able to deliver information contents with the 5R adaptation. The system will automatically provide a user with the information contents adapted to the user's information profile, time, location as well as the device. Usually, the system is a server-client web application. The web server application provides information contents and adaptation computing while the client application provides the user interface and collects user and learning context information. For the 5R adaptation framework enabled information system, the client applications include web-mobile client application running on a mobile or computer PC device and web client application accessible through any web browser.

The 5R adaptive cultural heritage management information system (CH-MIS): two essential aspects of any information management system are information contents creation and delivery. The CH-MIS is a centralized location-based information management system, which provides instructors with a platform to generate the 5R adaptive information contents and offers device users the 5R adaptive information contents through cultural heritage information client applications.

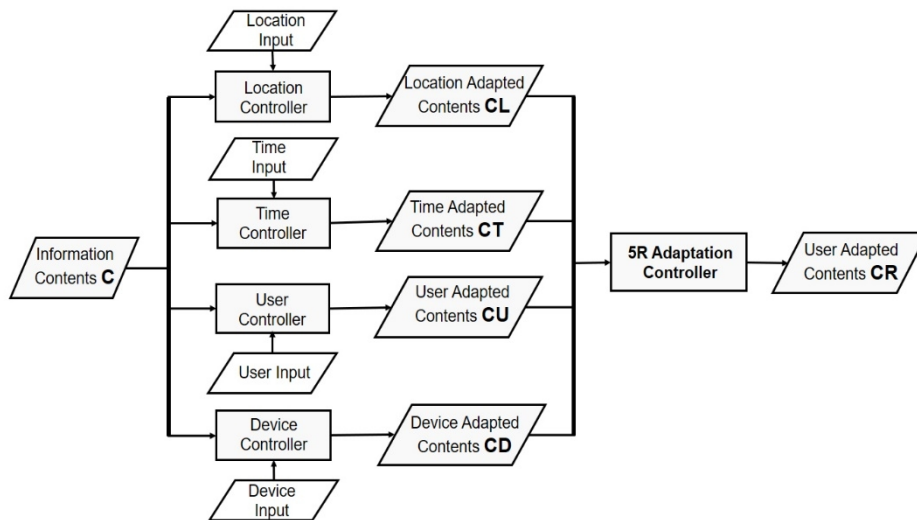


Figure 4. The 5R adaptation mechanism and process model

The 5R adaptation framework enabled system architecture is shown in ‘Figure 3’. The 5R adaptation mechanism shown in ‘Figure 3’ reflects the 5R process model illustrated in ‘Figure 4’. In the CH-MIS, the instructors use a location-based information contents creation platform to develop location-based information contents. The platform is designed based on the 5R input constraints to ensure that the information contents developed and stored can be retrieved and assembled by the 5R adaptation mechanism.

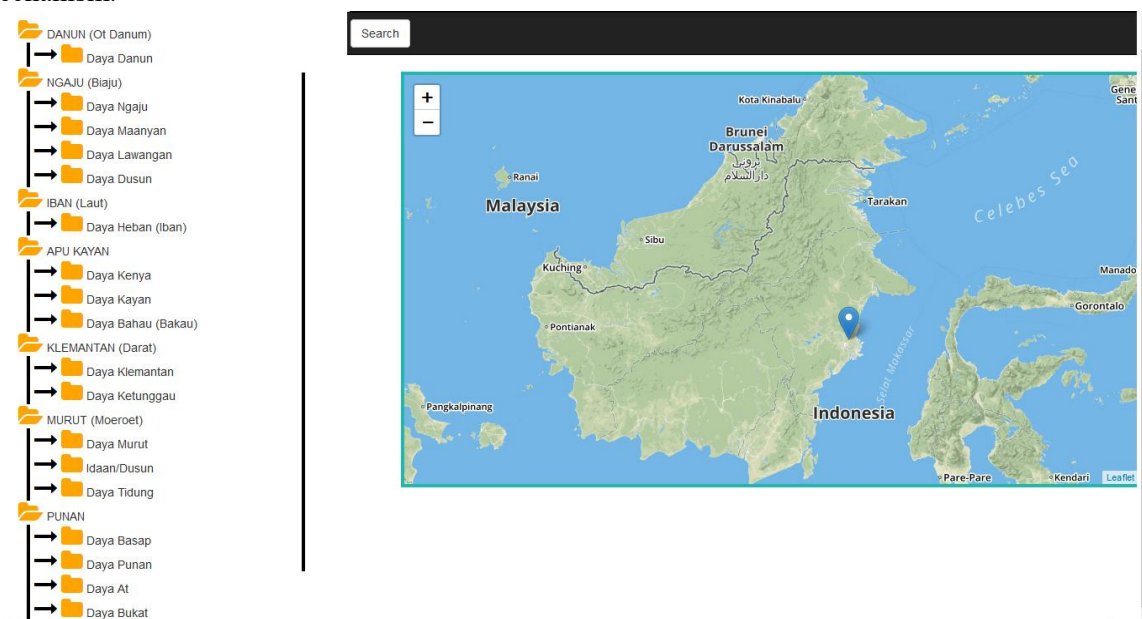


Figure 5. Screenshots of user interface from the website (url: <http://dayak.culture.or.id/>).

Furthermore, the 5R adaptation mechanism can be considered as a meta-architecture by which various design or implementation strategies could be applied as long as the architecture and functions of cultural heritage information application comply with the 5R adaptation constraints. The CH-MIS provides a generic platform to different culture information applications with the 5R adaptation implementation and it is hosted on an application web at the Dayak (URL: <http://dayak.culture.or.id/>). Screenshot of web interface shown in ‘Figure 5’.

## 5. Conclusion

The development of information and communication technology-based culture is a duty of citizens to preserve the cultural heritage as a national identity. For this reason, this research has designed a framework within the cultural heritage domain of the Borneo Dayak tribe which refers to the cultural domain of UNESCO. Mapping cultural domains based on tangible and intangible cultural elements. Then it can be found that in the process of developing and utilizing cultural heritage directly or indirectly related to location, time, device and information content so that the framework developed will be well integrated and appropriate which adapts the five elements.

The concept of the 5R adaptation framework for the cultural heritage management information system of the Dayak tribe Borneo is proposed as one of the development frameworks approaches in knowledge management of cultural heritage that contents information: location, time, users, devices and content. We call this framework "e-Dayaknese" which will then be developed in the culture information system as an effort to integrate information and preserve the diverse cultural heritage of the Dayak tribe Borneo.

Future research will apply the 5R adaptation framework, we believe that this concept is appropriate and applies to the management of cultural heritage information systems based on The Right Location, The Right Time, The Right Users, The Right Devices and The Right Content. However, we also think it needs to be enhanced, revised, and improved

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