iWareBatik: Digital Information System for Enhancing Batik Learning in the Framework of Heritage Preservation and Sustainable Tourism

Doctoral Dissertation submitted to the
Faculty of Communication, Culture, and Society of the Università della
Svizzera italiana

in partial fulfilment of the requirements for the degree of
Doctor of Philosophy

presented by
Puspita Ayu Permatasari

under the supervision of
Prof. Lorenzo Cantoni, PhD

February 2022

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I certify that except where due acknowledgement has been given, the work presented in this thesis is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic awards; and the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program.

Puspita Ayu Permatasari
Lugano, 22 February 2022

To my family and all textile heritage lovers

Do not only practice your art, but force your way into its secrets, for art and knowledge can raise men to the Divine.

Ludwig Van Bethoven

Abstract

Digital technologies play important roles in improving the preservation, raising people's awareness and the mediation of intangible cultural heritage (ICH). This doctoral study addresses the issues on how to orchestrate digital media in order to resolve the challenges of preserving Indonesian Batik textile heritage in the era of digital technology. Indonesian Batik was inscribed on UNESCO's List of Intangible Cultural Heritage (ICH) on October 2nd, 2009. The fundamental elements of this living heritage reside in its safeguarding practices and its artistic components. The exceptional cultural values of this tradition consist of evolutionary patterns and motifs, socio-cultural values related to the philosophical meanings, wearing rules, the complexity of production technique that belongs to thousand-year-old wax-resist dyeing history, and social empowerment. In light of supporting the sustainable preservation of Indonesian Batik, this study highlights the critical roles of Information and Communication Technology (ICT) in fostering the capacity building of people engaged in the heritage, tourism and fashion sectors through the development of digital platforms called iWareBatik. Based on the action service design framework, this study provides chronological and representational outlooks manifested through a concrete research project while addressing the contributions and challenges of ICT intervention in fulfilling the overarching missions of ICH preservation.

Digital technologies for ICH shall be carefully curated in order to better communicate exceptional cultural values better of this tradition, protect the cultural identity of local communities, and disseminate its cultural significance to diverse audiences. Over the last decade, digital technologies to preserve Batik textile heritage have significantly increased. However, most are developed following traditional information systems that serve limited communication purposes for few audiences. Given the complex mission of ICH preservation and its wide range of communication objectives, this study offers an exemplary research project that aims to provide new approaches in adopting hypermedia-intensive ICT and artificial intelligence as an innovative breakthrough for communicating Indonesian Batik as UNESCO ICH since 2009. Through the creation of iWareBatik digi-

tal platforms as the central part of this study, the thesis further demonstrates the five roles of digital technologies Access, Better Experience, Connect, Disintermediate, and Educate, known as an acronym of ABCDE. iWareBatik digital platforms were designed and developed in accordance with four theoretical frameworks, namely Online Communication Model (OCM), ADDIE model, Analysis of Web App Requirements (AWARe), and service design research.

From the conception to the evaluation phase, the development of iWareBatik digital technologies includes curating a knowledge database covering the philosophical meanings of 124 Batik motifs, thematic wearing rules, and information of 129 Indonesian cultural/natural tourism destinations nationwide. This doctoral dissertation includes several scientific publications that provide a path to comprehend the core challenges of preserving Indonesian Batik in the digital era, while outlining the conceptual design, development, and evaluation in the context of heritage and tourism. Considering the complex communication goals in the ICH domain, a systematic requirement analysis was conducted in order to produce a conceptual service design that holistically accommodates the needs and requirements of Batik-related stakeholders. This study is addressed to scholars and practitioners in tourism, heritage, and fashion to inspire intended users to better manage and valorize the textile heritage in its due contexts.

Starting from the literature review in Chapter 1, this dissertation further elaborates benchmarking study in Chapter 2, which addresses the 5th element of OCM theory. Chapter 3 outlines the co-creation process of user requirement elicitation based on the OCM and AWARe models. Chapter 4 discusses the conceptual design and technical development of the artificial intelligence pattern recognition system of the Batik Recognition Tool, embedded within the iWareBatik mobile app. Chapter 5, as the final part of this thesis, covers the evaluation activities carried out as learning and citizen engagement activities, conducted with the participation of 997 bachelor student participants in collaboration with 33 Indonesian universities and tourism institutes nationwide. A structural analysis using NVivo text query method is generated in order to illustrate the key points addressed by 79 focus group discussions and 628 essays collected from the participants. This study serve as an exemplary case study of evaluating digital technology for ICH involving multidisciplinary stakeholders. An iWareBatik international hackathon event 2021, participated by 156 selected Indonesian bachelor students, was conducted as part of the UX evaluation study, which at the same time contributed to increasing the capacity building of young Indonesian stakeholders to preserve Indonesian textile heritage. Due to the limitation of the thesis, further improvements are suggested in order to progress the advancement of digital technologies in the preservation of living heritage.

Acknowledgements

Every beauty has a soul, portrayed in a motif of textile. I dedicate this dissertation to the everlasting values of humanity embodied in the Batik hand-drawn textile heritage.

My greatest gratitude to Allah SWT, for His blessings in allowing me to accomplish this PhD journey and for granting me an important part of my destiny as a human being: to extend the wisdom of the past contained in Batik through the advancement of digital technologies.

I would like to thank my Dissertation Advisor Prof. Lorenzo Cantoni, Ph.D. for the wisdom I inherit from him and for his immeasurable support across the journey of this study. You are a channel of knowledge, Sir. You are a wonderful conductor in scientific orchestra. May all your contribution towards science and technology continue and flourish across time.

To Dr. Stefano Tardini for your invaluable contribution to the development of iWareBatik technology.

To Prof. Dr. Maria Gravari-Barbas of Université de Paris 1 Panthéon-Sorbonne in France, an inspirational supervisor during Master degree, thank you for giving me a chance to learn from you in the first place. Let this dissertation be an expression of gratitude.

To my family: my mom and dad, Rr. Noeke Anny Pratiwi and Much. Tri Wibowo: despite all boundaries, this dissertation is the embodiment of love and support that you both have given. To my aunt Rr. Ivonne Yanti Suryandari, my late grandmother and aunt, Rr. Sri Sulastri (1932-2020) and Rr. Onny Anny Anggriani (1964-2016): this dissertation might have never been conceived without your teachings: noble contributions shall come from the loving heart.

To my ancestor, Dr. H.C. Sultan Abdurrachman Pakunataningrat (1780-1854) Kingdom of Sumenep (1269-1929): may this study be the continuation of your contribution to British Sir Thomas Stamford Raffles's on the book of History of Java (1817) and to the fulfilment of Javanese culture inheritance.

My gratitude goes to Reinard Lazuardi Kuwandy, as his efforts and family's support in building the Batik Recognition Tool allows this research to record the

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Chapter 1

Literature Review

The discourses of cultural heritage, mainly Intangible Cultural Heritage (ICH), have shifted from traditional realm to the embodiment of modern reality. According to Ashworth [2016], "Heritage can be seen as a resource, a process and an outcome and all three approaches". ICH continuously evolves and shapes the communities' worldview and identity and those who belong to this living heritage. The advancement of digital technologies has become an integral part of postmodern society, which help promote the transmission of traditional knowledge and the wisdom of ICH to the public. The intervention of ICT in this heritage domain brings on diverse choices in documenting, learning, and experiencing its exceptional cultural values. The idea of this thesis arises from the interest in understanding and formulating holistic approaches in designing digital solutions that address the communication challenges in ICH preservation, especially in the case of the Indonesian Batik.

The concept of ICH and its safeguarding practice is referred to the UNESCO Convention in 2003, which defines this type of cultural heritage as, "the practices, representations, expressions, as well as the knowledge and skills (including instruments, objects, artefacts, cultural spaces), that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This intangible cultural heritage, transmitted from generation to generation, is constantly recreated by communities and groups in response to their environment, their interaction with nature and their history, and provides them with a sense of identity and continuity, thus promoting respect for cultural diversity and human creativity." According to this convention, ICH includes several oral traditions and expressions, such as local language, performing arts, social practices, rituals and festive events, knowledge and practices concerning nature and the universe, and traditional craftsmanship [UNESCO, 2020]. As of January 2022, 629 ICH

Figure 1.1. Map of History of Batik since ca.5000BC - 21C [Wronska-Friend, 2016; Supriono, 2016; Druding, 1982]

elements corresponding to 139 countries were enlisted by UNESCO. Living heritage incorporates two types of knowledge: 'to know-how' or savoir-faire and 'in the state of knowing' or 'savoir-etre', which strongly emphasize the importance of making process in each cultural practice [Boily, 2004]. As the fundamental element in the ICH practice, the tacit knowledge is commonly transmitted by storytelling, or typically known as oral tradition, and through face-to-face interaction with local practitioners. The tangible artefacts resulting from ICH practices further contribute and bring about significant innovations in the community's socio-economic development [Wang, 2019].

The fundamental issues of ICH preservation lie in maintaining the continuity of this living heritage, from the practical elements, community development, and knowledge management of this legacy. Ensuring the continuity of local culture, the intervention of ICT is essential as it is able to showcase different dimensions of ICH knowledge and as a communication instrument that provides access to all levels of society. In this regard, the development of any ICT innovations shall be adapted to relevant stakeholders' needs, requirements, and goals, while attracting wider audiences to participate in the common goal of ICH preservation [Robbins, 2010]. Research on digital technology for cultural heritage can be distinguished by two approaches, one tackles ICT from social sciences perspective and the other one from the engineering point of view [De Ascaniis and Cantoni, 2016]. The role of the researchers in the digital technology domain is to analyze the current issue of ICH preservation, identify the challenges, and come up with possible solutions to improve heritage preservation through human-centered digital innovation. In doing so, the development of ICTs devoted to ICH shall bring a sense of empowerment that enables local people to utilize, create, and explore the digital technologies, which can facilitate them to learn and communicate their heritage, and enhance the added value of their products in economic sectors.

The richness of Batik culture does not only lies on its philosophical motifs but also how local people maintain the authenticity and transmit the traditional production methods across generations through storytelling [Permatasari, 2016]. Thomas King [2003] stated "By their very nature, stories that are passed down orally over the course of innumerable generations are continually changing". Stories as the core of this living heritage rely on people's memory and willingness to transmit exceptional wisdom through different modalities. Therefore, this study aims at providing theoretical and practical contributions on how to develop educational digital technology in order to showcase and communicate the story of Indonesian Batik motifs, with the intention to help local people to connect with the depth of their Batik culture and attract wider participation through

Asia Pacific
Australia
Azerbaijan
Indonesia
China
India
Indonesia
Malaysia
Rusia
Singapore
Sri Lanka
Thailand

Africa
Egypt
Cameroon
Ghana
Mozambique
Nigeria
Senegal
South Africa
Swaziland

Europe
Austria
England
France
Germany
Ireland
Netherland
Poland
Spain
Switzerland
Ukraine

America and Latin America
Argentina
Bolivia
Brazil
Canada
Carribean
Hawai
Mexico
United states

The Map of Batik Global Art Practice 2018

Sources:
- Part of research findings through online presence as of October 2018, Permatasari & Cantoni, 2019. Indonesian tourism and Batik : An Online Map.
- Supriono, P. 2016. Encyclopedia of Batik.
- Wronska-Friend, M. 2016. Javanese Batik to the World.

Figure 1.2. Batik as global art practice [Permatasari and Cantoni, 2019a; Wronska-Friend, 2016; Supriono, 2016](source: author's graphic elaboration from multiple sources, 2018)

interactive digital technology. This digital innovation ensures an active exchange and knowledge transfer about Batik among stakeholders in a new media concept, as well as to safeguard this oral tradition in a well-curated digital platform.

Before elaborating the design and development of ICT for Batik textile heritage, this chapter outlines the background study and related literature review. This chapter consists of four sections. The first section addresses the Batik community, from traditional practices to virtual ones. The second section introduces the ICTs applied in textile heritage preservation, underpinning its crucial roles in relevant domains such as heritage, tourism, and fashion. The third section addresses the systematic literature review that identifies the research gap in the current development of digital technologies dedicated to Indonesian Batik. Finally, the fourth section is devoted to methodology and associated elements, constituting the study's conceptual framework.

1.1 Indonesian Batik: traditional community of practice to global virtual community

The first question arised from the beginning of the study was, "What is the landscape of Indonesian Batik in the digital world?". First of all, Indonesian Batik is identified as a textile-making culture that indicates the practice of a thousand-year-old manual wax-resist dyeing technique to manifest symbolical visual art on a piece of textile. This tradition is transmitted as an oral tradition from generation to generation, shaping the traditional community of practices in many rural areas in Indonesia. The term 'culture' is derived from a Latin word of 'cultŭra', while the verb is 'colere' that signifies 'to cultivate' [De Ascaniis and Cantoni, 2016]. Addressing its broad definition in the modern context, culture refers to the cultivation of the human mind that serve two particular dimensions: the method and the spiritual dimension. As a method, culture indicates a way and a process of cultivation in order to manifest a tangible result, i.e. agriculture. In its spiritual dimension, the word 'cult', which is derived from a Latin word, implies maintaining spiritual relationships such as individual and social practices of worshipping God. The other meaning of culture refers to cultivated human intellectual and skills thanks to the continuous education, practices, and learning experiences (ibid).

Indonesian Batik is a typical tradition that embodies these two cultural dimensions. As a method, this wax resist-dyeing technique has been developed since 5000BC [Druding, 1982]. The journey of the historical wax-resist dyeing in four continents across centuries is illustrated in Figure 1.1. The colouration method involves natural dyes obtained from the cultivation of local herbs in order to produce distinctive auratic colour. As for spiritual purposes, Batik hand-drawn textile devoted for the offerings in religious ceremonies incorporates more sophisticated elements, as the motifs expressed on the fabric convey prayers and wishes for the gods. For this reason, Indonesian Batik was inscribed as an oral masterpiece of UNESCO's List of Intangible Cultural Heritage of Humanity on October 2nd, 2009. Behind two facades of artistic and social components, Indonesian Batik possesses four exceptional cultural values that consist of (1) philosophical meanings behind Batik's distinctive patterns that are in line with the history of each region, (2) authenticity on wax resist dyeing production technique, (3) wearing rules in particular contexts, and (4) social empowerment enacted within its valorization activities.

Since the apparition of Batik in the archipelago in the 6th century, the Indonesian Batik community evolved as a traditional community of practices for

Map of Batik Creative Sectors in Indonesia (2017)

5.849 Batik Motifs (Situngkir, 2015)

Figure 1.3. Map of Batik creative sectors [MCSME-Ministry, 2015; Situngkir, 2015]

centuries. According to Lave [1993], a community of practice is defined as a social formation historically constituted with a particular system of activity and assigned meanings depending on its location. This cultural community produces a set of cultural activities whose values are developed and maintained across generations. As a community of practice strongly depends on the adherence of its members [Wenger et al., 1998], this thousand-year-old art legacy is developed by the capacity of the agents (Batik makers, apprentices, etc.) to continue producing and transmitting its tacit knowledge to the younger generation. All components behind Batik textile making (knowledge, values, etc.) serve as a cultural identity that binds all stakeholders to care for its continuity and sustainability. In doing so, the Indonesian government has committed to empowering textile producer communities, and the most important one is to raise the awareness of young generations through educational activities [Wang, 2019].

With more than 190 million of internet users in 2021, Indonesia grows as emerging digital country [Kepios, 2019]. This can be an opportunity and a challenge for optimizing the use of digital outlets in order to support Batik practitioners and attract users to participate in the missions of preserving Indonesian textile heritage in general. The rise of internet users and the growing of digital technologies in the country serve as a momentum to leverage on the power of technology for carrying out massive heritage campaign and virtual activities. Es-

pecially during years of the Covid 19 pandemic [WHO, 2020, 2022], where global tourism sectors including Indonesia suffer from a huge socio-economic setbacks. Apart from the enactment of Covid19 recovery programs, the country shifts its policy to boost domestic consumption by revitalizing the creative sectors, including textile heritage as one of the strongest contributor to the national GDP. For this reason, Indonesian ministry of tourism and creative economy emphasized on two main agendas namely, capacity building of professionals involved in creative sector and tourism industry, and redefining new types of tourism such as rural-based cultural and ecotourism [MTEC, 2021a]. At this point, the capacity building of textile heritage sector through the use of digital technology, as addressed by this study, serve as a timely contribution in order to strengthen the ties among traditional community of practice and attract wider audience to join the cause through education and social empowerment.

1.1.1   Relational approach of knowledge in Batik cultural communities

Batik cultural communities is composed of several groups with complex relationships, structure of workers, and hierarchy among members [Permatasari, 2016]. In order to provide holistic solutions with regards to Batik preservation through digital technology, it is important to understand and reflect on the relational aspects of the actors and other fundamental elements of this cultural community.

According to Carlile's relational approach to knowledge [Carlile, 2004], there are three intersecting dimensions of practice-based relations: differences, dependencies, and change. The differences of each cultural practice and the philosophy behind this traditional practice shape the authentic identity of the local communities. As a particular example, Batik production method develops into many different styles, according to local customs, period, and place of origin. The dependency issue is highly accentuated in this cultural community, especially among the artisans. Each member of the textile artisans community is an agent who guards a certain level of knowledge, personal experience, and wisdom characterizing particular textile making. Despite massive promotions on its tangible product, lack of youth participation and the decreasing awareness from public to Batik socio cultural importance still remains as a challenge in maintaining the continuity of this heritage. Given the urgency of the issue, a fundamental question arises regarding the knowledge transmission of this living heritage: In which way could Batik tradition be preserved and communicated in modern context of society?. In this regard, knowledge can be seen as an integral part that strength-

ens the community's sense of belonging and as a social instrument in broadening relations.

Figure 1.4. Sindjang Javanese Batik ancient manuscript (ca. 18C) on the standard of Indonesian Batik motifs for royal families (source: photo courtesy of Indonesian National Library, 2018)

According to Østerlund [2003], "knowledge is shared across a broad set of circumstances that one must specify the particular relations focused on and the actual empirical practices". Brown and Duguid [2001] identify four elements as the key factors influencing knowledge-sharing in a community of practice: individual formation of identity, communal distributed knowledge, networks of practice across communities, and organizational boundaries [Brown and Duguid, 2001]. As knowledge-sharing is identified with the norms of reciprocity and a deep level of trust among the community [Scarbrough and Swan, 2001; Huysman, 2014]), a community of Batik practice is evolved thanks to the new ideas from the newcomers. The apprentices (the newcomers) might carry various sets of knowledge from the exposure and experiences in different communities. These learners jointly improve the Batik community by proposing or bringing about new interpretations and suggestions aligned with practices in other network communities.

1.1.2   Enhancing knowledge sharing via virtual community of prac- tice

Small communities of craftsmen and manual workers as social elements in Batik community have homogenous perspectives on how they view their world and traditional practices. As this community expands to the virtual realm, knowledge is shared as a critical element within and across community boundaries [Huysman, 2014]. In view of this, it is necessary to build a comprehensive framework for the digital technology devoted to ICH practice that underlines the main goals of the communication sender (main stakeholders) and the communication receiver (the audiences). It may raise some questions and concerns from the original community, such as to what extent the information is allowed to be shared, protected, etc. The question of protecting intellectual and cultural property rights enters into the discussion of digitalization of ICH knowledge [Purba et al., 2020].

The intervention of digital technology fosters knowledge transmission, which in turn, gradually shapes and strengthens the relations of among members in Batik community. Members and people exposed to this heritage shall be equally informed about the basic principles of preserving Batik textile, the origin of the motif, and other identity-related information. In addition, the creation of digital technology devoted to Indonesian Batik shall further address the real issues that are related to the regeneration of Batik makers and the capacity building of professionals in the tourism and fashion sectors to better valorise this heritage. ICT may facilitate and encourage the engagement of young stakeholders within the Batik safeguarding activities through offline and online activities. Some people might be interested in becoming apprentices and learning from the senior Batik makers. Their participation in the trajectory of Batik making and learning activities ensure the inclusivity and the continuity of this traditional practice. Senior Batik makers as the established members may expect consistent learning behaviour of Batik apprentices as a new member in order to fully engage within the production and promotion of Batik textile. Starting from being observers, the gradual engagement of apprentices within the scope of Batik activities allows them to learn what constitutes the community and identify rooms for improvements within the sector. Once they capture some ideas on how to valorise the traditional practice and its products in a better way, they envisage a *change*. This *change* may start from online communication, such as posting their experience in making Batik or wearing Batik through social media channels (i.e., TikTok, Instagram, Youtube, etc). This virtual interaction becomes a new tendency that shapes a growing virtual community of practice that serves recent trends in the digital era.

According to Cantoni [2006], the definition of virtual community is "a group of people to whom interactions and communications via computer play an important role in creating and maintaining significant social relations.". Digital platforms and social media become the connecting hub of people worldwide who share the same interest in Batik art and culture. The virtual community on Batik gradually develops into global virtual communities, represented from the presence of website dedicated to Batik in many countries (see Figure 1.2). There are websites dedicated to discuss different theme and focus of interest related to Batik such as Batik Guild a UK-based website[1] that focuses on Batik as visual art, heritage, natural dyes, Batik fractal fashion and craft community[2], Baobab Batik in Swaziland[3] and those related to Batik or textile rural tourism such as Pesona Desa Indonesia[4]. Through continued collaboration and exchanges among the community of practices, the shared knowledge can be shaped, transformed, and transmitted [Huysman, 2014]. The evolution of this living heritage is strongly shown in the expansion of knowledge exchange and the learning process, especially since the interaction among members shift from face to face encounters to the virtual ones. Digital technology accelerates the exchange of ideas through multiple forms of access and improve knowledge creation in the community of practice.

Romana Andò [2020] stated "the way individuals and communities dress is often a sign especially determined by the context". This notion is manifested in the wearing rules of Batik textile heritage that originally lies on specific context depending on the state of the mind of the wearer and social events. Specific patterns are even reserved for spiritual purposes. Batik textile is also deemed as a language of value exchange (expression of intention, friendship, commerce, etc.), which has been believed as common values by Indonesian society for centuries. The integration of textile heritage within tourism, fashion, and creative sectors brings new interpretations, at the same time making it more adaptable to many different social contexts and purposes. Figure 1.3 outlines the map omnipresence of Batik creative sectors in Indonesia. The identity of textile artisans contains more than their role as the actor in this traditional practice, but also a citizen or a residence of a place, to which they represent in their art creation. Brown and Duguid [1998] assert that communities in different practices possess different assumptions and interpretations on making sense related to a certain issue. The perceptions and practical actions perceived by non-heritage stake-

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[1]www.batikguild.org.uk
[2]www.batikfractal.com
[3]www.baobab-batik.com
[4]www.pesonadesa.id

holders when it comes to preserving Batik textile heritage may vary depending on the capacity, role, occupation of the individuals. However, since each actor develops his or her apprehension about Batik, through continuous and dynamic social exchanges, the interpreted meanings of this tradition are prone to shift from the original ones. Each stakeholder in each domain tries to bring on possible interpretations to preserve Batik ICH. As a result, sometimes some entities may produce online content that weighs upon the textile usage values without addressing the importance of its intrinsic elements. The dependencies among actors within the Batik community also develops, from those involve in offline activities to the online activities supporting the promotion of this cultural practice.

The role of knowledge-sharing digital platforms is deemed essential in order to reinforce the community's sense of belonging towards their textile heritage and unify the narrative in favour of its sustainable preservation [Khanwalkar et al., 2018]. During the user requirement elicitation process, as outlined in Chapter 3, various needs and requirements were elicited and documented in light of better understanding how different stakeholders may have other ways to support Batik preservation according to their respective domains. A well-designed digital platform becomes the hub of different kinds of community of practice, which is essential for helping all stakeholders understand Batik as UNESCO ICH and how to implement its safeguarding activities adapted to their social context in a better way. Indeed, it is necessary to analyse the differences, dependencies, and changes as relational components in this subject in order to improve the design of digital technology devoted to ICH that provides a holistic improvement to the Batik community.

1.1.3   Divergent versus convergent : challenges of Indonesian Batik knowledge sharing

One of the biggest challenges of preserving ICH in the digital era is to demonstrate whether ICT intervention is sufficient to maintain and transmit the authenticity of ICH values over time. The common problem is that the knowledge of ICH remains inaccessible by its own communities due to the exclusive nature of this heritage. Therefore, despite its strong usage values, ICH should be protected from the detrimental effect of cultural commoditization, which merely focuses on the material impacts of the heritage without respecting its cultural significance for the community. Indeed, the focus of ICH valorization nowadays oscillates between two paradigms: maintaining education to strengthen and achieving eco-

nomic goals to sustain. There is clear evidence of governmental and public participation in increasing the promotion of Batik hand-drawn textile to enhance the revenues of its traditional practitioners. However, the fundamental issue remains in the role of education and raising awareness of the general public, especially young generations, in better understanding the cultural components, identity and the local wisdom embedded in each textile masterpiece.

In order to create digital technology that serves the purposes of ICH education and knowledge sharing, it is essential to understand the contexts and learning characteristics drawn from this cultural practice. During field observation in Batik village in Sragen city, Central Java in 2018, it is observed that there are two components of the creative thinking process embodied in the Batik learning process, which involves divergent and convergent design thinking. According to Cropley [2006], "Creative thinking seems to involve two components: generation of novelty (via divergent thinking) and evaluation of the novelty (via convergent thinking)." He argued that convergent thinking is critical as it provides grounded definitions and pathways to do something according to the standard. In mastering Batik making skills, convergent thinking lies in the mastery of procedures and skills to produce this textile art. Batik apprentices learn the structured knowledge about the Batik production step by step from the seniors and the tutors, such as the pattern making using the canting (a hand copper tool to put hot-melted wax on the cloth), soaking process, hand colouring, etc. This structured practical knowledge also includes understanding the philosophical meanings of patterns and motifs and the layout combination.

Regarding divergent thinking, creativity applies when it comes to creating motifs, patterns, and the purposes of the product. This type of design thinking is seen from the originality, fluency, and artistic elaboration of the work [Runco and Acar, 2012]. In the Batik learning environment, apprentices' performance is measured from their ability to follow the standard of technical production. In ancient time, the mastery of Batik standard motif and philosophical meanings was compulsory for the Batik apprentices and the royal nobles. Bab Sindjang Javanese Codex illustrated a guidance for making Batik for royal motif (see Figure 1.4). Today, few attention was given to the learning of Batik philosophical meanings. In general, the vast majority of the Batik artisans and consumers tend to focus more on the creative and aesthetic values of Batik. Less attention is given to dedicated one's time in order to learn from trusted sources (books, encyclopedias, etc.) on how to interpret the significance conveyed by the motifs. In many situations, divergent thinking as characterized in creative works may be used and alternate simultaneously, in combination with the structured point of reference (as the nature of convergent thinking) in order to avoid immense

deviations from its original conduct [Halatchliyski et al., 2011]. Without careful identification of challenges, needs and expectations of local producers, digital technology can bring a detrimental effect, as it can widen the gap between indigenous cultures and the orientation of ICTs intervention. Alternatively, digital technology for this purpose shall have the capacity to engage and cater for practical information needed by diverse stakeholders, from the artisans, to those dealing with tourism and fashion sectors. With a moderate amount of information and easy practicability, the ICT shall provide access to everyone, especially for younger segments of society, to enjoy and valorize the heritage in a new mode of presentation.

Building a well-aligned convergent and divergent design of knowledge sharing may contribute to a better learning system, generating better and more meaningful creative products [Runco and Acar, 2012]. These two design thinking (divergent and convergent) are helpful for the study to identify the necessities and find the gaps behind the Batik learning environment, whose results can be adapted for other learning purposes. In particular, building a comprehensive concept of textile heritage as an embodiment of culture and creativity is crucial in fashion education. It supports learners to develop critical thinking while maintaining the artistic excellence and traditions [Andò, 2020]. A synthesis drawn from this analysis supports the idea to formulate a digital technology that provides interactive and insightful information on the philosophical values of Indonesian Batik motifs, in order to enrich convergent knowledge sharing within this community. Moreover, its socio-cultural contexts in wearing rules, and other historical and geographical elements may help artisans and consumers obtain a better understanding of Batik masterpiece.

1.2   New Media: definition and integration

Digital technology shapes a revolution in the midst of our community, which leads to the creation of a new culture in communication. From the traditional perspective to the new one, the development of media is influenced by technology, techniques, modes of information, and codes of communication [Gamaleri, 2019]. Those elements indicate how technology affects different subjects' perceptions and understanding [McLuhan, 2015]. The emergence of new media has been previewed within McLuhan's theory of Media Ecology, which elaborates the evolution of mass media from the age of literacy, printed materials, the electronic age, to the era of new media [Logan, 2010]. In 1997, the concept of 'New Media' was introduced as a form of media, emerged from the use of communication

technology and the internet, to carry on different types and formats of information to the intended audiences [Fidler, 1997; Cantoni and Tardini, 2006]. The definition of new media is further detailed as any form of information communication technology that aims at showcasing different types of content/messages (textual and visual) to the intended users. Content creation, modification, and sharing, as in the characteristic of new media, offer people the flexibility of access to information regardless of the scope of time and space [Cantoni and Tardini, 2006; Shilpa, 2014]. The role of digital technology has tremendously increased in many sectors, as it gradually forms a globally interconnected society where shared knowledge serve as a driving force for achieving development goals in social, cultural, economic, and environment [Weigel and Waldburger, 2004]. As an instrument of change and innovation, digital literacy enters as the key component in determining key performance indicators on sustainable development [Radovanović et al., 2020]. Cultural heritage, both tangible and ICH, is situated in the heart of three major societal forces of society: culture, education, and economic sectors. According to Cantoni [2018], ICT provides a number of opportunities to connect local people and young generations with cultural heritage in 5 major areas i.e:

1. Access, which refers to information access and online experience sharing. Especially in the field of ICH, the issue lies on the provision of access in many levels, such as access to quality information, access to deeper meanings of ICH conveyed through affordable modes of applications, such as website and mobile app that functions in both online and offline, so as to cater for the needs of those living in rural areas.

2. Better Experience provided by digital technology for the users to acquire information. This principle is shown from the examples of mobile access [Pucciarelli and Cantoni, 2012], augmented reality [Korkut et al., 2020], open-source platforms, and many other innovative ways to inform outstanding universal values of cultural heritage to the public [Schieder et al., 2014].

3. Connect is related to the role of ICT that connects people regardless geographical boundaries and time to access the information through several modalities such as digital storytelling, informal learning, gamification [Adukaite and Cantoni, 2016], social media, and online reviews [De Ascaniis et al., 2018].

4. Dis-intermediate (some) relationships where digital technologies streamline, or facilitate, the information distribution, communication and promotion support that involve NGOs, local involvement, Small Medium Enterprises, and heritage stakeholders.

5. Educate is a crucial role in the use of digital technology in order to transmit structured information to upskill the capacity of professionals, learners, cultural

practitioners, etc; through eLearning, open educational resources (OER), Massive Open Online Course [Rosani et al., 2018].

1.2.1   New media in cultural documentation and learning

The pervasive development of new media contributes to the improvement of global society, especially in multidisciplinary social sciences. According to the Commission of the European Communities [2001], "The use of new multimedia technologies and the internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration". This idea sets the foundation for other initiatives to address strategic issues of the society that involve various stakeholders and multidisciplinary coordination. Cultural heritage connects learning and tourism as part of educational activities. Textile heritage is an evolutionary cultural artefact that embodies the ancestral culture and style characteristics, which are strongly related to the experience of artisans and the history of the region of origin. With all embodied dimensions, textile heritage is integrated within art diplomacy as public relation instrument of Indonesian local/national government [Cohen, 2019].

According to Gibson [1991], the communication continuum of public relations addresses the diffusion of information, persuasion, and argumentation. The concept denotes that the diffusion of information plays a central role in strengthening the relationship among stakeholders, especially in heritage conservation. Blyth [2005] argued, "museums have long been hybrids, playing a variety of significant roles as collectors and preservers of material culture, as educators, and as entertainers". Museums are the primary cultural bodies whose main roles are limited to cultural objects and diffuse, expose, and conduct knowledge mediation of cultural artefacts to the members of society [MacDonald and Alsford, 1994]. Knowledge mediation is not an easy task. This duty should be carried out with structural knowledge, creativity and sensitivity on the public presentation. According to Heo [2007], the audience is at the heart of art management, whereby all communication efforts revolve around the needs and expectations of the public and the managers of the art institutions. In other words, public audiences play the role of communication sender and receivers of cultural communication. Message differentiation might be slightly curated for those who act as main stakeholders of the heritage and those of the general audience. ICT helps museal institutions to fulfil the task of documentation, dissemination, and presentation to the public, while at the same time streamlining the relationship among stakeholders. Digitalization is not always the answer to all heritage problems when it comes to preserving heritage properties. Since the beginning of the 1990s, curators have

used web-based applications in many art institutions and universities as heritage documentation and archival instruments, which were made available to the public. However, despite rich material and sophisticated technological features being developed on the web, some obstacles arise, and these digital instruments remain inadequate when it comes to broadening public interaction and participation in acquiring valuable knowledge [Cameron, 2003; Ioannidis et al., 2014]. In particular, documentation and cultural mediation in relation to living heritage require special expertise on knowledge codification [Langlais, 2005; Matthews and Aston, 2013]. The top-down narrative defined by historians provides limited perspective and interpretation to the symbolical meanings of the textile. In addition to the assigned definitions and limitations, the specificity of textile heritage opens to a new interpretation or re-interpretation without neglecting the original context of its meanings. This curational approach to indigenous culture gives opportunities to shared authorship [Langlais, 2005], not only to the professionals (artisans, textile collectors) but also to the individuals who are inspired by the aura of the textile art. Further verification on history, community background, and other elements shall also be addressed as it may contain sensitive subjects to specific groups.

Experience is part of the essential components of ICH practice. Knowledge obtained through experience of participating and observing the practice of this living heritage could last longer in the mind of its communities. Based on Edgar's cone of experience [Dale, 1969; Molenda, 2003], experience can be in the form of direct or indirect as well as concrete and abstract in pictorial devices. The intervention of digital technologies seamlessly connects and enriches the in-situ experience of the visitors in learning cultural heritage. Other than knowledge sharing platform, digital technology is helpful to facilitate experience-led learning (such as simulation games, hybrid forums) and provide more possibilities for other autonomous learning and exploration. Both virtual and offline learning experiences are important for learners in order to internalize and comprehend the wisdom of cultural expressions.

Thanks to various technological possibilities, a digital knowledge-sharing platform is useful to reinforce the experiential and educational nature of ICH, thus increasing public participation in its safeguarding activities. Digital storytelling is one of the most popular digital technology for serving this purpose [Flottemesch, 2013; Kong and Zhang, 2021], as it combines various types of content, including images, sound, and video, in order to convey a narrative with a strong emotional component [Educause, 2008]. In order to convey exceptional cultural dimensions of ICH, ICT-based systematic teaching and learning shall be curated in a way that is in compliance with the practical and ethical principles of the pro-

posed domain [Desiningrum et al., 2019], such as the principle of continuity, professional code of Batik artisans, valorization ethic of textile art, etc. [Ministry, 2016]

1.2.2   New media in sustainable tourism and creative sectors

As Seneca, a Roman philosopher, said, "Travel and change of place impart vigour to the mind", the discourse of this thesis zooms in the role of new media in facilitating travellers in acquiring cultural knowledge in pre, during, and post travelling experience [Kalbaska et al., 2016]. United Nations [2005] stipulated 12 pillars of sustainable tourism, which provide guidance for policymakers to ensure economic viability, local prosperity, employment quality, social equity, visitor fulfilment, local control, community wellbeing, cultural richness, physical integrity, biological diversity, resource efficiency, and environmental purity. ICT intervenes as a connector that improves several aspects, such as visitor fulfilment, community wellbeing, cultural richness, economic viability, and local prosperity. Since 1994, ICT has started to be integrated within the tourism domain [Buhalis and Law, 2008]. The term 'eTourism' began to be used as a term to indicate the use of digital technology in transactional and operational activities in the tourism domain [Longhi, 2008]. ICT provides opportunities for governmental actors and tourism players to conduct destination management and promotion more effectively and efficiently and increase the capacity of tourism professionals through a devoted digital education platform [Cantoni and Kalbaska, 2010; Kalbaska et al., 2013]. Despite the growing tendency of tourists to create their own travel planning, however, the roles of travel agents are still pictured in the frame, as they provide more products and services adapted to the travellers' needs of experience at the destination. Indonesia witnessed the upheaval of digital tourism since 2008 [Shihab and Murtadho, 2011], which set a new phase of the country's economic landscape. Under the ministry of tourism, the Indonesian National Tourism Organisation managed an Adhoc website (www.indonesia.travel), which provides suggestions on natural/cultural destinations to visit for international tourists. This site also serves as Online Travel Agency (OTA) to manage hotel booking or give options to local tour operators to suit travellers' needs. Along with the stipulation of community-based tourism (CBT) as a national tourism policy, an increasing number of private-run CBT eTourism platforms have been developed in the past decade [Priatmoko and David, 2021]. In order to support local tourism and creative sectors, DMOs, cultural associations, and other local tourism actors actively promote rural tourism, including tours in textile artisan villages and other traditional villages.

In terms of creative sectors, Tomczyk [2018] stated, "the adjunct sector for the creative one is the cultural sector that has a real impact on the tourism". Textile heritage is regarded as the most strategic creative sector that brings multiplier effects on Indonesian socio-economic development. At this point, tourism serves as the window through which travellers can learn to appreciate, feel, and acquire a story to tell from their encounters with textile artisans in a destination. Social media and eCommerce platforms are types of ICT that facilitate global users in creative sectors to conduct virtual interactions in the forms of online discussions, posts, and groups related to textile heritage. Along with the stipulation of International Year of Creative Economy for Sustainable Development 2021 by the United Nations General Assembly, Indonesia launched a devoted digital initiative in order to boost the national creative sector [5] as a way to showcase the works produced by textile artisans and other related products.

Considering these different priorities, it is important to define the main goal of new media designed for Indonesian Batik that complies the safeguarding mission as stipulated in UNESCO Convention 2003 [UNESCO, 2020]. Since the grand mission is to support educative objectives upon Indonesian Batik safeguarding and awareness-raising, therefore the creation of digital technologies on this aim is focalized in providing hypermedia-intensive digital platforms. According to Bolchini [2003], hypermedia-style of web-based application incorporates certain interactive features, hyperlinks, and navigational paths with structured textual information and visual graphic design that allow users to explore, find, access, and learn the curated content within the digital platform. This type of ICT design is commonly used within art management institutions or those aiming for educational objectives. At this point, the conceptual design envisaged for the ICT emphasizes not only the informative content related to exceptional cultural values of Indonesian Batik, but also on the history of the region of origin, artisans community, textile village, and its associated destinations as the representational elements of this textile arts.

1.2.3   New media for intangible cultural heritage

New media is a powerful communication tool for enhancing new experiences and connecting users with the ICH artefacts and its practitioners. According to the UNESCO Convention 2003, the term 'Safeguarding' refers to "measures aimed at ensuring the viability of the intangible cultural heritage, including the identification, documentation, research, preservation, protection, promotion, en-

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[5]www.karyakreatifindonesia.co.id

hancement, transmission, particularly through formal and non-formal education, as well as the revitalization of the various aspects of such heritage." [UNESCO, 2020]. Furthermore, in light of increasing the sense of identity of local communities, digital technology can be used to assist local governments in creating a cultural inventory of their region and registering the stories and the know-how of ICH. Besides, the interoperability and interactivity in new media provided opportunities to attract broader participation in learning about a new culture from various perspectives [Baoill, 2008]. To this end, the conceptual design of new media dedicated to ICH shall be directed in helping documentation, cultural mediation and the transmission of historical and cultural elements of the living heritage.

Garbelli [2015] explains further that digital technologies for this ICH safeguarding purpose shall be adapted into two principles: representativity and community based dissemination. Those elements include prior research activities, such as identifying, capturing, and transmitting the authentic values/messages of ICH in a collaborative manner. On top of the representativity, inclusivity, and community points out by Garbelli [2015], Selmanovic et. al [2020] proposed three additional elements: validity, temporality, and sensitivity in the principles. Validity addresses the importance of accuracy and validity of historical records, as the existing narratives are susceptible to misinterpretation and contain subjective bias. Temporality adds to the notion of a contemporary approach on living heritage through the lens of access and connectivity. This concept also relates to the use of software and hardware that are user-environment friendly, which in other words, accessible and available from where and when it is needed in the context of technology adoption [Kent and Williams, 1996]. Finally, the sensitivity addresses the curational aspect of ICH-related content, which requires a deeper level of understanding regarding sensitive issues (such as religious, political issues, etc.) that may affect the agenda of ICH preservation.

Based on three theoretical frameworks outlined above, this study draws a reflection from the most important elements in order to generate a conceptual framework of ICT, adapted to the purpose of preserving textile heritage. The combination of ABCDE theory [Cantoni, 2018] and the elements of representativity and engagement [Garbelli, 2015; Selmanović et al., 2020] lead to a new synthesis of conceptual framework for ICT. This proposed conceptual framework consists of 4 principal components as the baseline of ICT devoted to textile heritage: Access, Representativity, Education, and Engagement, abbreviated as AREA. The AREA concept focuses on the role of accessibility, education, and stakeholders' involvement in textile heritage. Table 1.1 outlines the main and sub principles of the concept along with associated components. Figure 1.5 shows the primary

role of ICT is to provide access to all stakeholders that opens new possibilities for the general public to be representatives, to access educational information, and to participate in ICH-related engagement activities.
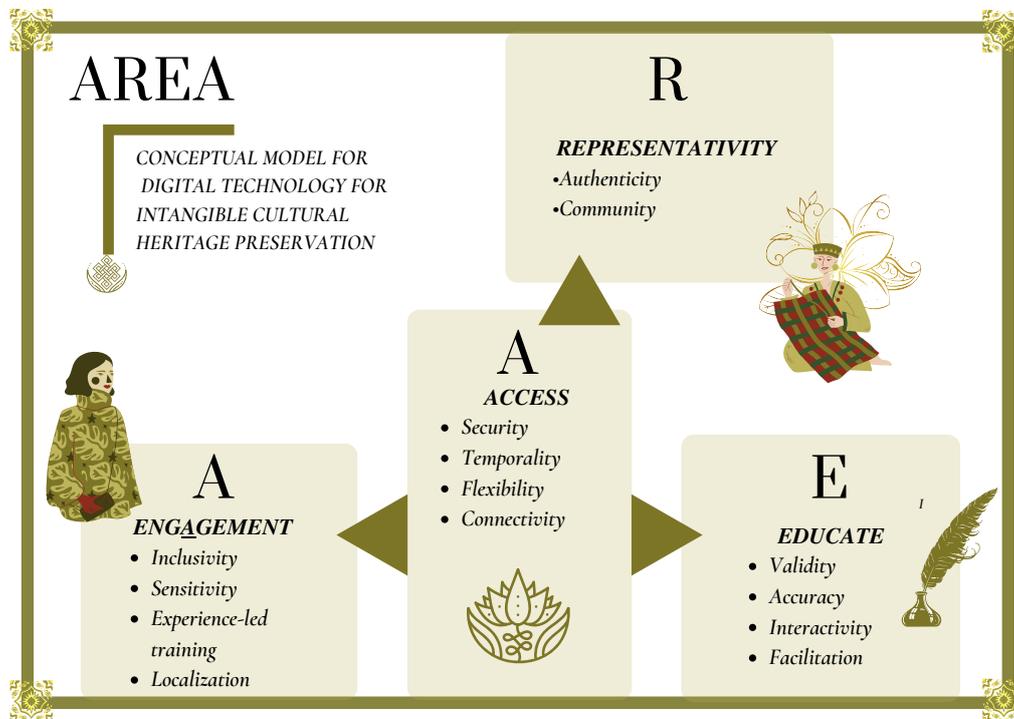
Figure 1.5. Proposed AREA Model on digital technologies for textile heritage (source: author's visual elaboration on AREA concept, 2022)

1.2.4 New media and cultural resources management for ICH

ICT devoted to ICH opens up a new horizon of knowledge for the members of communities and provides better exposure of ICH artefacts and their intrinsic values. The interoperability of ICT and adapted use of multimedia leads to the increasing interaction and the engagement of the public audience towards the heritage. Langlais [2005] suggests that the knowledge codification on ICH shall be conducted by combining dominant narratives (top-down approach) as obtained from major representatives of cultural communities with the one that emerges from the stories of the artisans (bottom-up approach). There is a void that needs to be addressed by giving a chance to the ICH practitioners to define their own narratives, add the richness of local values based on their customs

Principle	Sub principle	Definition	Components
A - Access	Security Temporality Flexibility Connectivity	ICT provides access to ICH knowledge as the primary step of preserving this practice. This principle includes flexible connectivity in terms of hardware and software and mode of operation (online/offine), to the secure database that ensures the community's trust and protection upon the legacy	Software/hardware, Online/offline access Secure database Multilanguages
R - Representative	Representativity Authenticity Community	The social component of ICH not only revolves around the circle of artisans but also professionals in other sectors. Representativity addresses main stakeholders and those who are involuntarily supporting the continuity and the authenticity of ICH practice. This principle includes other communities whose works and sectors, to a certain degree, are in line with the valorisation of ICH artefacts.	Identification of places of origin, artisans, etc Academician, Government, Professionals in business sectors (tourism, fashion, creative sectors)
E - Educate	Validity Accuracy Interactivity Facilitation	ICT acts as a functional and educational platform to store ICH-related knowledge around skills, motifs, and philosophical values as the manifestation of ancient heritage.	Feature/functionalities Educational content Knowledge-based Textual/Visual materials Students Apprentices
A - EngAgement	Inclusivity Sensitivity Experience-led training Localization	ICT helps intercultural dialogue and encourages mutual respect for other ways of Batik safeguarding culture and practices in other areas and other different communities.	Intercultural elements Thematic discussion Transboundaries (national/international)

Table 1.1. AREA Model. Proposed conceptual framework on the principles of building ICT devoted to textile heritage

and understandings, and safeguard their storytelling tradition in a new presentation. As minor representative, Batik communities has the least chance to present their own narrative. This suggestion improves their opportunities to express the meaning of specific cultural practices and significances according to their family customs, historical events, family legacies, etc. [Permatasari, 2016]. In this regard, transparency and inclusivity are key principles that broaden the discourse and ensure plurality and representativity embraced through ICT. In doing so, a feature to contribute a new narrative can be added on the digital platform to increase public participation, especially from the artisans, to add stories or other narratives to the cultural database.

Addressing the protection of ICH practices, UNESCO convention 2003, specif-

ically articles 14 and 15, outlines the holistic approach of ICH safeguarding, particularly the role of Education on awareness-raising, capacity-building and social engagement [UNESCO, 2020]. It also highlights scientific research and documentation to include places of memory and other contextual discoveries related to the identification of the ICH [Crofts, 2010, 2018]. Furthermore, through various technological, new media devoted to ICH is directed to represent cultural specificity and transmit the idea of the ICH expressions [Cameron, 2003]. Similarly, cybermuseology in the ICH context shall be adapted to knowledge-driven rather than object driven context in disseminating ICH expression through digital technology [Langlais, 2005; Crofts, 2018]. Extending the role of digital technology to transmit the identity and widen the ICH's representativity is crucial. It is considered a form of acknowledgement for the legacy under the permission of the community beholder [Situngkir, 2015]. Furthermore, digital protection of cultural property rights under customary rules provides security on revealing such fragile heritage to the public. In terms of engagement, the Convention suggests attracting the widest possible participation, especially the young generation, to follow meaningful activities that lead to practical implications on ICH preservation. Given the specificity of ICH traditional knowledge, cultural ressources management is adopted in order to represent the intrinsic significance of a textile heritage in a holistic manner. Based on the definition in contemporary context, Cultural Resource Management (CRM) is an archaeological methodology that is used for identifying and managing cultural resources, in forms of tangible artefacts and living traditions whose values are significant to people, according to socio-historical importance of the past for future dissemination, while taking into considerations of needs, public policies, and related conditions to local human populations [Hatton and MacManamon, 2003; Sebastian and Lipe, 2009]. Clark [2010] explains that CRM shall be conducted by bridging the intrinsic values of the conserved heritage with the socio-economic and environmental instruments of the addressed cultural legacy. Given Indonesia's cultural diversity portrayed on each traditional textile, it has been challenging to codify the specificity of traditional textile produced in each of 34 Indonesian regions. In order to simplify and address the fundamental issue in managing textile heritage as cultural resources, the inherent quality values of this legacy are depicted from the historical importance of the artwork, personal values, and socio-geographical instruments influencing the creation of the piece [Clark, 2010]. Combining Clark's [2010] prepositions with those in the text of UNESCO Convention 2003 [UNESCO, 2020], textile heritage documentation and cultural database creation were conducted according to the following principles:

    1. Knowledge about the production method, which refers to inherent mean-

ings behind the motifs, and the socio-cultural context of wearing rules. In particular, textile pattern is considered cultural DNA, which is formed as information sequences inherited from generation to generation [Suhandana et al., 2019; Permatasari, 2016]. This type of information requires special attention as it constitutes the main elements of the exceptional cultural values of ICH.

2. Sense of identity depicted from the personal thoughts and feelings of the representative (artisans, individuals wearing textile tradition) to the identity of the groups at community and regional level.

3. Bequest value refers to the importance of a heritage property or a legacy that shall be protected with the aim to lend it into the hands of future generations.

4. Distinctive values related to the story of the makers, particular intention or context behind the textile creation that closely related to the personal and social identity.

5. Religious values inspiring the creation of the textile heritage such as good wishes, spirituality, peace and tolerance, which demands special attention on its sacred purposes.

6. Places of memories/historical events refer to the events or places where the creation of the textile heritage is intended as a tribute to commemorate certain meaningful social events

7. Natural elements refer to the natural ingredients employed within the production process, or it can be related to the meta reflection of nature or animated beings as the source of inspiration to the textile creation.

8. Material elements refers to any valuable materials used in the textile such as silk, cotton, or other special elements constituting the excellence of the craftsmanship.

9. Myths and folklores depicted on the textile as storytelling transmitting the local wisdom to the wearer.

10. Artisanal environment is related to the workshop or gallery where the artisans work individually or in a group. These examples are seen from several visual patterns of some Indonesian Batik textiles that illustrate the working environment of the artisans.

11. Geographical indications serve as an important associative element of textile masterpiece to acknowledge the geographical origin of the artisans or where the main cultural elements belong. Furthermore, this information serves as an essential reference in order to protect the copyright of traditional knowledge.

12. Specific curatorial signifies other aspects related to the ownership of the work, such as time and to which institutions or individuals the work belongs. Unfortunately, in practice, many heritage fabrics have insufficient information to analyze based on the above-mentioned criteria. However, researchers may add

curatorial details in order to classify the textile.

Cultural Ressource Management in ICH is essential to mitigate the copyright issue or minimize the risk of cultural appropriation, as a growing concern by the ICH community [George, 2010; Farah and Tremolada, 2015]. Several solutions are drawn for adding the measures to protect traditional knowledge of ICH, including copyright statements, collective trademarks, and geographical indications, whose elements are adequately detailed in this section.

1.3   Systematic literature review

Research and studies conducted on Indonesian Batik as an ICH have significantly increased over the past decades, especially in terms of innovations in production technique, socio-economic impact, natural science, engineering, waste management, information system, and communication technology. During September 2021 to January 2022, a systematic review was conducted by investigating the existing publications from 2015 to 2021 in the field of Indonesian Batik and information communication technology in order to identify research gaps and other research dimensions. The iterative search activities on "Batik and information communication technology" as the keyword have been conducted into two phases. The first phase was performed by investigating the presence of the topic in global research platforms on technology such as IEEE, ACM, and IOp.org. The first phase of the systematic review yielded 95 research publications, which are codified into six categories such as Artificial Intelligence (Convolutional Neural Network (CNN), Gray-Level Co-Occurrence Matrix (GLCM), Scale-invariant feature transform (SIFT), textural image retrieval, extraction ensemble learning), Batik Design (fractal and computer-generated design), Augmented Reality, Virtual gallery (virtual museum, virtual fitting room, Batik 3D design space), knowledge database (web-based information system), Games (animated storytelling, quizes, etc.).

The second phase of the search employs the Google scholar search engine as an additional platform to identify international journals related to the topic. The final outcomes identify 117 scientific publications where most of the results are focused on technology-driven research products in twos domains: artificial intelligence and Batik computer-generated design (see Figure 1.8). Figure 1.7 reveals the number of research published on Batik and ICT in the period from 2015 to 2021. Few research is identified on web-based application devoted to vocational school and regional Batik industry [Widiaty et al., 2018; Soesanti, 2016]. As inferred from the systematic review, none of the topics tackles the

communication-intensive design and development of ICT on Batik combining website and mobile application for specific purposes as addressed in the case of this thesis. In addition, with the advancement of computer science, artificial intelligence contributes significantly to the archival and documentation of textile arts [Hermawan and Arifin, 2015; Kuwandy, 2021]. Therefore, the conceptualization, development and evaluation of iWareBatik (website and mobile app) are intended to address the identified research gaps, which address the issue of how to orchestrate digital media and artificial intelligence in order to support the documentation and communication of textile heritage using the Service design research and Online Communication Model framework in the context of heritage learning, tourism and fashion.

By combining new media and artificial intelligence, iWareBatik is manifested as a new advancement over the previous digital initiatives on Batik learning ever launched to the public since 2013 (see Figure 1.6). Figure 1.9 shows the hexagonal diagram illustrating ABCDE theoretical framework and additional artificial intelligence as the foundation of iWareBatik research and development. Distinctive interactional relationships between ethnographic, new media and human-computer interaction (HCI) requires special attention in addressing the issue of ICH cultural documentation and dissemination [Kim and Underberg, 2011]. iWareBatik development is adapted to this collaborative interactional model, where the three aspects are combined in order to deliver seamless experience of digital cultural database (see Figure 1.10).

1.4   About iWareBatik digital technologies

As part of the thesis outcomes, the iWareBatik, an interactive digital tool in the form of a website and a mobile app, was developed and launched on August 17th, 2021, in conjunction with the Indonesian 75th declaration of independence day. This educative platform integrates a cultural database of philosophical meaning behind 124 Batik motifs combined with 129 tourism/UNESCO sites in 34 regions and Batik/textile heritage villages in 34 regions; all presented through audiovisual (images, video) and textual contents in an engaging storytelling way. The iWareBatik digital tools, both website and mobile app, are available in Indonesian and English, equipped with interactive maps to provide users with a better experience to discover Indonesian Batik regions. Available to be downloaded in android and iOs, the mobile app possesses two interactive features called spinning wheel as a form of gamification feature to choose any Indonesian region and Batik recognition tool randomly. Furthermore, in connection with the smart-

Digital Initiatives and AI-based Augmented Reality in Batik Learning
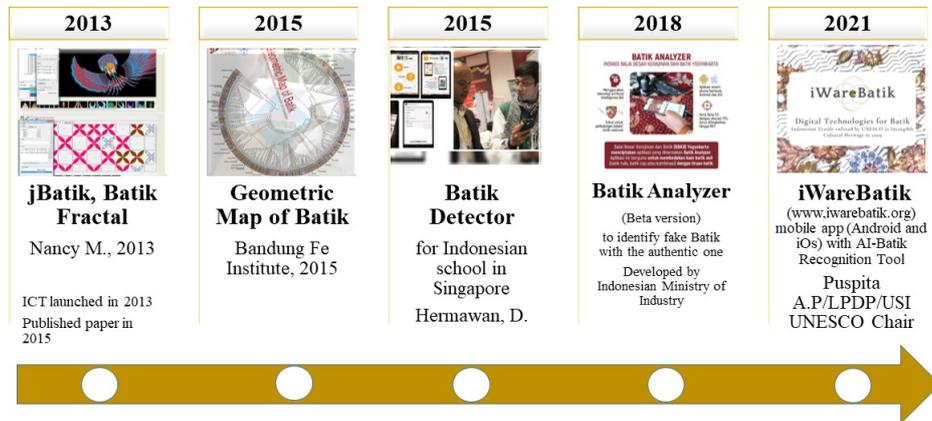
Figure 1.6. ICT for Batik learning since 2013 to iWareBatik (source: author's graphic elaboration, 2022)
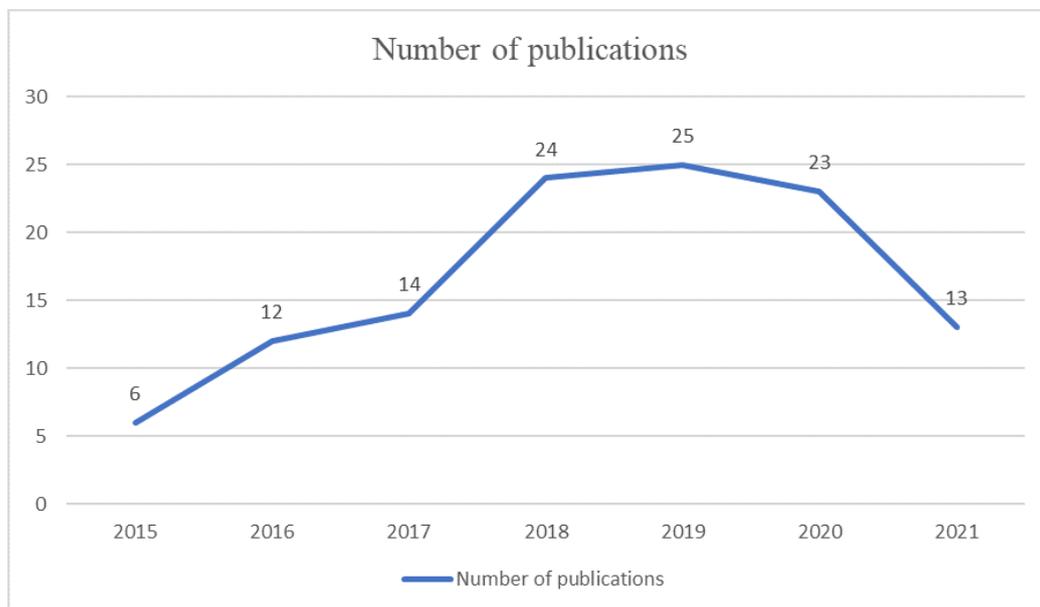
Figure 1.7. Number of publication on Batik and ICT in the period from 2015 to 2021
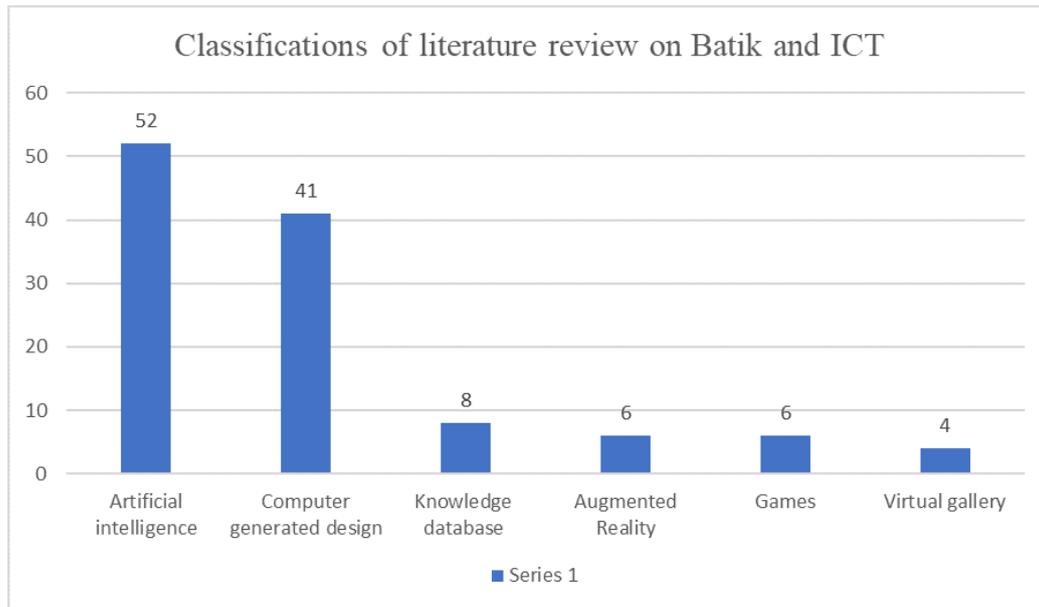
Figure 1.8. Classification of literature review on Batik and ICT in the period from 2015 to 2021

phone camera, the Batik recognition tool helps users recognize the motif image captured by users according to 8 classes of Batik motifs such as Ampiek, Ceplok, Gurda Kawung, Lereng, Mega Mendung, Merak, and Parang. iWareBatik serves as a digital cultural mediation that supports safeguarding missions of Indonesian Batik, as UNESCO ICH since 2009, and capacity-building of its stakeholders. Its main functions are to store and communicate the traditional knowledge in terms of Batik significances, motifs, procedures, history, origin, the production process in 34 Indonesian and other related information. Overall, iWareBatik provides audiovisual materials that improve Batik teaching activities and help make the learning experience memorable. Figure 1.11 presents the outlook of iWareBatik website interface, while Figure 1.12 displays interactive map of iWareBatik website that allows users to explore the diversity of Indonesian textile heritage from the web interface. Figure 1.13 shows the interface iWareBatik mobile app along with its features and functionalities, as well as the result example of Batik Recognition Tool.

The name of iWareBatik is defined according to semantic and linguistic perspectives. The "I" indicates as interactive, or can also be interpreted as "I" as the first person singular pronoun in English. The syllable "Ware" has a double interpretation. One meaning refers to "Software" in technology. The other one is an English adjective word of "Aware", which means having knowledge or conscious-
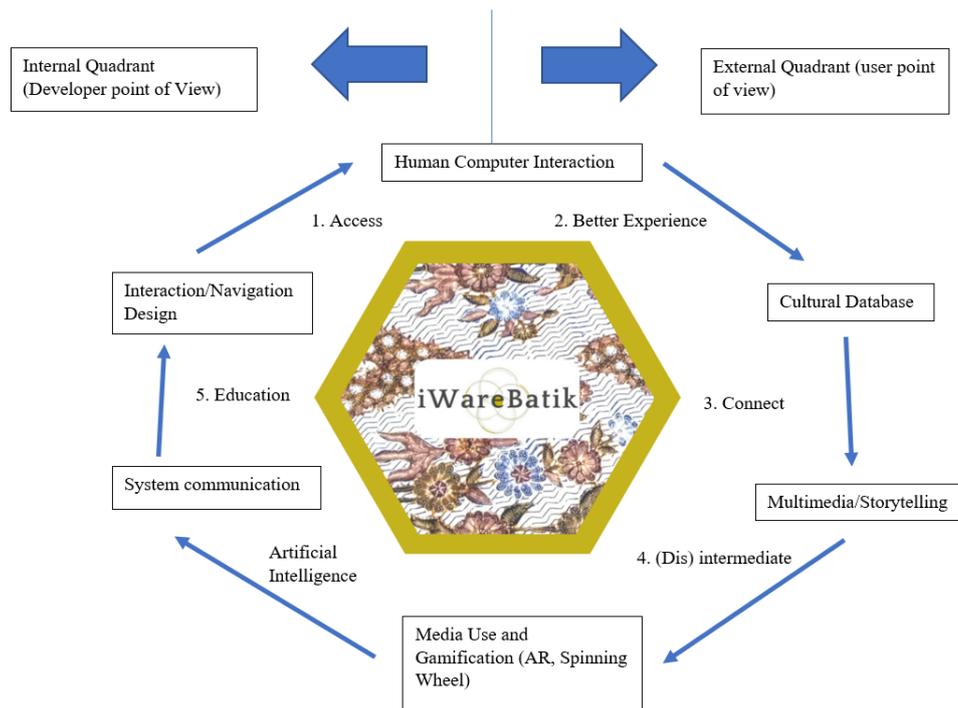
Figure 1.9. ABCDE theoretical framework and artificial intelligence as the foundation of iWareBatik research and development (source: author's graphic elaboration of the ABCDE theory+AI analysis, 2022)

ness about a particular thing, specifically referring to the awareness towards the exceptional cultural values of Batik as a UNESCO ICH since 2009. In addition, the word "ware" also has similar pronunciation (homophone) with an English verb "Wear" that signifies "to wear, to put on (clothes)". Therefore, the name 'iWareBatik' has two meanings, which refers to the technological abbreviation of "interactive softWARE of Batik", and another semantic signification as "I am aWARE of Batik" or "I wear the Batik". The logo of iWareBatik contains a letter "e" that signifies information technology as an electronic-based instrument. The four rings circling the letter "e" symbolizes its function as digital technology to facilitate heritage preservation, education, tourism and fashion. This four-circles logo was inspired by the Kawung motif, a Batik pattern from Central Java, which signifies the four noble virtues of maintaining communication and relationship with God, oneself, fellow human beings, and the environment (Figure 1.14). iWareBatik as digital media serves the role of ICT in 5 major areas in accordance with ABCDE theory as follows:
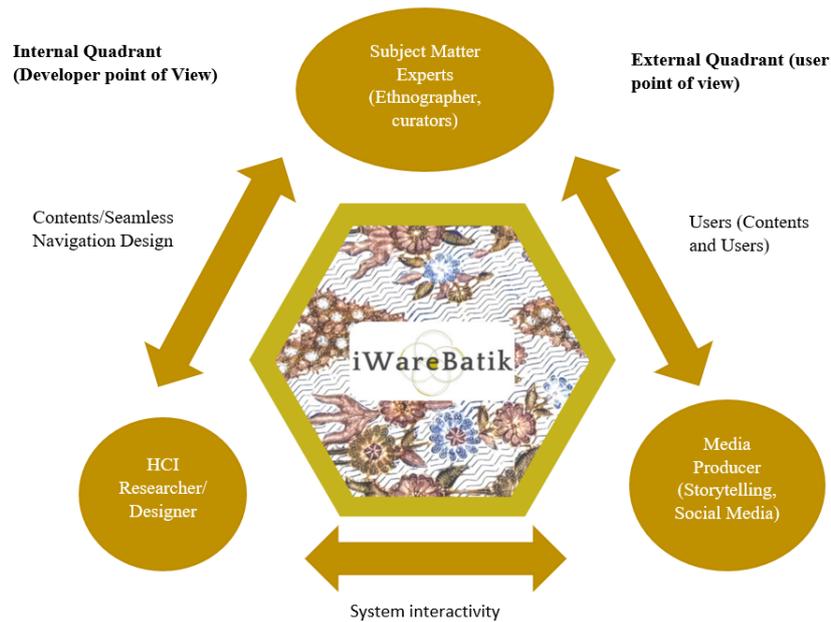
Figure 1.10. Collaborative Interactional model of iWareBatik cultural database adapted from conceptual model of ethnography, new media and HCI [Kim and Underberg, 2011] (source: author's graphic elaboration of interactional model, 2022)

Access. Available in English and Indonesian languages, the iWareBatik digital technology gives Batik heritage information to two types of audiences, domestic and international. Since some schools and training centers in rural and remote areas may not have access to the internet, iWareBatik mobile app can be used both offline and online in order to gain access to the motif database and region descriptions. When the app is connected to the internet, users can enjoy additional features such as watching video materials and accessing Batik Recognition Tool.

Better Experience. iWareBatik is equipped with dynamic and interactive features such as interactive maps (both within the website and mobile app), mobile app spinning wheel, the evolution of Batik motif timeline across centuries on the website, and AI-powered Batik recognition tool embedded within the iWareBatik mobile app. iWareBatik displays rich audiovisual information depicting the diorama of nationwide Indonesian Batik producer communities in the form of images of 124 Batik motif and 129 Indonesian destinations, videos related to each destination, how to produce Batik and one-minute video of Indonesian

Figure 1.11. Interface of iWareBatik website. (source: www.iwarebatik.org)

Figure 1.12. Interactive map of iWareBatik website. (source: www.iwarebatik.org)

App Overview
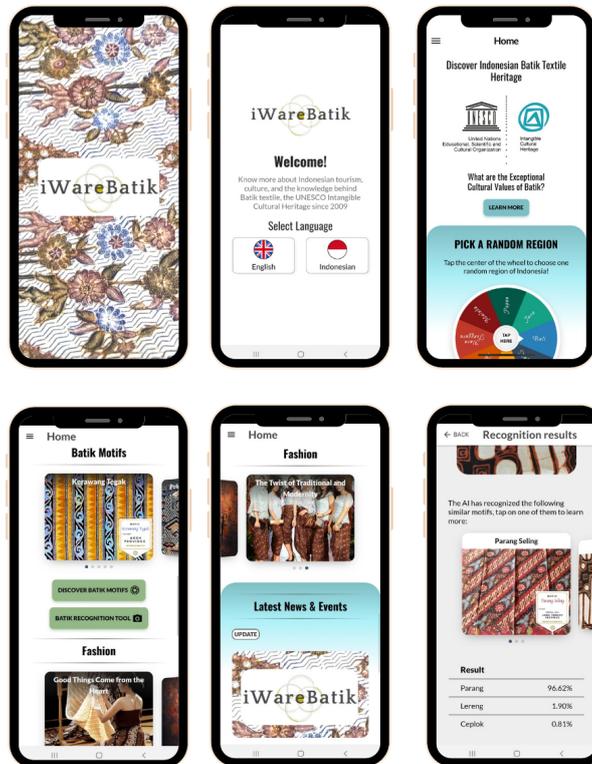
Figure 1.13. iWareBatik mobile app features and functionality and the results of Batik recognition tool (iWareBatik app download is available at Google play store and iOs apple store)

Batik destination in 34 provinces.

Connect. iWareBatik digital platform connecting people to the ancient memories of Batik and new insightful narratives about the map of cultural diversity in 34 Indonesian regions. Using interactive features and multimodalities, it showcases multiple facts about Indonesian Batik in tourism and fashion contexts and communicates suggestions about preserving Batik textile in a sustainable way. iWareBatik has a dedicated Instagram account with 670 followers (as of 14 January 2021), connecting the Batik community (artisans, designers, textile lovers, etc.) worldwide to get updated and join some online activities organized by the iWareBatik team.

Dis-intermediate. iWareBatik facilitates Batik information seeker to shortcut the long process of obtaining quality information by accessing one platform. Each content was managed and written in accordance to multiple sources, such as the official documents of Indonesian cultural archives, information texts/voices obtained from local producers telling about the rare motif and its wisdom during the field study, and literature reviews on Indonesian fine arts published by Indonesian universities. The content composition was analyzed and written based on an ethnographic method that conserves the folktale and generates insightful interpretations. iWareBatik website also provides an online form for those who want to be content contributors to alleviate public participation by attracting people to produce personal narratives about Batik heritage in forms of written or audiovisual formats.

The provision of the AI-powered Batik Recognition Tool (BRT) is also an example of the role of ICT in dis-intermediating the information process. Instead of acquiring knowledge from many ubiquitous online sources, the motif database embedded inside the app help user access the hidden identity of the motif. This tool is adapted for two scenarios: information inquiry and voluntary scenarios. Information inquiry scenario is a condition when a user captures a motif that belongs to one of the 8 class motifs; BRT feature provides three possible results according to the percentage of image similarity provided by the AI system. This scenario applies to the textile collectors, museum curators, Batik artisans, or knowledgeable users. However, due to the complex process for adding more classification, BRT is still helpful in getting acquainted with the most popular Batik motifs in Indonesia. On the other hand, in the voluntary scenario, the user captures an image of a motif, a surface, or any object (even a selfie photo) that does not belong to the eight motif classifications and still feels curious about BRT's results. In this way, the user can still access the information about 3 possible results among 8 Batik motif classifications. The latter scenario is usually tested by general users who have the least knowledge of Batik or do not possess any Batik-related products. In this way, BRT may incite further dialogue among users. They come across the unique experience of finding out the story of the Batik motif (or any patterned object), while acquiring new information about Indonesian Batik culture.

Educate. The iWareBatik digital storytelling research aims at increasing the experience of learning Batik intangible heritage through the fusion of new media convergent so that users could interactively learn by playing the functions chosen from a more comprehensive array of segmented information in order to get a better understanding of Batik motifs developed in each searched area. Dange [2015] concluded that educational experiences with physical learning, in-
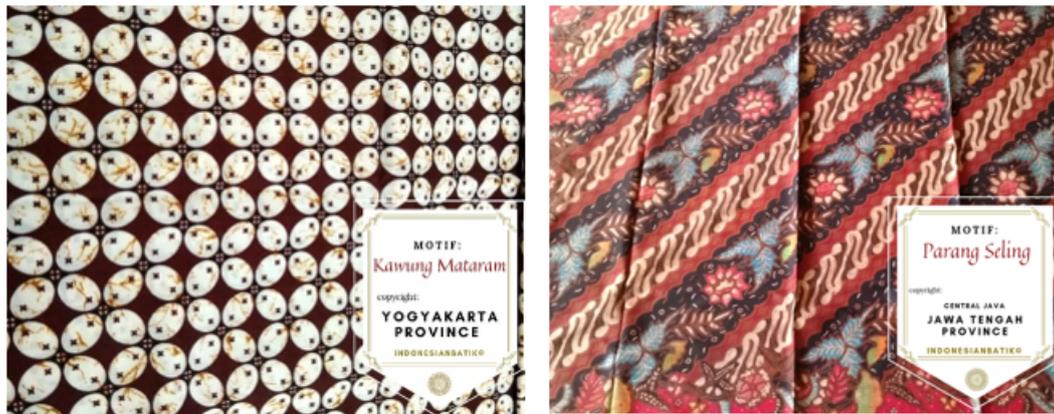
Figure 1.14. Examples of Kawung motif (left) and Parang Seling motif (right) on iWareBatik website and mobile app. A visual label is attached on each motif to provide copyright information such as motif name and its place of origin (source: www.iwarebatik.org)

teraction, and concrete are retained longer than abstract learning model which is traditionally done by learning from text, in-class lecture. iWareBatik digital storytelling software conforms several types learning experiences for the user, i.e tactile, kinesthetic, Visual experiences, still pictures/radio/recordings, motion pictures/television/computers, Virtual learning experiences, where every individual user are allowed to touch and physically interact with the learning tool in order to search thematic Batik motifs according to symbols and meanings, to input their story from text-based narrative to audiovisual, as well as learning the information generated from the curated database. It is an effective way of diffusing the conservation campaign on Batik safeguarding and satisfies the curiosity of every Batik lover instead of simply hearing or seeing a lesson.

Adding to ABCDE principles, the development of the iWareBatik digital initiative adopts the principle of Representative and Engagement, as proposed in the AREA model (Access, Representative, Educate, and Engagement). These two elements are vital to incorporate the inclusivity and responsibility of the involved stakeholders in asserting and supporting the adoption of digital technology for ICH (see Table 1.1).

Representative iWareBatik digital technology obtained significant support from the Batik artisans, academicians, USI UNESCO Chair, Indonesian governmental bodies, Indonesian overseas student association alliance (OISAA), and Sobat Budaya as the leading cultural association in Indonesia, in order to increase its visibility and other relevant aspects for communicating Batik preservation in

Figure 1.15. Examples of motif information displayed on iWareBatik website with a (textual) copyright statement to protect cultural property right of Batik motifs as ICH knowledge (source: www.iwarebatik.org)

international and domestic contexts. During its development, several stakeholders engaged in tourism and fashion sectors contributed to the content creation and creative components of iWareBatik. In addition, the process of defining the historical content of Batik involved a cultural database from higher authorities and research bodies, along with information obtained from literature reviews on Indonesian Fine Arts for documenting insightful meanings of textile motifs.

Figure 1.16 outlines the curation process and tasks hierarchy within the development of iWareBatik digital database, from the literature review, copy editing, video making, to the refinition of 8 Batik motif class used in Batik Recognition Tool. In order to protect traditional knowledge, a copyright statement is presented in two different formats: a visual label containing motif information such as the name, geographical indications, etc. (see Figure 1.14) and copyright statement protected under Indonesian cultural property law under motif information presented on the website (see Figure 1.15).

Engagement. Since its launching on August 17, 2020, iWareBatik digital technology has been extensively promoted nationally and internationally through various webinars and scientific talks. As a result, since its launching until 11th May, 2022, the iWareBatik website has achieved 114'282 visitors and 3'670 app downloads on Android and iOs. As mentioned in several online dialogues, many Indonesian schools, Batik training centres, local tour operators, and museums

Figure 1.16. Content curation process of iWareBatik cultural database (source: authors' graphic elaboration, 2022)

use iWareBatik as an additional tool for teaching and learning activities. Another socialization activity was conducted by involving 997 bachelor students from 33 Indonesian universities nationwide in order to participate in the user experience evaluation activity, conducted from August 12 until September 25, 2021. This evaluation activity serves as a learning activity and community engagement, which are deemed necessary for the upskilling and awareness-raising of students as young stakeholders towards this living heritage. In addition, iWareBatik help Indonesian representative government bodies and Indonesian embassies worldwide to facilitate Batik cultural promotion to international and Indonesian audiences.

1.5   Research methodologies

In order to produce a salient and robust research contribution for supporting living heritage preservation, the design, development, and evaluation of iWareBatik digital technologies employ the incorporation of four methodologies, namely service research design, ADDIE instructional design, online communication model and Analysis Web App Requirement (AWARe) model. Service design research is seen as a catalyst for societal change thanks to the intervention of digital technology that address problems resulting from the emergence of social needs and cases [Rytilahti et al., 2015]. This type of research aims to develop new knowledge obtained from the cycle of the action research process, in order to formulate a theoretical or practical contribution as an exemplary case study for other related research projects. According to Suri [2008], service design research involves explorative, generative and evaluative design approaches, which combine an in-depth understanding of human-centred insights in a socio-cultural and technological context. It implies continuous learning throughout the process of developing and delivering scalable service products. The satisfaction of users and developers is paramount in service design research. Rytilahti et al [2015] claim that user interfaces of any service product shall comply with the usability principles, effective, and desirable in order to ensure the utmost clients' and users' satisfaction upon the delivered service.

This thesis introduces a conceptual framework and a case study through the creation of iWareBatik digital technologies (a website and a mobile app), as empiric evidence of how participatory design of ICT and online communication model are successfully integrated into an action-based service design research framework. The initial steps include defining ideation and prototyping, which determine the final product's characteristics as adapted to the needs of various

categories of the users (teachers, batik artisans, governmental bodies, domestic and international tourists, etc.). The presented outcomes of the thesis contribute to enhancing the perspective of practitioners and professionals engaged in digital technology and heritage conservation domains by providing a detailed journey, combining theories and practical outlook to illustrate the holistic process of developing digital technology devoted to ICH. Starting from the analysis, design, implementation and evaluation stage, this thesis illustrates all the steps required while ensuring its quality through a series of experiment-based research outcomes and user testings.

Seals and Richey [2012] define research and development as a systematic assessment that focuses on the design, development and evaluation of programs and learning products that must meet the criteria of validity, practicality, and effectiveness as an value-added to education management [Alavi et al., 1997]. To this extent, service design research is an action-based conceptual framework that conforms with the participatory elements of the study and provides structural design thinking as the added value of the project. This framework directs a research project from the design research, co-creation, user experience, learning, and community engagement. Furthermore, several conceptual frameworks are employed in order to form a coherent analysis throughout the research work. Under the service design research framework, the study uses the ADDIE instructional model that stands for Analysis, Design, Development, Implementation, and Evaluation [Botturi, 2003; Armani et al., 2004]. This model ensures formative evaluation is conducted not only to the outcome of the digital artefacts but also on to the three prior stages (Design, Development, and Implementation) [Botturi, 2003]. ADDIE model is a popular instructional model for developing an eLearning system that is congruent with the research structure, from the analysis to evaluation purposes of the technology innovation. During the development of the iWareBatik knowledge database, Cultural Resource Management (CRM) [Clark, 2010] is used as an effective methodology in order to provide guidelines in the documentation and curation of Indonesian Batik intrinsic values.

In combination with the ADDIE model, the online communication model (OCM) acts as the theoretical concept employed within all phases of the ADDIE model framework. It provides detailed guidance in understanding online communication and its contextual information, human-computer interaction elements, design requirements and evaluation aspects for communication-intensive digital artefact, as manifested by iWareBatik project. This model starts from benchmarking and user requirement elicitation (URE) analysis, which are used to inform the design elements for developing content, features, and functionalities, based on the extensive analysis of stakeholders' needs, requirements, and

technical dimensions. In order to elicit the needs and requirements of main stakeholders and site users at a more granular level, this research adopts Analysis Web App Requirement (AWARe) as the conceptual guidance to conduct the URE activity. This method is chosen for its distinctive way of guiding the URE process while stressing on 'the awareness' of the needs, requirements and communication objectives elicited between main stakeholders as an information provider and site users as information receivers (see Figure 1.18). Furthermore, this concept aligns with the goal of iWareBatik in serving the purposes of the organizations involved in this project. AWARe allows technology designers to transform the elicited requirements and soft goals (ill-defined goals) of the stakeholders into a goal graph that codifies seven design elements: Access (A), Content (C), Presentation (P), Structure of Content (SC), Navigation (N); User Operation (U), Interaction (I), and System Operation (O). Figure 1.17 displays the overall theoretical frameworks constituting the body of iWareBatik research.

1.5.1   Research questions

iWareBatik research and development followed and completed all stages indicated in service design. The analysis of design research as the first element continues with co-creation through URE, prototyping, and followed by formative evaluation (see Figure 1.19). According to Suri [2008], evaluative or formative design research is part of the engaging learning process that brings the spirit of co-design and co-discovery to reflect on the concept with intuition, creativity and critical thinking. Prototyping serves as a way to build a tangible representation of the preliminary idea of digital technology through iterative ideation exercises, design sketches and prototypes [Hartson and Pyla, 2012]. For example, Perrone [2019] built the first version of iWareBatik mobile app as a prototype of the interface and interactional design. Through participatory heuristic evaluation [Muller et al., 1998], the expert review was conducted by the experts to give feedback and suggestions in order to test, validate, enhance, and improve the design decisions before the launch and actual user testing. Time flexibility, cost-effectiveness and accuracy are advantages of expert review in the early stage of project development [Hartson and Pyla, 2012]. Further study was conducted to define the intended audience, data synthesis, methods and analysis of device or materials used for the development. At this stage, the outcomes are triangulated with the feedback of experts and colleagues.

As the last stage of this thesis, the evaluation activity is a crucial step in order to measure technology adoption and evaluate to which extent iWareBatik is successful in achieving its goals and providing good users' experience accord-
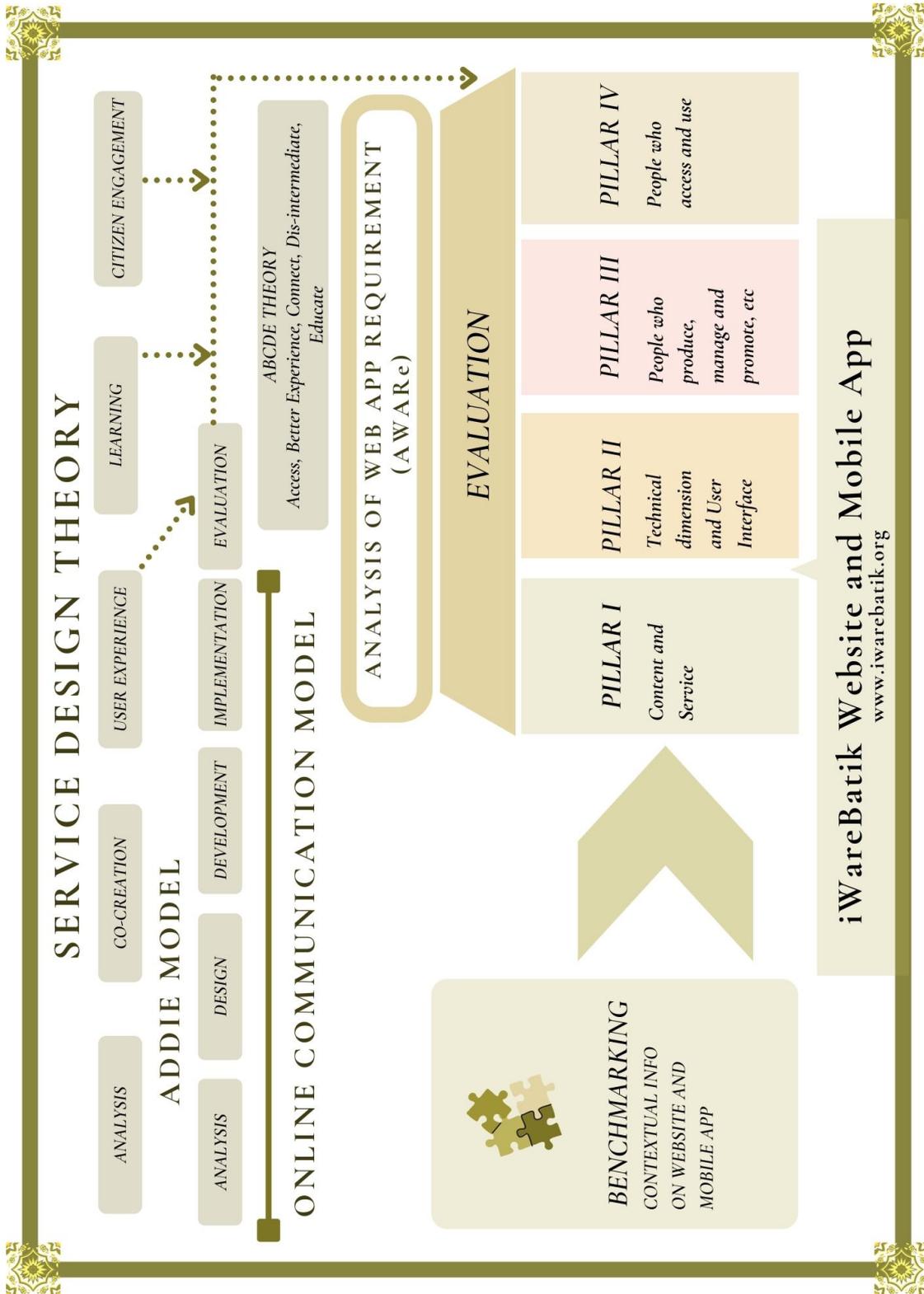
Figure 1.17. Theoretical frameworks of iWareBatik (source: authors' graphic elaboration, 2022)

Figure 1.18. iWareBatik online communication map, (source: authors' graphic elaboration, 2022)

ing to the given scenarios. According to service design theory, user experience

evaluation activities, as the final part of this study, shall be conducted according to three purposes: obtain evaluation feedback for iWareBatik digital platforms, provide a learning experience for the student participants and strengthen community engagement. Therefore, iWareBatik evaluation activities aims to harness citizen engagement by involving 997 bachelor students to deliver feedback for iWareBatik and provide locals to access the virtual learning program on how to safeguard textile heritage through the use of digital technology. Measurements and elements used within the evaluation usability were formulated based on ADDIE instructional model, Online Communication Design, and AWARe.

Analysis   Benchmarking studies
- October 2017-July 2019
- Chapter 2: "Indonesian Tourism and Batik: An Online Map", "Mapping Mobile Apps on Batik, A Journey across Heritage and Fashion", "From Web 1.0 to Web 4.0: Digital Heritage for UNESCO properties in Indonesia", and "Digital Technologies for Communicating Fashion Heritage"

Co-creation   Design and Development
- July 2019-July 2020
- iWareBatik web-based cultural database, backend development of iWareBatik mobile app and Batik Recognition tool
- Chapter 3: "Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage. The Case Study of iWareBatik"

Launching   Implementation
- July 2020-August 2021
- The launch of www.iwarebatik.org and iWareBatik mobile app on August 17th, 2020
- Chapter 4: "Unveil the Hidden Meaning: Batik Recognition Tool"

User Experience   Evaluation (Learning and Citizen Engagement)
- August 2021-December 2021
- Learning activities and citizen engagement through iWareBatik UX workshops with 997 bachelor participants in collaboration with 33 Indonesian universities nationwide.
- Chapter 5: "More Than Words: Evaluation Study on iWareBatik Digital Technologies in the Perspective of Batik Learning and Sustainable Heritage Tourism"

Figure 1.19. iWareBatik research and development according to service design theory

Through series of experiments and studies, the dissertation outlines the results of doctoral research according to the following research questions (RQ):

RQ 1. How is Indonesian Batik presented online? Sub-question: What kind of digital technologies that exist to communicate Indonesian Batik?

RQ 2. How should iWareBatik digital technology be developed to better communicate the preservation of Indonesian Batik in the tourism and fashion

context? Sub-questions: a) What are the needs and requirements of relevant stakeholders and audiences for developing digital technologies dedicated to Indonesian Batik?

b) What kind of features, functionalities, and contents that shall be developed and curated for iWareBatik website and mobile app according to elicited requirements?

c) What kinds of content and features should be provided in order to better communicate Indonesian Batik as UNESCO ICH 2009?

RQ 3. How should the Artificial Intelligence-based Batik Recognition Tool as part of the mobile app feature developed? Sub-question: What is the comparison between VGG16 and MobileNetV2 as Convolutional Neural Network in terms of accuracy for building Batik pattern recognition?

RQ 4. How are the iWareBatik digital technologies evaluated under the perspective of sustainable heritage tourism? Sub-question: Which elements are the most influential in determining satisfaction and behaviour intention to use iWareBatik?

1.5.2   Data collection and methods

This data collection process of the research is conducted in several stages as follows:

Observation. Observation is a technique of collecting data by conducting a systematic observation and recording of the symptoms or phenomena in the studied area. Field study observation was conducted by on-site participation in the social setting in a certain period while employing several ways to document and collect the data through the use of audiovisual technology, voice recordings, and conventional ethnographic notes [Bryant, 2015]. The observational data was conducted using the ethnographical approach in order to interact and obtain information from local Batik experts, listen to their knowledge and compile the information, then transcribe the interviews. Madden [2017] asserts that the ethnographic method is defined as "an interpretive and explanatory story about a group of people and their sociality, culture, behaviours", whose narratives are gathered based on systematically analyzed data. This methodology is deemed effective for collecting primary data based on the actual situation and inductive discovery. Moreover, it provides a deeper understanding in capturing the nuances obtained from the observation. The study integrates findings, interviews, and notes obtained from field research activities during the previous master study on developing sustainable cultural tourism based on the valorization of Madura Batik villages in Indonesia [Permatasari, 2016]. The field study

Figure 1.20. Batik workshop environment in one of Batik villages in Sragen city, Central Java, Indonesia. (source: author's documentation in July, 2018)

included observation on Batik workshops and interviews with various stakeholders such as Batik artisans, merchants, and governmental officials in four cities along the Madura northern coastline, namely Bangkalan, Sampang, Pamekasan, and Sumenep. During the course of PhD research, the subsequent research observation was conducted in four cities in Java island, Indonesia, namely Cirebon city in West Java, Sragen, Lasem and Solo city in Central Java in July 2018. The field study obtained primary observational data in the form of audiovisual data and interviews with Batik practitioners, museum curators, travel guides, gallery owners, etc. The data gathered during field study were used to build the Indonesian Batik cultural database and inform design elements of the iWareBatik website and mobile app in Chapter 3, as well as presentation materials in some scientific seminars [Permatasari, 2018].

Figure 1.20 illustrates author's involvement in Batik workshop in Sragen city, Central Java, Indonesia. Figure 1.21 illustrates the painting process by young Batik makers in Lasem city, Central Java, Indonesia. Figure 1.22 presents young male Batik makers working at a Batik exhibition in Sragen city, Central Java, Indonesia.

Literature review. This study applies two types of literature review: an integrative review and a systematic review. Integrative literature review refers to

Figure 1.21.   Young Batik painters in one of Batik villages in Lasem city, Central Java, Indonesia (source: author's documentation in July, 2018)

the synthesized analysis of several research articles, books, and other published text relevant to the research topic. This type of review may address broad to narrow research topics, ranging from theoretical framework to practical contributions, providing an overview of the studied area. A systematic review is a research method that provides reliable analysis and critical identification on empirical evidence obtained from reviewing articles relevant to pre-defined (specific) search criteria to answer the research question [Snyder, 2019; Moher et al., 2009]. Davis et al [2015] assert that systematic review on social science provides meta-analysis and synthesized guidelines in identifying find concepts or theoretical foundation to constitute the state of the art. The literature study also provides an overview of previous research results as an essential systematic comparison to developing digital artefacts.

Interview. The study uses non-probability sampling, especially purposive sampling, convenient sampling, and snowball sampling [Saunders et al., 2009]. The purposive technique is a technique that requires researchers to have preliminary information (through literature review, observation, etc.) as a rough or approximate understanding in order to determine certain people as key informants that represents a cross-section of the population [Battaglia et al., 2008]. Convenient

Figure 1.22. Male Batik painters working at a Batik exhibition in Sragen city, Central Java, Indonesia (source: author's documentation in July, 2018)

sampling refers to informants chosen from the author's personal contacts, whose expertise and characteristics align with the interview objectives. Finally, snowball

sampling refers to people recommended by convenient informants who may add or complement information that emerged from the study [Saunders et al., 2009]. The combination of those interview techniques yielded an in-depth exploratory study on public opinion with regards to challenges and current phenomena on education, social behaviour, and ICT intervention in the context of Indonesian textile heritage.

*Questionnaire or Survey.*In addition to interviews, data collection employs questionnaire techniques during user requirement elicitation and usability user testing. Salient and sound survey questions necessitate rigorous literature review and expert evaluation in order to ensure effective data collection that serve research objectives in the digital technology domain [Alkhafaji et al., 2018]. Each research questionnaire was administered through an online Qualtrics survey platform and is designed according to the studied context. Open questions survey allow respondents to answer according to their own opinions. Closed-ended ones enable participants to choose one or more answers or statements that are relevant to them [Krosnick, 2018]. Multiple choices and Likert assessment model were integrated, offering options for respondents to express their inclination and level of agreement or disagreement (ibid).

1.5.2.1   Data analysis methodology

The research employs a convergent mixed method design approach, which combines both qualitative and quantitative methods in order to generate a comprehensive analysis of the collected data (observation, case study, literature review, online data mining, and survey results) to strengthen the research findings [Chaumba, 2013]. This method provides a holistic instrument for participatory research design as it ensures reliability and validity of the empirical evidence through qualitative-quantitative analyses of phenomena [Fetters et al., 2013].

Given the multidisciplinary nature of the study, several mixed methods were employed, such as triangulation, embedded design, and explanatory sequential design [Green et al., 2007]. Triangulation refers to parallel data analysis that combines the quantitative and qualitative data analysis data conducted at the same time in order to gain an in-depth understanding of particular research subjects. This method was employed for assessing the benchmarking study in chapter 2 and during the experimental of the Batik recognition tool in Chapter 4. Embedded design mixed method refers to the inclusion of qualitative part, or vice versa, into the study in order to support findings achieved by the priority method. This method was employed during the participatory-based user requirement elicitation, where the qualitative interview method complements and

strengthens the design decisions obtained from survey results, as explained in Chapter 3. Explanatory sequential design prioritized quantitative data analysis in the first phase, whose results inform the criteria selection and are triangulated with qualitative analysis performed in the second phase. This method was employed in the usability evaluation study outlined in Chapter 5.

Qualitative method. The qualitative data is generated from interviews, field observations conducted in several cities and literature studies that ensure the quality of research findings combined with the survey results. The objective of intra-analysis is to collect and depict a range of narratives from the stakeholders by structuring the problem and visualization process [Noor and Nordin, 2012].

Quantitative method. The quantitative method is an experimental research analysis conducted through calculations, embedded statistical scale and modelling [Chaumba, 2013]. The research further employs descriptive statistics as research methodology, which provides an overview of the results of the object studied through graphs, frequency diagrams, tables, etc. This methodology was employed to analyse the online presence during the benchmarking studies, to define design elements during the URE phase, and to assess satisfaction and behaviour intention to use during usability evaluation.

1.5.3   Research publications

Considering that the success of digital technology relies on its fundamental role in enhancing community awareness on the importance of ICH, this thesis addresses the challenge of improving its dissemination to the society by building engaging and effective digital technologies based on action research design frameworks and Online Communication Model (OCM). The accumulative PhD study is composed by the following results:

Chapter 2 consist of design research analysis resulted from four research papers on benchmarking study as follows:

1. A study entitled "Indonesian Tourism and Batik: An Online Map" was conducted to investigate the way how Batik textile heritage communicated online by looking at the online presence of Batik in the Indonesian tourism context, both addressing international and Indonesian domestic tourists. The study analysed 200 web pages that cover Batik information in tourism context in Indonesian and English languages. The research was published in January 2019 within the E-review of Tourism Research (e-RTR) [Permatasari and Cantoni, 2019a].

• Permatasari, P. A., and Cantoni, L. (2019). Indonesian Tourism and Batik: An Online Map. E-Review of Tourism Research, 16(2/3).

https://journals.tdl.org/ertr/index.php/ertr/article/view/331

2. Analysis of the features and functionalities found in existing mobile application dedicated to communicating Indonesian Batik, both in Android and iOs platforms. A study entitled "Mapping Mobile Apps on Batik, A Journey across Heritage and Fashion" was published as Full Paper in the conference FACTUM 21 – Fashion Communication: between tradition and future digital developments in July 2019 [Permatasari and Cantoni, 2019b]. This paper outlines the categories and common features of 164 mobile apps on Indonesian Batik.

• Permatasari P. A., Cantoni L. (2019) Mapping Mobile Apps on Batik: A Journey Across Heritage and Fashion. In: Kalbaska N., Sádaba T., Cominelli F., Cantoni L. (eds) Fashion Communication in the Digital Age. FACTUM 2019. Springer, Cham. doi:10.1007/978-3-030-15436-315

3. Another benchmarking study was further conducted by analyzing mobile apps dedicated to communicating 18 UNESCO properties (nine tangible and nine intangible cultural heritage) in Indonesia. This research aims at widening the horizon of understanding the digital environment of Indonesian cultural heritage in general by identifying 322 mobile apps in cultural heritage based on the given categories. A study entitled "From Web 1.0 to Web 4.0: Digital Heritage for UNESCO properties in Indonesia" was published in Virtual Archaeology Review (VAR) journal in 2020 [Permatasari et al., 2020].

• Permatasari, P. A., Qohar, A. A. and Rachman, A. F. (2020). From web 1.0 to web 4.0: the digital heritage platforms for UNESCO's heritage properties in Indonesia. Virtual Archaeology Review, 11(23), 75-93.
https://polipapers.upv.es/index.php/var/article/view/13121/12730

4. A study entitled "Digital Technologies for Communicating Fashion Heritage" illustrates an overview of best practices and examples conducted to communicate national textile heritage and luxury brand heritage through digital technology. The study was published as a book chapter in the "Heritage, Tourism, and Technology" in February 2022. [Permatasari and Kalbaska, 2022].

• Permatasari P. A., Kalbaska, N. (2022) Digital Technologies for Communicating Fashion Heritage. In: Silvia De Ascaniis and Lorenzo Cantoni (eds) Handbook on Heritage, Sustainable Tourism and Digital Media. Edward Elgar 2020, UK. https://www.e-elgar.com/shop/gbp/handbook-on-heritage-sustainable-tourism-and-digitalmedia-9781788970075.html

Chapter 3 focuses on the co-creation activity to define design elements of iWareBatik digital technology based on OCM and AWARe model

5. The design process of iWareBatik digital technologies was developed according to OCM and AWARe model. A research article entitled "Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage. The Case Study of iWareBatik", was presented in the Human-Computer Interaction

Internation Conference, Washington and published in LNCS Journal in July 2021 [Permatasari and Cantoni, 2021].

• Permatasari, P. A., and Cantoni, L. (2021, July). Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage. In International Conference on Human-Computer Interaction (pp. 88-106). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-030-78224-57

Chapter 4 addresses the implementation of Batik Recognition Tool that provided new discovery of artificial intelligence machine learning architecture to support the research objectives

6. As part of the digital product, a pattern recognition system to recognize 8 Batik motifs classifications, called 'Batik Recognition Tool' embedded within the mobile app, was developed together with Reinard Lazuardy Kuwandy, a Master student in Computer Science at USI – Università della Svizzera italiana, Switzerland. A scientific paper entitled "Unveiling the Hidden Meanings: Using AI to Build a Batik Recognition Tool within a Mobile App", outlining the conceptual design and the development process, had been submitted and was rejected by Journal on Computing and Cultural Heritage (JOCCH) in January 2022. The paper has been revised according to JOCCH reviewers' comments and was resubmitted to another journal in February 2022.

• Permatasari, P. A., Kuwandy, R. K. and Cantoni, L. Unveiling the Hidden Meanings: Using AI to Build a Batik Recognition Tool within a Mobile App.

Chapter 5 addresses the evaluation of iWareBatik digital technology as the final stage of the research that provides learning opportunities for locals and serve as citizen engagement of the project.

7. iWareBatik evaluation activities were conducted through 17 batches of UX workshops, involving 997 bachelor student participants in collaboration with 33 universities nationwide from August 12th until September 25th, 2021. As the result of the study, a scientific paper entitled "More Than Words: Evaluating iWareBatik Digital Technologies in the Context of Heritage and Tourism" has been submitted to a journal in February 2022.

• Permatasari, P. A., Ningrum, F. U, Uriawan, W., and Cantoni, L. More Than Words: Evaluating iWareBatik Digital Technologies in the Perspective of Heritage Tourism.

On top of the cited research publications, the thesis includes two additional research publications and one artwork resulting from iWareBatik research and development.

Appendix A. A study entitled "iWareBatik: Promoting the Wise Use of Digital Technology to Preserve Batik Intangible Cultural Heritage in Tourism Context" was published as a working paper in the 3rd volume in Massive Open Online

Course (MOOC) on Tourism Management in World Heritage Sites, organized by USI-Università della Svizzera italiana, Switzerland in collaboration with Université de Paris 1 Panthéon-Sorbonne, France [Permatasari, 2021].

• Permatasari, P. A. [2021]. iWareBatik: Promoting the Wise Use of Digital Technology to Preserve Batik Intangible Cultural Heritage in Tourism Context, in S. De Ascaniis, M. Gravari- Barbas and L. Cantoni (eds), Tourism Management at UNESCO World Heritage Sites vol. 3, Università della Svizzera italiana, Lugano, chapter eTourism. Link: http://bit.ly/TMUNESCOvol3.

Appendix B. A research paper entitled "Reviving the Lost Heritage: Batik Cultural Route in the Indonesian Spice Route Perspective" was presented in the proceedings of Tourism, Gastronomic, and Destination International (TGDIC) Conference 2021 [Permatasari and Wijaya, 2022].

• Permatasari, P. A., Wijaya, D. [2021]. Reviving the Lost Heritage: Batik Cultural Route in the Indonesian Spice Route Perspective. Presentation material in Tourism, Gastronomic, and Destination International (TGDIC) Conference 2021.

Appendix C. Contemporary artwork for Batik textile entitled 'Astral Moon' by Puspita Ayu Permatasari.

1.5.3.1   Research scope and contributions
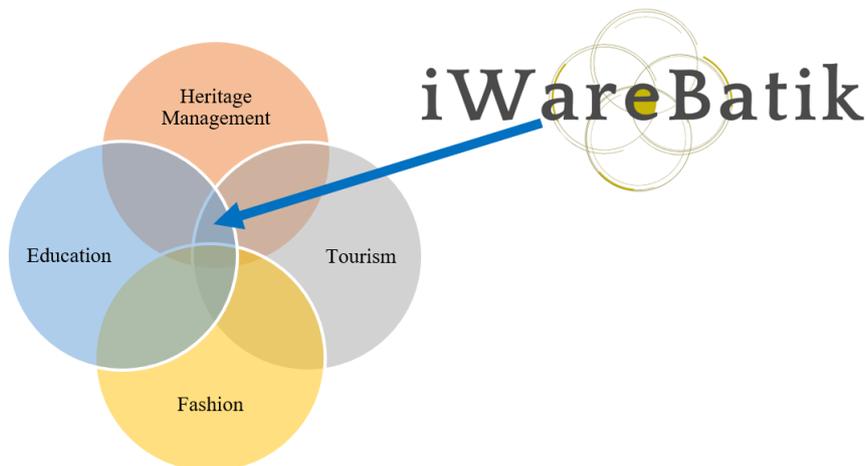
Figure 1.23. iWareBatik research contribution domain

iWareBatik research (design, development, implementation and evaluation) provide theoretical and practical contributions with regards to the use of digital

technology to communicate textile heritage in four domains: heritage management, education, tourism and fashion as part of creative sector (see Figure 1.23). Given the limitation, this study does not include the economic implications and other externalities regarding the use of iWareBatik technology in tourism and the creative industry. Future research improvements can be directed to investigate the use of iWareBatik from the perspective of the creative sector and the evaluation of iWareBatik digital technologies in the context of Indonesian fine arts education. The overall design of iWareBatik research and development is outlined in Figure 1.24. Several contributions drawn from the research activities are as follows:

1. Topic classification in terms of the online content analysis of textile heritage in relation to sustainable tourism.

2. Mobile app classification framework dedicated to textile heritage.

3. Feature classification of digital heritage on UNESCO's properties.

4. An overview of best practices related to communicating national heritage and luxury brand heritage online.

5. Exemplary case study of user requirement elicitation conducted with multinationality from different types of stakeholders (tourists, students, textile artisans, collectors, government bodies, etc.).

6. The implementation of web app design analysis and user requirement elicitation based on AWARe and OCM.

7. Practical contribution in forms of interactive cultural database (website and mobile app) linking the richness of Indonesian textile heritage with cultural/destination.

8. AI-powered pattern recognition tool within the app to communicate hidden identity of Batik motif.

9. The comparison of VGG16 and MobileNetV2 in recognizing 8 classes of Batik motifs.

10. A case study of successful integration of pattern recognition tool within the mobile app.

11. Exemplary case study of user experience evaluation in combination with learning activities and citizen engagement to support textile heritage, conducted based on service design research, AWARe, and OCM frameworks.

IWAREBATIK: DIGITAL INFORMATION SYSTEM FOR ENHANCING BATIK LEARNING IN THE FRAMEWORK OF HERITAGE PRESERVATION AND SUSTAINABLE TOURISM

Research Question	Methodology	Title of publications	Publication year	Contributions
RQ1: How is Indonesian Batik presented online? Sub question: What kind of digital technologies that exist to communicate Indonesian Batik?	1. Service Design: • First Pillar – Design research 2. ADDIE (Analysis, Design, Development, and Evaluation) Model 3. Online Communication Model (OCM) • Fifth Pillar – Benchmarking Research approach: Content analysis, Qualitative, Quantitative, Model driven, Literature review	1. Permatasari, P. A., and Cantoni, L. (2019). Indonesian Tourism and Batik: An Online Map. E-Review of Tourism Research, 16(2/3). https://journals.tdl.org/ertr/index.php/ertr/article/view/331 **Data Collection:** Web content mining (n=200)	January, 2019	Online content classification of textile heritage in relation to sustainable tourism.
		2. Permatasari P. A., Cantoni L. (2019) Mapping Mobile Apps on Batik: A Journey across Heritage and Fashion. In: Kalbaska N., Sádaba T., Cominelli F., Cantoni L. (eds) Fashion Communication in the Digital Age. FACTUM 2019. Springer, Cham. doi:10.1007/978-3-030-15436-3_15 **Data Collection:** Mobile app content mining (n=164)	July, 2019	Mobile app classification framework dedicated to textile heritage
		3. Permatasari, P. A., Qohar, A. A. and Rachman, A. F. (2020). From web 1.0 to web 4.0: the digital heritage platforms for UNESCO's heritage properties in Indonesia. Virtual Archaeology Review, 11(23), 75-93. https://polipapers.upv.es/index.php/var/article/view/13121/12730	July, 2020	Digital heritage classification framework dedicated to UNESCO's properties
		4. Permatasari P. A., Kalbaska, N. (2020) Digital Technologies for Communicating Fashion Heritage. In: Silvia De Ascaniis and Lorenzo Cantoni (eds) Handbook on Heritage, Sustainable Tourism and Digital Media. Edward Elgar 2020, UK. **Data collection:** Web and mobile app content mining (Website, n=180; App, n= 322) **Data collection:** Case studies	November, 2020	An overview of best practices related to communicating national heritage and luxury brand heritage online
RQ2: How should iWareBatik digital technology be developed to better communicate the preservation of Indonesian Batik in the tourism and fashion context? Sub questions: a) What are the needs and requirements of relevant stakeholders and audiences for developing digital technologies dedicated to Indonesian Batik? b) What kind of features, functionalities, and contents that shall be developed and curated for iWareBatik website and mobile app according to elicited requirements? c) What kinds of content and features should be provided in order to better communicate Indonesian Batik as UNESCO ICH 2009?	1. Service Design: • Second Pillar – Participatory value creation 2. ADDIE Model – Design, Development, Implementation 3.Online Communication Model (OCM): • First Pillar – Define technical content and services • Second Pillar – Define technical dimensions prioritization (software, hardware) • Third Pillar – Define main stakeholders (as information sender) • Fourth Pillar – Define intended users (information receivers) 4. Analysis of Web App Requirement (AWARe) 5. Cultural Resources Management (CRM) Research approach: User requirement elicitation, Content analysis, Qualitative, Quantitative, Data driven.	5. Permatasari, P. A., and Cantoni, L. (2021, July). Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage. In International Conference on Human-Computer Interaction (pp. 88-106). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-030-78224-57 **Data collection:** User requirement elicitation online surveys (n= 192), Semi-structured interviews (n=15)	July 2021	Exemplary case study of user requirement elicitation conducted with multi-nationality from different types of stakeholders
		ACTUAL DEVELOPMENT OF IWAREBATIK WEBSITE AND MOBILE APP * iWareBatik Website (www.iwarebatik.org) * iWareBatik Mobile App (available on Android and iOs) ➤ 124 Batik motifs and meanings in 34 Regions ➤ 129 tourist destinations and UNESCO sites ➤ AI-based Batik Recognition Tool in mobile app	17 June 2019 -17 August 2020 (Launching Year)	1. Practical contribution in forms of interactive cultural database (website and mobile app) 2. AI-powered pattern recognition tool within the app to communicate hidden identity of Batik motif
RQ3: How should the Artificial Intelligence-based Batik Recognition Tool as part of mobile app feature developed? Sub question: What is the comparison between VGG16 and MobileNetV2 as Convolutional Neural Network in terms of accuracy for building Batik pattern recognition?	1. Service Design: • Second Pillar – Participatory value creation (Artificial intelligence and cultural heritage) 2. ADDIE Model – Design, Development, Implementation 3. Convolutional Neural Network (CNN) for pattern recognition. VGG16 and MobileNetV2 architecture 4. Online Communication Model (OCM): • First and Second Pillar	6. Permatasari, P. A., Kuwandy, R. K. and Cantoni, L. Unveiling the Hidden Meanings: Using AI to Build a Batik Recognition Tool within a Mobile App. Submitted to a journal in February 2022. **Data Collection:** Google image search (n=834), Personal collection of Batik images (n=42)	Submitted in February 2022 (Under peer review)	1. The comparison of VGG16 and MobileNetV2 in recognizing 8 classes of Batik motifs. 2. A case study of successful integration of pattern recognition tool within the mobile app
RQ4: How is the iWareBatik digital technologies evaluated under the perspective of sustainable heritage tourism? Sub question: Which elements are the most influential in determining satisfaction and behaviour intention to use iWareBatik?	1. Service Design: • Third Pillar – User experience • Fourth Pillar – Learning • Fifth Pillar – Citizen engagement 2. Online Communication Model (OCM) • First, Second, Third, and Fourth Pillar – Evaluation Quadrant 4. Analysis of Web App Requirement (AWARe) Research approach: Quantitative-Qualitative analysis Survey, Nvivo Text Query analysis	7. Permatasari, P. A., Ningrum, F. U., Uriawan, W., Cantoni, L. More Than Words: Evaluation Study on iWareBatik Digital Technologies in the Perspective of Batik Learning and Sustainable Heritage Tourism. Submitted to a journal in February 2022. **Data collection:** User experience evaluation surveys (n=797), participants essays (n= 628), project documents	Submitted in February 2022 (Under peer review)	Exemplary case study of user experience evaluation in combination with Learning activities and citizen engagement to support textile heritage

PHASE 1 - Analysis
• Benchmarking and Case Study

PHASE 2 - Co-creation
• Design and Development
• Prototyping

PHASE 3 - Evaluation
• User Experience
• Learning and Citizen Engagement

Figure 1.24. Table of iWareBatik research contribution and theoretical frameworks

Chapter 2

Benchmarking

This chapter serves as preliminary study in understanding Indonesian Batik through a benchmarking analysis upon its online presence in websites, mobile apps, and other relevant case studies. This research is part of the contextual analysis according to the fifth element of Online Communication Model (OCM) [Cantoni and Tardini, 2006], within the framework of service design research [Rytilahti et al., 2015] and ADDIE model [Botturi, 2003]. Four published papers are presented as follows:

1. Permatasari, P. A., and Cantoni, L. (2019). Indonesian Tourism and Batik: An Online Map. E-Review of Tourism Research, 16(2/3).

   https://journals.tdl.org/ertr/index.php/ertr/article/view/331

2. Permatasari P. A., Cantoni L. (2019) Mapping Mobile Apps on Batik: A Journey Across Heritage and Fashion. In: Kalbaska N., Sádaba T., Cominelli F., Cantoni L. (eds) Fashion Communication in the Digital Age. FACTUM 2019. Springer, Cham. doi:10.1007/978-3-030-15436-315

3. Permatasari, P. A., Qohar, A. A. and Rachman, A. F. (2020). From web 1.0 to web 4.0: the digital heritage platforms for UNESCO's heritage properties in Indonesia. Virtual Archaeology Review, 11(23), 75-93.

   https://polipapers.upv.es/index.php/var/article/view/13121/12730

4. Permatasari P. A., Kalbaska, N. (2022) Digital Technologies for Communicating Fashion Heritage. In: Silvia De Ascaniis and Lorenzo Cantoni (eds) Handbook on Heritage, Sustainable Tourism and Digital Media. Edward Elgar 2020, UK. https://www.e-elgar.com/shop/gbp/handbook-on-heritage-sustainable-tourism-and-digitalmedia-9781788970075.html

2.1   Indonesian Tourism and Batik: An Online Map

ABSTRACT[1] Indonesian tourism has been promoting extensively the country's heritage, be it tangible or intangible. In particular, Batik hand-drawn tradition is featured as a major attraction, encompassing materials and production techniques, motifs, fashion and wearing rules, as well as its philosophic and spiritual roots. Batik has been, additionally, enlisted in 2009 among the UNESCO Intangible Cultural Heritage list, providing a further opportunity for Indonesian tourism to leverage on this. An extensive research, covering both the Indonesian and the English languages, so to cater for domestic and international travelers, has been performed online in order to unveil the role played by Batik within the tourism-related online narratives. Such research has considered the main actors (be they national or international ones), has well as the most frequent types of contents and viewpoints on the Batik online tourism-related world of meaning. While a clear role of Batik as part of Indonesia-related tourism narratives is depicted, the research shows that most of the values stressed by UNESCO are only seldom covered and that there is room for improvement when it comes to providing a deeper understanding of Batik to domestic and international travelers.

2.1.1   Introduction

Indonesian Batik is a textile hand-drawn applying hot-melted wax and natural dyes with intricate patterns designed in accordance with cultural and philosophical meanings (Figure 4.9). Batik was inscribed in the List of UNESCO intangible heritage of humanity in 2009 for its Outstanding Universal Values: (i) its special craftsmanship elements, (ii) philosophical values contained in its motifs, and (iii) rich social-cultural norms characterized in (iv) its wearing rules (UNESCO, 2009). Batik has existed as fashion heritage since the Hindu Buddhist era (7th-8th Century) in Indonesian Archipelago. Batik has intrinsic semiotic and symbolic meanings, sacred motifs are to be used by particular people and in specific events (king, weddings, state occasions, funerals, etc.) [Yunus and Tulasi, 2012]. Nowadays, Batik has been adapted and widely used as daily dress of Javanese people as traditional costumes and modern ready-to-wear clothing [Hitchcock and Nuryanti, 2016, p.35].

After almost one decade of UNESCO inscription in 2009, Indonesian government decided to promote Batik as valuable textile for souvenirs and fashion

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products as part of cultural tourism attraction [Ministry, 2011]. Indonesian government also encourages all related Batik stakeholders – including the tourism ones – to provide information through digital platforms in order to promote Batik products [MSE-Ministry, 2017]. That phenomenon has given rise to several questions when it comes to safeguarding the original meaning of Batik: *to what extent has Indonesian Batik been shaped (and potentially mis-interpreted) through tourism narratives?* In order to Batik and its implication in the tourism domain, we need to analyse how Batik is dealt with online by different tourism-related information providers after its inscription. This study is intended (i) to explore the differences between online sources (webpages) covering batik and tourism in Indonesian and in English languages based on the online communication model, (ii) to draw a reflection on the conformity of such tourism-related online narratives with the goals of the UNESCO inscription. The result shows that Batik has been strongly integrated into tourism as cultural attraction, and remained as fashion commodity enjoyed by both Indonesian people and global consumers. There is also significant support from various stakeholders to encourage the batik producers through diverse initiatives. Moreover, a reflection on the conformity of such tourism-related online narratives with the goals of the UNESCO inscription will be presented.

2.1.2   ICTs, tourism and intangible heritage

The eTourism plays a major role at all levels in tourism industry, ranging from the individual one, industry, up to the level of governance and policy-making [Kalbaska et al., 2017]. In order to foster sustainable tourism [UNEP and UNWTO, 2005], the United Nations have highlighted the three main sustainability layers: economic, environmental, and socio-cultural sustainability [UNWTO, 2018]. ICTs can help to communicate cultural heritage, as it is indicated both in UNESCO's 1972 Convention on the protection of the world cultural and natural heritage as well as in the UNESCO's 2003 Convention on Intangible Heritage. Linking the three aspects of sustainable tourism, heritage, and ICTs, one can single out five main areas of intervention [Cantoni, 2018]: (i) Access of quality information; (ii) Better the experience once at the destination; (iii) Connect the three main players: heritage, locals, and visitors; (iv) Dis-intermediate some relationships, so to ensure that local communities can benefit from tourism-related economy; and (v) Education, which includes also the training of tourism players. In order to capture information flow of Batik in online tourism domain, the analysis of the present study adopts the Online Communication Model Cantoni and Tardini [2006], focusing on the 1st pillar (the content and functionalities)

Figure 2.1. Batik Hand-painting textile of Madura Island, Indonesia

and the 2nd pillar (accessibility tools and type of publication outlets).

2.1.3   ICTs, Batik textile, and tourism

Various Batik stakeholders use ICT to harmonize and coordinate the activities of local stakeholders, to connect with travelers, communicate their tourism and cultural assets (e.g., Batik), as well as build destination brand communication strategies [Fernández-Cavia et al., 2017]. They integrate tourism services, with e-commerce and other relevant information in order to connect users with the relevant stakeholders [Fesenmaier and Xiang, 2014]. In addition, DMO websites are mostly designed in a way that represents the region and convey the spirit of the place, and its intangible values [Fernández-Cavia et al., 2014], and differentiate their destination image as tourism attractions from others [Blain et al., 2005].

In 2014, the Indonesian government improved its eTourism by building a B2B platform, with the aim to link all tourism service providers with online travel agents [Nugraheni et al., 2018]. Thanks to the significant growth of internet users [Kemp, 2017][2], which support the eTourism initiative, Indonesia achieved its target of increasing tourism visits by 14.04 million of international tourists,

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[2]In 2017, the internet users of Indonesia reached 51% of its population or 132.7 million people; social media users became 40% or 106 million users

and more than 252 million domestic tourists in 2017. These figures suggest that an analysis of the relationship between Batik intangible heritage and tourism, when it comes to online communication, is not only possible considering international tourism, but also – if not first of all – considering the domestic one. The existing scientific works on the online presence of Intangible Cultural Heritage and tourism, have been conducted, such as in the case of Indian sari [Khanwalkar et al., 2018], and other related online presence researches [Severo and Venturini, 2016; Piñeiro Naval et al., 2018; Garbelli et al., 2017]. The study on Batik and Indonesian tourism is intended to give a scientific contribution about Batik, as Indonesian intangible cultural heritage, and its viewpoints in online tourism domain.

2.1.4   Methodology

The research was conducted from January to May 2018 and has covered 200 websites: 100 in the Indonesian language and 100 in the English one. By doing so, the study aims at observing the emerging issues around Batik in online tourism domain by analyzing the difference between the coverage in the two languages: one aimed at a domestic audience, while the other at an international one. The research implements a bottom up methodology [**?**]. The bottom-up approach is a way to analyze data collection from the grassroots, in this case, webpages covering Batik and tourism found through the Google Search Engine were set as the object of the research. According to Chi [**?**], such approach gives also a space for more discovery, experimentation and a better feeling to capture the needs at the bottom level. This research aims to answer two main research questions: (i) How can tourism-related Batik online narratives be mapped? In particular, according to their: (a) type of publication outlets, (b) formats used (information displayed in forms of text, image, video), (c) locations, (d) content of textual information (e.g: Batik Outstanding Universal Values; Batik production; Stakeholders; Usage Values; and Cultural Tourism). (ii) Are the online tourism narratives related to Batik in line with the key-points of the UNESCO inscription?

This research adopts quantitative and qualitative methods in order to investigate the presence of a given type of content in a given set of websites/webpages [Cantoni and Tardini, 2006]. The sample has been collected by searching for the keywords: 'Tourism', 'and', 'Batik'. Those queries are used altogether in Google search engine, retrieved the first 100 relevant results, reachable through the first 17 results' pages; the same has been done for the Indonesian language, searching for 'Pariwisata', 'dan', 'Batik' (18 results' pages had to be retrieved in order
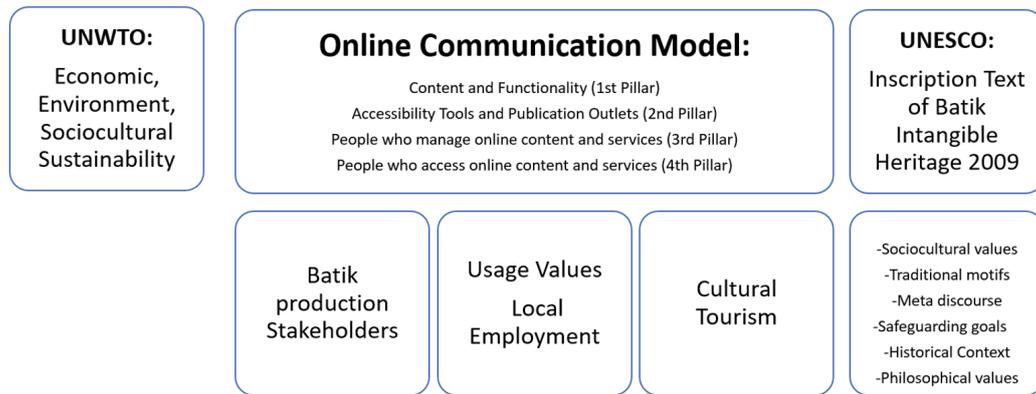
Figure 2.2. Main Categories of Content Analysis

to order to collect 100 relevant results). In determining the web samples, only webpages providing tourism information have been included in the sample, excluding results from scientific papers (e.g., Google Scholar), advertisements, as well as webpages referring to other countries (e.g., the Caribbean, Ghana, India, Malaysia, etc.). We did not specify 'Indonesian' in the queries, to check possible online presence about Batik also in other countries. The main indicators were built based on the Online Communication Model, the universal values according to UNESCO inscription text of Batik in 2009, and the three layers of sustainable tourism of UNWTO 2018: economic, environmental, and socio-cultural sustainability (Figure 2.2). Additional indicators were defined iteratively until saturation. When any new type of content was found, it was added to the table of indicators, and the samples were re-analysed. The process of assessing and classifying each website/page to fill-in relevant indicator(s) adopts a qualitative content analysis, performed by a human coder. The quantitative method was used in the process of exploring and annotating the contents based on the given indicators. This was done by assigning grid value of "1" and "0". The value "1" is given when the indicator is present in the web samples, and "0" when the indicator is absent.

2.1.5   Results

The two most frequent types of publication items covering Batik and Tourism in the Indonesian language are 'News and Media' (46%), 'DMO/Tourism Bureau' (27%) and 'Research Center and Museum' (5%). The high presence of 'DMO/-Tourism bureau' webpages illustrates their active role in producing articles about Batik as a distinguished local product, associated with cultural tourism attrac-

tions in the regions. In terms of English web pages, the presence of main player covering Batik and tourism is distributed more evenly among seven different actors: 'News and Media' (25%), 'Blogs' (12%), 'DMO/Tourism Bureau' (10%), 'Online Travel Reviews' (9%), 'Travel Agents and Tour Operator' (9%), 'Travel guides' (8%), 'Tourism Related Info (Hotel, Flight)' (8%). The searched Indonesian and English web pages mostly use visual formats (English 72%; Indonesian 85%), and some with additional videos (see Table 2.1). The research also indicates that Indonesia as general location of Batik products and there are also 44 particular locations: cities and regions across Indonesian archipelago as the origin of Batik textiles (Indonesian 84%; English 79%). It signifies that there is a growing number of new Batik regions, locates in Java and other islands, which are covered and promoted online by different stakeholders.

Indicators	English	Indonesian	Indicators	English	Indonesian
A. Type of Publication Outlets			B. Formats		
First Outlets			Pictures		
News and Media	25%	46%	No Batik Picture	27%	13%
DMO/Tourism Bureau	10%	27%	With Batik Picture	72%	85%
Blogs	12%	3%			
			Videos		
Secondary Outlets			No Batik Video	93%	94%
Travel Agents	9%	2%	Full Batik Production Video	3%	2%
Online Travel Reviews	9%	1%	Batik Fashion Show, Tourism related Video	4%	2%
Travel Guides	8%	1%	C. Locations		
			Common Location		
Tourism Related Info (hotel, flight)	8%	3%	(Indicating Indonesia as general origin)	21%	16%
			Particular Locations		
Research centre and museum			(indicating certain cities in Indonesia as the origin of Batik)	79%	84%
Third Outlets					
Indonesian government bodies	4%	3%			
Social Media	3%	3%			
Batik Companies (SMEs, Batik Fashion House)	3%	3%			

Table 2.1. Type of Publication Outlets, Formats, and Location

The emergence of printed Batik textiles leads to some problems at the tourism destinations, since such fabrics are considered "fake Batik," and are produced by printing machines. Consequently, many tourists get trapped by malicious sellers and fall into buying the fake ones with expensive costs. The study also noted that there is a number of online articles covering how to distinguish the original Batik from the fake ones and tips to avoid the trap of fake Batik at the destination (see Table 2.2). These contents are mostly written in online travel review, blogs, travel guides by experienced online users or travel guides. Both English and Indonesian webpages recognize also the high presence of Indonesian non-governmental

Indicators	English	Indonesian	Indicators	English	Indonesian
A. Outstanding Universal Values			**D. Batik Usage Values**		
Sociocultural values (Rituals, wearing rules, intergeneration,)	34%	20%	Tourism attraction	88%	90%
Traditional motifs	29%	44%	Exhibition and Fashion Show	14%	26%
Meta discourse (motifs of animal, and nature)	22%	32%	Batik retails	11%	9%
Safeguarding goals	22%	30%	Seminar and Conference	8%	7%
Historical Context	21%	24%	Supporting industry in Tourism (e.g: interior design, amenities production, co-branding with tourism)	7%	6%
Philosophical values	17%	25%			
B. Batik Productions			**E. Local Employment**		
Fabric materials	71%	59%	Batik producers	47%	59%
Other type of Material (wood, leather)	15%	16%	Youth engagement	12%	23%
			Marginalized people (disability, prisoners)	0	1%
Original Batik (Hand-painting, stamp)	62%	51%			
Technical aspect (natural dye, tools, tailors)	57%	36%	**F. Cultural Tourism**		
Fake Batik (printed textiles)	17%	10%	Batik centre	52%	59%
Ecological value	5%	2%	Batik tours	54%	29%
C. Stakeholders			Workshop for tourists	34%	20%
Indonesian (person, community)	83%	74%	Tourist experience	30%	10%
Indonesian government	38%	80%	Workshop for locals	17%	17%
International (governments, agencies, tourists)	60%	21%	Batik museum	9%	5%

Table 2.2. Contents of Textual Information

support, which refers to all initiatives done by individuals and local communities to valorise Batik intangible heritage by means of creating workshops, providing tours and other Batik related activities (see Table 3.2).

2.1.6   Conformity with UNESCO inscription

The goal of this study is to analyse how far the Batik intrinsic universal values and its safeguarding goals based on the UNESCO inscription text in 2009, are explicitly included in tourism narratives. From the analysis, we can conclude that Batik cultural values that are most emphasized by UNESCO – namely 'Socio-cultural values,' 'Philosophical Values,' 'Historical Context,' 'Safeguarding Goals', and 'Type of Traditional Motifs' – are still underrepresented in both Indonesian and English webpages. Hereafter the details. Indonesian webpages present higher results when it comes to communicating Batik intrinsic values compared to English ones. The highest results of Indonesian webpages are Traditional Motifs (44%), and Meta-discourse of Batik (32%). English webpages

emphasize more on Socio-cultural values (34%, Indonesian result: 20%). With regards to 'Safeguarding goals' category, Indonesian samples show a higher result of 30%; while English web pages present slightly fewer contents (22%) that contain an explicit statement of safeguarding goals in the online tourism narratives.

2.1.7   Conclusions

Indonesian Batik, as UNESCO intangible cultural heritage, has evolved not only as a fashion heritage but also to become a major tourism attraction. Such a relationship is clearly seen in the sketched map of its online presence. The traditional notion of Batik, which was merely limited to its production and philosophical values, as evolved. Nowadays Batik is gradually regarded as a strong asset for local people also in order to develop domestic and international tourism. However, seeing these huge improvements of Batik usage values, we need to reflect also on the essentials of Batik for fear that it might lose its intrinsic, outstanding universal values as a cultural heritage of humanity, as acknowledged through the 2009 UNESCO inscription. This study has contributed to map the main online narratives about Batik and tourism, as well as to pinpoint some gaps when it comes to safeguarding goals stressed by the UNESCO inscription. It suggests the tourism-related stakeholders to pay attention and improve the quality of the information when it comes to communicating Batik to the domestic and international travellers. Further studies are required in order to find suitable strategies to better promote and disseminate the values of Batik as intangible heritage without overexploiting its usage values in tourism and fashion industry.

2.2 Mapping Mobile Apps on Batik. A Journey Across Heritage and Fashion

ABSTRACT[3] As one of the leading clothing exporters in the world, Indonesia has the chance to promote the richness of its textile heritage, particularly hand-drawn Batik textile, in the global fashion industry. Batik is an Indonesian fashion heritage, recognized as a UNESCO Intangible Heritage of Humanity since 2009. Apart from its historical production technique, Batik contains outstanding universal values associated with the socio-cultural aspects of Indonesian lives. These include philosophical and spiritual meanings contained in its distinctive motifs, the rules for its wearing, as well as social empowerment. The advances of digital communication can play an important role in communicating and shaping Indonesia's Batik usage values between tradition and contemporary fashion. This research is presented to identify how Batik is communicated through mobile apps in terms of their contents, functionalities, apps' purposes, as well as their alignment with UNESCO's safeguarding narratives.

2.2.1 Introduction

As the fourth largest population country, Indonesia is home to 633 ethnicities [Statistic, 2015]. It has a rich cultural diversity of textiles in terms of forms and motifs **?**. Batik is one of them. It is produced by wax resist dyeing technique, which has existed since 5000 BC- 2600 BC [Silk, 2021; Druding, 1982]. The denomination of "Batik" is derived from Javanese words "amba" ("scribing") and "tithik" ("dots"). In other words, "Batik" means "writing down dots". It could have been derived also from the phrase "mbathik manah", which means "to draw with the whole heart"[Lestari, 2012]. This production technique entered the Indonesian archipelago through merchants from India (Gujarat), who got in contact with local artisans during the heyday of the Silk Road maritime trading period (2 CE-15 CE). In 6th–8th centuries, Batik textiles were restricted for use to royalty and nobility, especially in Java. From then on, it has been preserved as fashion heritage from generation to generation. The evolution of Indonesian civilization can be traced along the Batik motifs and symbols drawn on the textile. Each of these motifs and symbols represent a specific historical period.

The motifs of Indonesian Batik are developed according to the prevalent philosophical ideas that characterized each period. The philosophical meanings, which show the historical and cultural values of each colour and symbol, are incorporated in the rules for its wearing [Yunus and Tulasi, 2012]. Certain Batik motifs are dedicated for special life events (weddings, funerals, etc.) and certain social statuses (king, queens, middle-class, commoners, etc.). However, the usage values of Batik has evolved and differed from one era to the other. With such inherent outstanding universal values, Batik was inscribed in the List of UNESCO Intangible Cultural Heritage of Humanity in 2009 [UNESCO, 2009b]. After one decade since its recognition, today Batik has been adapted into Indonesian modern lifestyle, not only as uniforms for traditional ceremonies, but also as modern ready-to-wear for fashion purposes and business attires (see Figure 2.3).

Figure 2.3. The motif of Batik Sidomulyo. It is one of classical motifs, which is specifically used for the bride's costume in Javanese royal wedding [4].

The recognition of Batik as UNESCO intangible heritage has benefited national Batik small and medium enterprises (SME), and allowed them to grow to

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[4]It symbolizes good wishes for the wearer to achieve glory, harmonious family, and highly respected social status[Wahida et al., 2018]

a higher level. In order to support local producers and increase the domestic consumption of Batik textile heritage, in 2009 the Indonesian government initiated a policy that encourages the use of Batik attire for civil servants on every Friday [Ministry, 2009]. Furthermore, Indonesian government encouraged all Batik-related stakeholders to promote and provide information in terms of Batik products, origins, history and usage values through digital platforms (such as websites and mobile apps) [MSE-Ministry, 2017]. As the motifs represent the cultural uniqueness of each region, this initiative was conducted in order to increase their market share and to promote their tourism. These major initiatives to support Batik, its culture and related businesses, have raised the issue of the relevance of Batik textile heritage within the contemporary fashion narratives: *to what extent have the usage values of Batik been interpreted and re-adapted into modern lifestyle (also) through online fashion narratives?* While there are already studies about Batik in the digital fashion domain, however, an analysis of how mobile apps do cover Batik and its heritage is still missing. Hence, this study is intended to:

a. analyse the online communication of Batik through mobile apps, both in Indonesian and in English language;

b. assess to what extent Batik is presented within relevant mobile apps in line with UNESCO's safeguarding goals;

c. see how Information and Communication Technologies (ICTs) may communicate Batik usage values in modern lifestyle.

This study provides a twofold contribution in the field of digital communication of cultural heritage in textile: it offers a methodological model of how to map Batikrelated mobile apps, while at the same time providing a first map of them. Moreover, it might be also of interest for practitioners, both in the field of Fashion, and in the field of Tourism, who might be interested in leveraging on mobile communication in order to promote a more extensive knowledge of Batik, and awareness about its value and heritage.

2.2.2   ICTs, fashion, and intangible cultural heritage

The role of digital technologies is paramount in fashion industry in terms of promoting, disseminating information, teaching and learning of clothing and textiles [Kalbaska and Cantoni, 2017; Kumar, 2012]. When it comes to promoting textile heritage as fashion product, we need to include also information about the production technique, semiotic meanings, as well as the sociocultural aspects of such fashion heritage. In this case, fashion heritage is regarded as an ensemble

of materiality of objects in combination with intangible elements, such as sets of local knowledge, social processes and cultural practices. A textile heritage has undergone an intergenerational selection from the past, it has been passed to the present, and is being transmitted to the future [Pistilli, 2018].

In order to preserve the inherent values of Batik intangible heritage, ICTs may help to promote safeguarding practices, raise awareness, and communicate important messages, in line with the goal of UNESCO Convention on Intangible Cultural Heritage. Furthermore, according to Cantoni [2018], ICTs could enable stakeholders in the tourism domain in five main areas, which can be adapted to the fashion heritage. (i) Access. Provide access to quality information on fashion heritage; (ii) Better. Improve the actual experience of such textile; (iii) Connect the three main players: heritage, locals, and fashion stakeholders; (iv) Dis-intermediate. Streamline some relationships, so to ensure that local communities can benefit from fashion production and distribution; and (v) Educate. ICTs provide learning platforms to facilitate relevant stakeholders to learn about Batik design and fashion production.

According to Jesús Martín Barbero, communication media is perceived as 'mediator' between tradition and modernity which gives birth to new cultural perceptions [Martín-Barbero et al., 1993; Richardson, 1994]. In this process of mediation not only cultural bodies, but also recipients contribute to add new perspectives on a cultural legacy. There are many ways in which people appropriate media and use it to produce meaning and create their own identities. This present paper also gives an example about a case of cultural mediation through digital communication, which illustrates the shift between traditional and new cultural perceptions reflected in Batik mobile apps. The study aims at observing the digital foot-prints of the immense variety of Batik usage values adapted to contemporary fashion and popular culture, while few are still conserving its traditional wearing rules and fully display its philosophical roots.

In addition, this research examines the mobile apps covering Indonesian Batik by using the Online Communication Model [Cantoni and Tardini, 2006]. The model introduces four main pillars and a fifth element, which are the key points to be analyzed in communication media, namely: (i) contents and functionalities; (ii) accessibility tools and publication outlets; (iii) people managing the online resources; (iv) people accessing them, and (v) the relevant information market. This study focuses on the first pillar (content and functionalities) and the second one (accessibility tools and type of publication outlets) of such model.

2.2.3 ICTs, Batik textile, and fashion branding

According to Sproles [1974], fashion refers to aesthetic expression of clothing style and adornment, which changes over time and is culturally endorsed within a social system or group of associated individuals. A brand in fashion means the non-tangible attributes, codes, and a set of symbols, which allow consumers to learn the intrinsic characters and the quality of a fashion product [Jin and Cedrola, 2017]. Given the fact that textile heritage encompasses a pattern of identity, rich of meanings and philosophical symbols, authentic, and credible at the cultural level, the branding management of a textile heritage should emphasize the intrinsic values and cultural importance of such product [Rakhmawati, 2016].

In terms of communicating Batik fashion-related values, its wearing rules are categorized into two dimensions of time: ancient and modern/contemporary style. Communicating fashion brand identity can be effectively done by using digital technologies and online channels, as it allows fashion-related stakeholders to promote their products and lifestyle in an attractive way [Amerkhanova and Topalidou, 2014]. Indonesian Batik has been extensively promoted online since its inscription as UNESCO intangible cultural heritage. The success of its branding and positioning cannot be separated from domestic and global factors. As one of world's top ten clothing export countries with the total export values of 8.2 billion USD [Lu, 2017], Indonesia's fashion products have achieved important gains in terms of domestic and global market shares. It is noted that the export values of Indonesian Batik textiles reached 58.46 million US dollars in 2017, with the main export destinations such as Japan, USA, and certain European Countries [State-Secretariat, 2019]. In addition, in 2015 there were 47'755 Batik SMEs in Indonesia [Detik, 2019], which provided job opportunities to 199'444 people (local artisans, designers, etc.).

In order to support local producers and increase the domestic consumption of Batik textile heritage, in 2009 the Indonesian government launched a policy, which requires that all Indonesian people, especially those who work in public offices, to wear Batik attire every Friday [Ministry, 2009]. This policy helps to boost Batik fashion branding and revive the Batik industry. Regional tourism also receives benefits, since promoting fashion-related content (Batik culture and its producer regions) as an attraction, could potentially boost their destination [Kalbaska, Ramírez and Cantoni, 2018]. The Indonesian government launched different initiatives to encourage all Batik-related stakeholders both in tourism and fashion to provide relevant online information concerning Batik cultural practices in their respective fields. Well-informed consumers are

encouraged to buy original handmade Batik products instead of printed ones, as it gives economic benefits to the local producers. However, such positive partici- pative branding by different stakeholders might result in diverse narratives about Batik usage values. This online content analysis will provide a better understand- ing of Batik usage and its transformation in terms of fashion, from traditional to modern twists. Previous studies providing a content analysis and a map of the on- line presence of intangible cultural heritage, have been conducted, for instance, about Indian Sari [Khanwalkar et al., 2018], mobile apps devoted to World Her- itage Sites [Schieder et al., 2014], cyberbranding of Batik [Rakhmawati, 2016], Indonesian tourism and Batik: an online map [Permatasari and Cantoni, 2019a].

2.2.4   Methodology

A Mobile Application is a type of Information and Communication Technologies (ICTs) which consists of a program/software operated on a handheld/mobile de- vice (smartphone, Personal Digital Assistant, etc.) and performs certain tasks for the user [Kumar, 2012]. Mobile apps are developed by certain mobile applica- tion developers, publishers and providers [Kumar, 2012]. The main objective of this study is to observe how mobile apps do cover Indonesian Batik. Data col- lection was conducted from 3 until 25 November 2018. In order to map Batik online narratives, both a top down and a bottom up approach have been used. While already defined dimensions have been adopted, additional ones have been defined through a bottom-up process [Lizzi et al., 2011]. The research aims at investigating three main questions as follows:

(1) How are Batik intangible cultural heritage and its fashion related narratives presented within relevant mobile apps? Particularly in terms of: (a) Types of mobile apps publishers; (b) Contents provided in the General Information page of the apps; (c) Media used; (d) Features; and (e) Content of textual information (e.g.: Batik production; Types of Batik products; Batik usage values; Outstand- ing Universal Values)

(2) How are the UNESCO key-points addressed within Batik mobile apps?

(3) To what extent Batik usage values are interpreted and adapted into contem- porary fashion? As Batik is associated to intangible heritage with a rich tradition of cultural significances, what are the new meanings of Batik in the contemporary fashion world?

This research combines qualitative and quantitative methods in order to iden- tify the presence of specific contents within a given set of online data sources.

First Phase. The research was initiated by finding all relevant mobile apps through searching for the keyword: 'Batik' on iTunes and on Google Play (the

platforms collecting iOS and android apps, respectively). Due to the fact that on iTunes only 5 apps were available, such platform has been discarded, and only Google Play results have been further considered. On this platform, the search has provided a list of 164 mobile apps covering Indonesian Batik in the two studied languages: English and Indonesian. Such sample was determined after filtering out few results of Batik mobile apps referring to other countries (e.g.: India, Malaysia, etc.). If a developer published two Batik mobile apps with different purposes and for different audiences, both apps were included in the research. The collected data refer to those mobile apps specifically developed to communicate information and activities related to Batik intangible cultural heritage online (commercial, tourism, fashion, etc.), excluding social media platforms (Facebook, Instagram, etc.), and webpages/websites (even if they are accessible via smartphones).

Second Phase. In order to content-analyze the apps and their description on Google Play, some indicators were defined a priori, from the Online Communication Model and the universal values according to the UNESCO inscription of Batik in 2009 [**?**], also some indicators used in a research on mobile apps dedicated to World Heritage Sites [Schieder et al., 2014] have been adopted/adapted. Such indicators are listed in Figure 2.4.

Each app retrieved from Google Play was downloaded to be examined and classified based on the defined indicators. Beside them additional indicators were added iteratively based on found characteristics. This set of new indicators was added into the table of indicators, and the corpus was re-analyzed until thematic saturation was reached. The qualitative analysis was performed by a human coder to annotate each content to relevant indicators. In order to complement and clarify the qualitative assessment, the quantitative method was conducted by assigning grid value of "1" and "0". The value "1" is added to indicate the presence of the indicator, on the other hand, "0" when it is absent.

2.2.5   Results

2.2.5.1   General information, features, and main functionalities

Please refer to Table 4.9 for a synopsis of results.

When it comes to mobile apps publishers, there is a minor contribution by Batik SME (10%) and researchers (3%). However, it was not possible to define suitable categories for all other app developers, since most of them merely put their personal email without further information about their activities or services. It can be assumed that these developers are independent ones or students, who

Online Communication Model	UNESCO Inscription Text of Batik Intangible Cultural Heritage in 2009:	
(i) Contents and functionalities; (ii) Accessibility tools and publication outlets; (iii) People managing the online resources; (iv) People accessing them (v) The relevant information market	A. Batik production B. Batik products (fabric, non-fabric) C. Usage values (fashion, tourism)	UNESCO Outstanding Universal Values 1. Traditional motifs 2. Socio cultural values (wearing rules) 3. Meta discourse 4. Historical context 5. Safeguarding goals 6. Philosophical values
- Type of publishers - Formats (Photo, Video) - Features - Types of intended users - Batik mobile apps based on its type of information - General Objective of the apps - Language (English, Indonesian) - Location - UNESCO related contents (acknowledgement, reasons of UNESCO inscription)	**Contextual Modern Usage Values of Batik**	
	Batik fashion apps based on clothing categories: - Couple/family - Kids - Men - Women - Mix (Men, women, couple - Muslim women apparels - Traditional gowns	Batik mobile apps based on different purposes: - Batik textile catalogue apps - Batik fashion and clothing apps

Figure 2.4. Main indicators of Batik mobile apps research

aimed at creating a Batik-related mobile apps for fulfilling their passions or for any lucrative purpose. 82% of the found apps are in Indonesian language, while 18% in English.

All apps do provide some general information on themselves on the Google Play platform, which might tackle the intrinsic values of Batik, facts about Batik inscription as UNESCO intangible cultural heritage, as well as app's goals and intended users/audiences. The apps were created for Batik fashion followers (70%), Batik textile lovers (21%), Learners (7%), and Tourists (2%). In addition, 85% of apps present visual representations of Batik clothes, textiles, and diverse motifs, intended for giving ideas of Batik usage values in fashion and additional references for the users. On the other hand, 15% of apps could be named "informative ones": they provide less photo collections, but better quality of Batik information for users. While it is noted that all mobile apps display images of Batik textiles, dresses, etc., only 3% offer also video materials. The major found features were the following ones: photo sharing (38%); Functionality

to set the Batik image as smartphone's Wallpaper or Whatsapp profile pictures (26%); add to favorites (19%); download pictures (17%), share on social media (15%); and view counter (13%). The study found some further functionalities, which could enhance user interaction. For instance, some apps provide a Batik photo montage feature, which allows users to create composite photograph by combining their facial photo with an image of ladies/gentlemen wearing Batik apparels, or alternatively, the app offers some options of Batik textile to be used as digital photo frame.

Indicator	(%) n = 164	Indicators	(%) n = 164
A. Type of Publisher		**D. Formats**	
1. Batik SME	10%	1.Photo gallery	100%
2. Research Center and Museum	3%	2.Video	3%
3. Others (independent developers)	87%		
B. Contents of General Information		**E. Features**	
1. General Objective of the App	100%	1. Add to favorites	19%
2. Language:		2. Download Picture	17%
- English	18%	3. Online Transaction	7%
- Indonesian	82%	4. Product Description (for e-commerce)	7%
3. Location: - Indonesia as general location	86%	5. Functionality to set the Batik image as smartphone wallpaper or Whatsapp's profile picture	26%
- particular location/cities in Indonesia	14%		
4. UNESCO related contents:		6. Sharing menu for photos	38%
- Acknowledge Batik as Indonesian Heritage Legacy	60%	7. Social media (FB, Twitter, Instagram)	15%
- Reasons why Batik is inscribed in UNESCO's list	7%	8. Tools (Photo montage/frame, Batik motif recognition tool, games)	4%
		9. View Counter	13%
C. Types of Intended Users:		**F. Batik mobile apps based on type of information**	
1. Batik fashion followers, Designer	70%	1. Batik products visual representations (these apps only display pictures, without in-depth information about Batik)	85%
2. Batik textile lovers	21%	2. Informative and Educative apps (these apps display all needed textual and visual information about Batik)	15%
3. Learners (Batik practitioners, researchers, students)	7%		
4. Tourists	2%		

Table 2.3. General Information and Functionalities of Batik Mobile Apps [5].

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[5]How many apps, in %, are presenting a specific indicator. Sum doesn't always correspond to 100% due to the fact that some indicators are not mutually exclusive

2.2.5.2 Batik intrinsic values and UNESCO key-points

Analyzed apps cover information on original Batik (32%), Batik production (21%), and give some clue about printed Batik textiles (12%). This content are valuable piece of information for consumers who wish to buy the original Batik, or if they wish to distinguish the real Batik with the fake ones. The most common pieces of information about Batik values do cover Socio-cultural values in terms of 'Modern wearing rules' (49%), which refer to Batik prêt-à-porter or ready-to-wear clothing and designs adapted to contemporary fashion and modern lifestyle, in addition to its traditional motifs (41%). Apps do present also meta discourse (nature, animal interpretation in Batik motifs) (22%), and Batik historical context (20%). In less cases, one can find also in-depth explanations of socio-cultural values in terms of ancient wearing rules (17%), and philosophical values (11%). Likewise, only 13% of the mobile apps present an explicit statement of UNESCO's safeguarding goals (see Table 2.4).

Indicator	(%) n = 164	Indicators	(%) n = 164
A. Contents related to Batik Production		**D. Outstanding Universal Values**	
- Batik producers	21%	1. Traditional motifs	41%
- Original Batik (using wax-resist dyeing method)	32%	2. Socio-cultural values (spiritual, wearing rules, etc.)	
- Printed Batik Textiles	12%	- Ancient wearing rules	17%
		- Modern wearing rules	49%
B. Types of Batik Products		3. Meta discourse (nature, animal interpretation in Batik)	22%
- Fabric	94%	4. Historical context	20%
- Non-fabric (leather, wood, etc)	3%	5. Safeguarding goals	13%
C. Batik Usages Values		6. Philosophical values	11%
- Fashion	87%		
- Others (tourism, interior art)	13%		

Table 2.4. Content of Textual Information within the Mobile Apps

2.2.5.3 Contextual modern usage of Batik

Furthermore, the classification of 164 mobile apps based on their functionalities and features might shed a light on what kind of functions and visual information do these apps offer to the users. For instance, Figure 2.5 illustrates the number of

Batik Mobile Apps based on Different Purposes (n=164)
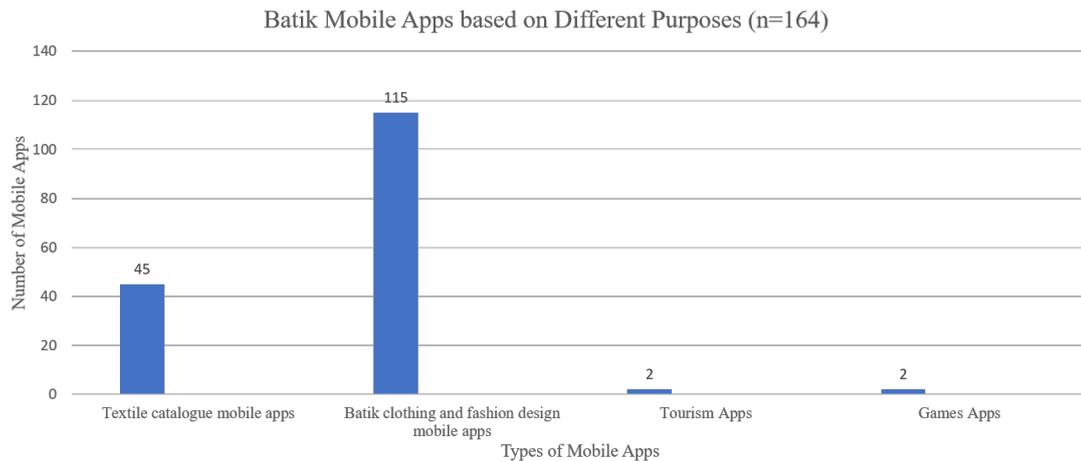
Figure 2.5. Batik mobile apps based on different purposes

Batik Fashion Apps based on Clothing Categories
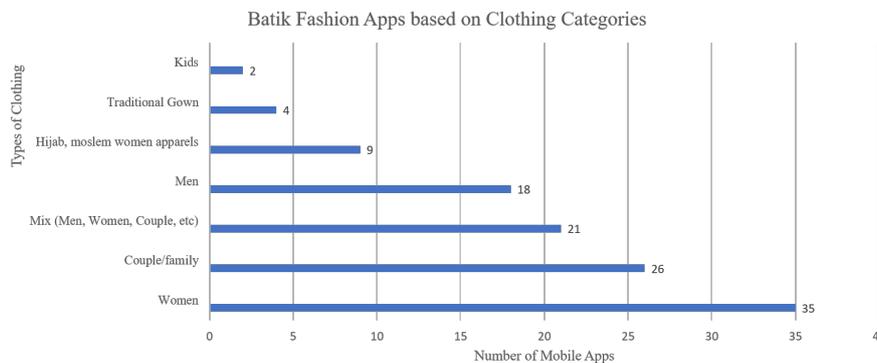
Figure 2.6. Batik Fashion Apps based on clothing categories

Batik apps which could be classified as textile catalogues (45 apps; 27%), Batik
fashion and clothing images (115; 70%), and apps with Tourism purposes or pro-
viding Educative Games (2; 1% each). The textile catalogue apps only provide
visual representation of Batik textiles and its distinctive motifs, with minimum
textual information. Additionally, Batik clothing and fashion mobile apps con-
tain visual representations in terms of Batik garments, textiles, and people (men,
ladies, kids, couples, and family) wearing Batik in many different ways. These
apps are such a collection of fashion ideas and style references for specific au-
dience such as fashion followers and designers. The two tourism apps provide
Batik textile images, plus its motifs, history, origin, galleries to visit, and cultural
tourism.

The Batik games, on the other hand, offer new ways of learning the meanings

of Indonesian Batik, such as Batik motif discovery games and coloring Batik app. The Batik discovery games "Mencari Batik" attract users to discover the meaning of each Batik symbol that they find along the game. While "Batik Colouring" game invites users to color the Batik motifs, yet it contains no textual information when it comes to Batik cultural-related contents and meanings. When zooming into the 115 Batik mobile apps for fashion, the research discovered many new ways of wearing Batik traditional textile developed so far, which are also adapted to modern taste and style (see Figure 2.6). For instance, the traditional wearing rules put Batik cloth as a sarong, which is an ankle-length wraparound skirt for male and female, the social status is shown from the motifs on the Batik cloth worn by each individual. Nowadays, Batik clothes are used to produce any garments for any type of person, purposes of social functions.

Figure 2.7. The types of Batik fashion, from traditional (left) to modern ones (middle, right)

As the largest Muslim population country in the world [Atlas, 2019], there is a significant increase of ladies wearing hijab in the past recent years. This might be the reason why a number of Batik fashion apps promoted Batik apparels and design for Muslim women, in order to meet special needs of this new fashion market. The action of wearing Batik is not merely representing individuals, it includes couples and families. Indonesian people show trends of wearing the same Batik textile with similar patterns, color, and motifs for a couple and family while attending certain social function such weddings, gatherings, etc.

A significant number of mobile apps in Indonesian language promote new wearing rules of Batik for Couple and Family (26% of 115 apps in Indonesian language). We can assume that persons wearing Batik clothes as a couple and/or a family do want to convey the impression that they have an harmonious relationship and/or a sense of belonging among members of the family (see Figure 2.7).

2.2.6 Conclusion

The advent of digital technology has brought an impact in terms of promoting the usage values, significances, and raising awareness of Batik safeguarding practices in modern society. Since the participation of Batik related stakeholders has been improving significantly in recent years when it comes to communicate Batik online, this study has contributed to see how the values of Batik is interpreted, shaped and communicated in the digital society especially through mobile apps. Moreover, the study has also pointed out that there is a shift in terms of wearing rules of Batik, especially in the context of contemporary fashion world. In addition, only few apps communicate Batik outstanding universal values, as well as safeguarding goals and other key points stressed by UNESCO. Since the scope of this study was limited to the analysis of applications' contents and functionalities, this study can be improved by including usability analyses and a qualitative analysis of users' experience with the analysed apps.

Addressing such critical safeguarding issues, it is deemed important to initiate a strong cultural policy regarding the strategy of communicating intangible cultural heritage through online communication media. In addition, while the study observed that the traditional wearing rules of the past are communicated much lesser than modern ones, it is also necessary to provide adequate online information about Batik cultural related meanings and usage values from the traditional perspective. It is deemed important for government and Batik-related stakeholders that produce con-tents and promote this textile heritage through digital media, in order to raise aware-ness and educate Batik fashion-related stakeholders, so that they can build a more sustainable fashion industry and continue to preserve the cultural identity of Batik's intangible cultural heritage.

2.3 From Web 1.0 to Web 4.0. The Digital Heritage Platforms for UNESCO's Heritage Properties in Indonesia

ABSTRACT[6]. The advent of information and communication technologies (ICTs) has had and is having a major impact on Indonesian cultural resource management, and on the safeguarding methods of its tangible and intangible cultural heritages. Despite varied levels and visible gaps between rural and urban regions in terms of technology usage, innovative initiatives have been created, which correspond to the needs and expectations of a technology-savvy public. As a starting point, a number of public institutions dealing with tangible cultural heritage (e.g. museums, palaces, temples, World Heritage Sites (WHS)) do use innovative digital tools in order to communicate to various audiences, as well as to enrich visitors' experience, especially taking into consideration young generations. This paper will firstly examine the role of ICTs in intangible cultural heritage (ICH) (e.g. Batik, Wayang puppet theatre, etc.); secondly, the authors will explain how ICTs can help to communicate and promote the values, history, and significances of ICH products, both for locals and tourists, with the goal of raising awareness on cultural identity. However, the knowledge of ICH still requires contacts with its own communities and is vulnerable, as it can be exposed to excessive cultural commoditization through e-platforms.

This study aims at giving an overview and some examples of digital interventions for cultural heritage communication implemented by various stakeholders in Indonesia. In addition, this paper analyses to what extent a participatory approach engaging local communities, academics, private sectors, NGOs and the government, can ensure higher levels of effectiveness and efficiency, hence supporting the conservation of UNESCO tangible/ICH in Indonesia. This paper aims at: (1) presenting the development of digital heritage platforms in Indonesia; (2) providing a grid of analysis of digital heritage knowledge platforms dedicated to UNESCO tangible and ICH in forms of websites and mobile apps.

2.3.1 Introduction

The conservation of cultural heritage is varied based on its categories. Cultural heritage, in general, is defined into two types namely, the tangible and the in-

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tangible heritage. According to the UNESCO Convention on the World Heritage Sites (WHS) in 1972 [UNESCO, 1972], tangible heritage refers to the physical artefacts, such as architectural works, monuments temples, which are known for their socio-cultural importance for humanity. Other than the historic and artistic values, the assessment of the cultural heritage has not only emphasized on the aesthetic point of view but also evolved by further considering the value of identity, the capacity of the cultural heritage object to interact with memory and the living traditions as the immaterial heritage [Titchen, 1996; Vecco, 2010].

In order to tackle the challenges of immaterial heritage conservation, the UNESCO Convention in 2003 on the Safeguarding of Intangible Cultural Heritage (ICH) entered into force in 2006 [Marrie, 2008]. It encourages all its member states to preserve the living traditions or living expressions inherited from the past generations, which are still preserved and practised by the local communities. The elements of the ICH are oral traditions, performing arts, social practices, rituals, festive events, knowledge, and practices concerning nature and the universe or the knowledge and skills to produce traditional crafts [Marrie, 2008]. To improve the conservation of the outstanding universal values of cultural heritage, UNESCO stipulated the "Five Cs" of Strategic objectives namely: Credibility, Conservation, Capacity-building, Communication, and Communities [Albert, 2012]. To this extent, the conservation of UNESCO Cultural Heritage, both in terms of tangible and intangible ones, should be directed in preserving and promoting the cultural heritage objects and the living traditions based on the Five Cs outlined above.

The rise of Information Communication Technology (ICT) has brought a significant impact on the process of heritage documentation [Blanco Pons et al., 2016]. ICT plays major roles in cultural heritage dissemination, as it provides possibilities to showcase cultural heritage information in forms of texts, audio, 2D/3D images, and videos through various digital platforms [Redweik et al., 2017]. It also fosters sustainable heritage tourism which not only contributes to the sustainability of the tangible/intangible heritage but also to the wellbeing of local communities [Cantoni, 2018]. The Five Cs strategy is an essential aspect to maintain the sustainability of UNESCO properties, especially in Indonesia. Indonesia –a country located in Southeast Asia– has charted 18 UNESCO properties both in terms of tangible and ICH (see Table 2.5) . The preservation of UNESCO properties has been one of the top priorities for the Indonesian government since the 1990s [Fitri et al., 2015]. The governmental institutions launched several initiatives aiming at engaging various stakeholders such as private sectors, academicians, start-ups, and local communities in order to increase the public's participation in the heritage conservation activities. The Indonesian

government also supports the creation of digital information platforms dedicated to the heritage preservation and increases community capacity building to improve the quality of cultural tourism at World Heritage conservation. This paper aims at (1) presenting the development of digital heritage platforms in Indonesia, and (2) providing a grid of analysis of digital heritage knowledge platforms dedicated to UNESCO tangible and ICH in forms of websites and mobile apps.

Name of Country	World Heritage Sites (WHSs)	Intangible Cultural Heritage (ICH)	Total
Vietnam	8	12	20
Indonesia	9	9	18
Philippines	6	3	9
Cambodia	3	5	8
Thailand	5	1	6
Malaysia	4	2	6
Laos	3	1	4
Myanmar	2	0	2
Singapore	1	0	1
Brunei Darussalam	0	0	0
Total	41	33	74

Table 2.5. The number of UNESCO World Heritage Sites and intangible cultural heritage inscriptions in South East Asia (as of September 2019).

2.3.2   Indonesian heritage conservation: an overview

The management of Indonesian cultural heritage preservation was initiated during the Dutch colonial era in the 18th century. Some of the previous conservation works refer to the three cultural heritage sites which were later inscribed as UNESCO WHS in 1991 and 1996: the Borobudur Temple compounds, Prambanan Temple, and the Sangiran pre-historic site of Java Man (Pithecanthropus Erectus Palaeojavanicus). The Borobudur and Prambanan temple compounds were founded by Sir Thomas Raffles, a British statesman in 1811-1814 [Aljunied, 2004]. The Sangiran pre-historic site was discovered by Eugene Dubois in 1889 (ibid). Koninklijk Bataviaasch Genootschape van Kunsten en Wetenschappen (Royal Batavia Society of Arts and Science) was the first museum, which was built in 1778 during the colonial era to conserve the artefacts collection of the Indonesian archipelago [Lewis, 2015]. In January 1950, the Indonesian government took over the Royal Batavia Society of Arts and Science. Later in the 1970s,

the government decided to change its name into the National Museum that conserves the principal ancient artefacts of Indonesia [Katwinto, 2013]. In effect, the establishment of Monumenten Ordinantie (MO) Staatsblad 238/1931 during the Dutch colonial era is regarded as the first heritage legislation in Indonesia [Fitri et al., 2015].

In 1945, Indonesian proclaimed its independence and started to follow the heritage preservation protocols and policy guidelines issued by several international agreements. First, at the beginning of 1960s, following the Venice Charter of 1964, the Borobudur temple restoration campaign was launched and supported by ICOMOS [UNESCO, 1964]. Later, the Borobudur restoration project was conducted from 1973 until 1983 and became one of the pilot projects managed under UNESCO Convention for the Protection of Cultural and Natural Heritage in 1972 [UNESCO, 2017]. The project also received important international supports in terms of technology transfer, restoration experts, and researches. This assistance contributed to the rise of local initiatives on reviving the cultural heritage at the national level. In 1992, the Indonesian government issued Law no. 5 in 1992 on the assessment criteria of national cultural property [Ministry, 1992; Praharini, 2014]. This regulation emphasized the registration and the preservation of heritage for education purposes. However, the legislation has not sufficiently specified the roles and the involvement of the community as one of the key stakeholders who contribute to heritage preservation. Hence, the previous legislation was amended by Law No. 11 of 2010 on cultural heritage conservation. The new legislation highlights the concept of sustainability and strengthens multi-stakeholders engagement in order to maintain the cultural heritage conservation and its outstanding universal values [State-Secretary, 2010].

Along with the advancement of ICT and the rise of industry 4.0, the Indonesian government improved the legislation by stipulating the Law number 5 of 2017 on Cultural Advancement. The industry 4.0 involves the seamless integration of advanced Information Technology and automation technology within the industrial value chain, which brings on versatile organizational implications [Lasi et al., 2014; Smit et al., 2016]. The law is intended to build and improve the cultural database with an integrated cultural heritage registration system, community capacity building, cultural event promotions, and cultural village revitalization in each region [Ministry, 2017]. It also views the integration of ICT as a means to facilitate the valorization of the cultural heritage by developing a database containing information of local wisdom, indigenous arts, and fostering cultural education for youth, as well as promoting tourism and living traditions of the region [Zulkifli and Azhari, 2018]. Thanks to this new policy, Indonesian Directorate General of Culture collected a number of online registration en-

tries for 435 museums, 28 cultural parks, and 86'425 tangible and ICH across 34 provinces in Indonesia in 2019 [Ministry, 2019a]. Among them, a total of 41'898 of cultural heritage objects and sites have been verified. The Indonesian government also approved 819 ICH nominations that have been proposed by the local government. The central government also increased its financial supports in order to enhance 2001 cultural communities and improve the preservation of 453 indigenous cultural villages that are spread over 34 provinces in Indonesia (ibid).

2.3.3   New media to promote virtual communities in digital heritage and tourism

The history of New Media is preceded by the history of human communication across centuries. McLuhan (McLuhan, 1964 as cited in [Logan, 2002] classifies the history of human communication into five periods: tribal age (pre-literate), age of literacy, the print age, electronic age, and lastly the new media cultures [Logan, 2002]. The electronic age was marked by the invention of television and the radio in 1906. After the digitalization of signals and the birth of multimedia 1980, the development of media technology radically increases the potential range of diffusion and dissemination of information on cultural products [Veltman, 2005].

In the era with a high dependency on technology, McLuhan explains that communication technologies become the primary cause of the change in culture. Media technologies play a central role in structuring social arrangements and facilitate broader relationships. Generally, McLuhan explains that technology determination leads to cultural change that shapes the changes in human life and affects the cultural institutions of the community. On the other hand, the opposite pole of technology determinism is social constructivism. Elbanna [2009] states that, "Social constructivism suggests, with different degrees of strength, the importance of the social in shaping the technology, either in use or in production". The two different perspectives lead the way to open a discussion in the Actor-Network Theory, which elaborates the networks of connections between human agents, technologies and objects, as well as global and local networks, as the vehicle of development [Stanforth, 2006]. Kéfi and Pallud [2011] further investigate the success of the Actor-Network theory in the field of digital heritage in the museum, which also correlates well with this study. The study on digital heritage dedicated to UNESCO WHS and ICH in Indonesia can be analyzed further with the Actor-Network Theory framework. It could be investigated by
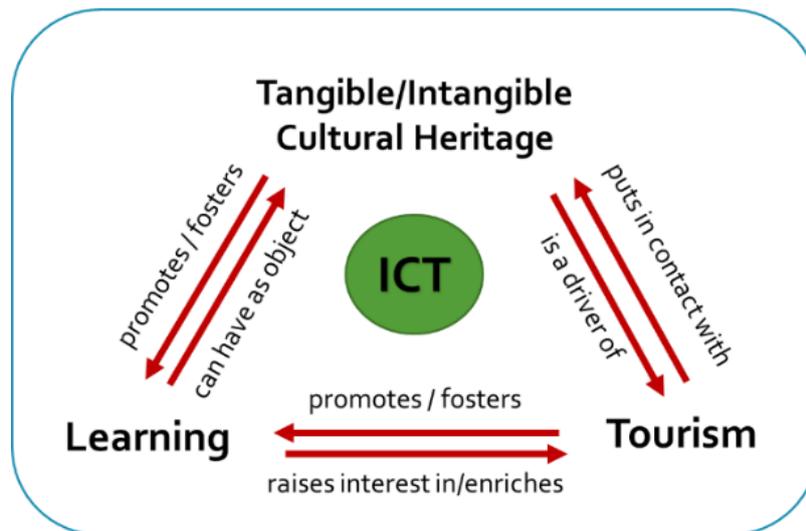
Figure 2.8. The relation between ICT, Tangible/ ICH , and Tourism [De Ascaniis and Cantoni, 2016]

looking at the presence of ICTs, in which way they communicate the heritage objects and the stakeholders who produce and promote it.

Lechner and Schmid [2001] point out that media plays a vital role within the virtual community formation in two possible areas: facilitation and constitution. The study further elaborates that ICT functions as a medium to facilitate communication among the community [2001]. In one case, a community or an organization may design a structured communication technology based on the necessities and employ the ICT to facilitate and foster their communication processes [Cantoni and Tardini, 2006]. On the other hand, ICTs may spur the constitution of a community by adopting the same digital communication technology. ICT serves as a medium that is used by the community members to communicate and share experiences (ibid). The advent of ICT facilitates the possibility of people frequently interacting through the world wide web and form virtual communities, discussing their interest in many different fields, including cultural heritage. Tardini [2003] mentions that virtual communities are "a group of people to whom interactions and communications via computer play an important role in creating and maintaining significant social relations". Thus, a community or certain group of people may use ICT as a medium, as it helps to spur the communication or information exchange related to particular interests. Digital technologies can also facilitate the constitution of an organization, as frequent online interaction activities may lead to common logical space and promote activities in the real-world [Lechner and Schmid, 2001; Cantoni and Tardini, 2006].

Since ICTs play a fundamental role in the success of enhancing community awareness on the importance of Outstanding Universal Values, the advent of digital innovations shall not be a threat in fostering the preservation of both tangible and intangible heritage (see Figure 2.8). It must go hand in hand in all ways, not only to be used for promoting the tourism destination of WHSs, but also to raise the awareness of the tourists and local communities to participate in the heritage conservation [Cantoni, 2018]. The communication strategy shall be directed to raise the understanding and awareness of different communities in the light of protecting their cultural identity as well as to facilitate local business and thus increase the economic benefits to the local community [Robbins, 2010]

To this end, the ICTs innovations shall be localized and adapted to the needs of local society, heritage conservation, as well as bring a sense of empowerment. According to Cantoni [2018], the roles of ICTs in promoting sustainable tourism and the preservation of cultural heritage can be singled out in five main areas:

• **Access**: Widen access and raise awareness; broaden access of information to the relevant stakeholders;

• **Better experience**: Enrich visitor's experience while onsite with digital communication devices such mobile access, location-based services (LBS), Augmented Reality (AR), Virtual Reality (VR), multiple voices, gamification, etc.

• **Connect**: Connect local stakeholders to the heritage (locals with heritage, locals with visitors, visitors with heritage); increase ownership and promote interpersonal encounters through digital storytelling, informal learning, gamification, sharing economy; connecting young generations with their heritage, and empowering them through it, e.g. WHACY (World Heritage Awareness Campaign for Youth) in Southern African Development Community (SADC) where >100000 students involved in «Junior Minister Competition» [Adukaite and Cantoni, 2016]; listening to online travel reviews, e.g. Saint Paul Outside the Walls (Rome, Italy) [De Ascaniis and Cantoni, 2013] and Lalibela rock-hewn churches in Ethiopia [Mutinda and Cantoni, 2016];

Social media campaigns, e.g. #faces4heritage campaign in support of the global #Unite4Heritage UNESCO initiative [De Ascaniis, Della Monica and Cantoni, 2017].

• **Dis-intermediate**: (Dis)intermediate (some) relationships in terms of information distribution, communication support, and promotional activities. ICTs are used in many business activities in order to ensure direct benefits between stakeholders. For example, ICTs for connecting between the museums and the visitors; ICTs for facilitating the visitors with the SMEs and local communities who live at the WHS [David and Cantoni, 2015].

• **Education**: To facilitate training and education activities to the relevant stake-

holders through e-learning platforms, digital archives, MOOCs (Massive Online Open Courses), e.g. MOOC on Tourism Management at UNESCO WHSs vol. 1 that gained >6500 registered learners from 166 countries. [Rosani et al., 2018].

2.3.3.1   Web technologies

The world wide web, known for its abbreviation the "WWW", was invented by Tim Berners-Lee in the years 1989 and 1990 at CERN (Conseil Européen pour la Recherche Nucléaire –European Organization for Nuclear Research) in Geneva, Switzerland [Berners-Lee et al., 2000]. Through all external hardware such as cables, infrared, satellites, etc., the WWW or the internet connects through Transfer Control Protocol (TCP) and Internet Protocol (IP), which was invented in 1973. This communication protocol (TCP/IP) facilitates the communication between the computer and the systems, and enable all types of data and media (audio, textual, visuals) to be shared between the digital devices. Websites become the most used online platforms that allow broader conversations, interactions and file sharing. It connects all kinds of documents in several accessible online platforms (ibid).

According to Webopedia, a website is a site (location) on the WWW. Each website contains a homepage as a landing page where users can find other additional documents and files based on the categories assigned to them [Cantoni and Tardini, 2008]. Each site could be owned by an individual, company or organization that manages the site based on the defined communication strategy. The websites represent structured contents whose electronic format text (hypertext) provides links to access the other page on the internet. The internet search engine operates in 3 main activities: by spidering the web, organizing (indexing) submission of websites to the internet database, and responding to the users' queries entered in the search engine. The internet gathers the related web pages to create a list of web resources and provides users access to a large range of other information resources and media (ibid). Other than websites, other online entries such as newsgroups, social media accounts, images, audio, and videos, blogs, maps, etc. are indexed in the internet search engine.

Based on Cantoni and Tardini [2006], there are two types of websites which are dominating the online presence in the last few years, namely blogs and wikis. Blogs (a short term for weblogs) are defined as a type of online outlet that was originally intended to be used as a personal journal for individual purposes, publicly accessible and regularly updated. Today, the blogs serve as a publication outlet for multiple types of information, whose contents are designed based on the communication goals of the web publisher. As web-based electronic diaries,

blogs are very useful tools for one direction micro-publishing, as they usually provide limited discussion or comments on site page (Hall, 2002 as cited in [Danesi, 2013]). On the other hand, Wikis or wiki is a form of publication outlet, whose name is taken from the Hawaiian word 'wiki wiki' that means 'quick' [Serrat, 2017]. The Wikis are collaborative websites that allow users to contribute to building the content or make any changes to the original content [Danesi, 2013].

In 2004, Dale Dougherty introduced web 2.0 as the evolution of the web 1.0 version developed in the 1990s. Web 2.0 is the second generation of the WWW that offers more dynamic and interactive web experiences. It is known as a participative website platform that expands the virtual space for users to collaborate in broader contexts. The platform functions as 'a medium' for sharing information online in forms of posts, comments, inputs via social media, blogging, and websites. It allows users not only to experience more flexible web design, but also facilitates its creative reuse, updates, collaborative and modification of content creations [Murugesan, 2007; Aghaei et al., 2012]. At this point, social media sites such as Facebook, Youtube, Flickr, etc. are commonly used by users. From the development of web 2.0, users may interact with the computer machines to join in a virtual community and its conversation activities such as listening (reading), speaking (writing), and vice versa [Cantoni and Tardini, 2008]. Later in 2006, web 3.0 was developed as the third generation of the web 1.0, which marked the birth of Internet of Things (IoT) and the rapid development of mobile service ecosystem (mobile apps) [Atzori et al., 2010]. Web 3.0 is regarded as a web of cooperation, which operates with two main platforms, namely semantic technologies and social computing environment [Aghaei et al., 2012]. It integrates the link and performs discovery and data analysis from various data sets, as well as automation and reuse across multiple applications.

Along with the development of digital technologies outlined above, online users prone to voluntarily contribute and share information or media in forms of text and audiovisual data (images, videos). This interaction of content suppliers and content consumers contributes to the aggregation of user-generated content (UGC) in the semantic web. UGC is a result of pattern recognition over online users' behaviour by recognizing the keywords they use in accessing digital content [Krumm et al., 2008]. It also implies the generic results of links that are the most referred or accessed by online users with certain keywords (ibid). The most frequented online platforms, either in forms of websites or mobile apps, may have high user-generated contents that are promoted by the online interactions among online users [O'Hern and Kahle, 2013].

2.3.3.2   Mobile apps

The second type of ICTs for cultural heritage is mobile apps. The mobile application is a type of ICT containing a program or software operated on a mobile device (smartphone, Personal Digital Assistant (PDA), etc.). Mobile apps are developed by mobile application developers and publishers. The mobile apps are usually developed to perform one or a few tasks and provide certain functionalities on particular topics based on its objectives or user requirements [Islam et al., 2010; Basole and Karla, 2012].

The study of web 4.0 reached its peak during 2014-2017 [Almeida, 2017]. The emergence of web 4.0 also marked the birth of artificial intelligence that fosters interconnectivity and faster performance of human and machine interaction [Aghaei et al., 2012]. The symbiotic interaction of users and machine learning in artificial intelligence plays a central role in fostering the development of industry 4.0 [Demartini and Benussi, 2017]. Beside cyber-physical systems, the new revolution of industry 4.0 emphasizes cloud-based systems with real-time responsiveness, which are well provided by web technologies 4.0 (ibid). In terms of culture and tourism domain, web 4.0 allows greater participation and collaboration among online user communities. It connects all tourism and heritage stakeholders into global online networks. Destination Management Organizations (DMOs) and tourism-related stakeholders extensively use ICTs to promote tangible/ICH as the cultural attraction of the tourism destination both through websites and mobile applications. Websites and mobile apps become the most used publication outlets when it comes to communicating the cultural heritage and its related aspects (tourism, fashion). The ABCDE (Access, Better Experience, Connect, (Dis)intermediate, Education) theory may help to provide an insight about the use of ICTs in relation to culture and tourism domain, as outlined in the previous section [Cantoni, 2018].

2.3.4   The digital converge of Indonesian cultural heritage

The digital convergence of tangible cultural heritage refers to the convergence of technologies, software and categorizing systems in documenting, archiving, as well as mediating cultural heritage [Stuedahl, 2007]. It is also defined as the digital transformation of recorded knowledge, documents, and data into electronic information, which leads to broader access and the functional integration of libraries, archives, and museums (Dempsey, 2000 as cited in [Marty, 2014; Dabello, 2016]. The digital transformation in the field of cultural heritage conservation covers not only in the forms of visualization technologies for

documenting archaeological data and related documents but also the ICTs for dissemination and mediation purposes [Redweik et al., 2017].

According to the Five Cs UNESCO Strategic Objectives, the dissemination and the mediation of cultural heritage play significant roles in engaging more stakeholders, which in turn, contributes to the continuity and the sustainability of cultural heritage conservation. Thus, more attentions have been paid on how WHSs and its Outstanding Universal Values (OUV) are presented on and offline. The online presentation of tangible/ICH shall be aimed to foster responsible and respectful behaviour among visitors and raise public awareness about the importance of this heritage [Garbelli et al., 2017]. The digital convergence of Indonesian cultural heritage started by the development of Digital Heritage Network in 1998 as part of the first digital library project initiated by KMRG (Knowledge Management Research Group) of Bandung Institute of Technology in Indonesia [Fahmi, 2002]. The following years later, the more and more public institution developed digital heritage platforms, which involved broader stakeholders from private sectors, education institutions, and local communities.

2.3.4.1   ICTs for tangible cultural heritage

Since 2010, the use of ICT in Indonesia has started to grow extensively, characterized by the growing number of social media users, the advancement of e-tourism, and financial technology. Based on the Global Digital Report of January 2019 [Kepios, 2019], Indonesian internet users and social media users both reach 56% of the total population which counts as much as 150 million people, compared to 132.7 million internet users in 2017. Indonesia also ranks the 4th country in the world after India, China, and the USA in terms of internet absolute growth rankings. This result shows the dynamic growth of Indonesian virtual communities. Kuswarno [2015] indicates that internet users reach 51% in urban communities and 49% in rural areas. Based on his research, several factors are deemed essential to accelerate the growth of online users in Indonesia, such as software applications, social networks, communication devices and extensive IT infrastructure in rural areas with wider broadband coverage.

The Indonesian government also encourages the youth community –including the heritage community– to support national goals to become the Digital Energy of Asia in 2020 by launching national movements of 1000 start-ups creation in 2017. The government also encourages all related stakeholders to support national creative industries and cultural tourism, as well as to foster the preservation of tangible and ICH through digital technologies [Ministry, 2019a].

The development of the digital heritage platform in Indonesia was first started

by pro bono movements. This initiative corresponds to voluntary work coordinated by a group of Indonesian scientists with the aim to facilitate the development of Indonesian cultural heritage inventory in 2008 [Situngkir, 2010; Avi, 2014]. The increasing number of endangered Indonesian artefacts and weak cultural database led the cultural activists to create a significant digital initiative. The first wiki-based website platform budaya-indonesia.org was created by a group of scientists involved in Bandung Fe Institute in collaboration with Sobat Budaya Cultural Association. In 2011, the initiative was amplified by the launch of a cultural movement called "Towards 1 million Cultural Data Inventory". The goal of this movement was to encourage all stakeholders in order to support the protection of Indonesian tangible/ICH by inviting public participation in enriching the cultural database and registering local heritage into the digital heritage platform [Situngkir, 2019]. In 2019, the digital database movement has succeeded in collecting more than 50000 digital cultural entries submitted by the online contributors across 34 provinces in Indonesia (ibid).

The implementation of law number 5 in 2017 on Cultural Advancement increases the awareness of heritage and tourism-related stakeholders to employ new media technologies. Heritage sites and destination managers are active to promote heritage sites and raise public participation in conservation activities through online publication and advanced web technologies. Digital innovations can be found in some of the UNESCO properties in Indonesia. For example, Borobudur Conservation Center invests in social media marketing and online publications, such as a mobile app, interactive website and other media outlets. The Borobudur interactive website features 360° images, videos, virtual tour of Borobudur temple and provides blogs to promote other cultural tourism offers in the area [Gunarto, 2007; Diarta, 2017].

2.3.4.2   ICTs for intangible cultural heritage (ICH)

ICH is characterized by tacit knowledge shared by the community and maintained as such through intergenerational transmission. As of August 2019, 508 ICH elements of 122 countries were enlisted by UNESCO [UNESCO, 2019a]. The fundamental aspects of this ICH reside on safeguarding practices, as well as its artistic, historical and cultural related values such as the making process, meanings and philosophy behind each cultural symbol.

The intangible heritage underlines the importance of the know-how or savoir-faire and 'in the know' behind each cultural practice. Boily [2004] defines the "in the know" or 'savoir-être' as 'the incorporation of knowledge and the process of know-how'. The tacit knowledge incorporated in the ICH is commonly trans-

mitted by oral traditions and through face-to-face interaction and experiences by local practitioners. ICT intervention on the preservation of living heritage shall be based upon the following principles [Garbelli, 2015]:

- Inclusive: The public participation through ICTs contributes to social cohesion and encourages a sense of identity and responsibility. It also helps individuals to feel part of one or different communities and foster a sense of belonging. Different stakeholders could take part in building a digital technology platform, cross-cultural storytelling content, and contextual mediation of the living heritage for their society.

- Representative: The use of ICTs to document and showcase all kinds of tacit knowledge concerning living heritage. It facilitates users to access the knowledge database regarding the making process, skills, cultural symbols, and philosophies as the elements of the living heritage.

- Community-based: ICT helps intercultural dialogue, and encourages mutual respect for safeguarding living heritage. The importance of ICH is not the cultural manifestation itself, but rather the wealth of knowledge and traditional skills, transmitted through ICTs from generation to generation.
The digital interventions should help to alleviate the participation of the society by attracting people in producing their own story of the living heritage based on their own perspective in the form of written or audiovisual narratives. Overall, the functions of ICT intervention in the field of intangible heritage conservation are as follows: (i) Identify, (ii) Capture, (iii) Transmit, (iv) While maintaining its authenticity [Garbelli, 2015].

Indonesia leverages on its rich living traditions as cultural tourism assets to boost the local economy. The rural tourism development goes hand in hand with the use of digital technologies that play major roles in connecting the local stakeholders, the destination managers with the tourists [Jonathan and Tarigan, 2016]. To this end, the local stakeholders could engage academicians, young artists, and communities to make the best use of the ICTs by creating dedicated blog posts, websites, and mobile apps for the living heritage. Such initiative could increase the online presence of living heritage, as presented in the case study of Indonesian Batik textile heritage in relation to Indonesian cultural tourism and digital mediation [Permatasari and Cantoni, 2019a; Rakhmawati, 2016].

2.3.5   Methodology

The number of Indonesian digital knowledge platforms has increased in the last recent years, thanks to the continuous support of cultural heritage preservation through the use of ICTs.

In order to better understand the digital knowledge platform of cultural heritage existing in Indonesia, this study aims at:
(a) identifying the online presence of Indonesian WHS and its type of publishers by analysing 180 webpages in English and Indonesian languages,
(b) classifying several digital heritage websites which serve as important cultural heritage knowledge platforms in Indonesia,
(c) providing a map of 312 mobile apps dedicated to WHS and ICH retrieved from Android and iOS platforms. The study is conducted by investigating the type of mobile apps, formats, type of publishers, features and functionalities according to the given indicators.

The study was conducted from 15th July to 15th October 2019 by analyzing 180 web pages and 322 mobile apps in Indonesian and English languages covering 18 UNESCO's properties: nine WHSs and nine ICHs in Indonesia. The research adopts a top-down methodology based on the indicators drawn from the previous studies and bottom-up methods by searching for new possible indicators drawn from the samples and the research experimentation [Lizzi et al., 2011]. The bottom-up approach, according to Chi [1997], allows further discovery and experimentation to get a better understanding of the online narratives of the specific subject at the bottom level.

2.3.5.1   Website data collection

The data samples are collected by primarily entering the name of one UNESCO WHSs in Indonesia as the keywords in the search query. For example: "Borobudur Temple Compounds" in English and "Candi Borobudur" in the Indonesian language. Once the query was entered, the Google search engine shows the results of web pages and articles related to the keywords. Only web pages shown on the first page of the search result are examined and classified based on the type of online publishers.

The study excludes the links of scientific papers and advertised web pages. The research collects 180 webpages in English and Indonesian as data samples, 90 webpages in Indonesian language and 90 webpages in English one. The collected samples were analysed iteratively by using grid analysis with the predetermined indicators (see Table 2.6). The indicators used the grid analysis are drawn
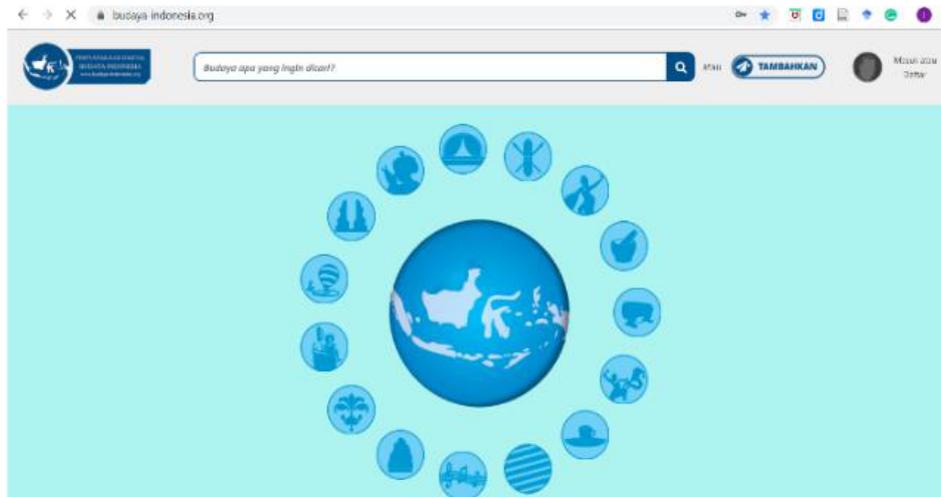
Figure 2.9. An example of participative digital heritage platform run by the public initiative. www.budaya indonesia.org

from the Online Communication Model [Cantoni and Tardini, 2006], Indonesian tourism and Batik: an online map [Permatasari and Cantoni, 2019a], and online platforms for 3D visualisation of heritage [Statham, 2019].

						General Information				
			AH	AI	AJ	AK	AL	AM	AN	AO
app name	Developer	Heritage App	General description of the app	General description of the broader area/region	History of the object	Geography of the WHS/ICH	philosophical values (identity, moral, sacred)	Opening hours of the site	Selected POIs/highlights/proposals	Suggested tour(s) (Galleries for ICH)
Keris Indonesia	Gyt Good	1	1							1
Keris Sakti Heritage	Beni Pelindung		1		1		1			
Kamus Keris Lengkap	Arya Buana Diwangkara	1	1		1		1			
Museum Keris Nusantara (Wedharing dan Urwanng W)	Prodi D3 Teknik Informatika FMIPA UNS Surakarta		1		1					
Virtual Museum Keris Nusantara (Esthining Lampah)	Prodi D3 Teknik Informatika FMIPA UNS Surakarta		1		1					

Figure 2.10. The grid analysis of the online presence of Indonesian World Heritage Sites: websites and mobile apps.

Type of Publication	Type of Digital Heritage	Features
UNESCO WHS	Top – down approach	Thematic Map
Blogs	Bottom up approach	Thematic blogs
Travel Guides		Simulation
Encyclopedia		Online sources and database
Social Media		3D objects
News & Media		360 pictures Virtual tour
Online travel review		Participative cultural database
Tourism Board and Official Bodies		Scientific Rigorous
Association and Foundations		
Research Centers and Museums		
Travel Agency/Tour Operator		
Adhoc Websites		
Others		

Table 2.6. Indicators of website grid analysis.

2.3.5.2   Mobile app data collection

As for the mobile apps, similarly, each name of the UNESCO heritage site/ICH was entered as the keywords in the search query both within the Google Play for Android smartphones, and within the Apple store for iOS mobile devices. All the apps retrieved from Google Play and Apple Store were examined and identified based on the relevant indicators. The main indicators were set based on the triangulation of the Online Communication Model [Cantoni and Tardini, 2006], mobile apps dedicated to WHSs [Schieder et al., 2014], mapping mobile apps on Batik ICH [Permatasari and Cantoni, 2019b], and online platforms for 3D visualisation of heritage [Statham, 2019]. The apps that operate in two different platforms (Android and iOS) are counted as one single app in the grid analysis. After identifying each name of WHSs and the year of its inscription, each mobile app was analysed according to the following set of indicators (see Table 2.7).

Categories	Sub categories	
1. Number of Apps	1.1. Android	
	1.1. iOs	
2. Type of mobile apps for WHS	2.1. Encyclopedia	
	2.2. Travel	
	2.3. Games (Quiz and animation)	
	2.4. Mix Reality (AR/VR)	
3.Type of mobile apps for ICH	3.1. Encyclopedia	
	3.2. Multimedia	3.2.1. Videos Entertainment
		3.2.2. Fashion
		3.2.3. Image Catalogues (textile, heritage objects)
		3.2.4. Music Instruments
	3.3. Games	3.3.1. Quiz,
		3.3.2. Animation games
	3.4.Mix Reality (AR/VR)	
4. Type of Publishers	4.1. Association	
	4.2. Independent developers	
	4.3. Media agency	
	4.4. Companies	
	4.5 Research institutes and museums	
5. General Information	5.1. General description of the app	
	5.2. History of the site	
	5.3. Geography of the site	
	5.4. Philosophical values of the place	
	5.5.Tourism information (maps, transportation, accommodation)	
6. Information on UNESCO WHS/ICH	6.1. Information on WHS	
	6.2. Information about UNESCO convention 1972	
	6.3. Year of inscription	
	6.4 Explicit reason of inscription	
7. Language	7.1. Indonesian	
	7.2. English	
8.Formats	8.1. Text	
	8.2. Photo gallery/slide show	
	8.3. Audio material	
	8.4. Video material/ YouTube channel	
9.Features	9.1. Games with animation	
	9.2. Quiz games	
	9.3. Interactive tools	
	9.4. Scientific content	
	9.5. Augmented Reality	
	9.6. Virtual Reality	
	9.7. 360 and Virtual tour	
	9.8. Sharing by users	
10. Number of Downloads	10.1.10-50 downloads	
	10.2. 100+	
	10.3. 500+	
	10.4 1000+	
	10.5. 5000+	
	10.6. 10,000+	
	10.7. 50,000+	
	10.8. 100,000+	

Table 2.7. Indicators of mobile apps' grid analysis.

2.3.5.3   Grid analysis

The study combines the qualitative method of content analysis with the quantitative assessment in order to analyse the presence of a given type of content in a given set of data (webpages, mobile apps) [Cantoni et al., 2007]. The qualitative method was conducted by analysing each app, both in terms of the contents and the features provided. This analysis is intended to identify the presence of each type of content and annotate them into the relevant indicators (see Figure 2.10). The table of indicators consists of the main indicators, which are taken from the previous scientific works, together with additional indicators that emerge during the qualitative analysis process (ibid). The quantitative process was done to clarify the qualitative judgment by assigning the grid value of "1" when the indicator is present. Otherwise, the value of "0" was given when it is absent. These qualitative-quantitative analysis processes are performed on the dataset until thematic saturation was reached [Permatasari and Cantoni, 2019a].

2.3.6   Results

2.3.6.1   Indonesian WHS online presence

Based on Google organic results, the three most frequent type of publishers covering Indonesian WHSs in the English language (n=90 webpages) are 'UNESCO WHS' (14%), Blogs (14%), and Travel Guides (14%) of the total webpages. The result also shows the active roles of international tourists and travel guides to discuss Indonesian WHSs online, indicated by the good presence of blogs and travel guides site pages. The analysis conducted on 90 Indonesian webpages shows that 'Social Media' (23%) and 'News and Media' (22%), and 'Encyclopedia' (18%) are the three common online platforms presenting the Indonesian UNESCO WHSs (see Figure 2.11) . The high presence of 'social Media' shows active participation of the Indonesian public towards their national heritage. The outcome also indicates the strong support from 'News and Media' agencies who produce creative and informative content about Indonesia WHS. The digital encyclopedia is shown as one of the highest user-generated contents on Indonesia cultural heritage. In terms of digital heritage platforms, there are several websites which are dedicated to disseminating cultural knowledge as well as to provide access for the public for learning the Indonesian cultural heritage. Table 2.8 presents the lists of the digital heritage platforms, which are managed by the government, museums, and national library and other heritage stakeholders. The digital heritage platforms are also classified based on their approaches in communicating the website, e.g. top-down and bottom-up approaches. Some
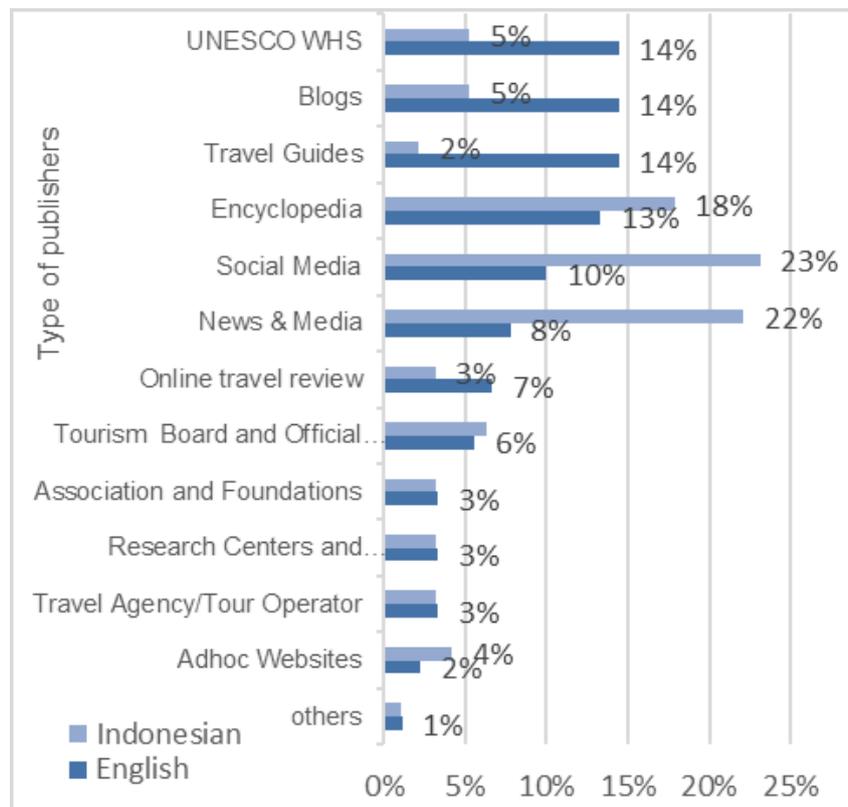
Figure 2.11. Online presence of Indonesian WHSs

of these digital heritage platforms are managed by public initiatives and media agencies (see Figure 2.9). Such efforts give rooms for broader online users' participation in terms of enriching cultural database and contents related to cultural information. These sites are administered by certain expert committees, as they are also in charge of editing and verifying the information submitted by the users [Situngkir, 2019].

2.3.6.2 Indonesian WHS mobile apps' presence

The study collects a total of 13 mobile apps, consisting of nine Android mobile apps and four mobile apps in iOS. The result shows that only four out of nine Indonesian WHSs that have dedicated mobile apps.

All collected samples are classified as one single mobile app that only operates in one single platform (Android/iOS). This study is done by investigating all mobile apps retrieved from the two mobile app platforms into the grid of analysis. Table 2.9 reveals mobile apps' functionalities based on major categories, e.g. en-

Name of Websites	Platform Manager	Features
Top Down Approach		
www.perpusnas.go.id	Government and national library	Thematic Map
www.kebudayaanindonesia.net		Online database (manuscripts, ebooks, etc)
www.situsbudaya.id	Media Agency	Thematic blogs
www.museumnasional.or.id	Museums	Thematic blogs
www.museumkaa.iheritage.org		3D objects
		360 pictures
		Virtual tour
Participative - Bottom Up Approach		
www.budaya-indonesia.org	Research Center	Participative blogs
www.kairaga.com	Cultural Association of Indonesian Ancient Letters	Thematic maps
		Ancient letter simulation
		Thematic blogs
www.indonesiakaya.com	Foundation	Participative cultural database
		Thematic blogs

Table 2.8. Classifications of common Indonesian digital heritage websites.

cyclopaedia (five apps), travel guide (four apps), and games/AR/VR (four apps). Table 2.10 shows detailed information about the type of publishers. Independent developers are the most frequent publishers of the studied mobile apps. Few of them are produced by 'Research Centre and Museum, 'Association', and 'Tech Company'. In terms of the number of downloads, five out of 9 Android apps dedicated to Indonesian WHS gain 100+ downloads. There is only one animation game app called Prambanan education game, which gained popularity and crossed >100'000 downloads.

Table 2.12 indicates that all mobile apps provide general information and geographical information. Even though most of them do cover the history and related information about the cultural heritage, however, the inscription and other relevant information about UNESCO WHSs, are scarcely mentioned. Nine mobile apps do present tourism information at WHSs, such as transportation, maps, hotels, and attraction highlights. In terms of engagement, the study captures the number of downloads on Android mobile apps.

No	World Heritage Sites	Year of Inscription	Operating system		Type of mobile apps		
			Android	iOs	Ency clopedia	Travel	AR/ Games/ VR
1.	Borobudur Temple Compounds	1991	3	3	2	3	1
2.	Komodo National Park	1991	-	1	-	1	-
3.	Prambanan Temple Compounds	1991	3	-	2	-	1
4.	Ujung Kulon National Park	1991	-	-	-	-	-
5.	Sangiran Early Man Site	1996	3	-	1	-	2
6.	Lorentz National Park	1999	-	-	-	-	-
7.	Tropical Rainforest Heritage of Sumatra	2004	-	-	-	-	-
8.	Cultural Landscape of Bali Province: the Subak System as a Manifestation of the Tri Hita Karana Philosophy	2012	-	-	-	-	-
9.	Ombilin Coal Mining Heritage of Sawahlunto	2019	-	-	-	-	-
	Total sum		9	4	5	4	4
	Total mobile apps in android and iOs		13		13		

Table 2.9. The classification of mobile apps dedicated to Indonesian World Heritage Sites.

Table 2.11 shows the number of mobile apps that provide additional features such as AR, VR, and game animation. It also presents detail classification about the type of formats (video, photos, audio materials) and the number of apps with qualified scientific content. The "Interaction tool" indicator in the analysis is related to additional console features for gamification built in the mobile app. Figure 2.12 illustrates an example of storytelling mobile app of Prambanan Temple Compounds. This mobile app provides interesting animation, audio material, textual information, and games. Figure 2.13 presents an example of Borobudur

Type of Publishers	Type of Apps		Number of Downloads	Number of WHS apps (in Android)
	Android	**iOs**		
Association	1	-	10-50 dl	2
Independent developers	5	4	100+	5
Companies	1	-	500+	1
Research Institutes and Museums	2	-	1000+	-
Total	**9**	**4**	5000+	-
			10,000+	-
			50,000+	-
			100,000+	1

Table 2.10. The classification of type of publishers and the number of downloads (WHS mobile apps).

mobile app that features 3D images and virtual tour navigation.

multirow graphicx

Formats	Number of Apps	Features	Number of Apps
Text	10	Games	2
Photo gallery/ slide show	6	Augmented Reality	1
Audio material	3	Virtual Reality	2
Video material/ Youtube channels	-	Animation	1
Language		Interactive tools	3
		Scientific content	4
Indonesian	9	360/Virtual Tour	2
English	4	Sharing by users	4

Table 2.11. Results on formats, language, and features on WHS' mobile apps [7].

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[7]The sum does not always correspond to 100% since all indicators presented in the table

[8]The app presents the storytelling about the history of Prambanan Temple and the folktale of Princess Roro Jonggrang and Prince Badung Bondowoso [Studio, 2018]

[9]It is equipped with two interaction features for navigating the view of Borobudur through the screen [Indo3one3, 2019]

[10]Items number 3 and 4 are related to the Indonesian Batik as intangible cultural heritage

General information	Number of Apps	Information about UNESCO WHS	Number of Apps
General description of the app	13	Information on WHS	10
History of the site	12	Information UNESCO/ UNESCO convention 1972	3
Geography of the site	13	Year of inscription	1
philosophical values of the place	3	Explicit reason of inscription	1
Tourism information (map, transportation, accommodation)	9		

Table 2.12. Results on general information and information about UNESCO World Heritage Sites (the sum doesn't always correspond to 100% since all indicators presented in the table are not mutually exclusive).
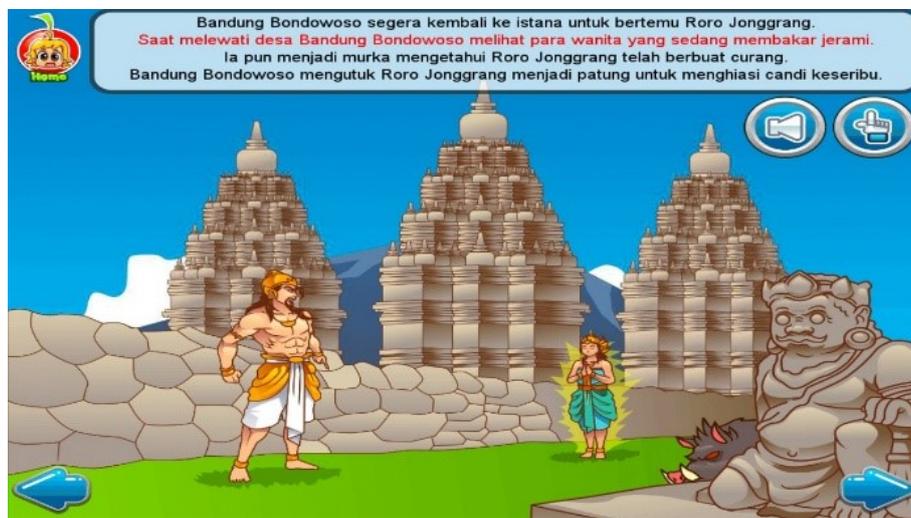
Figure 2.12. Example of an educational mobile app of Prambanan Temple Compounds [8].

2.3.6.3   Indonesian ICH mobile apps' presence

The study finds 299 mobile apps dedicated to Indonesian ICH in the Android platform. Such findings show a higher interest of the Indonesian public towards the mobile apps dedicated to preserving the living traditions. The study also finds that 10 mobile apps operate in both Android and iOS platforms. Since similar apps are counted as a single app, hence, the study only takes the mobile apps collected from the Android platform. Seven out of nine Indonesian ICH have dedicated mobile apps, namely Indonesian Kris traditional dagger, Wayang puppet theatre, Indonesian Batik wax-resist dyeing textile heritage, three genres of Bali traditional dances, and Pinisi, the art of boat building in South Sulawesi.
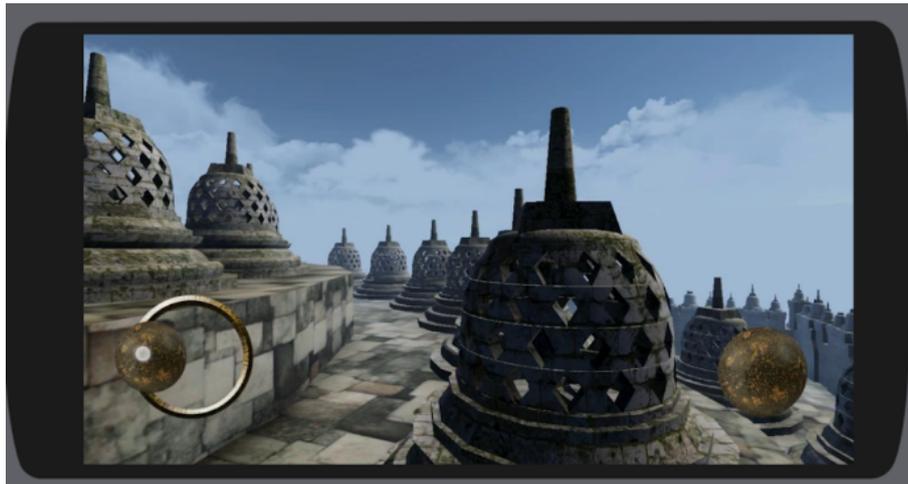
Figure 2.13. Example of virtual tour mobile app dedicated to Borobudur Temple Compounds [9].

The list of mobile apps is outlined in Table 2.13.
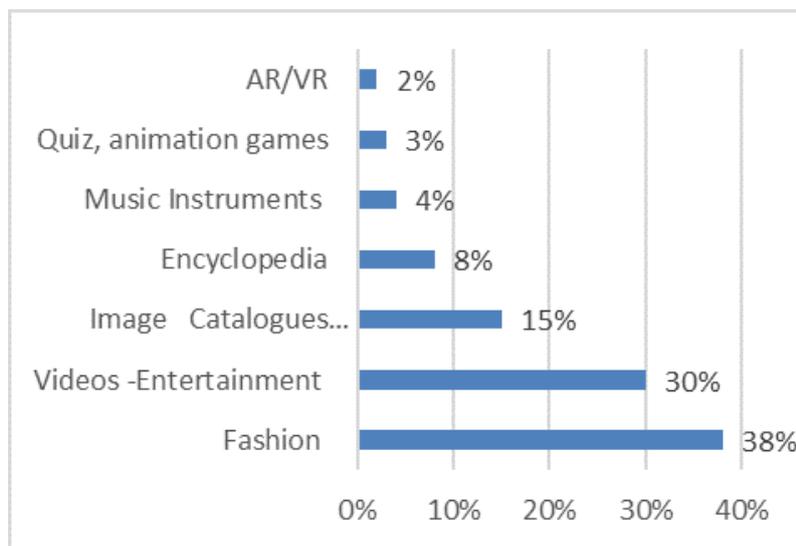
Figure 2.14. Types of mobile apps dedicated to Indonesian ICH (n=299)

The major type of publishers shown in Table 10 is mostly independent developers. The apps created by independent developers accounted for 51% of the total mobile apps or 151 mobile apps (n=299). The second biggest type of publisher is new and media stakeholders who published 96 mobile apps or 36% of the total samples. In terms of the number of downloads, we assumed that mobile

No	Name of Intangible Cultural Heritage	Year of Inscription	Number of mobile apps based on operating system	
			Android	iOs
1.	Indonesian Kris traditional dagger	2008	6	-
2.	Wayang puppet theatre	2008	110	-
3.	Indonesian Batik wax-resist dyeing textile heritage	2009	164	4
4.	Education and training in Indonesian Batik intangible cultural heritage [10]	2009		
5.	Indonesian Angklung	2010	10	3
6.	Saman dance	2011	-	-
7.	Noken woven handicraft of the people of Papua	2012	-	-
8.	Three genres of traditional dance in Bali	2015	5	3
9.	Pinisi, art of boat building in South Sulawesi	2017	4	-
	Total		299	10
	Total apps in Android and iOs		309	

Table 2.13. The classification of mobile apps dedicated to Indonesian Intangible Cultural Heritage

apps for Indonesian ICH draw much bigger engagement than those of the WHSs. For example, there are 32% of the total apps (95 mobile apps) which gain more than 1000 downloads. In addition, 70 mobile apps or 23% of total mobile apps gain more than 100 downloads. The "Pazia Angklung" music instrument mobile app achieves the highest number with more than 100'000 downloads on Android [Pazia, 2012].

Table 2.15 provides the number of mobile apps based on the major clusters

and its subcategories. In terms of apps' purposes, the research identifies 22 mobile apps that serve as an encyclopaedia and provide quality content about the history and the knowledge behind the Indonesian ICH.

Table 2.14 shows a much high presence of multimedia apps, in comparison to the number of encyclopaedias and games apps. The percentage of each indicator is presented in Figure 2.14. The study finds 88 mobile apps that are dedicated to showcasing Indonesian Wayang Puppet performance. Wayang is an ancient form of storytelling of wisdom, religious values, and ancient epics. It is originated from the Indonesian Java island, existed since around 15 BC. It was inscribed in UNESCO's Masterpiece of Oral and Intangible Heritage of Humanity in 2008. Its performance involves various repertories, musical accompaniments consisting of bronze instruments and gamelan drums. The Wayang performance is conducted and led by the master puppeteer, or Dhalang. He performs the shadow theatre by manipulating the puppets with compelling storytelling of ancient epics and spiritual wisdom. The Dhalang profession is one of the most prestigious cultural professions in Indonesian, given their talents and abilities [Boonstra, 2014]. They are able to conduct Wayang performance in a way that is entertaining the audience with senses of humour, teaching wisdom and life lessons conveyed through Wayang stories repertory (ibid). In this case, the ICT in forms of mobile apps also serve as digital tools for the Dhalang, or the master puppeteer to maintain their connections with their loyal viewers or fans. These apps do contain video materials/YouTube channel of Wayang performances, as well as some textual information about the Wayang characters. Besides, it also provides the users with access to watch the audiovisual recordings of Wayang performances conducted in many cities on Java island. Figure 2.15 presents an example of a mobile app for Wayang that provides educational contents and interactive games.

The second subcategory of 'Multimedia' is the fashion mobile apps for Batik textile heritage (Table 2.14 and Figure 2.14). Batik is a textile made by using the wax-resist dyeing technique and decorated with intricate patterns incorporating socio-cultural importance of Indonesian society. The Batik textile permeates in the life of Indonesian society as a symbolic textile used in every social occasion such as spiritual ceremonies for the religions, the birth, the wedding, the death, as well as the outfits for the royals or public figures [UNESCO, 2009b]. UNESCO recognised two nominations of Batik under the List of ICH of Humanity, namely 'Batik safeguarding practice' and 'Education training of Batik intangible cultural heritage' [UNESCO, 2009a]. Since the two nominations refer to Batik ICH, no differentiation was made within the mobile apps' analysis. The mobile apps for the fashion category are explicitly intended for fashionistas to get inspirations and ideas about Batik clothing designs for men, women, family, and traditional

gowns [Permatasari and Cantoni, 2019b]. The apps also provide suggestions in terms of modern and traditional wearing rules of Batik textile. Figure 2.17 presents an example of Batik encyclopedia app, called Map of Batik. It depicts more than 500 Batik motifs across Indonesian archipelago [Situngkir, 2011].
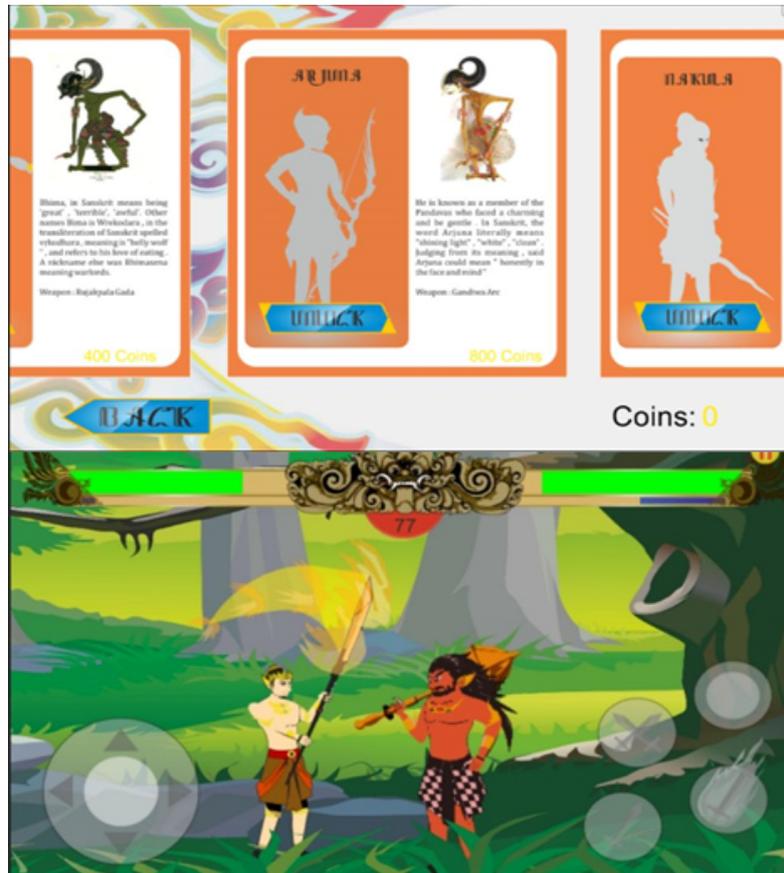
Figure 2.15. Example of an educational game for Wayang Puppet Theater. The game provides not only informative content about the character of wayang figures, but it also provides the personalization in terms of storyline and figure choices cite Surakarta [2016]

The third subcategory of multimedia (Table 2.14 and Figure 2.14) is related to the mobile apps that display images catalogue of the heritage objects. For example, the images related to Batik textile patterns, the Javanese Keris traditional dagger, the figures of Wayang theatre puppets, and the Pinisi boat of South Sulawesi. The fourth subcategory is addressed to mobile apps that serve as a learning app for Indonesian Angklung traditional instruments. Angklung is a bamboo traditional music instrument that can be played by single and multiple players.

No.	Category	Sub Category	Number of Apps (Android/iOs) n=299	%
1.	Encyclopedia	Encyclopedia	22	8%
2.	Multimedia	2.1. Videos-Entertainment	88	30%
		2.2. Fashion	115	38%
		2.3..Image Catalogs (textile, heritage objects)	45	15%
		2.3.Music Instruments	13	4%
3.	Games	Quizzes and animation games	10	3%
4.	Mix Reality	AR/VR	6	2%
	Total		299	100%

Table 2.14. The classification result of ICH mobile apps according to features and functionalities

Since one angklung instrument only represents one tone of melody, so in a musical ensemble, one player is responsible for producing a sound/tone through an angklung s/he carries. An expert player can play multiple instruments at once producing a harmonious melody according to its musical arrangement.

The mobile apps for angklung are designed with various user interactions to produce audio outputs. For example, some apps do provide functionalities to produce angklung tone by shaking the mobile device. Some other mobile apps allow possibilities to play multiple Angklung instruments by screen touch interactions (see Figure 2.18). Other than mobile app for learning musical instruments, it exists a mobile app that provides a complete tutorial for learning traditional Bali dance (see Figure 2.16) .

As seen in Table 2.16, all mobile apps provide general information about the app (n=299). Within the general information, 37% of the total mobile apps mention History of the App, 34% provide information on Geography of the concerned WHS/ICH, 38% indicate philosophical values of the WHS/ICH, and 12% suggest tours at WHS or visit galleries of ICH. In terms of mobile apps for ICH, the result shows a good number of mobile apps (66%) that provide information

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[11]The app presents information about Angklung history and 3D image that can be played by the user. The user may touch or shake the phone to produce the sound of Angklung [Raza, 2016]

[12]The sum doesn't always correspond to 100% since all indicators presented in the table are not mutually exclusive

[13]The sum doesn't always correspond to 100% since all indicators presented in the table are not mutually exclusive

Figure 2.16. Example of a mobile app for learning Bali dance. The app presents the tutorial of Bali dance step by step [Arya, 2016]

concerning historical aspects and philosophical values of the ICH in apps' general information. On the other hand, only 6% of the total mobile apps state explicit information about UNESCO WHSs and safeguarding goals.

Table 2.17 indicates the details of formats and features provided within the mobile apps. The majority of mobile apps (84%) display the collection of images and slide shows. 32% of the mobile apps are equipped by audio material such as recordings and voice over for games, AR, VR, and encyclopaedia. 20% of the total samples display long textual information within the encyclopedia apps, education games and AR. Many apps classified in Multimedia apps (video entertainment, fashion, images catalogues, and music instrument) as presented in Table 2.14, only display titles, images, and audiovisual contents, without providing qualitative written information. The result shows 88% of mobile apps

Type of Publishers	Number of Apps (Android)	%	Number of Downloads (in Google Store)	Number of Apps (Android)	%
Companies (IT company, SMEs)	34	11%	10-50 dl	70	23%
News and media	96	32%	100+	70	23%
Research center and museum	18	6%	500+	18	6%
Independent developers	151	51%	1000+	95	32%
Total	299		5000+	24	9%
			10,000+	18	6%
			50,000+	3	1%
			100,000+	1	0.1%
			Total	299	100%

Table 2.15. The classification of mobile apps dedicated to Indonesian Intangible Cultural Heritage according to type of publisher and the number of downloads
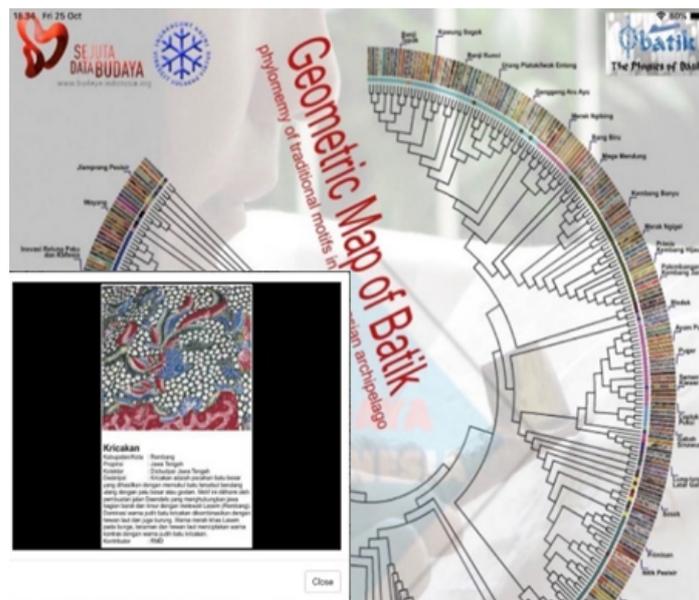
Figure 2.17.   Example of encyclopedia map for Batik intangible heritage (Situngkir, 2015)

samples dedicated to ICH are in the Indonesian language and the rests are in English. The study also finds that ICH is promoted in various types of digital
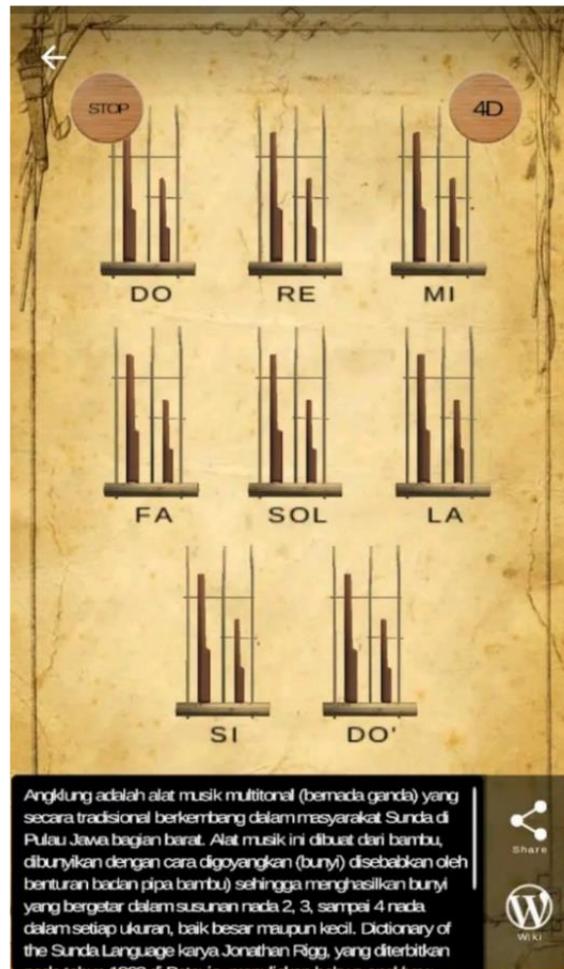
Figure 2.18. Example of educational mobile app for Angklung traditional music available on Google Play[11].

technologies. The study finds that 11 mobile apps for ICH are equipped with fascinating animation and games apps. Some games provide quizzes and additional control menu to personalise or choose characters (Table 2.17). Those apps also provide immersive features such as AR and VR. The research observes that 13% of the total mobile apps can be used as e-learning tools, as they do provide scientific contents about history, philosophy, or other specific information about the ICH objects. The apps present scientific content in different modes and formats, such as through textual information, games, pictures, AR, and VR.

General information	Number of Apps	%	Information about UNESCO ICH	Number of Apps	%
General description of the app	299	100%	Information on ICH	197	66%
History of the object	112	37%	Information about UNESCO ICH convention 2003	17	6%
Geography of the WHS/ICH	101	34%	Year of inscription	12	4%
Philosophical values (identity, moral, sacred)	113	38%	Explicit reason of inscription	13	4%
Suggested tour(s) at WHS or Galleries of ICH	36	12%	Safeguarding goals	19	6%

Table 2.16. Results on general information and information about UNESCO Intangible Cultural Heritage (ICH)[12].

Formats	Number of Apps (Android)	%	Features	Number of Apps (Android)	%
Text	60	20%	Games with animation	11	4%
Photo gallery/ slide show	250	84%	Quizzes	3	1%
Audio material	97	32%	Interactive tools (game console, character options)	16	5%
Video material/ YouTube channel	10	3%	Scientific content	40	13%
Languages			Augmented Reality	3	1%
Indonesian	262	88%	Virtual Reality	3	1%
English	37	12%	360 and Virtual tour	4	1%
			Sharing by users	164	55%

Table 2.17. Results on formats, language and features in ICH mobile apps [13]

2.3.7   Conlusion

The study captures the journey of Indonesian society to preserve the UNESCO WHSs and ICH from the 19th century until the digital era 4.0. Since the beginning of the 2000s, the rise of ICTs brought significant impacts in fostering the

growth of internet users and the creation of digital start-ups in Indonesia. Facing the critical challenge of heritage conservation, digital heritage platforms become an undeniable solution to raise public engagement, to disseminate cultural heritage values and its conservation aspects, as well as to promote sustainable tourism at the heritage sites.

By analysing 180 webpages and 322 mobile apps through the lens of the online communication model and related studies, this research has contributed to providing an online map of UNESCO WHSs and ICH in Indonesia. The result shows that Indonesian digital heritage platforms are developed both by top-down approach and bottom-up approaches. The governmental support in terms of facilitation and policy guidelines combined with the strong local initiative helps the expansion of digital heritage platforms such as online cultural database websites, blogs, and mobile apps. The study reveals that in terms of addressing the English audiences, the online presence of Indonesian WHSs is mostly referred through UNESCO WHS official website and travel-related webpages for English audiences. The encyclopaedia is one of the most common types of publishers when it comes to covering the cultural heritage in the Indonesian language. Therefore, it is deemed important to provide informative and educative content within the ICTs for heritage and tourism, in order to improve the capacity of the local stakeholders and to raise the awareness of international tourism towards the conservation of the heritage. In terms of mobile apps, most of the developers are coming from private sectors consisting of independent developers, tech companies, the research centres, and museums. We assumed that the high presence of mobile apps and the number of downloads illustrated in the study indicate a certain level of enthusiasm from Indonesian online users regarding the dissemination of cultural heritage through ICTs. Such tendencies would bring beneficial impacts to the improvements in cultural heritage conservation in the future.

In terms of the number of mobile apps, the Borobudur and the Prambanan Temple Compounds are the only two sites among all UNESCO WHSs in Indonesia that possess several dedicated mobile apps. As for the UNESCO ICH, the study also records a huge number of mobile apps in relation to Batik and Wayang puppet theatre. This research finds that some mobile apps offer innovative ways of communicating cultural heritage through interactive quizzes, gamification apps with animation, AR/VR, etc. Since the scope of the research is only limited to analyse the online presence of WHSs in Indonesia, this study can be improved by further research, such as the online presence of Indonesian ICH. This study focuses on the analysis of the type of publishers, contents, and functionalities of mobile apps dedicated to UNESCO WHSs and ICH. Therefore, the research could be expanded to other topics such as usability, apps' user experiences, as well as

the content analysis of the users' comments on both Android and iOS platforms. Such researches may give a theoretical contribution that can be used to assess the quality of the apps.

As the research shows that only a few apps communicate the UNESCO related information and safeguarding goals, it is deemed important to define a standard content requirement when it comes to communicating good quality messages about the cultural heritage through digital technologies. It should be noted that the issue of cultural heritage is not only related to local identity but also related to socio-cultural sustainability, which implies shared responsibilities among stakeholders. It is necessary for the Indonesian government to maintain the inclusion of local communities, educational institutions, media, and tourism-related stakeholders in the creation of ICTs for culture and heritage. It is also suggested that each UNESCO tangible and ICH in Indonesia could have at least one or a number of representative mobile apps. Those apps would be valuable to facilitate and better promote the cultural importance and to support the cultural communities of the concerning heritage.

2.4　Digital Technologies for Communicating Fashion Heritage

Introduction[14]. Fashion is one of the cultural and creative industry sectors that most benefit from the cultural dimension of a community [Solima and Minguzzi, 2014]. Fashion involves an intensive creative process, from the design and manufacturing, to promotional exhibitions and events. The production and activities related to fashion increase the value-added of creative industries in a specific territory and affect the image of a city as a tourism destination. Moreover, the organization of fashion events boosts the local competitive advantage and its tourism appeal [Lazzeretti et al., 2017]. Since fashion is closely related to the history of humankind, specifically the way of wearing and producing apparel, textiles and designs, it becomes a part of cultural heritage that is worth to be taken care of and promoted by museums as cultural institutions. Displaying fashion in museums becomes an effective strategy with the aim of better showcasing the tangible and intangible characteristics of fashion such as design, craftsmanship, art, and the history of its production-making to the public. The integration of fashion items and events within a museum could attract larger visitors from diverse cultural backgrounds to visit the museum and stimulate the growth of the creative industry in the territory [Kalbaska, Ramírez and Cantoni, 2018]. Fashion is also highly dependent on other creative industries such as design, music, media, Information and Communication Technologies (ICTs) [Lazzeretti et al., 2017]. The roles of digital technologies are becoming crucial when it comes to communicating fashion and its heritage values to the visitors in a better way, as well as to provide related information to the public about the fashion events organized in a tourism destination. During the last decades, the integration of digital media in the fashion exhibitions has brought up a significant impact on the development of fashion communication. Digital media allow visitors to enjoy better experiences in valorizing the fashion heritage both in terms of its tangible and intangible elements.

Based on fashion branding communication [Jin and Cedrola, 2017], fashion is classified into luxury brands, premium brands and mass-market brands, which are commonly known as fast fashion. A luxury brand is characterized by several features, namely high price, excellent quality and aesthetic, exclusive small se-

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[14]Permatasari P. A., Kalbaska, N. (2022) Digital Technologies for Communicating Fashion Heritage. In: Silvia De Ascaniis and Lorenzo Cantoni (eds) Handbook on Heritage, Sustainable Tourism and Digital Media. Edward Elgar 2020, UK. https://www.e-elgar.com/shop/gbp/handbook-on-heritage-sustainable-tourism-and-digital-media-9781788970075.html

ries, and superfluousness [Dubois et al., 2001; Noris et al., 2018]. Luxury brand heritage possess exquisite traits on its tangible elements such as the textures and materials of the fashion products. It is closely linked with geographical roots and is produced in fine arts workshops, incorporating craftmanship techniques that are based on artisanal heritage practices [Kapferer and Bastien, 2010]. The immaterial culture of luxury brand heritage lay on the rich know-how or savoir-faire in the textiles and garments manufacture, which are acquired by continuous practices. In addition, a premium brand combines the elements of luxury and mass-market brands [Kapferer, 2008]. Premium brands propose high-quality products designed by well-known designers, with prestige and unique product differentiation [Jin and Cedrola, 2017]. With a reasonable premium price, the concept of premium brands provides alternatives to luxury for better value, yet fulfils the needs of social prestige of its consumers [Hameide, 2011; Jin and Cedrola, 2017]. On the other hand, the mass-market brands offer lower or acceptable quality products, and are generally mass-produced in factories and widely distributed [Hameide, 2011]. Mass-market brand usually provides ready-to wear garments, whose trends are continuously changing based on demands in the market. They use cheaper quality fabrics and simple technique they could save time and maintain efficient production costs [Jin and Cedrola, 2017]. A new type of fashion that emerged from cultural tradition is called cultural heritage fashion [Ko and Lee, 2011]. In the case of certain cultures, producing some types of textiles has become an intergenerational tradition of a community. According to the UNESCO Convention of 2003, a cultural tradition to produce textiles with strong cultural values acknowledged by a community is classified as intangible cultural heritage (ICH) [UNESCO, 2020].

We are aware of the strong presence of mass-market brands or fast fashion companies, however, due to the specificity of categories related to intangible elements of fashion products, such as philosophical values, craftsmanship, historical and cultural significances, this chapter will discuss fashion heritage associated with luxury brand heritage and cultural heritage fashion. The multi-facets of fashion heritage and its heritage elements should be communicated in an engaging way, both to the fashion industry stakeholders and to all the others. ICTs can greatly help to communicate the values entailed in fashion heritage. This chapter will present several cases of digital communication strategies adopted by luxury fashion companies and intangible heritage fashion communities. For instance, it will discuss the recommendations about cities, galleries and cultural sites, which respond to the needs of international tourists.

This study presents examples of the different types of interventions – the five areas depicted in the ABCDE framework – allowed by digital media in fashion

communication for tourism purposes, especially focusing on the possibility they give to enlarge Access to information.

2.4.1 Fashion as a cultural heritage product

According to Blumer [1969], "fashion" refers to a process of taste formation in relation to clothing styles through "collective selection" by a group of people responding to "the spirit of the times." As fashion evolves over time, in the context of well-characterized places and in conjunction with events, Simmel [1997, 1904] argues that fashion is not merely related to apparel and styles, but is fundamentally a process of psycho-social development of modern societies. He looks at fashion as a representation of embodiment and identity through any kind of object and clothing, which represent ideas, novelty and taste that influence individual behaviors in a certain period.

Fashion is considered as culture as it is strongly related to the aesthetic forms of how wearing objects (e.g: clothing, jewelry) might demonstrate taste, preferences of an individual or group of people in accordance to their identity, philosophy, religion, music, habits, and customs [Simmel, 1997]. Entwistle [2000] mentions that fashion is not just a system of dress representing a social system to express the presentation of bodies, but is also characterized by continuous improvements of innovative aesthetics in presenting, performing and transmitting the ideas and the meanings of dresses through the fashion display. This cultural process of fashion includes constant changing of objects, styles and designs as the identity symbol of an individual or collective group, which denote to which social strata and origins they belong to [Kalbaska, Sádaba and Cantoni, 2018]. In other words, as the manifestation of culture, fashion is related to the expression of novelty, sensibility and individuality, yet still represents a certain culture of social collectiveness [Back et al., 2012]. While tangible elements of fashion are emphasized on external elements such as the textiles, materials and patterns, its intangible elements are related to a set of cultural knowledge, values and customs constituted in the fashion production itself [Sikarskie, 2016].

As already mentioned, this chapter focuses on distinguishing two kinds of fashion heritage, namely: cultural heritage in fashion and luxury brand heritage. Both kinds of fashion heritage have distinctive characteristics in terms of sources, stakeholders and goals in communication. On the one hand, cultural heritage in fashion is usually in the form of textiles or related artworks or known as national textile heritages [Ko and Lee, 2011]. Some of the textile arts are inscribed under the List of Intangible Heritage of UNESCO (e.g. Indonesian Batik, Taquile Textile Arts of Peru, Jamdani Weaving of Bangladesh, etc.) [UNESCO, 2019b]. The tex-

tiles are the manifestation of local living traditions and recognized by communities as the result of intergenerational cultural transmissions. The communication goals of national textiles heritage are to raise awareness on the meanings, philosophy, wearing rules and historical significance of such artworks. Such efforts are also intended to invite public participation to support the cultural community, as the producer of the textile heritage. The intrinsic values such as the know-how, the philosophical values, the craftsmanship of the textile production, are embodied in the belief system of the makers, who live and work individually or collectively in a certain community. Given the long history of cultural practice, knowledge transmission and collective characteristics in producing fashion objects, this tradition is classified as intangible heritage. The rules of preservation and the safeguarding practices of this intangible heritage are stipulated in the UNESCO convention of Intangible Cultural Heritage of 2003.

On the other hand, luxury brand heritage refers to luxury fashion houses (e.g. Louis Vuitton, Valentino, Prada, etc.) which have gained international reputation, while rooting their brand identity into the tradition and intangible heritage of their company origins, and the long history of the company's craftsmanship's expertise in producing their luxury goods [Morley and McMahon, 2011; Cantoni et al., 2020]. In this regard, the brand itself communicates the tangible and non-tangible attributes and stylistic codes through a set of semiotic symbols, aiming at inciting certain emotions [Ciappei and Surchi, 2011]. The objectives of the communication strategy would be related to the articulation of the aesthetic aspects of the clothing apparels, to interpret design ideas behind a fashion object, and further to lead the audiences in the historical narratives of the dresses in connection to certain popular public figure(s) of a certain era and style [Bai, 2017]. The exhibitions of luxury brand heritage often aim at evoking the audience's curiosity through art, which triggers sensations of novelty and self-indulgence in their mind towards the luxury textiles.

Apart from the cultural elements described above, fashion synergizes the two facets of economic production and personal consumptions [Back et al., 2012], which are indirectly connected to the tourism value chains. Cominelli and Greffe [Cominelli and Greffe, 2012] point out the role of intangible cultural heritage as a source of creativity and innovation, where it is highly important to build protection systems of the skill, knowledge and rights of the community as the creators, as well as facilitate new opportunities to nourish these creativities. Fashion as byproduct of innovation and creative process certainly increases the tourism products and services of a city. It involves local cultural institutions such as museums and creative industries that work on designs, creative agencies, retail galleries and other related fields [Gilbert, 2006]. As a result, fashion and

tourism progressively enrich each other through the creation of creative activities that enhance the image of the city and create a brand-new identity of the contemporary urban environment [Jansson and Power, 2010]. Thus, fashion events such as festivals and fashion weeks become tourist attractions and important elements for the promotion of creative cities and cultural destinations. Local Destination Management Organizations (DMOs) tend to develop and promote "fashion tourism" in the cities with a strong presence of the fashion industry, design centers and creative clusters [Kalbaska, Ramírez and Cantoni, 2018]. For example, customizable guided "fashion tours" are offered to the tourists who visit Florence and wish to discover fashion museums, retail districts, galleries, artisanal workshops, designers headquarters, fashion exhibitions and festivals [Pratt et al., 2012; Lazzeretti et al., 2017].

2.4.2   Fashion collections, museums and tourism

Fashion exhibitions and relevant events become major attractions in global tourism destinations, which entice people to learn about the culture and the identity of a society represented through fashion. Fashion exhibitions used to be staged mostly in ethnography museums where art, design and history were merged. In the mid-twentieth century, the dress curators started to become the key actors in conducting fashion curation. Fashion curation refers to an activity of translating the historical dresses into the context of contemporary times, by selecting, staging and designing thematic exhibitions in a way that they are beautiful, insightful and able to engage the audience and to immerse it in its artistic values and historical significance. The word "curation", derives from the medieval Latin curatus, meaning "looked after". Fashion curation has been used to signify the major activities of curators in preparing fashion expositions as cultural objects to the public. Sometimes fashion exhibitions are also created by performing theatrical spectacles, which invite the audience to interpret the symbolic meanings of the costumes [Vänskä and Clark, 2017].

There are museums of fashion that were created quite some time ago: Musée de la Mode et du Textile and Musée de la Mode de la Ville in Paris (France), Kyoto Costume Institute in Kyoto (Japan), Great Britain's Museum of Victoria & Albert in London (UK), Museum of the Fashion Institute of Technology in New York (USA). In the last decade, new museums specialized in fashion appeared as well: Mode Museum in Antwerp (The Netherlands) was established in 2002, the Fashion and Textile Museum in London (UK) was established in 2003, or MUDE Museo do design et da moda in Lisbon (Portugal) was established in 2008. It is interesting to note that several fashion museums are situated in the fashion

capitals that host main fashion weeks, which are also among the most visited cities globally by tourists (e.g. Paris, New York, London, Milan), thus creating a cluster of fashion-related attractions that can potentially attract tourists.

Fashion helps museums, which were not exhibiting fashion collections before, to appear relevant and appealing to the public, as they are capable to generate greater visitor numbers and wider demographics, including foreign tourists being attracted by those particular exhibitions. Museums dedicated to a particular fashion item (e.g. handbags, shoes) are also attractive for visitors, being they local or tourists, for instance: Museum of Fine Arts and Lace (Musée des Beaux-Arts et de la Dentelle) in Alençon (France), and the Museum of Bags Purses (Tassenmuseum Hendrikje) in Amsterdam (The Netherlands). We can mention the museums dedicated to a specific fashion designer. For instance, Christian Dior's childhood home on the outskirts of Granville (France) debuted as a museum in 1988. Recently Gucci and Ferragamo have opened private museums of their own brands in the heart of Florence (Italy). We can also think of the Foundation of Pierre Bergé-Yves Saint Laurent in Paris and a recently opened museum dedicated to the same fashion designer in Marrakesh (Morocco).

According to Melchior [Melchior, 2011] fashion exhibitions, especially those presenting contemporary fashion designers of 20th-century fashion history, attract an audience that generates a significant entrance revenue and a high number of visitors for the museums. Museum exhibit fashion also because of its commercial and marketing potential. When fashion is on display, the museum is more likely to attract media attention, and as a result, the attention of the public interested in fashion, but that usually does not attend the museums. The first major fashion exhibition: "Fashion: An Anthology" by Cecil Beaton, held in 1971, exhibited dresses collections of contemporary celebrities in Great Britain and abroad, and attracted 90'000 visitors [Haye, 2006, p.132-133]. Hence, due to this successful event, the method of fashion curation that merges fashion staging with art, culture, commerce, entertainment and tourism, was then adopted globally by several other museums.

Indeed, public interest in fashion exhibitions has been increasing in the last decade. In 2011, the record-breaking Alexander McQueen exhibition at the Metropolitan Museum of Art (London, UK) attracted over 650'000 visitors [NYT-Association, 2011]. The same exhibition dedicated to the fashion designer, "Savage Beauty," was held at the Victoria Albert Museum in London and attracted a total number of 493'043 visitors from both the UK and overseas, making it one of the most visited exhibitions throughout the museum's history [Calinao and Lin, 2017]. Special exhibitions such as "Savage Beauty" may also prove effective in attracting tourists, leading to increasing cultural tourism once tourists learn

more about the city's culture, which includes fashion.

According to Vanity Fair [Vanity-Fair, 2018], the exhibition dedicated to "Christian Dior, couturier du rêve", attracted more than 708'000 visitors in the first six months from its official start, which is a record for the Museum of the Arts Décoratifs in Paris (France). The "Heavenly bodies – Fashion and the Catholic Imagination" exhibition at the MET Museum[NYT-Association, 2011] opened in spring 2018, featuring a dialogue between fashion and medieval art taken from the MET collection. It emphasized on the unique cultural theme that highlights modern fashion's engagement with the devotional traditions and religious practices of Catholicism [MET, 2018]. This exhibition caught a significant media interest and was attractive for both locals and foreign tourists during their visit to New York.

Indeed, modern and sophisticated tourists seek destinations and particular attractions that fulfill their needs for new tastes in garments, shoes, accessories, shopping and the overall experience of the destination's culture that reflects its creativity, history and innovation. As previously discussed, fashion-related exhibitions and museums can become and are already such an attraction. Given that tourists use digital media to search for information about tourist attractions, events at the destination in pre-, during and post-travel activities [Solima and Minguzzi, 2014; Kalbaska, Ramírez and Cantoni, 2018], fashion and tourism stakeholders could maximize the use of websites and social media to promote the upcoming fashion events and provide tourists with information about fashion-related activities.

2.4.3   ICTs used to communicate fashion as a cultural heritage object in the tourism domain

In the contemporary world, digital innovations have improved fashion communication in many ways. They foster stronger connections between stakeholders as well as offer varied ways to understand the individual and collective behaviour in the society, both online and offline [Neri, 2019; Kalbaska, Sádaba and Cantoni, 2018]. The internet acts as a dis-intermediation tool and provides direct access for the fashion community to interact (ibid). Neri [2019, p.67] specifies the dis-intermediation of the internet in the field of fashion as: '[...] the Web offers a more immediate relationship through blogs, social media, as well as interactive, and experiential sites dedicated to this theme (fashion), between those who produce, those who communicate and those who follow fashion [...]'.

Choi [2019] considers that the internet and social networks provide creative

platforms to communicate fashion and interaction of personal expressions between users and fashion stakeholders. Since fashion is characterized by the production of textile and garments, the development of digital media for fashion should care about the garment's multifaceted hybrid forms, which could be facilitated by providing crossover interactions among digital media, fashion designs, textile scanning, electronic engineering and computer sciences [Quinn, 2012]. Sikarskie [2016] outlines that the roles of digital technologies in the field of cultural heritage in fashion are classified into several functions, namely preservation, providing access, curation and interpretation in the digital age. For example, in 1935, a British weaver called Ann Sutton pioneered the use of programmable dobby loom which is connected to computational design application (ibid). Along with the digitalization of the textile industry, individual crafters make use of a variety of digital technologies to create quilts, embroideries and tapestry. In terms of branding strategy, Ko and Lee [2011] point out that the use of websites as e-commerce platforms also helps to increase the promotion of fashion brands as well as to disseminate the socio-cultural values of the fashion heritage in Korea, China and Japan.

Fashion heritage as a cultural product of a community also acts as a vehicle to boost the attractiveness of a tourist destination. In this regard, digital media play major roles in connecting fashion, the cultural community, and tourism stakeholders, in five main areas [Permatasari and Cantoni, 2019b]: (i) Access: provide access to quality information on fashion, its cultural heritage elements, and fashion tourism destinations; (ii) Better: improve the actual experience of visitors in the fashion exhibitions; (iii) Connect the stakeholders: heritage, residents, tourists and the fashion industry; (iv) Dis-intermediate: streamline some relationships and facilitate the distribution of products and services related to the fashion and tourism industry; and (v) Educate: they provide learning platforms to facilitate relevant stakeholders to learn about fashion production, cultural significances, designers, local communities and fashion.

In order to maximize the potential of fashion as a tourist attraction and educational cultural events, digital media are being adopted as part of the fashion curation in the exhibitions and museums by both fashion houses and museum curators [Vänskä and Clark, 2017]. The adoption of digital media is intended to communicate the messages of the fashion heritage, increasing the experience of the public in distance and visitors in accessing digital archives of the museums. The other purpose of communicating cultural heritage's values using digital media, is to raise people's awareness of the importance of preserving textile heritages, for its socio-cultural values and its impacts as major source of inspiration and ideas for future generations. In terms of brand fashion heritages, there are

top luxury fashion houses that are based on brand fashion heritage such as Louis Vuitton, Prada, Chanel, Salvatore Ferragamo, etc. They adopt a large scale of ICTs installations to perform visual and artistic digital projections with the aim to show the uniqueness of their brands in the fashion curation events. These initiatives are usually applied either in ephemeral exhibitions or at major museums.

Beside highly integrated omnichannel websites, those luxury fashion houses develop dedicated digital media (e.g. digital archive of papers, videos, images and mobile apps) to communicate their visions, which transcend beyond luxury fashion business and towards performing responsibilities in terms of sustainable environment and heritage safeguarding by supporting art foundations, empowering local artists, or promoting global travel destinations through their remarkable collections [Masè and Cedrola, 2017]. For example, Prada merged the use of digital media and art extravagance concepts to create space technology that enhances visitors' experience in Prada retail spaces. Prada headquarter in New York is the commercial and exhibition space equipped with innovative digital media, such as wall-wide screen displays surrounding the building that can be set to change the colour and the ambiance theme of the Hall, while also presenting the digital archive of Prada collections that can be accessed in certain spots of the building [Masè and Silchenko, 2017].

2.4.4 Case Studies

The use of digital media in fashion has resulted in various creative innovations with the purposes of education, preservation and communication of fashion heritage objects. Various case studies on how fashion heritage is being communicated with the help of digital media to the public will be presented and discussed below. Based on the literature review, six types of digital media used in the communication of fashion heritage were identified. The cases will discuss both the providers of such technological innovations – e.g. museums and fashion houses – as well as the technology they use. We will start with the cases when (a) *Audio guides, video installations and interactive tables* are being used within the physical spaces of fashion museums. We will then proceed with (b) *Websites, mobile apps or social media profiles* of museums and fashion houses that are using digital media to communicate with the global public. After that, we will move to (c) *Virtual museums* dedicated to fashion houses, followed by the cases of (d) *Online galleries and digital archives*. Finally, the cases of (e) Augmented reality applications and (f) 3D scans will be discussed.

2.4.4.1   Use of audio guides, video installations and interactive tables in fashion museums

Digital media can help to achieve the balance between leisure, entertainment and learning in museums, but can also enhance the effectiveness in conveying the story and the meaning behind every fashion object. Marfia et al. [2015, p.1076] suggest that 'museums tend to integrate within their walls all kinds of digital paraphernalia, ranging from touch screens, up to audio guides, etc.'

Audio guides have been used in museums for the provision of an enhanced experience to visitors, including international ones. Fashion museums and exhibitions are not an exception. For instance, the Fashion Museum in Bath (UK) advises on its website that the admission ticket includes an audio guide available in twelve languages: English, Dutch, French, German, Italian, Japanese, Korean, Mandarin, Polish, Portuguese, Russian and Spanish. Such variety of offered languages is definitely valuable for the international visitors and their understanding and appreciation of the fashion exhibitions.

Intangible elements of fashion (e.g. the way the garments are produced, or how the tradition of the fashion production is being preserved by local communities) can be successfully communicated with the help of video guides and interactive tables used in museums. According to Capacete-Caballero et al. [2013, p.337], the creative use of video projections 'produces an immersive display, which has the potential to reinforce communication within the fashion exhibition, ultimately offering a greater potential for the viewers to connect with the displayed fashion object.'

Indeed, in the museum of the Fondazione Zegna (Italy), dedicated to the famous Italian fashion house, such video installations are on display and can be interactively used by the visitors, while helping them to get deeper knowledge on the exhibition [Zegna, 2000].

2.4.4.2   Use of websites, mobile apps or social media profiles by fashion museums and fashion houses

Prada, Gianfranco Ferré, Salvatore Ferragamo and Louis Vuitton – among others – have created their own Foundations and are managing dedicated websites intending to preserve, organize and give access to their cultural heritage and artworks for the general public, including tourists. For instance, the information dedicated to the Museum of Salvatore Ferragamo [15] is featured on the main website dedicated to the fashion designer. The website presents content related to

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[15]www.ferragamo.com

the designer, the building where the collection is hosted, past and present exhi-
bitions, as well as practical information (e.g. "how to get to the museum"; or
"buying tickets online").

Several luxury fashion houses (e.g: Chanel, Gucci) developed mobile apps
that focus on promoting and showcasing their seasonal collections. Louis Vuitton
and Prada have developed dedicated mobile apps, which provide users with vir-
tual tours, present the brand's capsule collections, as well as historical archives.
Such interactive apps are also helpful for those that would like to visit fashion
houses or exhibitions dedicated to fashion designers (e.g. the app of Armani
Sylos of Giorgio Armani).

A newly opened museum dedicated to Yves Saint Laurent in Marrakesh (Mo-
rocco), presents a well-designed website[16] in English and French. At the same
time, the museum has an important presence on main social media profiles: it
manages profiles on Facebook (over 112'000 likes), Instagram (over 68'000 fol-
lowers) and Twitter (over 3'300 followers), as of July 2020.

Danar Hadi Batik, a premium brand of Indonesian Batik textile heritage, in-
scribed by UNESCO in 2003, uses a well-designed website[17], in order to commu-
nicate and promote the importance of Indonesian Batik intangible heritage and
its cultural related information. The company also developed a Museum of Batik
in Solo city, Central Java, dedicated to showcasing the variety of motifs of Batik
across centuries, its tools, and other related documentation. So far, the fashion
company has a strong social media presence: it has a page on Facebook with over
31'700 likes and over 54'000 followers on Instagram, as of July 2020. Another
example is related to the fashion brand of Korean textile heritage which uses a
website to communicate the tradition of textile craftsmanship and its wearing
rules in Korean [Damyeon, 2007].

2.4.4.3   Virtual museums

Compared to the museums having a physical structure, creating a virtual one
has certain advantages in terms of the costs involved, as well as the potential to
reach international audiences. In addition, the flexibility of digital media enables
users to explore interesting relationships and interconnections between pieces of
archival content.

The case of a virtual museum we would like to present is dedicated to the
famous Italian fashion designer – Valentino Garavani[18]. It was opened in 2011

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[16]www.museeyslmarrakech.com
[17] www.danarhadibatik.com
[18]www.valentinogaravanimuseum.com

and incorporates 3D technology to document the designer's 50-year career. The collection includes more than 300 dresses, which are represented in seven virtual galleries. The user can see the dresses themselves while exploring all the details of the materials, as well as read the stories behind them (e.g. how the dresses were created; celebrities who wore them, etc.). For each garment, there is a rich back-story of videos, editorial images and sketches.

The virtual museum presents also the collection of video materials from the spectacular events where Valentino and his dresses were present. It includes a series of interviews with the couturier who presents his collection and shares his knowledge and passion for fashion. A vast media library includes over 5000 images and various fashion show videos. Unfortunately, the virtual museum of Valentino Garavani is a closed system, which is isolated from the social web. None of the archive's rich content is shareable and there is no integration with currently leading social platforms. We believe this is a missed opportunity to promote the museum and the collection among the admirers of the designer even further. The exhibition of Swedish royal dresses conducted 18 October 2016 – 12 March 2017, could be accessible through virtual reality technology. This innovation allows users to experience 3D and 360° tools about specific dresses through audio guide and video [Press, 2018].

2.4.4.4   Online galleries and digital archives

The most ambitious project on the digitalization of fashion heritage in the last years has been done by Google through its "We Wear Culture" project launched in 2017. The project presents an online archive showcasing over 3000 years of fashion.

This online archive includes digitalized collections from almost 200 (as of July 2020) museums, fashion academies and archives. It integrates visual materials dedicated to the fashion designers and their collections, the articles on the impact of fashion, for instance on "Why fashion matters" or "How Italy is Built on fashion", virtual tours in the fashion museums, and features Virtual Reality films for an even more enhanced immersive experience. Google Cultural projects also provide a platform for preserving the images and storing the information of 26'700 textile heritage items around the world as of October 2019 [Art and Culture, 2017]. Another prominent European case is Europeana Fashion5, an EU-funded initiative that deals with the aggregation and online dissemination of the digital fashion heritage from the most important European collections. The project started with a consortium consisting of 22 partners from 12 European countries and included the Victoria and Albert Museum (London), Les Arts Dé-

coratifs (Paris), MoMu (Antwerp). It also presents the archives of fashion brands, such as Missoni and Pucci. The main goal of Europeana Fashion according to Suls [2017] is to harvest the digital collections of fashion institutions and to re-present them in a uniform way on a specialized online portal.

Other than the ad-hoc online museum galleries, some museums adopt a participative curation approach in terms of preserving the textile data. The Los Angeles County Museum of Art (LACMA) used Flickr Commons to donate much of their digital archives into the public domain. Users can access the archive by finding the tags assigned on each data (e.g. fabric images) [Sikarskie, 2016].

In addition, several archives such as the University of Maryland and the University of Illinois Library in the USA, the British Library and the National Archives of Scotland in the UK, also adopt Flickr Commons accounts to facilitate the searches of textile data. Relevant data such as photographs, sounds, videos and documents of the textiles are kept along with the accessible Flickr Commons.

The development of social media allows the use of hashtags to be interlinked and followed more easily. In March 2015, the Fashion Institute of Technology (FIT) Museum's exhibition "Yves Saint Laurent + Halston: Fashioning the 70s," implemented the use of tagging, which allowed users not only to assign personal tags in their accounts but also to post their photos and tags in other social media platforms such as Twitter, Facebook, Flickr and Instagram (ibid).

In addition, digital innovations dedicated to textile heritage is continuously emerging in the past several years. For instance, iWareBatik digital technologies and Batik Fractal. iWareBatik was developed in order to communicate the exceptional cultural values of 124 Indonesian Batik motifs through interactive website6 and mobile app. Launched in 2020, iWareBatik mobile app is equipped with artificial intelligence-based Batik Recognition Tool feature, which helps user to recognize the meaning of Batik motifs according to 8 motif classifications. Batik Fractal[19] is also commonly used by the Indonesian Batik artisans to design and to learn from the existing Batik motifs, in order to get inspiration in their creative work [Margried, 2015]. According to Permatasari and Cantoni [2019b], the presence of 164 mobile apps on Batik on Android and iOs platforms illustrates active participations of online users to communicate Batik through digital media. 70% of the apps (115 mobile apps) showcase the fashion aspects of Batik, divided into different types of apparel. The study also finds 24 mobile apps solely illustrate textile catalogues, while the rests (25 apps) do provide textile images with educative information about Batik exceptional cultural values.

Another example is related to Brunei Darussalam, a country located in South-

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[19] www.jbatik.com

east Asia. In 2019, the government of Brunei Darussalam launched a mobile app called Kitani woven textile. The app is built in order to facilitate textile designers and producers to design woven patterns and colors [Ghani, 2019; Pixelated, 2019].
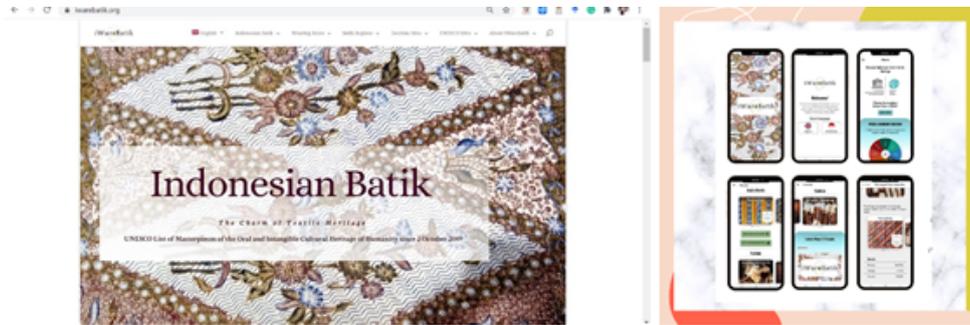
Figure 2.19. The interface of www.iwarebatik.org and iWareBatik mobile app (can be downloaded on Android/iOs platform)

2.4.4.5   Augmented reality apps

Some examples of augmented reality technologies can be found in the field of both cultural heritage in fashion and brand fashion heritage. For example, "Batik Detector", an augmented reality-based mobile application, was developed by Hermawan and Arifin [Hermawan and Arifin, 2015] for disseminating information about the Batik philosophical values as inscribed in UNESCO's list of intangible cultural heritage in 2009. It adopts a visual stylometry system to detect the batik motifs scanned from the textile and provides users with information about the origin of the Batik motifs and its socio-cultural meanings. Another example is related to a virtual dressing room for Indian Saree. Such innovation was developed by an Indian company [Tech, 2019]. This software can be used by both retailers and heritage stakeholders to showcase the variety of colors, styles and types of Indian Saree to potential customers.

Marfia et al. [Marfia et al., 2015] present the case of the PreTAporTek, in the Museum of Modern Art in Bologna (Italy), where vision and mixed reality techniques are used in order to help the experience of the user in the museum. The visitor is given a chance to try the clothes that have been adapted to their bodies as in a real dressing room.

We are not aware of any other current use of augmented reality applications within fashion museums, but can predict that this technology will enter the market in the nearest future as it is happening in other domains. We believe aug-

mented reality apps can be used for better communicating national heritages. For instance, in the shoe museums in Lausanne (Switzerland) the users can learn about the tradition of making shoes or virtually matching the socks or the cloth it has to the shoes they wear. Within the luxury collections of the fashion museums, the users can try the dresses with the help of an augmented reality app they would not be able to try in real life. For example, a dress of Ferragamo because of its cost, or a dress from the fourteenth century, because it just does not exist any longer or it is too fragile to be used in real life, could be experienced with the help of augmented reality apps.

2.4.4.6   3D scans

Several digital media innovations to communicate textiles such as 3D scans, 123D Catch scan technology and immersion screen displays have been also adopted in a big international event such as the London College of Fashion MA Graduate '13 Exhibition in 2013 (referred as MA'13) [Capacete-Caballero et al., 2013]. During the event, the installation of the exhibition projected moving images through triptych presentation that allowed the audiences to feel immersed by looking at the fashion display. The immersive three triptych screens enhance the visitors' experience to see the relationship between the garments and the living body through imagery slow-motion combined with the sound fulfilling the space. The fashion exhibition was equipped with digital tools, namely "SquareSpace", an online user-generated website builder, and "ThingLink", as an open source application for interactive imagery. The implementation of these digital tools is intended to enhance the interactive online cultural heritage experiences. At a broader level, these digital initiatives helped to showcase the physical exhibition of MA'13 in the online platform, while also providing information about the film, interactive ICT and 3D imaging used in the exhibition [London, 2019]. In the ThingLink platform, the uploaded images are tagged with relevant information regarding the cultural objects and linked to external sites.

Other digital interventions in the exhibition is the use of the iPad as a mobile device to communicate the 123D Catch technology on the website, which allowed visitors and distance public to interact with the image tagging and comment on the fashion works. Additionally, MA'13 featured the 3D scan technology, which was previously used as a curatorial strategy in 2011 by the American fashion curator Charles James [Vänskä and Clark, 2017]. This technology helped to provide rotated 360 degrees of a digital image, which gives a more detailed understanding of the historical garment.

One example is drawn from the exhibition of "Talking Cheongsams" in Sin-

gapore, which took place in January 2019. The exhibition displayed the twelve Chinese cheongsam dresses, which were mediated in forms of physical installation and storytelling to trace the history and the social landscape of Singapore. Through the interactive textile installation forms and web-based application, the visitors could access the Singapore's identity through the historical timeline of its textile heritage [**?**Singapore, 2019].

2.4.5 Challenges in the use of digital media to communicate fashion heritage

Despite the advantages of using digital technology in fashion exhibitions, there are still several challenges when it comes to communicating the tangible and intangible elements of fashion. Fashion is associated with clothing materials which correspond to physical elements assessed by human sensory, because the body feels the textures of the cloth, how it appears and fits in the body, and thus evokes the sensations of aesthetic experiences in the mind of the wearer. The use of digital media may only serve as information transmission mediums that provide limited the physical experiences and thus create some challenges when it comes to representing and communicating fashion as a cultural heritage object. The use of digital media in communicating fashion objects in museums faces several issues. Preservation and conservation of digital databases are very costly in terms of defining the metadata and preparing high quality textiles images to be maintained through backups and uploaded to new formats. Abby Smith [Smith, 2004] adds that the preservation of those apparels, as well as the maintenance of ICT systems and any digital objects, cannot occur by "benign neglect".

Digitization of textiles and media presents other challenges in maintaining a high quality of digital preservation and communicating fashion heritage. Digital archives and online platforms can be used as permanent cultural material storage; however, the ICT part depends on the information system and the quality of hardware and software updates, which require special care and various expertise. The content and information presented on each digital platform need to be constantly updated. Furthermore, the promotion of online platforms should be increased using a communication strategy of digital platforms and social media in order to improve the number of users visiting the websites. The enormous tasks in archiving different textile types and their production process through images and videos can be difficult and expensive for museums, whose goals are to communicate and transmit the knowledge of national textile heritage. These extended efforts in conserving the fashion heritage will require some attention

from government bodies and sponsors as well as managers in dealing with the budgeting of digitization projects.

Indeed, visiting the museum in person and visiting it online is a different experience to which the user is exposed. In addition to displaying pieces that are often out of the public eye in high-resolution format, the online exhibition creates a completely new dimension of accessibility for those who are unable to travel to see the pieces or costumes in person, as they can discover and obtain the information of the textiles or garments online. However, digital media might have technical or non-technical limitations to be fully accessed by users. The online museum might only cover certain elements of the exhibition due to the limited bandwidth, quota, or other organizational policy that determines which information to disclose [Crofts, 2018].

Although ICTs can help the dissemination of knowledge and information with regard to cultural textiles as UNESCO intangible heritage, however as Nicholas Crofts [2010, p.7] stated, '[...] there is a clear risk if intangible heritage is squeezed into the material heritage paradigm, transformed from living tradition into "assets" that can be collected, documented and exploited'. In this sense, ICTs inevitably facilitate the increasing demands and consumerism of cultural products on the part of the online users, while on the other side might lead to commercialization and mass production of sacred cultural textiles on the side of the producers. The documentation of ICH textiles could only benefit commercial actors, and thus the cultural community involved might feel jeopardized and receive the least return from their activities.

2.4.6   Conclusion and future research

Fashion incorporates the intangible cultural heritage and the creative skills of a local community in a tourism destination. Digital strategies and interventions in communicating fashion heritage outlined in this chapter are related to the primary function of ICTs and digital media in conveying the layer of fashion, especially the cultural heritage in fashion. Digital media help to facilitate the knowledge dissemination of fashion heritage among heritage stakeholders in several domains: preservation, providing access, curation and interpretation in the digital age. As it is also connected to the tourism domain and stakeholders in related domains, ICTs should also provide a better experience for the users, facilitate connections among stakeholders, streamline some relationship (dis-intermediate) and serve as an educational tool/platform to increase people's awareness about the importance of the fashion heritage. Looking at such close relation between fashion and tourism, fashion exhibitions are created to boost the attractiveness

of a tourist destination, while at the same time also communicate the importance of cultural heritage in fashion, as well as luxury brand heritage. Digital media help the museums and exhibitions to be more accessible and more attractive to the public: the visitors and online users could have a better experience in appreciating the objects by the high resolution of the visual data of the textile, produced by scanning technology (3D scan, 123D scan) and triptych projections with augmented reality apps available on-site and the possibility of social tagging online.

While virtual museums have already become a trend, we need to develop future research on the digital archiving on cultural heritage in fashion and brand heritage, the difference of communication goals, and how they are presented in online platforms. Other future research lines could be on virtual reality capturing the production process of ICH textiles, and other ICT-based experiences that can be built upon textile heritages. There is also room for research on analyzing participatory social tagging online and how it shapes tourism destinations through its fashion attraction events. In addition, designing an online communication model for communicating fashion heritage might be of interest to observe the tendency of the online content narratives and the exchanges that occurred on the online platforms.

In terms of national heritage, organizing and creating innovative digital media interventions to archive and document intangible cultural heritage in fashion and its production process must be conducted in parallel with the capacity building of the concerned community itself. Thus, digitalization could be used to complement the existing practices and help the practitioners in showcasing their cultural knowledge and preserving it for the next generations.

Chapter 3

User Elicitation Requirement

This chapter outlines the co-creation process of designing and developing iWare-Batik website and mobile app according to the service design theory [Rytilahti et al., 2015] and ADDIE model [Botturi, 2003]. In order to generate communication-intensive design and development of iWareBatik, one research paper on user requirement elicitation (URE) research is presented according to the first, second, third, and fourth pillar of Online Communication Model (OCM) [Cantoni and Tardini, 2006] and Analysis of Web App Requirement (AWARe) Model [Bolchini and Paolini, 2002].

Permatasari, P. A., and Cantoni, L. (2021, July). Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage. In International Conference on Human-Computer Interaction (pp. 88-106). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-030-78224-57

3.1 Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage

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ABSTRACT[1]. Heritage communication is more and more integrating digital media, which help to offer a wider and deeper understanding of heritage and its values. In particular, intangible cultural heritage (ICH) can find in information and communication technologies a powerful ally to share its facets and different dimensions, through multimedia technologies (especially videos), storytelling, and several other applications like mixed realities and artificial intelligence. Such media can help not only to provide access to information and knowledge, but also to enrich the experience of people exposed to such heritage, and to promote a deep connection between the heritage itself and interested persons.

This paper presents the process through which goals and needs to communicate and promote Indonesian Batik textile heritage, which has been inscribed by UNESCO among the Intangible Cultural Heritage list in 2009, have been collected and transformed into the design of digital communication outlets, namely a website and a mobile app. Such process has encompassed an extensive analysis of the presence itself of Batik in digital media through benchmarking, as well as the elicitation of needs and requirements of relevant stakeholders and target audiences, through in-depth interviews and surveys. The design has been done ensuring at every step that it was considering and integrating, as much as possible, the results of the previous analyses. While presenting the iWareBatik case, which has been successfully implemented and launched, with the support of the highest Indonesian cultural-related institutions, the paper describes in detail the used methodology, hence providing an itinerary, which can be adopted by other similar projects.

3.1.1 Introduction

The integration of Information and communication technology (ICT) plays a central role in bringing improvements and innovations in the field of cultural heritage (CH) conservation and communication, both for tangible and intangible

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[1]Permatasari, P. A., and Cantoni, L. (2021, July). Participatory Design to Create Digital Technologies for Batik Intangible Cultural Heritage. In International Conference on Human-Computer Interaction (pp. 88-106). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-030-78224-5₇

cultural heritage (ICH) [Cantoni, 2018; De Ascaniis and Cantoni, 2016]. Tangible heritage refers to the physical artefacts possessing socio-cultural importance such as monuments, temples, palaces, and other natural/cultural heritage sites [UNESCO, 1972], while the ICH is defined as the knowledge behind the living traditions and cultural expressions preserved by local communities and transmitted from generation to generation through cultural practices [**?**].

According to Cantoni [2018], ICT in heritage tourism contributes to five areas namely (i) Access, ICT provides access to heritage-related information; (ii) Better experience as ICT improves the experience of the travelers in acquiring information about the heritage; (iii) Connect, ICT connects locals, tourists and the concerned heritage; (iv) Dis-intermediate, to facilitate and streamline (some) relationships, so to ensure that local players can benefit from the heritage valorization activities; (v) Educate, ICTs facilitate learning and upskilling of the concerned professionals. Digital technologies also facilitate researchers in terms of documentation, scientific process, interpretation and its dissemination [Arnold and Geser, 2008; Garbelli, 2015; Owen et al., 2004]. In particular, the integration of ICTs also helps to support culture, education, and societal development of heritage related to fashion [Kalbaska, Sádaba and Cantoni, 2018; Noris et al., 2018]. Given the wide range of roles and functions, ICT has been strongly integrated within the implementation of UNESCO's "Five Cs" strategic objectives: Credibility, Conservation, Capacity building, Communication, and Communities [Albert, 2012]. A number of studies further elaborate the effectiveness of mixed reality [Alivizatou-Barakou, 2017], artificial intelligence [Hermawan and Arifin, 2015], gamification [Adukaite and Cantoni, 2016], videos, storytelling [Tussyadiah and Fesenmaier, 2009; Noor and Nordin, 2012] and mobile applications [Qinghua et al., 2019], in order to provide different experiences for users in cultural heritage sites, as well as improve their engagement towards ICH [Garbelli, 2015; Robbins, 2010; Cozzani et al., 2017].

Answering the challenge of building human computer interaction (HCI) for ICH, this study presents iWareBatik digital technologies[2] as a case study of promoting a wise use of digital technology for ICH preservation. Despite a growing interest on Indonesian Batik as UNESCO ICH since 2009, there is still a considerable gap to balance the online narratives that focus on usage values and the ones stressing the importance of tradition and its conservation [Permatasari and Cantoni, 2019a,b, 2021]: the multifacet dimensions of Batik ICH are not well-communicated within the digital publication outlets. This phenomenon might lead to a lack of people's awareness of the importance of Batik as intangible

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[2]www.iwarebatik.org

cultural heritage, which may degrade the value of this intergenerational legacy. Facing the challenges in communicating Batik as textile heritage, the paper outlines the process of developing iWareBatik, a digital initiative in forms of a website (www.iwarebatik.org) and a mobile app. iWareBatik stands for "I am aware of Batik", it is designed to communicate all dimensions of Batik ICH to domestic and international tourists, by providing users insightful contents about 124 Batik motifs, its meanings, and wearing rules, as well as about 129 tourism sites and UNESCO sites. It presents one-minute visual journey videos of 34 regions and interactive features such as an interactive map and a Batik Recognition Tool, an AI-driven tool built within the app to recognize 8 motifs [iWareBatik, 2020c].

Hereafter, Batik as ICH, the Online Communication Model as well as the AWARe Model are presented, with their background literature. A few lines are also devoted to outlining the final iWareBatik products.

3.1.2   Batik as an intangible cultural heritage

Batik is a wax resist dyeing tradition, existed since 5000 BC-2600BC [Druding, 1982]. In 2009, it was inscribed among the list of UNESCO ICH of humanity because of the following exceptional cultural values: namely historical production technique, socio-cultural meanings contained in its patterns and symbols, special wearing rules (characterizing life events and the social class of the wearer), and social empowerment within its valorization activities [UNESCO, 2009b]. Batik visual art represents the traces of cultural adherence, intercultural exchanges as well as many cultural dimensions associated with Indonesia since 6th Century until today [Hann, 2013]. Since 2016, the presence of Batik tradition is not only focused in Java island, yet this tradition has been spread and valorized across all 34 Indonesian regions [Ministry, 2013a, 2019b]. The nationwide Batik safeguarding practice provides employment to more than 200,000 people working on this cultural industry, and has thus become one of the major economic pillars of the nation [Ministry, 2019b].

3.1.3   Online communication model

One of the seven grand challenges in human computer interaction domain is related to ubiquitous learning and foster creativity Stephanidis et al. [2019]. Building experiential design of ICT is an essential aspect to help leverage on tourism branding [Marcus et al., 2013; Buditomo, 2018], and facilitate learning experience of local traditions and heritage of the destination [Pucciarelli and
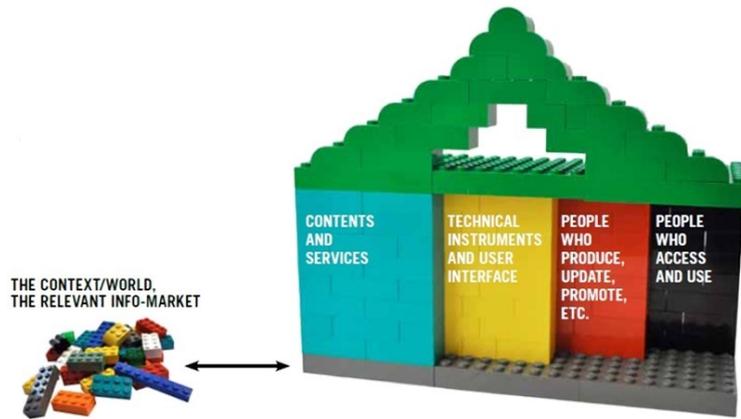
Figure 3.1. A graphic representation of the OCM.
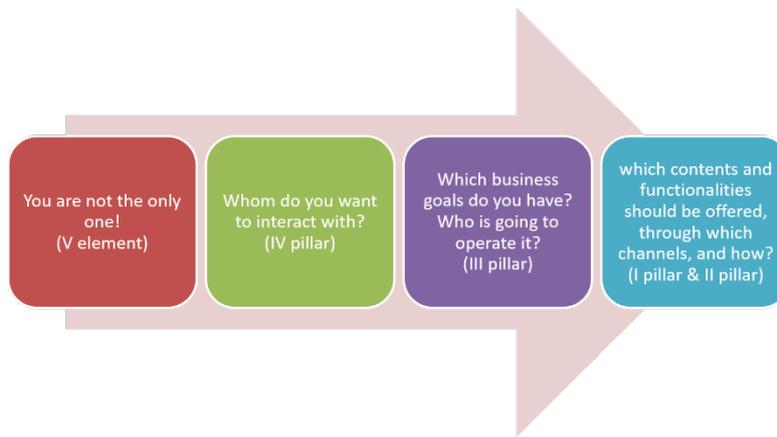
Figure 3.2. Design process according to the OCM.

Cantoni, 2012; Miralbell et al., 2014]. The challenge lies on designing hypermedia intensive communication outlets [Bolchini, 2003] that address the needs and expectations of all stakeholders. To this end, iWareBatik adopts the Online Communication Model (OCM) (see Figure 3.1) [Cantoni and Tardini, 2006; Bolchini et al., 2004]. The OCM is singled out in 4 main pillars and a fifth element, namely: (i) contents and services; (ii) technical instruments (software and hardware) that make accessible the contents and online activities; (iii) providers i.e. people who run the website or the application; (iv) users, intended audiences; and (v) the relevant information/communication context or market [Bolchini et al., 2004].

The design process moves along the five elements, addressing them as follows (see Figure 3.2): it takes into account the relevant information context (v)

analyzed through benchmark activities; elicits needs and wants of intended users (iv) and of main stakeholders (iii) through interviews, surveys and other strategies, in order to define (and prioritize) all technical dimensions (ii) as well as contents and functionalities (i).

3.1.4 Participatory design and AWARe – Analysis of web applications requirement

The design of iWareBatik has implemented, once the benchmark has been conducted, a participatory service design approach [Noor and Nordin, 2012; Qinghua et al., 2019; David and Cantoni, 2015]; in order to elicit and properly organize requirements, the AWARe (Analysis of Web Applications Requirement) model has been adopted [Bolchini, 2003; Perrone and Bolchini, 2004].

AWARe design leverages on five different areas: hypermedia design, communication theory, software engineering, information systems, and human computer interaction design [Bolchini, 2003]. It provides toolsets to analyze goal-oriented and stakeholder-oriented requirements through iterative refinements of user requirement elicitation (URE) [Perrone and Bolchini, 2004]. The user requirement elicitation (URE) analysis [Hartson and Pyla, 2012; De Ascaniis, Cantoni, Sutinen and Talling, 2017; Coughlan and Macredie, 2002] provides documentation, identification of requirements related to hypermedia structure and taxonomy, conflicts and influence analysis on personas, roles, goals, and user scenarios. AWARe further refines the priority goals, and thus strengthen the validation and consensus between designers and stakeholders [Bolchini and Paolini, 2002; Perrone and Bolchini, 2004].

The AWARe model emphasizes on the iterative refinement of requirements and of the needs elicited from stakeholders, as well as the analysis of user scenarios [Bolchini, 2003; Perrone and Bolchini, 2004; Bolchini and Mylopoulos, 2003], in order to build a final conceptual design (see Figure 3.3). Hereafter its main elements.

Stakeholders. AWARe organizes stakeholders into two categories, *users* and *main stakeholders*. *Site users* are the persons who may be interested in accessing the web or the app. A classification of users' personas, profiles, and roles is done in order to map potential users and audiences. *Main stakeholders* are project owners and main influencers: clients of the design process, decision- and opinion-makers, and the development team. *Clients* are defined as the persons/institutions who own and assign the digital project to the development team. *Goal Refinement Process*. AWARe classifies goals into *communication goals* and
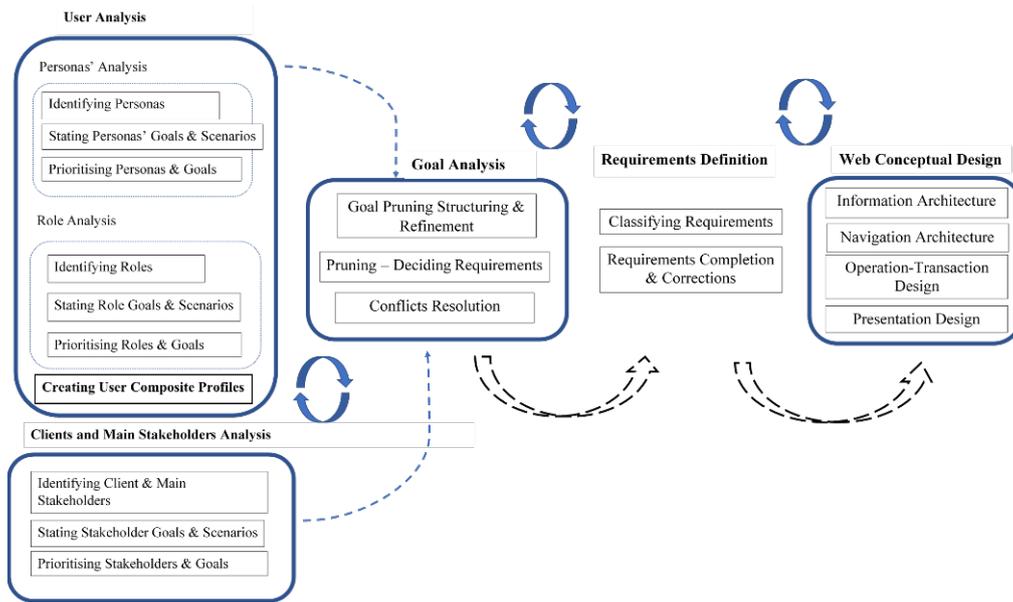
Figure 3.3. AWARE(Analysis of Web Applications Requirement) Model [Bolchini, 2003]

ill-defined goals or *soft goals*. Each stakeholder might have also tacit and implicit goals with regards to the design of a digital technology. Soft goals are more general, visionary, and describe general expectations of the stakeholders towards the digital application. The different goals and priorities, including their constraints, shall be clearly documented.

Scenarios and Priorities. AWARe takes into account different scenarios and goal priorities of users and main stakeholders, which are fundamental to guide the design process.

Transition to Goal Graph and Hypermedia Taxonomy. Once goals, soft goals, scenarios, priorities and constraints are set, a requirement analysis is conducted by mapping all gathered requirements into a goal graph and converting them into a requirement taxonomy. AWARe classifies requirements into six types namely, Access (A); Content (C); Presentation (P); Structure of Content (SC); Navigation (N); User Operation (U); Interaction (I); System Operation (O) [Bolchini and Mylopoulos, 2003].

Systematic Evaluation (Usability). Results of the requirement analysis can be traced back and reused for a systematic evaluation, in order to check if, how and how well they have been taken into account in the actual implementation of the project.

In light of obtaining high quality data, two methods of user requirement elic-

itation are adopted, namely a data driven method [Hartson and Pyla, 2012; Holtzblatt and Beyer, 1997] and a model inquiry method [Hartson and Pyla, 2012; Constantine and Lockwood, 1999]. Those two methods are used to explore both tacit and explicit needs/requirements.

3.1.5   The iWareBatik case

The successful integration of complex HCI design and the involvement of several stakeholders has helped to boost the online visibility of the iWareBatik digital initiative, encompassing a website and a dedicated app, available on both iOS and Android platforms.

Since the launching day on August 17th, 2020 until February 11th, 2021, iWareBatik has attracted 22426 visitors on the website and a total of 1'476 mobile app downloads. Such results have been reached through extensive communication and promotion activities, which have been supported by USI UNESCO Chair (Switzerland), Indonesian Presidential Cabinet, Indonesian Embassy in Bern, Indonesian Ministry of Foreign Affairs, LPDP – Indonesian Ministry of Finance, Sobat Budaya Cultural Association, Caventer Indonesia, and Overseas Indonesian Student Association Alliances (OISAA).

3.1.6   Methodology

Adopting OCM and AWARe, the iWareBatik design has been conducted along the following activities.

Benchmark. The research has adopted a model-driven approach, which was done by analyzing previous works/models designed and built for similar goals. Such benchmarking activities have allowed to define major types of contents and functionalities, to be used in order to inform subsequent analyses, especially to define a survey and to guide interviews.

Focus Group Discussion (FGD) and Prototyping Activities. Prior to the interview and survey, several FGD and some prototyping activities had been conducted from September until December 2018 with 12 Master students in Media Management and International Tourism of USI. Those activities were intended to obtain some ideas about main features of the digital technology from the potential users' perspective [Hartson and Pyla, 2012; Suchman, 1995]. The first design elements as a result of the prototyping activities were also used and integrated within the interview and survey.

Interviews. A series of interviews was conducted from February until March 2019. In order to gain international and Indonesian (domestic) perspectives,

the selection of 15 respondents was based on convenience sampling, consisting of 11 Indonesian representatives, and four international respondents from Croatia, Italy, Japan and USA. Some of them have several profiles, occupations and characteristics, making it easier to obtain several perspectives. Each participant was interviewed on average for 45 min, in a semi-structured fashion.

No.	Occupation	Nationality	#	Type of stakeholders		Roles			
				Site User	Main stakeholder	Client	Domain Expert in Tourism	Domain Expert in Batik	Opinion Maker
1	Indonesian diplomat in Switzerland	Indonesian	1	V	V	V	V		V
2	USI Master student	USA	1	V					
3	Fashion journalist	Japanese	1	V					
4	USI PhD student/ fashion follower	Italian	1	V					
5	Head of tourism promotion in Indonesian Ministry of Tourism	Indonesian	1	V	V	V	V		V
6	Journalist	Croatian	1	V					
7	Indonesian textile collector/travel blogger/ public official	Indonesian	1	V					
8	Batik practitioners	Indonesians	3	V	V			V	
9	Lecturers in institute of tourism	Indonesians	2	V	V		V		V
10	Head of Batik association (Batik expert and gallery owner)	Indonesian	1	V	V			V	
11	Batik researcher/ cultural tourism consultant	Indonesian	1	V	V		V	V	V
12	Head of Sobat Budaya Association/cultural digital library	Indonesian	1	V	V			V	V
		Total	15						

Table 3.1. Interviewed persons.

Survey. The survey was conducted from 8–15 April 2019 using Qualtrics Survey Software. It obtained a total of 191 responses, from 123 Indonesian and 68 international respondents. The link of the survey was disseminated through social media networks, emails, and during workshops of two master courses at USI. The survey recorded international respondents from 16 different countries (Albania, China, Croatia, Estonia, France, Germany, Italy, India, Iran, Japan, Lithuania, Malaysia, Maldive, Nigeria, Poland, Switzerland, Thailand, Turkey, Uganda, and Ukraine). Based on the previous activities, the iWareBatik tools – website and mobile app – have been designed and eventually developed and launched.

3.1.7   Results

The design elements of iWareBatik digital technologies were iteratively built mainly upon the result of benchmarking, interview, and survey, presented as follows.

3.1.7.1   Benchmarking

The benchmarking study has been conducted through an analysis of the online presence of Batik, mapping websites and mobile apps on Batik, as well as other apps related to UNESCO properties in Indonesia.

The content analysis of websites [Permatasari and Cantoni, 2019b] has contributed to identify the relevant themes/topics covered while communicating Batik online. 164 mobile apps on Batik have been classified into different categories. 70% of the apps cover Batik fashion and apparels for different publics (men, women, family, and kids), while the rest are classified as apps for Batik textile catalogues and encyclopedia. Only 2 mobile apps provide (limited) information about Batik and tourism in Indonesia. Also some elements learned from previous digital technology projects for Batik [Tresnadi and Sachari, 2015; Hermawan and Arifin, 2015; Widiaty et al., 2018] have been taken into account in the design process. Further benchmarking studies were conducted by analyzing 322 mobile apps dedicated to 18 tangible/intangible UNESCO heritage in Indonesia [Permatasari et al., 2020].

The overall result of benchmarking studies (the fifth element in the OCM) provides an overview on the online communication world of Batik ICH. First of all, it has highlighted essential elements to communicate it, which have been later used to inform interviews and especially the survey: the found communication "ingredients" have been presented in order to get a feedback and to define priorities for the iWareBatik design. Moreover, the benchmark has also unveiled gaps and areas of improvement in order to build a better HCI design for Batik ICH communication: in particular, the authenticity and the identity behind ICH practices shall be better captured and showcased in more detail, so to provide an effective information design [Owen et al., 2004; Crofts, 2010; Purba et al., 2020].

3.1.7.2   Interviews

The result of interview shows a huge interest of different stakeholders towards iWareBatik digital technologies. Table 3.1 provides an overview on the interviewed sample.

All stakeholders expect contents related to (a) Batik motifs, meanings and history, production process, wearing rules; (b) Local motifs, Batik galleries, things to do, tourism attractions, how to get there.

In relation to interactive features, all respondents are also interested in having (c) a feature like a "Spinning wheel", which could be played by the users to randomly access a motif or a region, so to inject some serendipity within the app, to accompany a more structured navigation; 14 respondents favor map features such as (d) "Batik Around You", a map connected to the GPS that would indicate the nearest Batik event; and (e) an Interactive Map of Indonesia.

In terms of visual presentation, 13 respondents specifically require (f) Images of Batik fashion, products, and accessories.

With regards to gamification, respondents were allowed to choose maximum two most preferred gamification features and give priority to the chosen ones. 9 respondents preferred (g) a Selfie function with the possibility of using a Batik motif as the frame; 5 people preferred (h) Drawing Batik motif with knowledge quiz (natural dye, specific plants, motif names); while 4 people opted for having (i) an Artificial Intelligence tool within the app to scan and recognize motifs; and (j) a Batik fashion mix match to redress male/female avatars with Batik dress/shirt. Only 2 people choose (k) a Batik puzzle game with Batik meanings. One person proposed to add (l) a Storytelling video with cartoon animation that explains the meaning of Batik motifs.

3.1.7.3   Survey

The survey is an important process to capture the needs and expectations of a larger population of potential users with regards to the iWareBatik design. The age range of respondents is 18 to 65, 145 respondents (76%) are young adults (18–30 years old), 46 respondents (15%) are 30–40, and the rests (9%) are 40–65. 103 respondents (53%) are students, 47 (26%) employees and professionals, while 41 (21%) are lecturers/PhD candidates. 180 respondents (94%) are aware of Indonesian Batik, but only 68% (126) are aware of its exceptional cultural values as inscribed by UNESCO in 2009. 124 respondents (64%) show the willingness to download an educative mobile application on Batik.

While asked about the visual contents, 128 people (67%) responded 'strongly agree' to see (i) images or videos depicting Batik products (such as garments and textiles) and its production process; 117 (61%) wanted to discover (ii) a map of Batik regions in Indonesia, each showing its typical Batik motifs; and 97 respondents (51%) to play (iii) a Spinning Wheel, which allows users to play and discover each motif or region; 38% expected to see (iv) a lady and/or a man wear-

ingBatik at Indonesian touristic destinations or heritage sites (palaces, temples, beaches, etc.) as the main screen of the app.

When it comes to contents, two third of the respondents recommended to include contents related to (i) philosophical meanings and history of Batik motifs; as well as (ii) a map of Batik regions showcasing typical Batik motifs and production process. 103 respondents (53%) expected contents related to (iii) Batik production centers, local tourism attractions, and how to get there. The survey recorded 126 respondents (65%) interested in having a (iv) Batik recognition tool, to scan batik patterns and find information on them, making it as the most preferred augmented reality (AR) feature by the survey respondents. The remaining AR options, such as photo montage tool, Batik puzzle game, and fashion mix and match tool were chosen by less than 50% respondents. About two third of the respondents expected that the iWareBatik web and mobile application would offer (v) the possibility to discover tourism regions to see their Batik motifs and their tourism attractions; while 119 respondents (60%) would use the app (vi) to gain information related to Batik Exceptional Cultural Values (production process, motifs, meanings, wearing rules).

3.1.8   Design process

3.1.8.1   Refinement of user goals

The first stage of goal refinement,moving from the interviews with main stakeholders and the survey was conducted by using NVivo software. As the survey received 114 textual answers from the respondents, the most frequent words of those texts were computed. Similarly, some parts of the interview transcripts containing the needs and requirements of the participants were added, so to find the most important keywords. The result of the computing process using NVivo show that some words were frequently mentioned such as learn, production process, history, meanings, types of Batik, interactive, contemporary, tourism, regions, pictures, games, fashion, video, copyright, educate, young people, map, story, workshop, price, local producers, and souvenirs. Those main keywords were used in order to inform the design of iWareBatik contents.

The second step of the analysis was done by analyzing, annotating, and translating each textual input into a table of indicators based on the AWARe requirement categories, detailed in Table 4.9. Some inputs imply ill-defined goals of the stakeholders. For instance, a respondent wrote, "Really put appreciation and hope for this app, because (it can be used) to attract awareness especially of Indonesian young generations". This textual inquiry data is classified as soft goals

of the respondent, anchoring other design elements and outputs to support this idea. The analyst and development team further worked on textual inputs, in order to understand which features, functionalities, contents were desired by respondents.

Requirement of Contents				Requirement of Content Structure		Requirement of Content Access		Requirement of Navigation		Requirement of Interface		Requirement on User Operations	
Exceptional Cultural Values of Batik (motifs, history, meanings, etc)	81	Across Indonesia (Whole Regions)	9	Batik motifs, its meanings, and history	71	Batik and Locals	62	Region >motif and meanings	67	Easy to use (uncomplicated menu)/user friendly/ prompt response	7	Able to read/ see contents	82
Identity (place of origin/region)	39	Promotion	8	Batik villages/ workshops/local producers	25	Thematic Batik	23	Batik motif/ meanings/ production technique >locals villages	30	Simple and Elegant	2	Able to choose options or categories	45
Production technique	25	Fashion/ Special wearing rules	6	Regions pages	20	Batik and tourism regions/sites	13	See certain themes of Batik	15	Engaging storytelling with short/ synthetic text	7	Able to discover interactive map, pages	19
Types of Batik	21	Batik making classes	4	Tourism sites	7	Buy Batik	7	Buy batik	11	Engaging design for young people	6	Able to purchase from the platform	13
Producers	15	Specific philosophy, Meanings for one's life	3	local culture	3	People wearing Batik	5	Region >tourism sites	11	**Requirement on Visual Presentation**		Able to watch video material	5
Batik products	14	Design evolution	2	Traditional Batik (royals, local motifs, etc)	2	Thematic Sites	5	Price	8	Video	9	Able to play (games, AR, AI, etc)	2
Raise Awareness	13	UNESCO	1	**Requirement on Types of App**				Highlight the classification of Batik wearing rules	5	Short Film	4		
Where to buy	12	Batik events	1	Informative	80			Promote Batik (for seller)	4	Images	6		
Destinations	12			Interactive	13								

Table 3.2. List of user requirements annotated from the 114 survey textual inputs. Numbers beside requirements indicate how many respondents mentioned them.

Another example of textual input is the following one: "Hope that this application can give the essence of Batik and its related history and development, the position of Batik in the world, and explanations about batik producers across Indonesia". The text implies more practical needs to discover the complexity of contents related to Batik, its history and the development of its motifs across centuries. Such input is easier to be defined and fit in the set of requirements. The keywords inferred from the computed analysis of textual data and the requirements table are combined and translated into an holistic paragraph, capturing the overviewof stakeholders' goals towards iWareBatik: "The iWareBatik digital innovation helps to better communicate Batik to international and domestic (Indonesian) tourists, it is helpful to educate and raise the awareness of young people. It is designed in a way that engages users to discover, learn, and com-

prehend the ancestor traditions through short stories about the beautiful motifs, different meanings, emotions, history, and philosophical contemplation behind the Batik making. iWareBatik offers interactive features both in its website and mobile app, such as games or maps, in order to highlight the images and videos of local Batik textiles, tourism regions, as well as the cultural experience of Batik workshops across Indonesia. As Batik symbolizes friendship, iWareBatik may be used to recommend consumers to buy meaningful batik souvenirs. The platform also provides information about the price and even a possibility to buy Batik within the app, or where to go to get one. It displays how to wear Batik as formal attire, dress in contemporary fashion for individuals or couples. All Batik patterns reflect cultural identity, which shall be protected with the proper legal instruments."

3.1.8.2   User composite profiles, scenarios, and priorities

The design of the website and of the application should meet the needs and expectations of users and main stakeholders. AWARe model defines users as the audience whom the site aims to attract and serve. On other hand, main stakeholders are those who have the interest in building the digital platform, aiming at communicating certain topics in a way that is in line with their organizational strategy and objectives [Bolchini, 2003], at the same time meeting users' needs and interests. For example, USI UNESCO Chair and Indonesian government, as the clients-main stakeholder of this digital project, ensure that the system design is in line with the safeguarding objectives of Batik ICH. In addition, the designer or the project analyst must be able to identify the objectives of all stakeholders, both from the users' perspective and from the main stakeholder's one [Bolchini and Paolini, 2002]. The next step of the design process is to define the personas and roles, in order to create composite profiles and scenarios/story of both users and main stakeholders.

Personas refer to personal characteristic of people who might be potential users in accessing the services provided by the platform. They encompass several dimensions such as age, profession, mindset, and roles characterizing a profile. Roles refer to the behavioral attitude of the user when using and accessing the site. Role goals refer to the objectives of specific online activities performed by the user. The combination of goals of a persona and a role generates a user composite profile, which informs the overall needs, tasks, and requirements inferred by the identity of the overall profile. Several personas are identified during the elicitation stage, namely: Tourist (International/Indonesian), Journalist, Art Student, Batik SME/Designer. The user roles applicable for the design of iWareBatik

project are Casual Surfer, Material Gatherer, Facts Finder, and Ideas Seeker. All elements of user personas and user roles are combined in a holistic description.

Defining user composite profiles helps analyst to assign the degree of importance of the addressed users during the goal refinement process. Once the user composite profile is generated, the user scenarios can be outlined in order to describe the situations or story on where, when, and how the user would access the digital communication outlet. Five different user scenarios were defined such as Tourist, Journalist, Fashion Designer, Art Student, and Indonesian Diplomat. Among them, two examples illustrating the site user and client user scenario were presented as follows.

Site User Scenario. A high school student living in a village in East Java heard about iWareBatik website and application from her friend. She had an assignment to present the art of Indonesian Batik and explain its meanings in the class. She looks into the website and finds a large collection of Batik motifs existing in 34 provinces in Indonesia. She discovers the interactive map of iWareBatik and clicks into East Java region. She finds it interesting to see the short story of the region and its Batik motifs, presented in one-minute visual journey video. As she lives in a village with limited access to internet, she is able to use the offline mode of iWareBatik app to learn and share stories about Batik with her peers, as well as to help Batik producers in her village.

Client User Scenario. A diplomat working at Indonesian Embassy in London, England has a mission to conduct a Batik exhibition in his city. He is informed about iWareBatik website and application from his colleague in Bern, Switzerland. He needs to prepare a material for the exhibition. He browses the iWareBatik website and finds all the information of Batik motifs, including its thematic meanings and places of origin across Indonesia, which are available in English and Indonesian language. He finds out that iWareBatik app has an artificial intelligence feature that can be used to recognize Batik motifs. It inspires him to integrate iWareBatik app in the event, so the visitors can learn Batik textile heritage in a better and different way.

Batik textile heritage in a better and different way. Based on the previous analysis, all the goals/soft goals associated to each stakeholder are converted into a table of user composite profiles (see Table 3.3). It appears that some stakeholders share similar objectives. The priority of a goal is weighed upon the number of stakeholders who have similar goals/soft goals.

Site User Profile	Roles	Goals	Soft Goals
Tourist	Casual Surfer	- Discover cultural/natural destinations and UNESCO sites in Indonesia - Get to know Indonesian Batik - To know the reason why Batik was inscribed by UNESCO - Batik picture and read short story about its meaning - Discover Indonesian Batik regions - Search for Batik villages and workshops	Attractivity Interactivity Simpleness
Journalist	Material Gatherer	- To know the reason why Batik was inscribed by UNESCO - Discover Batik in each region and its difference - Learn history of Batik - See Batik picture and find its meanings	Richness Accuracy
Art Student	Facts Finder	- Get to know Batik in each region and its differences - To know the reason why Batik was inscribed by UNESCO - Learn history of Batik - Learn how to make Batik textile - Discover the evolution of Batik across centuries	Richness Attractivity Accuracy
Batik Small Medium Enterprise (SME)/ Designer	Ideas Seeker	- Get to know Batik in each region and its differences - Learn how to make Batik - Learn how to wear Batik according to its purposes - Do something with the platform (to contribute article, to promote, to buy)	Attractivity Richness
Main Stakeholder Profile	**Roles**	**Goals**	**Soft Goals**
USI UNESCO Chair	Client, Decision Maker, Representative, Opinion Maker	- Raise people's awareness in preserving tangible and intangible cultural heritage (ICH) - Preserve UNESCO Sites in Indonesia - Safeguard Indonesian Batik	Accuracy Accessibility Attractivity
Indonesian Government (LPDP scholarship)	Client, Representative, Opinion Maker	- Safeguard Indonesian Batik - Preserve UNESCO sites in Indonesia - Promote Indonesian tourism - Promote Indonesian creative products	Attractivity Richness Accuracy
Sobat Budaya Cultural Association	Representative, Domain Expert, Opinion Maker	- Safeguard Indonesian Batik - Protect Indonesian cultural properties	Accuracy Security
Batik Artisans/ SMEs	Representative, Domain Expert,	- Promote Batik motifs and products - Safeguard Indonesian Batik	Attractivity Accessibility
Communication Manager	Decision Maker, Domain Expert, Opinion Maker, Development Team	- Effective Communication - Reduce costs and maintenance - Attract visitors and users	Effectiveness Attractivity

Table 3.3. The list of user composite profiles of all stakeholders (site users and main stakeholders).

3.1.8.3 Transition to design model

The goals of users and main stakeholders gathered during the elicitation process (interview and survey) are combined within the joint requirement analysis. Joint requirement analysis illustrates all goals/soft goals of users and main stake-

holder, as well as the associated requirements that are systematically arranged into a goal graph. The requirements are classified into 7 set of requirements namely Access (A); Content (C); Presentation (P); Structure of Content (SC); Navigation (N); User Operation (U); Interaction (I), System Operation (O) [Bolchini and Mylopoulos, 2003]. The goal graph illustrates goal refinement along with the identification of conflicts and influences, hypermedia taxonomy and set of requirements (see Figure 3.5). The elements of the goal graph are presented in Figure 3.4.
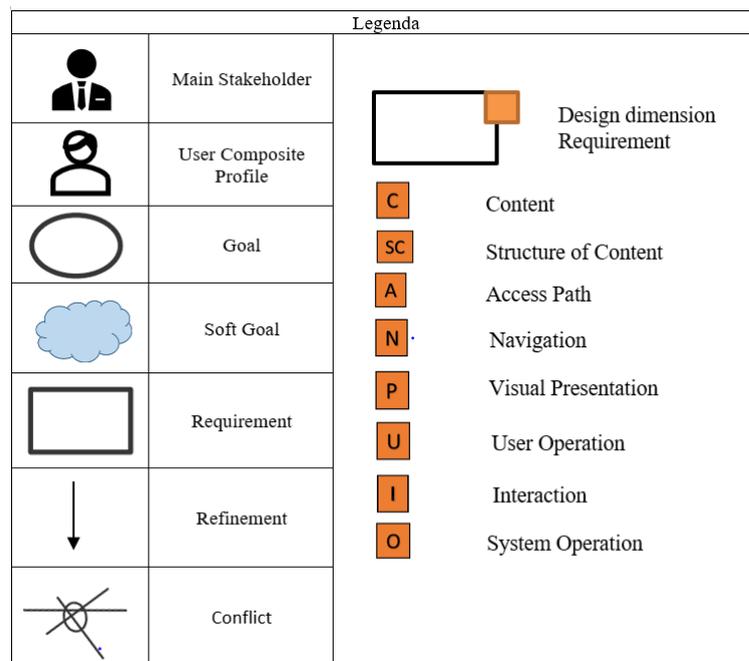
Figure 3.4. Elements of goal graph based on AWARe model.

The goal graph is divided into two parts, namely the main stakeholders (from the center to the right side) who aim to supply information and the site user profiles (from the center to the left side), whose goals are to obtain information. Eventually the main goal(s) of a user composite profile and main stakeholders need to be detailed in more specific goals. For example, a tourist wants 'to know Indonesian Batik culture'. This goal is specified into several goals such 'to know the reason why Batik was inscribed by UNESCO', 'see Batik picture and find its meaning', discover Indonesian Batik regions', 'search for Batik villages and Batik workshop'. Subsequently, each goal is linked to specific requirements that satisfy the goals outlined. For example, USI UNESCO Chair and Indonesian government, as the clients-main stakeholders, share similar priorities with regards to
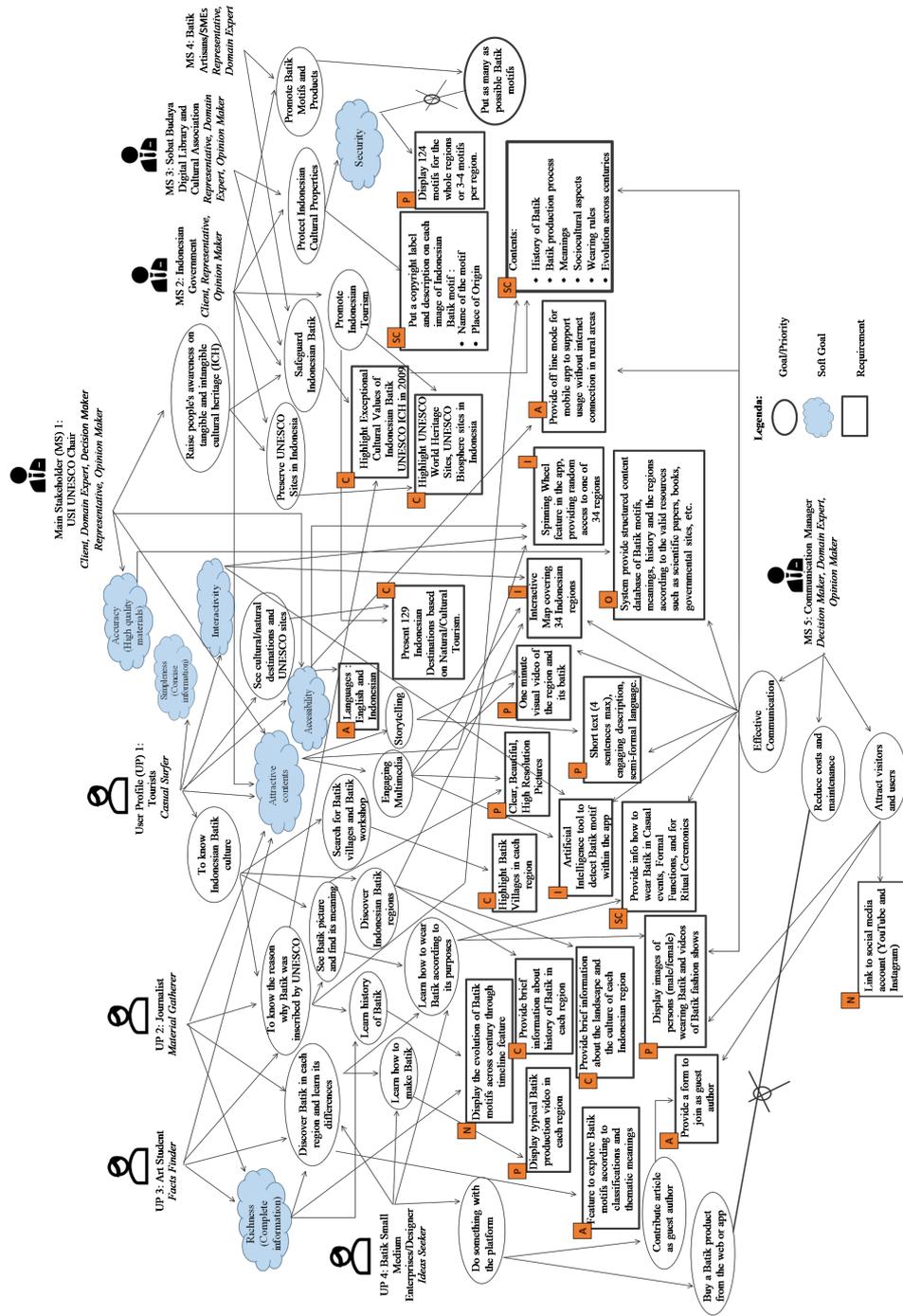
Figure 3.5. The goal graph as the result of Joint Requirement Analysis in AWARe model

raise people's awareness to preserve UNESCO Sites in Indonesia and safeguard Batik as UNESCO ICH. Those main goals are linked to several Requirements of Content (C) such as 'Highlight UNESCO sites in Indonesia' and 'Highlight Exceptional Cultural Values of Indonesian Batik UNESCO ICH in 2009'. The contents with regards to the exceptional cultural values of Batik are organized into requirements of structure of contents (SC) that outline 'the history of Batik, Batik production process, meanings, socio-cultural aspects, wearing rules, and evolution across centuries'. Those contents are systemized in a way that satisfies the goals of the site user profiles (Tourist, Journalist, Art Student in the left part), who wants to know the reason why Batik was inscribed by UNESCO.

Apart from that, another shared priority is to 'discover Batik in each region and learn its differences'. This goal is interpreted into more specific goals such as 'learn how to wear Batik according to its purposes' and 'learn how to make Batik', which are different from one region to another. Those priorities implicate several requirements of visual presentation (P) such as 'display typical Batik production video in each region' and 'display images of persons (male/female) wearing Batik and videos of Batik fashion shows', requirements of structure of content (SC) 'provide info how to wear Batik in Casual events, Formal Functions, and for Ritual Ceremonies', as well as a requirement of access path (A) that provide 'feature to explore Batik motifs according to classifications and thematic meanings'.

When it comes to fulfil the soft goals, several requirements were set in order to satisfy the expectations of associated stakeholders. For instance, 'Attractivity' is a soft goal shared by USI UNESCO Chair, Indonesian Government, Tourist, Journalist, and Art Student. In order to create attractive content, two sub goals are defined such as to provide 'engaging multimedia' and 'storytelling'. The requirements of visual presentation (P) for those objectives are to provide 'clear, beautiful, high resolution pictures', to create 'one-minute visual video of the region and its Batik' for each region, and to manage 'short text (4 sentences max), engaging description, semi-formal language'. Some requirements of interaction (I) also serve two soft goals: 'Attractivity' and 'Interactivity', such as to provide 'Interactive Map covering 34 Indonesian regions', 'Spinning Wheel feature', and 'Artificial Intelligence tool to detect Batik motif within the app'. In terms of 'Accuracy' and 'Richness', requirements of system of operation (O) and navigation (N) are put in place, such as 'system provides structured content database of Batik motifs, meanings, history and the regions, which is built according to the valid resources such as scientific papers, books, governmental sites, etc.' and provide 'the evolution of Batik motifs across century through timeline feature'. These two requirements are in line with the goal of the Communication Manager, which is to effectively communicate Batik and its all dimensions.

In terms of 'Accessibility', it is fulfilled by the provision of '2 languages: English and Indonesian' and 'spinning wheel feature' and 'off line mode for mobile app for non internet connection usage in rural areas'. Several conflicts were mapped such as the needs of Batik SME/Designer to sell Batik from the app are in contrast with goal of Communication Manager that aims at reducing costs and maintenance. It is decided that iWareBatik digital technology serves as an educative online platform to help people understand the Batik ICH. Another conflict is also identified in relation to the provision of Batik motifs information. Sobat Budaya Association cares for the security to protect the information of Batik motifs as cultural property. Two requirements and limitation are hence justified, namely 'put a copyright label and description on each image of Indonesian Batik motif and 'display 124 motifs for the whole regions or 3–4 motifs per region'.

3.1.9 Discussion and conclusion

The development of iWareBatik digital technology is an example of digital innovation that is built upon the triangulation of participatory service design research, online communication model framework, and AWARe method that extensively captures all requirements and the needs of the stakeholders involved within the field of Batik ICH.

Designing ICT for ICH requires a holistic approach that integrates not only the safeguarding goals of UNESCO Convention in 2003 and scientific elements of Batik as a thousand years-old visual art, but also the main stakeholders in connection with this heritage, especially the Batik artisans. The project has been designed and implemented not only to meet the explicit goals stated by its main stakeholders, but it also covers the underlying expectations of end users, which contribute to the satisfaction of user experience when accessing and exploring the digital platform. The AWARe model is a communication-oriented design methodology that effectively outlines the goals, both from the stakeholders' point of view and from the one of the design team. The goal oriented and participatory nature of AWARe model makes it suitable methodology for designing hypermedia intensive online platforms, especially those that address complex issues, are multidisciplinary, and involve large audiences.

The documentation of iWareBatik design process could serve as an exemplary model for building other similar projects related to cultural heritage and ICH. This research contributes to provide conceptual design thinking through iterative refinement of user requirement elicitation, involving various categories of stakeholders. The case offered in the paper may contribute to improve the measurement and the standard of online communication design for intangible

cultural heritage related to textile.

This study also provides an example of AWARe model that is implemented with huge data samples taken from the interviews and survey. Different methods were used during the process of data analysis, in order to extract them into user composite profiles and convert them into the goal graph. The implementation of conceptual frameworks outlined in this study may serve as a guide and an illustration for the design practitioners, in order to perform benchmarking analysis, identify the needs of the stakeholders through iterative refinement, manage the design transition, treat all the requirements and conflicts into applicable solutions, and accordingly build an effective user experience of digital technology. Since the scope of this study is limited to the documentation process of the design, the study can be further developed into the evaluation and the usability studies based on the set of requirements outlined above. The research topics can also be expanded to address other cultural heritage projects. It is deemed important that the online communication design of intangible cultural heritage truly corresponds to the safeguarding mission of the UNESCO, while taking into account various dimensions and effectively attract more stakeholders for supporting the preservation of the ICH.

Chapter 4

Implementation of AI-based Batik Recognition Tool

This chapter presents co-creation design and development process of machine learning architecture for Batik recognition tool, which is embedded within iWare-Batik mobile app. This experiment-based research addresses technical implementation conducted according to the result of participatory design [Permatasari and Cantoni, 2021], ABCDE Model [Cantoni, 2018], the first and second pillar of Online Communication Model (OCM) [Cantoni and Tardini, 2006], ADDIE model [Botturi, 2003], and service design framework [Rytilahti et al., 2015]. The research paper had been submitted and was rejected by Journal on Computing and Cultural Heritage in January 2022. The paper has been revised addressing the reviewers' comments and was resubmitted to a journal in February 2022.

Permatasari, P. A., Kuwandy, R. K. and Cantoni, L. Unveiling the Hidden Meanings: Using AI to Build a Batik Recognition Tool within a Mobile App. Submitted to a journal in February 2022

4.1 Unveiling the Hidden Meanings: Using AI to Build a Batik Recognition Tool within a Mobile App

ABSTRACT[1]. Digital technologies support cultural heritage preservation, as well as provide new ways of communicating and presenting its exceptional values. This article presents a way in which artificial intelligence and augmented reality can be integrated in order to preserve and communicate Indonesian Batik, inscribed since 2009 within the UNESCO List of Intangible Heritage of Humanity. Despite a growing attention devoted to safeguarding it, its philosophical and spiritual meanings, connected to thousand motifs, are scarcely communicated and understood, leading to a decreasing awareness of its socio-cultural importance. This article presents a research and development project aimed at developing a Batik pattern recognition tool, able to analyse eight categories of Indonesian Batik motifs. Such a tool has been integrated within the iWareBatik mobile app, which can be used by international travellers as well as by locals in order to get a high quality understanding of Indonesian Batik and rich environment. Two models of Convolutional Neural Network (CNN) architecture, MobileNetV2 and VGG16, have been tested, which are known as being among the most effective deep learning techniques for visual imagery analysis. Using a data set of 885 motifs, both system models yield comparable performance results: MobileNetV2 achieves a slightly higher accuracy rate of 88.6% than VGG16 of 87.5%. Image processing techniques, effective data set management, solid CNN architectures and related challenges are presented as the key issues to be considered in order to build a robust pattern recognition tool, ensuring the goal of supporting a deeper knowledge, understanding and appreciation of Batik textile heritage.

4.1.1 Introduction

Digital technologies have been integrated in providing solutions to address the rising issues within the preservation of cultural heritage and its usage values, while at the same time, linking them with engineering approaches where the ICT is designed/prototyped in order to support the goals of heritage preservation [De Ascaniis and Cantoni, 2016].]. Especially during the Coronavirus pandemic, the valorisation of Intangible Cultural Heritage (ICH) usage values could only be attained through online activities. The dissemination of textile motifs knowledge is a way to foster sustainable ICH safeguarding practices, which can

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[1]Permatasari, P. A., Kuwandy, R. K. and Cantoni, L. Unveiling the Hidden Meanings: Using AI to Build a Batik Recognition Tool within a Mobile App. Submitted to a journal in February 2022

be achieved also through the development of machine learning for image retrieval and recognition [Liu, 2020]. Images contain various information about the shape and patterns of Batik items and are useful resources to capture and conserve its values. Image retrieval techniques are a promising way to help users to search/obtain information about an heritage object [Liu, 2020], offering a just-in-time and just-in-place answer to their questions about the actual meaning of the encountered item. The development of image retrieval and pattern recognition technologies can thus contribute to enhancing the value of digital media in order to support the safeguarding of Indonesian Batik, a UNESCO intangible cultural heritage (ICH) since 2009 search/obtain information about an heritage object [UNESCO, 2009b].

A lack of quality information and an ineffective knowledge dissemination remain as challenges to many Batik stakeholders due to various limitations and technology constraints. Most of the time, the knowledge of the meanings of motifs is kept in the archives of cultural institutions, and in the minds of Batik producers and experts themselves. Even though internet search engines can provide information about Batik, a well-designed and curated digital technology for Batik is needed in order to facilitate learners to better understand its motifs and their philosophical values, so as to approach such ICH in a more comprehensive and holistic perspective [Permatasari and Cantoni, 2021]. In view of supporting the dissemination of the exceptional cultural value of Batik patterns, an AI-based app feature, called Batik Recognition Tool (BRT) was designed and developed. The BRT has been integrated within an existing mobile application: iWareBatik; it uses image retrieval technologies, developed by deploying deep learning CNN architecture for pattern recognition [Kuwandy, 2021].

Indonesia provides a very interesting context for this, as it ranks 4th among all countries in terms of internet users' growth [Kepios, 2019]. As the country grows as a digital society, there is a significant number of digital initiatives in favour of heritage preservation. Since deep learning is proven effective to perform visual retrieval and recognition [Amato et al., 2016; Razavian et al., 2014], this method has been applied in a number of experimental researches in relation to Batik pattern recognition [Rasyidi and Bariyah, 2020; Gultom et al., 2018; Wicaksono et al., 2017]. Combining AI-enabled image recognition with augmented reality technology provides a very interesting strategy to communicate Batik to interested persons just-in-time and just-in-place [Hermawan and Arifin, 2015]. Augmented and mixed reality through mobile devices contribute to enhancing users' experience while accessing and learning cultural heritage information [Korkut et al., 2020; Laato et al., 2021].

Connected with the phone camera, the BRT is an iWareBatik app's interactive

feature, which facilitates users to identify and get to know the hidden philosophical meanings of the captured image; it is currently recognizing eight classes of Indonesian Batik motifs - namely Parang, Kawung, Lereng, Ceplok, Gurda, Merak, Mega Mendung, and Ampiek [Kuwandy, 2021]. iWareBatik digital technologies include a website and a mobile app. Since their launch on August 17th, 2020 until February 18th, 2022, the website[2] has attracted 96'119 visitors and the app [iWareBatik, 2020a,b] has had 3'313 downloads.

This article contributes (1) to outline a case study of an AI-based pattern recognition tool devoted to Batik ICH; (2) to elaborate the integration of CNN architecture for pattern recognition in a mobile application; and (3) to present the methodologies for setting up the learning classifiers, the system architecture, and to compare the performance and accuracy of two CNN architectures: namely MobileNetV2 and VGG16.

This section outlines current research on Indonesian Batik and the role of artificial intelligence and CNN architecture supporting ICH preservation.

4.1.2   Literature review

4.1.2.1   Batik as intangible cultural heritage

Batik refers to an ancient textile art, whose intricate patterns are drawn using hot melted wax and involves several dyeing processes [Haake, 1989]. "Batik" is derived from 2 Javanese words which are "amba" and "thithik", which refers to draw dotted lines (thithik) on a piece of wide (amba) textile. Some other literature mentions that Batik means "to draw with the whole heart" [Lestari, 2012]. This wax-resist dyeing technique had been practiced by ancient civilizations since 5000 BC [Druding, 1982] and started to spread in the Indonesian archipelago since the 6th Century. Nowadays, Indonesian Batik patterns have been developed into 5'849 distinctive motifs, each showcases the philosophical and socio-cultural values characterizing its place of origins [Ministry, 2013a; Situngkir, 2015]. Batik patterns are divided into 2 categories, namely geometric motifs (i.e. Ceplok, Kawung, and Parang) and non-geometric patterns (i.e. Gurda, Merak, and plant ornaments). These patterns are usually arranged repeatedly as the basic pattern of the whole fabric, or combined with other motifs forming a thematic Batik visual layout [Haake, 1989]. The exceptional cultural values of Batik extends also to include its wearing rules and thematic motifs, which accompany and represent in a vivid way the history of Indonesian civilization [Permatasari and Cantoni, 2021].

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[2]www.iwarebatik.org

4.1.2.2   Artificial intelligence for intangible cultural heritage

Known as "ABCDE" framework [Cantoni, 2020], the roles of digital technologies for heritage (tourism) is singled out in 5 main areas [Permatasari and Cantoni, 2019b; Cantoni, 2018], namely to provide *Access* to heritage-related quality information; to *Better* the experience of users while accessing the heritage itself, for instance through mixed and augmented reality; to *Connect* the three main players in heritage tourism: locals, visitors, and the heritage itself; to *Dis-intermediate* or streamline certain relationships so to better support local communities; and to *Educate* and up-skill all ICH-related actors and professionals.

Artificial Intelligence (AI) research started around the 1940s [Buchanan, 2005], which then evolved into different sub fields for different tasks [Perez et al., 2018], such as expert system, robotics, machine learning, etc. As a sub field of AI, machine learning employs deep learning algorithms that are capable of learning an object's characteristics, hence becoming able to automatically recognize it within the complex high-dimensional data input to a system [Mehta et al., 2019]. Since 1995, the advancement of mobile device technology and digital cameras contributed to the rise of Content-Based Image Retrieval (CBIR) as an automation of visual recognition. CBIR integrates a deep learning architecture, which supports the visual search system, in order to retrieve the information about an object by simply taking a picture of it [Gudivada and Raghavan, 1995]. Convolutional Neural Networks (CNN) is one of the deep learning methods, which is extensively used in the digital heritage domain for its capacity to learn and classify a large set of predefined images and detect visual data [Rumelhart et al., 1986]. CNN architecture also accommodates different recognition tasks such as scene recognition, attribute detection, image classifications and image retrieval [Razavian et al., 2014]. Artificial intelligence (AI), as a wide-ranging branch of computer science, might play a special role in providing access to knowledge about heritage, in bettering the experience of persons when exposed to such heritage, as well as in providing opportunities to further cultivate and strengthen the connections between travellers, locals and the heritage itself.

The use of CNN in the field of digital heritage has been growing in the past decade, especially to perform image search and object recognition for heritage preservation, both applied for tangible [Kumar et al., 2020; Kulkarni et al., 2019] and intangible cultural heritage [Amato et al., 2016; Liu, 2020]. The idea of convolutional neural networks came up from biological processes in which the connectivity pattern between neurons resembles the organization of the animal visual cortex [Long and Gupta, 2008]. Instead of using only one hidden layer, CNN architecture encompasses several building blocks such as convolution, pool-

ing, fully connected layers, input layer and output layer [Yamashita et al., 2018]. The CNN architecture learns from a two-dimensional (2D) or three-dimensional (3D) grid represented by pixel values of digital images. This method uses a small grid of parameters called kernel, which serves as a feature extractor that helps the system to capture every feature contained within the image. These mathematical features extractor processes are repeated in several building blocks of convolution and pooling layers, to perform feature extraction of the 2D or 3D data input. The fully connected layers extract low-level features of the image that are used to form the feature maps. Generally, CNN does not require a separate feature extraction process, as it is done internally during the model training [Rasyidi and Bariyah, 2020]. In the final process, the fully connected layers map out the extracted features into a feature map or final probability numbers that are used for classifying the input images (see Figure 4.1)
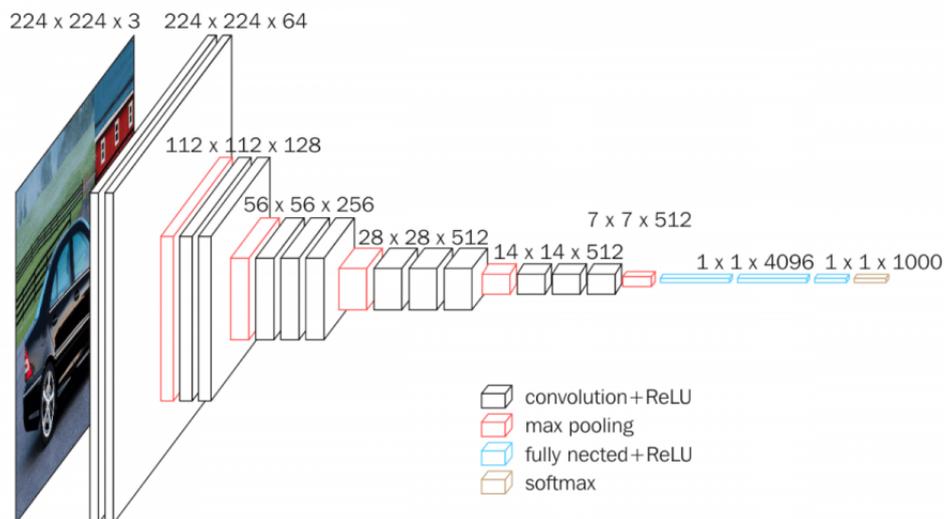
Figure 4.1. A Standard CNN Architecture [Hassan, 2015]

Many CNN architectures that have been developed and tested show good performances in image classification [Rasyidi and Bariyah, 2020; Liu, 2020]. Some popular CNN architectures are VGG (VGG16 and VGG19), ResNet (ResNet18, ResNet34, ResNet50, ResNet101, and ResNet152), DenseNet (DenseNet161, DenseNet169) and MobileNets (MobileNet and MobileNetV2). Some CNN-based technology for tangible heritage examples are: the use of VGG16 to build a device for detecting disaster-related damages in cultural heritage sites [Kumar et al., 2020], or the use of MobileNetV2 to build an image classifier to classify cultural heritage sites in India [Kulkarni et al., 2019].

In this research, a CNN - MobileNetV2 model is implemented, as it is considered light and fast compared to other common CNN models such as VGG16 or Resnet. MobileNetV2 network architecture uses depth-wise separable convolution that can reduce the computation. In addition, MobileNetV2 has fewer parameters than the other architectures but is deemed reliable in producing good accuracy as well. In order to measure the accuracy and method efficiency, this research provides the comparison results of MobileNetV2 with the VGG16, which have been recognized as top 5 Keras accuracy ranks [Keras, 2020].

4.1.2.3 Digital media and artificial intelligence for Batik

Since 2018, the development of digital technologies for Indonesian cultural heritage has been receiving growing attention. 164 mobile apps have been found covering Batik [Permatasari and Cantoni, 2019b], they could be classified into four types: textile catalogues (45 apps); Batik clothing and fashion (115); tourism (2); and games (2). Further research was done on 322 mobile apps on Android and iOs dedicated to UNESCO tangible/ICH in Indonesia [Permatasari et al., 2020]. The study outlines several types of innovative features, providing a landscape of Indonesian digital heritage features, such as informative encyclopedias, interactive quizzes, gamification apps with animation, AR/VR, etc. The same study finds that there is still no presence of AI-powered feature on pattern recognition within all analysed apps. Moreover, the research on building technology of image classification has been growing in the past years as well. Previous works on the development of a Batik classification tool were using several methods such as curvelet Transformation, HSV colour space, and k-Nearest Neighbor (KNN) classifier [Suciati et al., 2015], Multi Texton Histogram (MTH) with k-Nearest Neighbor (KNN) and Support Vector Machine classifier resulting the best accuracy of 82% [Gultom et al., 2018]. The use of gray level co-occurrence matrices (GLCM) and several types of feature extraction methods were performed to classify four Batik motifs, which yielded an average accuracy of 80% [Nurhaida et al., 2012]. Gultom et al.[2018] using VGG16 as a feature extractor, managed to get an average accuracy of 89±7% of 5 classes of Batik motifs. The study further compared CNN architectures used for developing classification systems, one of which could achieve the best accuracy of 94.3% using densenet201 [Rasyidi and Bariyah, 2020]. In another study, 11 classes of Batik motif classification were performed by combining CNN architecture such as GoogleLeNet and IncRes, resulting in 70.84% accuracy [Wicaksono et al., 2017].

From these previous studies, it can be seen that the Batik classification system which implements deep learning CNN architecture produced a fairly good accu-

racy. However, we note that the training data used in some of these studies were very limited. For example, Minarno et al. [2018] used only 300 images which were divided into 50 classes, with 6 images per class. Nurhaida et al. [2012] conducted data training with a total of 40 images, divided into four Batik classes. Training a deep learning model in order to handle real-world data is challenging, as the images might have varying levels of lighting, distortion, and perspective during image capture. The studies showed that the image data samples were also organized in such a way that the resulting model can be effectively used to handle the real-world data Rasyidi and Bariyah [2020].

Among pattern recognition models, this study implements MobileNetV2. Newer version of MobileNet such as MobileNetV3 [Howard et al., 2019] was considered as an alternative. However, the limitation lies on the tensorflow framework that is not available for this version of network architecture at the moment. Therefore, MobileNetV2 is chosen as it is deemed more stable, easy and ready to be implemented for developing Batik pattern recognition tool. Since the aim of this research is to create a ready tool, VGG16 was chosen as an optional network architecture in the case when the MobileNetV2 could not obtain optimum result. Moreover, VGG16 was used as control model in order to validate the performance of MobileNetV2 in handling the given dataset. Based on the outlined previous studies, a clear research gap appears, making the exploration of new modalities to automatically recognize Batik's motifs of particular interest; the same can be said about the integration of such feature within a mobile app, which might be used by travellers as well as by locals.

4.1.3   Methodology

The development of iWareBatik - Batik Recognition Tool consists of four main development phases, namely: design process, image processing, BRT deep learning development and RESTful API system integration. It goes along the following steps, namely (a) benchmarking; (b) data set collection, filtering and annotation; (c) artificial data enhancement; (d) image augmentation; (e) and App integration (see Figure 4.2).

The image processing incorporates all steps related to collecting, labelling and data augmentation. The dataset used throughout the machine learning development consists of a series of activities, such as training, validation, and testing. The trained dataset was evaluated using iterative validation in order to get an optimal model. The BRT was developed by four sequences of models, namely model building blocks, model compilation, model fitting, and model evaluation. Model Building Blocks were built using the Keras framework in accordance with
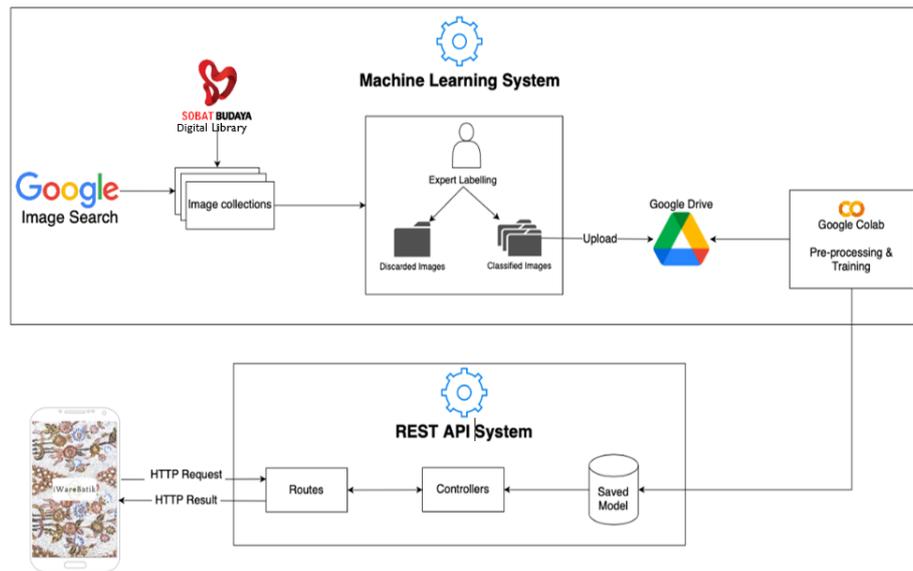
Figure 4.2. Overview of BRT methodology [Kuwandy, 2021]

the CNN models. The model consists of multiple layers that are used to perform the image predictions, such as convolutional, activation, pooling, fully connected layers, drop-out, flatten, and other connected layers. The final stage of the project ends by the integration of the RESTful API backend system, which facilitates hosting requests from iWareBatik mobile application to the BRT system. The AI development phase also includes model evaluation, where both methods are assessed in order to analyse their performance and their capacity in providing accurate results of image predictions. In order to evaluate the classification model, several common metrics were computed per image class, such as accuracy, precision, recall, and f1-score.

Accuracy can be defined as the total number of correct predictions, which are obtained from the sum of True (TP) and True Negative (TN) divided by sum of True Positive, True Negative, False Positive (FP) and False Negative (FN), as referred by this formula [Grandini et al., 2020]:

$$Accuracy = (TP + TN)/(TP + TN + FP + FN)$$

Precision is used to measure the value of correct prediction as observed from its false predictions. Higher precision indicates that the system yields more relevant results than irrelevant ones, as formulated below [Grandini et al., 2020]:

$$Precision = TP/(TP + FP)$$

Recall or sensitivity measures the ability of the model to predict relevant results (no false negative) through all observations in one class. It sums to which proportion of an image is correctly classified into one class as presented by this formula [Grandini et al., 2020]:

$$Recall = TP/(TP + FN)$$

Apart from Precision and Recall, there are also weighted precision and weighted recall, that can be generalized as following formula:

$Weighted_p = (P_1 * |c_1| + P_2 * |c_2| + \ldots + P_n * |c_n|)/(|c_1| + |c_2| + \ldots + |c_n|)$

$Weighted_r = (R_1 * |c_1| + R_2 * |c_2| + \ldots + R_n * |c_n|)/(|c_1| + |c_2| + \ldots + |c_n|)$

n is number of classes, P_n is precision of class n, R_n is recall of class n and c_n is weight of class n.

Lastly, f1-score. F1-score provides a single metric that measures the relative performance of the harmonic mean between precision and recall. Precision and recall are based on relevance. Higher score on precision and recall yields higher F1-score in terms of the image classification.

$$F1-score = 2((Precision * Recall)/(Precision + Recall))$$

4.2 Results

This section outlines the results of the research distributed into several stages of the Batik Recognition Tool system development, which include system design process, image processing, model structures and experimental settings, final output comparisons: VGG16 and MobileNetV2, image prediction beta testing and integration of BRT into mobile app system.

4.2.1 System design process

4.2.1.1 User requirement engineering

User requirements' elicitation was conducted through a survey and inter- views in order to properly design the iWareBatik app [Permatasari and Cantoni, 2021]. 126 respondents (70 % of the total responses) expected to have the BRT as an augmented reality feature within the iWareBatik mobile app. The interviews conducted with various stakeholders - ranging from governmental officers, Batik producers, lecturers, textile collectors, and tourists - have revealed a great interest for an interactive system able to provide access to high quality information

about Batik motifs, to enrich the experience of users while in front of Batik items, and to strengthen the connection among (heritage) tourists, locals, and the Batik heritage itself. Hence, A, B and C dimensions of the ABCDE framework had to be addressed. In fact, the app itself could somehow address the remaining two ones: dis-intermediate, through clear information about local Batik villages, and educate: enhancing the preparation of all relevant stakeholders when it comes to Batik as ICH.

4.2.1.2   Software requirements

From the technology developer's perspective, the creation of Batik Recognition machine learning requires reliable and robust, yet at the same time, efficient in terms of maintenance and web hosting resources. BRT system development consists of two main elements namely [Kuwandy, 2021]: the machine learning system (MobileNetV2 and VGG16) and the RESTful API system. Several frameworks and tools are required to support the overall system. The use of Tensorflow helps users to efficiently increase the performance of the training of the AI models on either CPU or GPU. Keras 2, one of the deep-learning frameworks, was used to effectively deliver high-level building blocks for many kinds of deep-learning models [Chollet, 2015]. Numpy, a python framework, assists the programmers to manage the data, especially during data collection, data forming, evaluation and visualization of the result or the AI model [Harris et al., 2020].OpenCV 5 or open source computer vision, an open-source programming library, supports visual data manipulations prior to the training process. Several processes were done in order to improve the efficiency of the data training, such as slicing, resizing, and cropping. Data training was conducted by using Google Colab notebooks, as it also facilitates free access to GPUs and easy sharing [Kuwandy, 2021]. The final outcome of the AI model built in Google Colaboratory was saved within the RESTful API system, which will be connected to the mobile application system for predicting the uploaded image.

4.2.2   Image processing

4.2.2.1   Data set collection and filtering

In this section, we introduce our studied data, the 8 batik motifs and give the details of the segmented batik motifs dataset used in the experiments. As we mentioned before, Batik motifs are divided into two categories: geometric and non-geometric. The images data set are mainly obtained from Google search

engine as well as authors' Batik textile collections. The quality of collected images are varied. Some images are sufficient for the training, while the low quality ones are still kept for image reference and real-time testing purposes. The annotation process was conducted by domain experts with the aims to classify and label 867 images based on their dominant patterns into eight classes of Batik motif namely: Parang, Kawung, Lereng, Ceplok, Gurda, Merak, Mega Mendung, and Ampiek. Each class has more than 100 images except for Ampiek, Gurda and Merak. The distribution of images for each class is presented in Table 4.1.

Geometric Batik Motif. The terms of geometry in Batik motifs refer to unique geometric ornaments based on several shapes such as square, circular, cubes and other geometric lines [Nurhaida et al., 2016]. Furthermore, the geometric patterns can be identified by the symmetry and repetition patterns in horizontal, vertical, and diagonal directions [Nurhaida et al., 2015]. In our research we choose four geometric motifs, namely, Kawung, Ceplok, Lereng and Parang (see Figure 4.3).

The Kawung motif, the oldest batik motif pattern, draws circles or elliptical shapes that are repetitive and overlap. Ceplok motif has repetitive geometric ornaments such as circular shapes, stars, squares, cubes and other geometric lines. Lereng motif structures as diagonal rows of patterns, filled - in-between - with small patterns. Lastly, the Parang motif is similar to the Lereng: it consists of parallel lines in diagonal form filled with small ornaments [Nurhaida et al., 2016] (see Figure 4.3).

Non-Geometric Batik Motif. On the other hand, non-geometric Batik motifs have unstructured patterns and random ornaments. Non-geometric Batik motifs typically do not form symmetrical patterns [Nurhaida et al., 2015]. Some non-geometric Batik motifs include Semen, Wayang, Gurda, Merak, Mega Mendung, and Ampiek (plant ornaments). During the filtering phase, four non-geometric Batik motifs were chosen, namely Gurda, Merak, Mega Mendung, and Ampiek (see Figure 4.4). Gurda or Garuda is a mythical bird, which has been designated as an Indonesian national emblem. Merak refers to a peacock animal, while Mega Mendung motif is a non-geometric motif, which resembles a bunch of clouds. Lastly, Ampiek is an indigenous tallow plant of Borneo Island.

4.2.2.2   Data augmentation

The challenge of building a Batik Recognition Tool lies on the small data set. Since a Batik motif might be composed of multiple motifs and complex arrangements, image segmentation shall be done prior to the training phase. This process aims at removing irrelevant and redundant imagery information, which

Batik Motif Class	# of Images
Ampiek	67
Ceplok	127
Gurda	88
Kawung	128
Lereng	101
Mega mendung	105
Merak	75
Parang	177

Table 4.1. Image distributions of the Batik Motifs Dataset

Figure 4.3. Examples of geometric Batik images used in this study: (from left to right) Kawung, Ceplok, Lereng and Parang [Kuwandy, 2021]

Figure 4.4. Examples of non-geometric Batik images used in the training phase (from left to right): Ampiek, Mega Mendung, Gurda, and Merak.[Kuwandy, 2021]

might be different from the original picture from the pre-defined motif class. For instance, in terms of non-geometric motifs such as Gurda or Merak, model

Batik Motif Class	Weight
Ampiek	3.58
Ceplok	1.00
Gurda	13.63
Kawung	1.87
Lereng	2.37
Mega mendung	2.28
Merak	16.00
Parang	1.35

Table 4.2. Class weight distribution of the Batik motifs dataset

training is set to focus on recognizing the main figures of the two motifs, as a whole Batik image. Furthermore, geometric Batik motifs such as Kawung and Parang can be augmented by image cropping techniques in order to increase the number of data (see Table 4.3).

Nevertheless, time limitation, the data shortage, and low-quality images often become frequent challenges in image recognition experiments as well. In order to increase the diversity of the training data, data augmentation can be used as another solution after the image slicing operation. The data augmentation is a technique to generate new variations from the existing images without collecting new data samples. This process was specifically conducted for training data whereby the input training images were augmented and transformed randomly in each iteration (see Table 4.5). This operation was facilitated by Tensorflow image data generator to perform image transformation such as rotation, reflection, flipping, decreasing or increasing brightness, and zooming [Tensorflow, 2021], as shown in Figure 4.5. Textile imageries taken in a real-life context, especially the worn fabric, might produce a non-flat image with subtle pictorial differences. This augmentation method is essential to increase the accuracy of training model result when dealing with many kinds of image variations. For the next training and evaluation phases, these images were normalized with a value between 0 – 1. This value is used to indicate image prediction probabilities, which means the similarity score between the input image and eight defined classes.

4.2.2.3   Slicing process

The slicing process was performed by dividing the images into half vertically and horizontally. Subsequently, all original images and the sliced ones were adjusted

into the width x height of 224x224 with 3 RGB colour channels. Therefore, the input image values was set as 224x224x3, in order to be fitted for MobileNetV2 and VGG16 models. As the total number of images for training increased after the slicing process, a total of 4'253 images were gained and distributed into each class, as shown in Table 4.3. The weight of each class is defined in order to weight the loss function during training and to tackle an imbalanced data set. The weight is determined by calculating the average number of images per class divided by the maximum average value. The weight distribution is outlined in Table 4.2.

Batik Motif Class	# of Images
Ampiek	335
Ceplok	1200
Gurda	88
Kawung	640
Lereng	505
Mega mendung	525
Merak	75
Parang	885

Table 4.3. Image distributions of the Batik Motifs Dataset after Data Augmentation

4.2.2.4   Split data

The final step of image pre-processing refers to the data split using the scikit-learn function. The images were mixed and split into 3 data sets: training, validation and test, with the ratio 60%, 20%, and 20% respectively, as shown in Table 4.4.

4.2.3   Batik Recognition Tool (BRT) model structures and experimental settings

The architecture of Batik Recognition Tool was developed through iterative experiments, which consist of defining algorithm learning parameters, structure, drop-out and batch size. The result comparisons between VGG16 and MobileNet2 are also presented as follows.

Type of Data	# of Images
Train	2483
Validation	919
Test	851
Total	**4'253**

Table 4.4. Data set distribution which will be used during train, validation and testing phase of BRT development

Table 4.5. Image augmentation parameters

Transformation	Value
Random rotations	20°
Zoom range	[0.5,1.0]
Width shift range	0.2
Height shift range	0.2
Shear range	0.2
Horizontal flip	True
Fill mode	Nearest

(a)   (b)   (c)
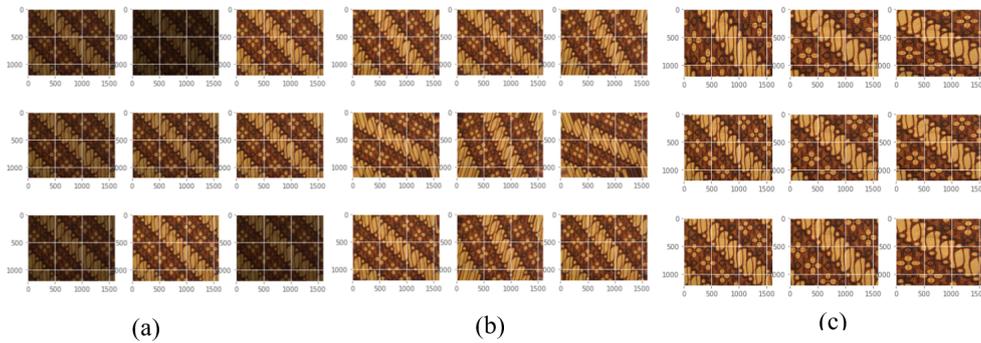
Figure 4.5. Examples of transformation results of Batik images; (a) Brightness (b) Rotation, and (c) Zoom transformation [Kuwandy, 2021]

4.2.3.1   MobileNetV2 model

Choosing the correct learning algorithm is essential for establishing the MobileNetV2 model of BRT. Among deep learning optimizers, the Stochastic Gradient Descent (SGD) optimizer with momentum was used within this model.

Several different values of learning rate and momentum were iteratively defined in order to optimally set the optimizer. Once the learning algorithm was established, the evaluation in respect to accuracy and their total parameters was conducted by adding different numbers of fully-connected layers.

Batch training. In order to improve the accuracy and performance, the hyper parameter of the MobileNetV2 model was set by defining the batch size. Batch size is the number of samples that will be trained and propagated within the built network. The batch training was conducted using 2'483 training images. Due to few data samples for the training process, 3 options of batch size were defined: 16, 32, 64. Due to the small dataset, the highest batch size was set to 64, as it allows each epoch to train 38 batches consecutively (64 images simultaneously per batch). Big number of batch size could not yield maximum performance, as it may reduce the number of images learned by the model in each epoch. Furthermore, early stopping rule was used in order to avoid overfitting. The rule of early stopping is defined as follow:

"When there is a change lesser/greater than (min_delta value) in (monitor) for more than (number of patience) epochs or iterations, it will immediately stop the training process."

Where min_delta value is minimum change in the monitored quantity to qualify as an improvement and number of patience is number of epochs with no improvement after which training will be stopped.

The experiment shows that batch size value of 32 yields the best result with 88.6% of accuracy and takes 2136.518 seconds of training process with early stopping at 70 of 300 epochs (see Table 4.6). As we defined batch size 32 as the core of our MobileNetV2 experiments, the other parameters were set such as the learning rate(0.001), momentum rate (0.9) and one fully connected layer without dropout setting.

Batch size	Accuracy	Epoch	Training Time
16	82.6%	52	1606.273
32	**88.6%**	70	2136.518
64	86.8%	57	1725.506

Table 4.6. Batch size comparison in terms of accuracy and training time

After a series of experiments shown in Table 4.7, the final MobileNetV2 model architecture was built using 1/8 dense layers/units with 70 epochs that yield the highest accuracy of 88.6%. The BRT system applies MobileNetV2 standard architecture, which is composed of one initial fully convolution layer with 32 filters

Conv. Layers	Dense Layers/Units	Total Parameters	Epochs	Accuracy
MobileNetV2	1/8	2,268,232	70	88.6%
MobileNetV2	2/256x8	2,587,976	96	87.5%
MobileNetV2	2/512x8	2,917,960	22	73.2%
MobileNetV2	2/1024x8	3,577,928	36	83.9%
MobileNetV2	3/512x256x8	3,047,240	82	86.6%
MobileNetV2	3/1024x256x8	3,834,184	47	86.3%
MobileNetV2	3/1024x512x8	4,098,632	13	58.4%
MobileNetV2	4/1024x512x256x8	4,227,912	13	86.1%

Table 4.7. The influence of fully-connected layer numbers on the accuracy value of MobileNetV2 model. All experiments were done using batch size of 32 and epochs value of 300 with early stopping rule.

and 19 residual bottleneck layers. In addition to the standard model, Rectified linear unit (ReLU) 6 was applied as the non-linearity function in the experiment as it is considered more robust when combined with low-precision computation [Sandler et al., 2018]. In order to reduce the spatial dimension of a feature map output, the Global Average Pooling (GAP) layer was applied within the final model. To achieve the highest accuracy, one fully connected layer was added along with the 8 units of classification channels (Dense 1), as presented in the Table 4.8 below.

4.2.3.2 VGG16 model

. VGG16 is a CNN architecture-based model, built using the structure network introduced by Simonyan and Zisserman [2014]. This model was proven effective to train 1000 classes and managed to achieve 92.7% top-5 accuracy on the ILSVRC-2012 dataset [Simonyan and Zisserman, 2014]. The base model VGG16

Layer (type)	Output Shape	Activation Function	Parameters
Input	(224,224,3)	-	0
MobileNetV2+ Global Average Pooling	(1280)	-	2257884
Dense 1	(8)	Softmax	10248
Total Parameters			2,268,232

Table 4.8. The final MobileNetV2 model configuration of BRT

consists of input convolutional layers, global average pooling (GAP) layer, and followed by 3 fully-connected layers, characterized by 3 Dense values (see Table 4.9). The first two dense values have each 4096 units and the third contains 8 channels, which are necessary elements to perform 8 classifications. In order to improve the recognition performance of VGG16 [Gultom et al., 2018], an additional dropout was added in between fully-connected layers, shown in Figure 4.6. Dropout facilitates the regularization process within the fully-connected layers, in order to avoid overfitting and random value change of hidden nodes [Srivastava et al., 2014]. Likewise, in MobileNetV2 network architecture, early stopping with the same rule was also performed in VGG16. By doing so, both accuracy and top-3 accuracy values achieve respectively, 87.5% and 99.7% (see Table 4.11). Despite its advantage for image recognition, VGG16 architecture is a large size and requires a lot of resources that might result in poor performance and high costs for real application development.

4.2.4   Final output comparisons: VGG16 and MobileNetV2

4.2.4.1   Confusion matrix and evaluation score

According to Pedregosa et al. [2011], confusion matrix refers to "the diagonal elements that represent the number of points for which the predicted label is equal to the true label, while off-diagonal elements are those that are mislabeled by the classifier". The confusion matrix was evaluated as the outputs of image prediction. This evaluation was conducted in order to assess the quality of both models in training the given data set. The higher the diagonal values of the

Layer (type)	Output Shape	Activation Function	Parameters
Input	(224,224,3)	-	0
VGG16+			
Global Average Pooling	(512)	-	14714688
Dense 1	(4096)	ReLU	2101248
Dense 2	(4096)	ReLU	16781312
Dense 3	(8)	Softmax	32776
Total Parameters			33,630,024

Table 4.9. The final VGG16 model configuration of BRT

confusion matrix the better, indicating many correct predictions. The diagonal values indicate the number of correct predictions that are tested by both models (see Figure 4.7). High recall values in the confusion matrix signifies high system performance in predicting the data set. The precision, recall and f1-score output from the confusion matrix of both models is detailed in Figure 4.7. The evaluation outputs indicate that both models perform well in predicting Mega Mendung, Ampiek, Ceplok, Lereng, Kawung and Parang. On the other hand, both systems show lower accuracy when recognizing Gurda and Merak. This happens due to an imbalanced data set, as the image collections of Gurda (88 images) and Merak (75 images) used in the training are very few in comparison to most of the other motifs (n>100 images). In particular cases, both systems show good results in terms of recognizing Ampiek motifs despite its small data set (67 images) and its non-geometric nature. As seen from the recall value of the confusion matrix (see Figure 4.7), the MobileNetV2 model yields more accurate results in predicting the given classes. The test showed that MobileNetV2 recognized non-geometrical motifs such as Gurda, Merak, and Ampiek, with the score of 0.69, 0.88, and 0.99, respectively, while the latter were 0.50, 0.69, and 0.97. Figure 4.11 shows the final training and validation loss of VGG16 and MobileNetV2.

4.2.4.2 Performance and accuracy

MobileNetV2 is considered the most optimal model for mobile apps as it yields the best result with minimum requirement in terms of saved model size. Other than the difference between training time and the size of the saved model, special attention is given to the values of result accuracy and Top-3 result accuracy values. Table 4.10 indicates that the size of MobileNetV2 saved weights is 17
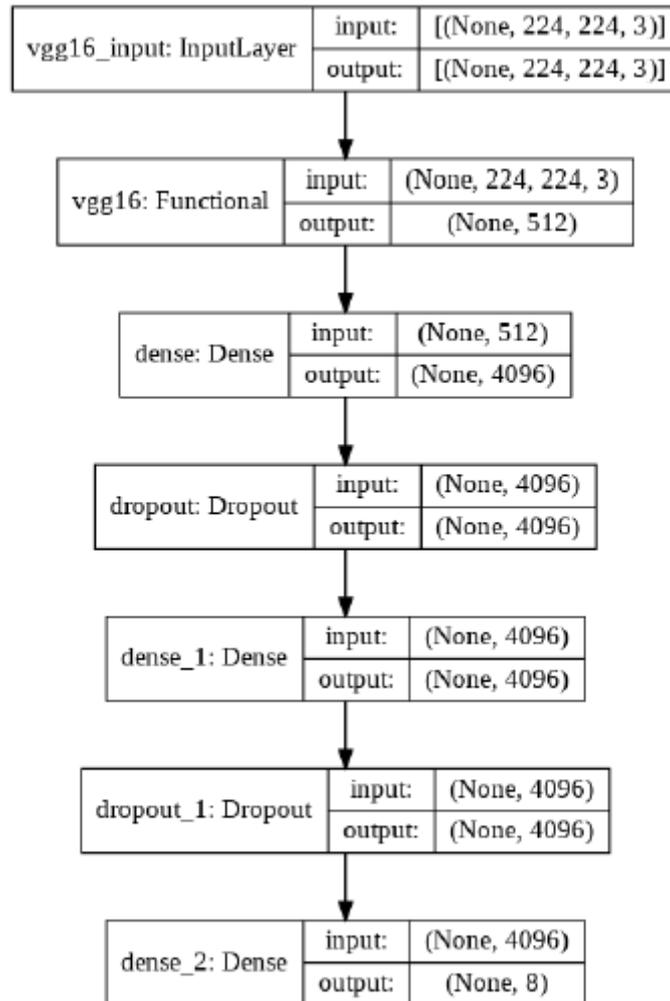
Figure 4.6. VGG16 structure applied in BRT system with 87.5% accuracy result [Kuwandy, 2021]

Mb, while the VGG16 model has much bigger size as 257Mb. indicates that the size of MobileNetV2 saved weights is 17 Mb, while the VGG16 model has much bigger size as 257Mb. MobileNetV2 reaches the highest accuracy of 88.7% with the top-3 accuracy of 99.6%, slightly higher than the latter model that shows 87.5% of accuracy (see Table 4.11).

MobileNetV2   **VGG16**


```
[INFO] evaluating network...                              [INFO] evaluating network...
              precision    recall  f1-score   support                   precision    recall  f1-score   support

      Ceplok       0.91      0.91      0.91       246            Ceplok       0.88      0.89      0.88       246
      Lereng       0.79      0.89      0.84       104            Lereng       0.78      0.86      0.82       104
      Kawung       0.82      0.89      0.86       130            Kawung       0.86      0.91      0.88       130
      Parang       0.92      0.80      0.85       180            Parang       0.87      0.80      0.83       180
 Megamendung       0.99      0.98      0.98        95       Megamendung       0.96      1.00      0.98        95
       Gurda       0.92      0.69      0.79        16             Gurda       0.89      0.50      0.64        16
      Ampiek       0.97      0.92      0.94        64            Ampiek       0.95      0.97      0.96        64
       Merak       0.61      0.88      0.72        16             Merak       0.79      0.69      0.73        16

    accuracy                          0.89       851          accuracy                          0.88       851
   macro avg       0.87      0.87      0.86       851         macro avg       0.87      0.83      0.84       851
weighted avg       0.89      0.89      0.89       851      weighted avg       0.88      0.88      0.87       851
```

Figure 4.7. Precision, Recall, F1-score per class as shown by the MobileNetV2 (left) and VGG16 (right) [Kuwandy, 2021]

Figure 4.8. The RESTful API integrated within Batik Recognition Tool system that runs in the web server. Kuwandy [2021]

Model	Training Time (in seconds)	Saved Model Size	Epoch
MobileNetV2	2136.518	17MB	70
VGG16	3472.21	257MB	83

Table 4.10. Performance comparison of MobileNetV2 and VGG16 models for Batik pattern recognition

Model	MobileNetV2	VGG16
Accuracy	88.7%	87.5%
Top-3 Accuracy	99.6%	99.7%
Weighted Precision	89%	88%
Weighted Recall	89%	88%
Weighted F1	89%	87%
Precision	87%	87%
Recall	87%	83%
F1	86%	84%

Table 4.11. The accuracy comparisons of MobileNetV2 and VGG16 models based on their evaluation

Figure 4.9. Eight predicted Batik images as the results of BRT beta testing, including one prediction mistake (bottom right) [Kuwandy, 2021]

4.2.5 Image prediction beta testing

The performance of both MobileNetV2 and VGG16 models were evaluated by introducing random Batik pictures from the dataset into each system. Figure 4.9

shows the correct prediction generated by the two BRT systems. Each text on top of the image indicates 2 elements, namely prediction result and the actual class (annotated by the domain expert). Both models show satisfying results as most of the Batik images were correctly predicted. Nevertheless, several prediction mistakes were recorded, mainly when it comes to recognising a Batik image that contains an ensemble of many different motifs. One of the prediction errors was Merak motif, as marked in Figure 4.9. The system falsely recognized it as Ceplok, which refers to a motif with geometrical circular shapes, while in fact, the main visual element within the Batik image depicts Merak motif, the symbol of peacock.

4.2.6 Integration of BRT into mobile app system

From the above analysis, the result shows that MobileNetV2 has more practical benefits to be integrated into mobile applications. From the evaluation activity of the machine learning system, the study observes that despite its small saved model size, MobileNetV2 model achieves a higher accuracy in terms of predicting Batik images than VGG16. However, VGG16 model is set as a baseline model of MobileNetV2 model for BRT. As the two models work to achieve the correct pattern recognition, the combination of both systems allows technology designers to explore and compare their performances.
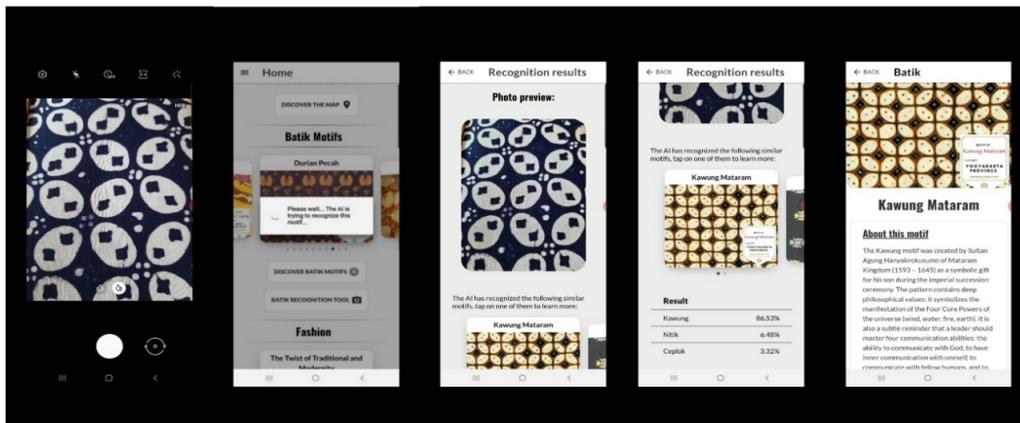
Figure 4.10. Integration of BRT within iWareBatik Mobile Application [iWare-Batik, 2020a,b]

4.2.6.1   RESTful API and iWareBatik app integration

The Batik Recognition Tool (BRT) system was equipped with RESTful Application Programming Interface (API) software architecture, integrated within a web server. Built using the Representational state transfer (REST), RESTful API combines a stateless-client-server architecture with related components and constraints that is able to streamline the communication with some particular protocols such as HTTP, FTP, Gopher or WAIS [Rodríguez et al., 2016].

A micro web framework written in Python called Flask is used to facilitate the BRT training model. The advantage to use REST API in BRT system lies on its ease of use, especially in terms of the initial development of the system. Consequently, the model must be updated and monitored in order to improve the accuracy. On the other hand, embedded model option was not chosen as it is considered hard during testing phase. The trained model of MobileNetV2 facilitates the RESTful API system of BRT to be integrated within the iWareBatik mobile application (see Figure 4.8). At the testing phase, the model is iteratively tested in many trial sequences, in order to fully recognize the images based on the given classes of Batik motifs [Kuwandy, 2021]. The connection of BRT within the iWareBatik app is facilitated by an HTTP request to the BRT model. As a result, the user is able to use the BRT feature of the app, which functions with the phone camera. The architecture of the mobile app is designed in such a way to pass on the imagery information captured from the app to be recognized by the BRT system. The smooth integration of AI model and web server allows iWareBatik app users to access the BRT from their mobile phone.

In order to avoid any confusion, the BRT feature only provides the top-3 predictions of image input, referring to the closest pattern among the 8 Batik motif classes. Considering the limitation of the model, the chance of the system to give the correct answer is still relatively high. The prediction results are converted from decimal format to percentage format. When the system is tested with real Batik images, which were used during the training stage, the system does not provide 100% accuracy of prediction value, instead, it provides 80 to 96%, indicating the maximum accuracy value reached by the two BRT models.

4.2.6.2   BRT – iWareBatik app front-end development

Before the result is displayed to the iWareBatik app interface, through the RESTful API, the app system retrieves information about the detected motif, such as the slug, url, title of the Batik information, etc. When the BRT system processes the image prediction for some seconds, the loading message is shown through the
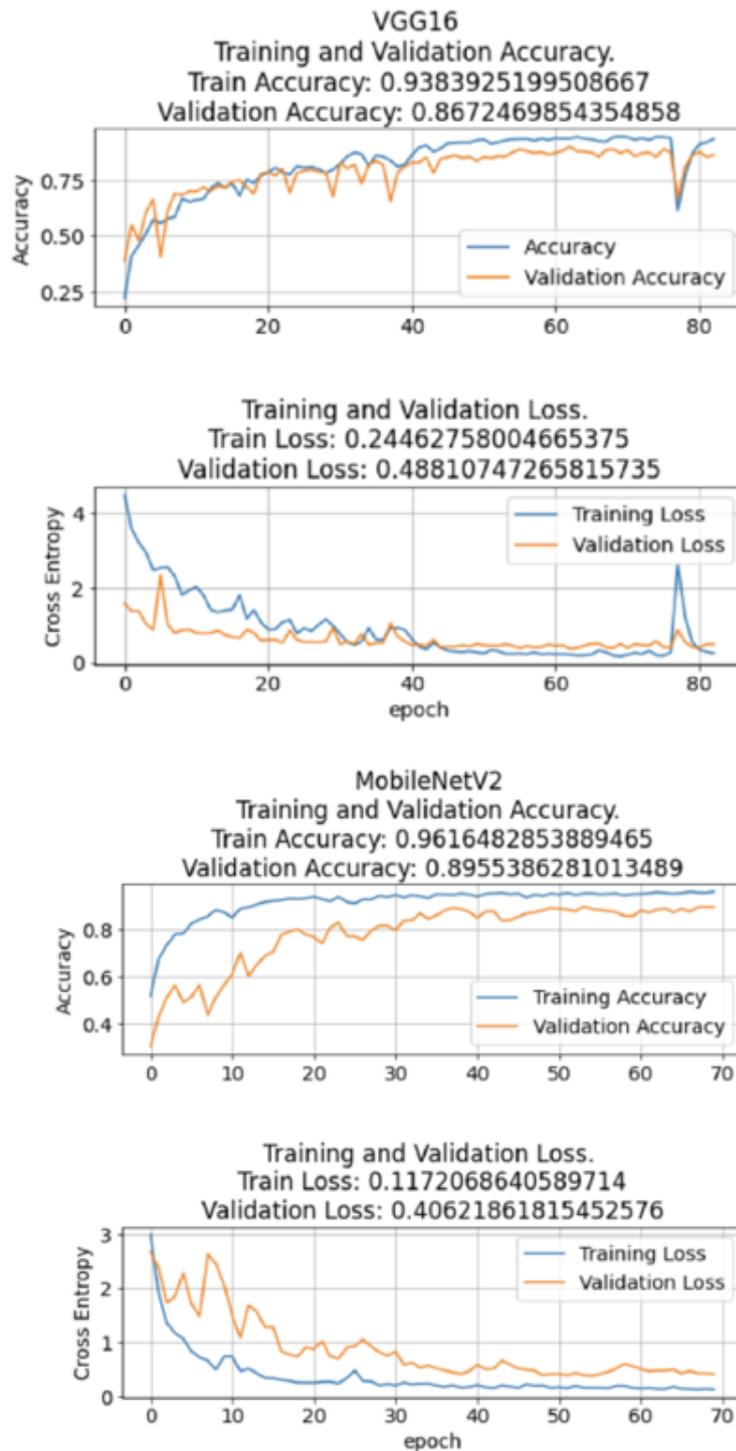
Figure 4.11. The final training and validation loss of VGG16 (above) and MobileNetV2 (below) [Kuwandy, 2021].

app front-end interface, indicating users to wait for the results (see Figure 4.10).
At this stage, the RESTful API controllers calculate the similarity of the visual
input according to the saved weights embedded within the machine learning
system.

The BRT system generates a query of Batik motif names, as the result of BRT
prediction. In order to obtain more information about the motif, the app pro-
cesses the name of the Batik motif as the result of BRT prediction based on the
slug key registered in the data.json file. The iWareBatik app back-end API system
processes the data.json file and subsequently stores them within the RESTful API
system. Once all stages are completely done, the top-3 predictions, their degree
of similarity (in percentage), along with their related information are shown to
the front-end system of the iWareBatik app (see Figure 4.10).

Six months after the launching of the app, the study registered relatively
active use of the BRT system and counted 513 images uploaded by BRT users.
Since the system adopts a closed prediction system, which depends on the given
eight Batik motifs dataset, it forces a prediction of every image, even if they
are not of a Batik textile, or do not depict any of the eight recognized motifs.
Our observation found that some images collected from the users were correctly
predicted by the BRT system, even though the image has been captured from the
textile or another media (e.g: a Mega Mendung pattern on a laptop surface).
While there were also several error predictions, for example, images presenting
non-batik images were still predicted by the BRT as Ceplok and Mega Mendung.

4.3   Conclusion and future works

Successful machine learning for pattern recognition requires several aspects to
consider, such as the saved model size, batch size, learning rate and the num-
ber of the samples. Finding the fittest model architecture for Batik Recognition
Tool was a challenging task, as the process to obtain optimal hyper parameters
requires iterative fine-tuning through a series of experiments. MobileNetV2 and
VGG16 architecture have come up with promising outputs in terms of prediction
accuracy, yet the only obvious difference is the saved model size.

Between the two models, the study observed that MobileNetV2 is the fittest
model for building BRT systems. MobileNetV2 achieves 88.6% of accuracy com-
pared to VGG16 that obtained 87.5%. In addition to this great performance,
its saved model size is small and does not require major resources, making the
training time faster than VGG16 (see Table 4.10). From the experiments, the
study noted that the successful architecture of BRT was generated from opti-

mizing the standard network architecture of CNNs framework. No additional fully-connected layers are needed as it does not improve the accuracy and also significantly increases the size of the parameter model. While the BRT system has succeeded in predicting and classifying 8 Batik motifs, the current system is still developed based on a closed classification framework. Thus, the system has not been set to differentiate the non-batik motifs uploaded by the users. The closed classification system of BRT processes any images input by the users and assigns the prediction based on the given class. In addition, inadequate size of the original data set affects the accuracy of each class, even though a series of data augmentation activities were conducted prior to the training phase.

MobileNetV2 and VGG16 architecture have come up with promising outputs in terms of prediction accuracy, yet the only obvious difference is the saved model size. Between the two models, the study observed that MobileNetV2 is the fittest model for building BRT systems. MobileNetV2 achieves 88.6% of accuracy compared to VGG16 that obtained 87.5%. In addition to this great performance, its saved model size is small and does not require major resources, making the image processing time faster than VGG16.

From the experiments, the study noted that the successful architecture of BRT was generated from optimizing the standard model of CNNs framework. No additional fully-connected layers are needed as it does not improve the accuracy and also significantly increases the size of the parameter model. While the BRT system has succeeded in predicting and classifying 8 Batik motifs, the current system is still developed based on a closed classification framework. Thus, the system has not been set to differentiate the non-batik motifs uploaded by the users. The closed classification system of BRT processes any images input by the users and assigns the prediction based on the given class.

In addition, inadequate size of the original data set affects the accuracy of each class, even though a series of data augmentation activities were conducted prior to the training phase. One of the biggest challenges in the study is the pattern variance and small data set for certain motifs. For instance, due to pattern variance and small data set, the BRT system receives many distortions in recognizing the Gurda and Merak motifs (non-geometric patterns), which results in relatively low accuracy compared to the other classes.

One of the biggest challenges in the study is the pattern variance and small data set for certain motifs. For instance, due to pattern variance and small data set, the BRT system receives many distortions in recognizing the Gurda and Merak motifs (non-geometric patterns), which results in relatively low accuracy compared to the other classes. This research has addressed the found research gap, about applying AI to Batik motifs recognition and integrating such recog-

nition within a mobile app. By doing so, it offers a first step towards a wise orchestration of digital technologies in order to support ICH preservation and communication. In particular, it offers a tool able to address most of the layers outlined by the ABCDE framework, in particular providing high quality information about Batik textile heritage, just-in-time and just-in-place enriched experience of persons exposed to Batik items, and a way to strengthen the relationships between the three main heritage players: locals, visitors and the heritage itself. This study can be improved by exploring other AI models or techniques that can be used to recognize Batik or other textile motifs. Pattern recognition tools might be improved by exploring the possibility to modify the classification problem to an open-classification, so that the model can distinguish the non-Batik images. Apart from that, the model can be improved by increasing the number of data and its variations. Since BRT still depends on the RESTful API that uses the internet to empower the BRT system, it is possible to develop an embedded model of BRT system within the mobile app. In this way, the embedded BRT model can allow users to use the feature without internet connection. Moreover, further research is needed in order to assess the actual usages of the BRT by users of the iWareBatik app, and their satisfaction with this tool.

Chapter 5

Evaluation of iWareBatik Digital Technologies

This chapter presents the design and organization of usability evaluation of iWareBatik, while fostering citizen engagement through providing learning experiences for 997 bachelor participants from 33 Indonesian universities nationwide. This research activity was conducted based on Online Communication Model (OCM) [Cantoni and Tardini, 2006] and AWARe model [Bolchini, 2003].

Permatasari, P. A., Ningrum, F. U, Uriawan, W., and Cantoni, L. More Than Words: Evaluating iWareBatik Digital Technologies in the Perspective of Heritage Tourism. Submitted to a journal in February 2022

5.1   More Than Words: Evaluating iWareBatik Digital Technologies in the Perspective of Heritage Tourism

ABSTRACT[1]. iWareBatik are two digital tools – a website and a mobile app – designed and developed to communicate the value of Indonesian Batik textile heritage, which has been inscribed by UNESCO among intangible cultural heritage in 2009. Such tools have been evaluated through a panel of 997 bachelor students recruited in 33 Indonesian universities. They have been involved in a process that encompassed user testing activities, filling in a survey related to them, participating in a focus group, and writing a short essay. 156 of them later on took part in hackathon type of competition, aimed at suggesting possible improvements to the iWareBatik set of tools. This paper outlines the overall design of the evaluation activities, and presents in detail the results of the user testing and the related survey, highlighting positive elements and dimensions to be improved. Such evaluation exercise is not only for the set of digital tools at stake, but can provide a relevant model for all those projects aiming at using digital media in the field of intangible cultural heritage, helping to fill-in the gap between design and development on the one side and evaluation on the other side.

Keywords: Intangible Cultural Heritage, Information Communication Technology, new media, documentation, safeguarding, user experience

5.2   Introduction

Tourism and ICH valorisation incite new opportunities for the creative industry to flourish and provide opportunities for locals to foster their socio-economic development [Tan et al., 2020; UNWTO, 2020]. As one of the top 5 main contributors to the GDP, Indonesian Batik as a UNESCO intangible cultural heritage (ICH) since 2009 has been a major case study in the context of Indonesian creative economy, especially in promoting rural tourism [MTEC, 2021b].

Despite positive growth derived from the Batik textile valorisation, there is an increasing concern on how to balance between the economic goals to sustain with the education to strengthen the safeguarding practice. This paper presents the evaluation of the iWareBatik digital platforms in order to measure the user experience (UX) of Information Communication Technology (ICT) in the framework of heritage safeguarding and tourism education. A series of UX work-

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shops were conducted by involving 997 bachelor students and 50 lecturers in collaboration with 33 higher education institutions, including tourism schools, in 15 Indonesian regions nationwide. This activity aims to evaluate user experience and satisfaction upon iWareBatik digital platforms and assess to which extent the users would advocate and adopt iWareBatik in their cultural/educational activities. iWareBatik was developed based on the Online Communication Model (OCM) and Analysis Web App Requirement (AWARe) model [Permatasari and Cantoni, 2021] as a digital solution to facilitate knowledge sharing and cultural dissemination of Indonesian textile heritage. This digital solution aims to facilitate knowledge sharing and provide users new experience to better understand the exceptional cultural values of Indonesian Batik textile heritage. iWareBatik is presented in the form of a website www.iwarebatik.org and a mobile app [iWareBatik, 2020a,b], available in Android and iOs platforms. In addition to bilingual features (English and Bahasa Indonesia), iWareBatik offers eight interactive audiovisual features such as the contents covering philosophical meanings of 124 Indonesian Batik motifs, 129 natural/cultural tourism and UNESCO sites in 34 regions nationwide, interactive maps, spinning wheel to access a random region, 1-minute videos, Batik evolution timeline, and an Artificial Intelligence(AI)-powered Batik recognition tool that helps users recognize Batik patterns according to 8 motif classes (see Figure 5.1).
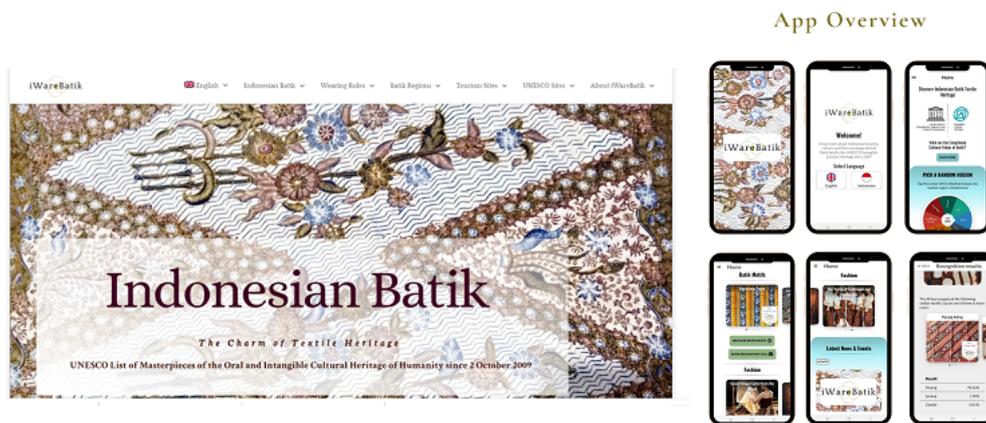
Figure 5.1. iWareBatik website [www.iwarebatik.org] and iWareBatik mobile app

Evaluation serves as an essential step to analyze the effectiveness of the digital solution in its context of use and whether it complies with communication objectives defined in the first place [Sein et al., 2011]. From its launching day on August 17th, 2020 until February 28th, 2022, iWareBatik gained 104'787 visitors

on the website and 3'433 downloads. After a period of its adoption, conducting a usability evaluation activity is a relevant phase in order to collect users' feedback, foster iterative learning, and improve the technology innovation [Mullarkey and Hevner, 2019; Rytilahti et al., 2015].

In combination with the OCM and AWARe models, service design research [Rytilahti et al., 2015] serves as the supporting framework to support UX evaluation exercise which is connected with educational activities and community engagement. In this regard, the conducted evaluation activities provided new learning experiences for locals, at the same time, attracts users to participate in Batik heritage safeguarding missions and harness strong connections between heritage practitioners, educational institutions, and students. This paper addresses the questions: (a) how the user testing has been designed, (b) what are the methods used for measuring user satisfaction? and (c) what are the results of the evaluation activities conducted in forms of survey, focus group discussion, and essays? (d) to what extent does iWareBatik help users to accomplish their goals based on given user scenarios and tasks? This evaluation study also identifies technology anxiety as important feedback for iWareBatik's future improvement.

5.3   Literature review

5.3.1   Digital technologies and ICH education in Indonesia

Indonesia, located in Southeast Asia, is known for the variety of its textile heritage spread in 34 regions nationwide. Among seven types of textile heritage, Indonesian Batik and Papuan Noken, have been inscribed as a UNESCO ICH of Humanity respectively since 2009 [UNESCO, 2009b] and 2012 [UNESCO, 2012]. The country's active role in fostering heritage valorisation through various educational collaboration has been recognized by UNESCO's 'Register of Good Safeguarding Practices' [UNESCO, 2009a]. Along with the growing community-based tourism in the early 2000, the role of higher education institutions is increasing, especially in enhancing community capacity in social, cultural and economic fields [Asmaniati et al., 2017].

Indonesia gradually shifted as digital society as the rising internet users reached 202.6 million or 73.7% Indonesian population [Kemp, 2021]. The extensive public policy on digitalization led to the creation of more than 300 digital innovations dedicated to UNESCO's heritage properties nationwide [Permatasari et al., 2020]. Starting from 2013, all levels of Indonesian education institutions have

begun to massively adopt educational technologies to support their missions [Republika, 2021]. Given this conducive technology environment, ICT development for specific education purposes creates favourable support system in addressing social necessities and widening learning opportunities for students within the framework of sustainable tourism [Winston, 2002; Cantoni and Tardini, 2006].

5.3.2   New media as eLearning for ICH and heritage

New Media refers to the development of information technologies, where computational elements (hardware and software) are designed and implemented by taking into account human interface designs into digital presentations in order to showcase and communicate diverse formats of messages (audio, visual, and textual) [Cantoni and Tardini, 2006; Etike, 2021]. eLearning is the use of new media and digital technologies that facilitate knowledge transfer and other formal and informal educational related activities [Cantoni and Kalbaska, 2010]. The roles of ICT in ICH and tourism can be singled out in five major areas [Cantoni, 2018] such as 'access' and 'better experience' in the learning experience for locals and visitors, 'connects' locals and visitors with the insights of ICH and its practitioners, '(dis)-intermediates' or provides a shortcut for learners upon the long process of obtaining valid information on heritage through access to digital database, and 'educates' and upskill professionals involved within the ICH and its related sectors. In terms of building ICT for ICH safeguarding, a first perspective was limited to only digitizing ICH knowledge by the use of audio and video recordings as documentation instruments [Robbins, 2010]. Designing this digital artefact encompasses other interactive elements of technologies. For example, the interplay of audiovisual and gamification reinforces critical thinking and increases student engagement through interactive and playful design elements to communicate a serious topic or non-game contexts [Rante et al., 2016; Adukaite and Cantoni, 2016; Tresnadi and Sachari, 2015], and thus increase willingness to learn through the support of mobile devices [Oyelere et al., 2018]. In addition, Selmanovic [2020] affirms that validity, inclusivity, representativity, temporality, sensitivity, and community, as well as textual and visual information [Heo, 2007] increases user-friendliness and interactivity. UX evaluation workshops implemented in secondary education could be used as an educational activity. This method has been proven effective since the engaged students are more equipped to provide constructive feedback, while developing their critical thinking on the addressed issues [Adukaite and Cantoni, 2016].

5.3.3   Usability and user experience evaluation of ICT for ICH

According to Horton [2001, p.111], 'Successful projects tend to be ones that consider evaluation from the start, not just in hindsight'. The definition of usability is specified as follows: 'the extent to which a system, product or service can be used (i) by specified users to achieve (ii) specified goals with (iii) effectiveness, (iv) efficiency and (v) satisfaction in a (vi) specified context of use' [ISO9241, 2018]. In this regard, satisfaction is a variable indicating users' positive emotions as a result of using a digital technology to accomplish certain task [Hartson and Pyla, 2012]. The communication quality and the design elements of digital artefacts are essential to determine users' satisfaction and the effectiveness of these tools in addressing users' needs based on specific user scenarios [Bolchini, 2003], while taking into consideration persuasive effects of the technology that successfully evoke a positive experience in users [Fogg, 2002]. The design of this evaluation study takes into account four elements of OCM theory namely, (i) contents and functionalities, (ii) technical instruments and user interface, (iii) producers, managers, and owners, (iv) and users (see Figure 5.2). Furthermore, evaluation criteria drawn from the triangulation of AWARe model and user requirement elicitation (URE) conducted in 2020 [Permatasari and Cantoni, 2021], illustrating soft goals that refer to users' general expectations when accessing the tools.

Inspired from previous works conducted on evaluation design of cultural heritage web apps [Inversini and Cantoni, 2009; Widiaty et al., 2018; Adukaite and Cantoni, 2016], this study provides an example of UX evaluation that adopts mixed method using survey and Nvivo text query analysis. The survey uses evaluation variables based on the OCM and AWARe model, such as Ease of Navigation (EoN), Content Conciseness (CC), Visual Design (VD), and Satisfaction (S). On the other hand, soft goals drawn from iWareBatik URE studies [Permatasari and Cantoni, 2021] serve as an evaluation instrument to analyse the individual essays and FGD excerpts such as awareness, effectiveness, learnability, and motivation (see Table 5.1).

5.3.4   Defining user scenarios

This evaluation study uses user scenarios and tasks drawn from previous iWare-Batik URE study [Permatasari and Cantoni, 2021]. During the recovery period of the Covid19 pandemic where this UX study was executed, international tourism activities were limited due to social restrictions in many impacted countries, including Indonesia [WHO, 2020; MoFA, 2021]. In order to evaluate the use of
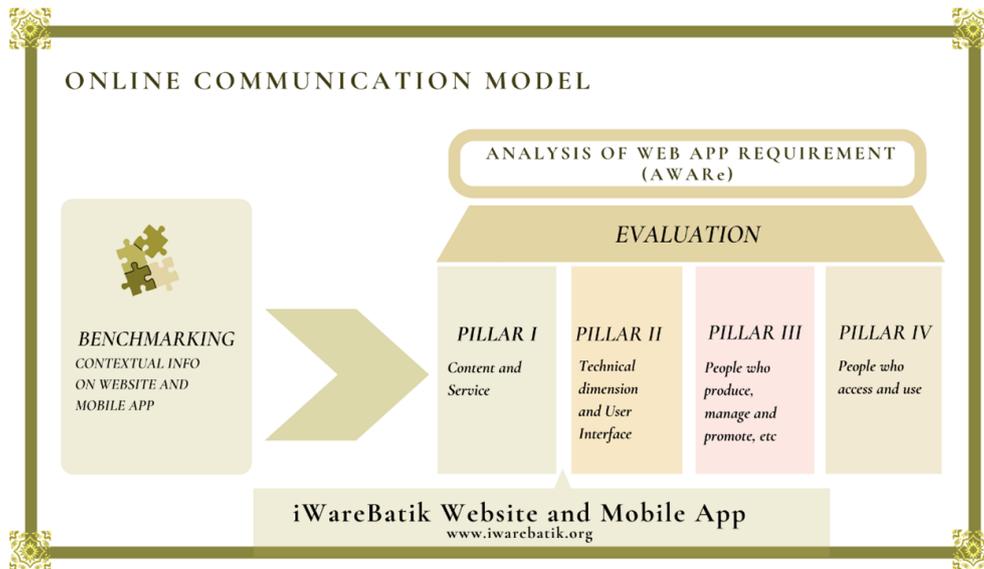
Figure 5.2. Theoretical frameworks of iWareBatik evaluation [Cantoni and Tardini, 2006; Bolchini, 2003]

Dimension based on AWARe Model	Soft goals dimensions of iWareBatik URE studies
Ease of Navigation (EoN)	Awareness
Content Conciseness (CC)	Effectiveness
Visual Design (VD)	Learnability
Satisfaction (S)	Motivation

Table 5.1. Evaluation dimensions drawn from by AWARe model [Bolchini, 2003] and the previous iWareBatik URE studies [Permatasari and Cantoni, 2021]

iWareBatik to revive domestic heritage tourism, two user scenarios were defined: Indonesian Tour Guide as Scenario 1 and Indonesian Tourist as Scenario 2, illustrated as follows:

User Scenario 1. Andi is an Indonesian tour guide who works in the South Sulawesi region. He is aware that South Sulawesi is known for its historical woven textile and Batik. He would like to create a cultural tourism experience offer for the local and international tourists whose goals are to discover the places related to the production of woven textile and its Batik motifs. He wants to search for some information through the iWareBatik website. He finds that iWareBatik provides a short history about this textile heritage and the meaning of each motif. Those are valuable materials for him to prepare a narrative storytelling for his clients during the visit. When browsing the iWareBatik website, he gets some

ideas to bring the tourists to the local Batik workshops and other nearby attractive destinations. He is inspired by artificial intelligence technology to recognize the Batik motif within the iWareBatik mobile app. He wants to integrate this new experience in his offer in order to create a better experience for his clients in learning Indonesian textile heritage.

User Scenario 2. Martha is an Indonesian travel blogger. She is fond of collecting traditional fabrics from various cities in Indonesia and writing her experiences on her travel blog. She always discovers the textile production workshops at the destination and visits the cultural villages. She loves buying gifts for her friends and family. Before travelling, she would like to search for some ideas, things to do, and what kind of textiles to buy at the destination. She opens the iWareBatik website and looks for the North Sumatra region. On the North Sumatra page, she watches the one-minute video. It inspires her to spot some of the most attractive destinations in the region and meaningful Batik or other textile heritage to collect. She also learns that the iWareBatik mobile application can be used to recognize the Batik motif she buys. As she likes to interact with youth communities in the cultural villages, she wants to use the offline mode of the iWareBatik app in order to do a storytelling session for children in rural areas about the diversity of Indonesian textile culture.

5.4   Methodology

5.4.1   Survey-based user experience evaluation

Introduction of the UX workshop. From August 12th to September 25th, 2021, 17 batches of online UX workshops were conducted using the Zoom virtual meeting platform. The UX activity consisted of an introductory presentation, filling out an online survey, a focus group discussion (FGD), and writing an essay addressing specific questions. The online survey is chosen for its convenient factors related to the evaluators (time frame, budget, and technological expertise) [Ritter and Sue, 2007].

Participants demography. The user experience activity involved 997 bachelor students in collaboration with 33 higher education institutions: nine tourism higher education institutions, 23 public universities, one polytechnic institution. The geographical origin of the participating institutions covers 15 out of 34 regions, located in 8 big islands that spread across the western, central, and eastern parts of Indonesia. The 15 regions are Bali, Java island (Banten, Central Java, East Java, Jakarta, West Java, Yogyakarta), West Kalimantan, North Maluku,

Papua, Sulawesi (South Sulawesi and Southeast Sulawesi), and Sumatra Island (Aceh, North Sumatra, and Riau). As a follow up activity, 156 best essays were chosen, whose authors were invited as student delegates to represent respective universities/institutes to participate in the iWareBatik International Hackathon on October 15th and 29th, 2021.

Ethical consideration. This research activity obtained institutional approval from all 33 participating universities in terms of ethical consideration. In addition, during the UX workshops, the participants were requested to complete the presence sheet and UX participation agreement form prior to the main session.

User scenarios and tasks exercise. Each UX session was split into several breakout rooms with a maximum of 15 participants. The participants of the same university were gathered in the same breakout room to join in individual survey session as the first UX workshop for 40 minutes. Each participant was invited to choose one of the two scenario online survey links until the number of participants on each scenario in each breakout room was balanced. By following through the user scenario outlined in each survey link, the participant was directed to individually execute a total of 27 tasks, comprising 16 tasks on evaluating the iWareBatik website and 11 tasks on the iWareBatik mobile app based on four evaluation dimensions, such as satisfaction (S), ease of navigation (EoN), visual design (VD), and content conciseness (CC). Each evaluation question was measured by Likert scale that consisted of 4 scales(1 = bad, 2 = fair, 3= good, 4 = very good). The 27 user tasks online survey are detailed in Figure 5.3 and Figure 5.4. Upon the completion of 17 UX workshop batches, the two online surveys received a total of 926 responses from 997 participants. After data clearance, 797 valid responses were obtained, consisting of respectively 403 and 394 for Scenario 1 and 2.

Additional survey questions. In addition to 27 tasks, the survey includes five multiple-choice questions concerning most favorite features on iWareBatik website and mobile app, users' perceptions on iWareBatik technology features and functionalities, and users' likelihood to recommend the use of iWareBatik on both website and mobile app. The survey on users' likelihood of recommending iWareBatik used Net Promoter Score (NPS), which distinguishes the responses into three categories, namely 'promoters' (9-10 scale), 'passive or moderate promoters' (7-8 scale), and 'detractor' (0-6 scale).

5.4.2   Focus group discussion (FGD)

After the individual survey session, a 40-minutes guided FGD was conducted within the breakout rooms as the second session. The UX facilitator supervised

No	Individual Essay	FGD
1	What are the three advantages of iWareBatik digital technologies to develop sustainable cultural tourism in Indonesia?	What is your general opinion after using iWareBatik?
2	How iWareBatik could be used to help learners to understand the Batik intangible cultural heritage?	Is iWareBatik useful in helping you to complete your mission in the scenario? If yes, what are the advantages of iWareBatik in accomplishing those missions?
3	How could iWareBatik promote rural tourism and support the creative industry in the region?	Did you encounter any problems while using iWareBatik? Which aspects need to be improved in order to better help you in the mission?
4	How could iWareBatik help attract learners and improve the capacity of professionals within the Batik ICH sector?.	

Table 5.2. List of questions distributed during UX workshops

the session and distributed a module containing three questions that serve as the reference during the FGD (see Table 5.2). All participants in the group were requested to provide a brief verbal explanation based on their experience executing the chosen scenario (each of scenario 1 and 2). Two student volunteers were assigned as a moderator and a note-taker. The moderator led the discussion according to the flow indicated in FGD module, while the note taker wrote the verbal answers of the participants in the breakout room.

5.4.3   Individual essay.

As for the final task, the participants were requested to submit an individual essay of max 500 words about their personal reflections. The essay shall be written by addressing to four questions (see Table 5.2) and submitted within 24 hours upon the completion of the UX workshop A total of 79 FGD documents and 628 student essays in Indonesian language were collected and translated into English using Google Translate platform. The translated versions of all documents were analyzed using NVivo text query analysis.

5.4.4   Textual data analysis

Text mining and word count in NVivo are useful methods in mapping the most frequent topics [2021]. Multiple text query iterations were conducted until saturation was reached using keywords associated with the evaluation parameters and variables (see Table 5.3). Each inference from the text query outcomes was further reexamined iteratively to ensure the validity of the results.

Task Theme (SCE1/SCE2)	Description	User Tasks (SCE1/SCE2)	Scenario 1 (Tour Guide) Min. 1.00 - Maximum 4.00				Scenario 2 (Tourist) Min. 1.00 - Maximum 4.00			
			Satisfaction (S)	Ease of navigation (EoN)	Visual Design (VD)	Content Conciseness (CC)	Satisfaction (S)	Ease of navigation (EoN)	Visual Design (VD)	Content Conciseness (CC)
Objective 1. Batik Info as ICH	General Goal (GG): Get an idea about Indonesian Batik	Task 1. Discover the universal values of Indonesian Batik as a UNESCO intangible cultural heritage in the web	3.43	3.31	3.44	3.44	3.40	3.24	3.49	3.41
		Task 2. Find the history of Indonesian Batik in the web	3.44	3.32	3.43	3.44	3.42	3.34	3.43	3.48
	Specific Goal (SG): Get an idea about Indonesian Batik	Task 17. Find out the universal value of Batik in the iWareBatik application	3.40	3.37	3.42	3.43	3.35	3.32	3.38	3.45
	GG: Explore the map	Task 3. Explore the interactive map of the iWareBatik website and discover the province of South Sulawesi (SCE1)/North Sumatra (SCE2)	3.35	3.32	3.45	3.46	3.43	3.32	3.48	3.46
		Task 18. Explore interactive maps in the iWareBatik application and discover South Sulawesi (SCE1)/North Sumatra (SCE2)	3.43	3.41	3.48	3.50	3.44	3.42	3.41	3.46
Objective 2. Obtain Batik-related knowledge		Task 19. Explore Batik motifs on the South Sulawesi (SCE1)/North Sumatra (SCE2) page in the app	3.45	3.43	3.49	3.50	3.46	3.45	3.47	3.50
		Task 4. Find information about Batik in South Sulawesi (SCE1)/North Sumatra (SCE2) in the web	3.38	3.36	3.48	3.43	3.42	3.34	3.43	3.45
	SG (1): Get an idea of all batik motifs in a region	Task 5. See how to produce Batik in South Sulawesi (SCE1)/North Sumatra (SCE2) in the web	3.30	3.27	3.40	3.43	3.31	3.33	3.37	3.35
	SG(2): Collect textual and visual data about Batik motifs	Task 6. Find the meaning of Batik motifs/traditional fabrics in South Sulawesi (SCE1)/North Sumatra (SCE2) in the web	3.43	3.37	3.42	3.46	3.45	3.40	3.42	3.51
		Task 7. Find out how to preserve traditional Batik/cloth motifs in the web	3.24	3.25	3.34	3.37	3.31	3.27	3.36	3.38
		Task 8. Find a village of Batik/traditional cloth in South Sulawesi (SCE1)/North Sumatra (SCE2) and see the address in the web	3.36	3.33	3.36	3.42	3.36	3.32	3.39	3.43

Legends:

Red Bad	Orange Fair	Yellow Good	Green Very Good
n ≤ 2.30	2.31-3.30	3.31 – 3.44	3.45 – 4.00

Figure 5.3. The detail of 27 user tasks (Objective 1 and 2) online survey to evaluate iWareBatik website and mobile app

Task Theme (SCE1/SCE2)	Description	User Tasks (SCE1/SCE2)	Scenario 1 (Tour Guide) Min. 1.00 - Maximum 4.00				Scenario 2 (Tourist) Min. 1.00 - Maximum 4.00			
			Satisfaction (S)	Ease of navigation (EoN)	Visual Design (VD)	Content Conciseness (CC)	Satisfaction (S)	Ease of navigation (EoN)	Visual Design (VD)	Content Conciseness (CC)
Objective 3. Obtain destination-related information	GG: Get an idea of tourist destinations in a region	Task 9. Watch a 1 minute video about the destination of South Sulawesi (SCE1)/North Sumatra (SCE2) in the web	3.40	3.36	3.46	3.43	3.42	3.40	3.41	3.46
		Task 10. Explore one of the tourism attractions in South Sulawesi (SCE1)/North Sumatra (SCE2) in the web	3.34	3.29	3.41	3.46	3.37	3.33	3.41	3.42
		Task 20. Open one of the destinations on the South Sulawesi (SCE1)/North Sumatra (SCE2) in the app	3.46	3.44	3.48	3.52	3.44	3.42	3.41	3.46
	SG: Collect textual and visual data about Indonesian destinations	Task 11. Watch a video of one of the tourist attractions in South Sulawesi (SCE1)/North Sumatra (SCE2) in the web	3.30	3.25	3.40	3.37	3.29	3.26	3.36	3.37
		Task 12. Concerning Indonesian Tourism, explore Cultural Village destinations in Indonesia in the web	3.43	3.35	3.43	3.45	3.38	3.35	3.42	3.44
		Task 13. Find out one of the UNESCO sites in Indonesia in the web	3.38	3.33	3.41	3.45	3.40	3.32	3.40	3.44
		Task 21. Explore the spinning wheel on the iWareBatik application to explore random provinces	3.48	3.47	3.47	3.51	3.46	3.47	3.50	3.49
		Task 22. Search for religious site tourism destinations on the application	3.37	3.29	3.43	3.44	3.37	3.33	3.36	3.40
		Task 23. About Batik in general, find Batik motifs with certain themes in the app	3.37	3.29	3.43	3.44	3.38	3.36	3.40	3.44
Objective 4. Obtain thematic information	GG: Get to know Indonesian Batik for certain categories	Task 14. About Batik in general, find Batik motifs with leadership themes in the web	3.30	3.20	3.38	3.36	3.35	3.28	3.39	3.42
		Task 15. About Batik in general, find Batik in the category of coastal motifs in the web	3.37	3.31	3.41	3.43	3.39	3.30	3.44	3.46
	SG: Discover Batik in certain meanings and special occasion	Task 16. About Batik in general, find out how to use Batik for formal events in the web	3.41	3.36	3.45	3.45	3.36	3.31	3.35	3.41
		Task 24. Take photos using the Batik Motif Recognition Camera (objects can be Batik cloth, selfies, etc.)	3.32	3.35	3.42	3.40	3.33	3.36	3.37	3.40
Objective 5. Accessibility	Offline	Task 25. Change the mobile app into offline mode	3.36	3.36	-	-	3.34	3.37	-	-
	Language	Task 26. Please change the language into English or Bahasa Indonesia	3.54	3.55	-	-	3.56	3.57	-	-
		Task 27. Quality of written language for English and Bahasa Indonesia	3.51	-	-	3.54	3.52	-	-	3.55

Legends:

Red Bad	Orange Fair	Yellow Good	Green Very Good
n ≤ 2.30	2.31-3.30	3.31 – 3.44	3.45 – 4.00

Figure 5.4. The detail of 27 user tasks (Objective 3, 4, and 5) online survey to evaluate iWareBatik website and mobile app

No.	Evaluation Parameters	Evaluation Variables
1.	Access to heritage quality information: a sense of belonging and awareness towards Batik textile heritage	Awareness Effectiveness
2.	Role of education on ICH: stakeholders empowerment through shared meanings and cultural representation	Learnability Motivation

Table 5.3. Evaluation parameters and variables used for NVivo text query analysis

5.5   Results

5.5.1   Evaluation survey analysis

Participants.   The survey received 403 responses for scenarios 1 and 394 responses for scenario 2. From the 797 responses, 97% of the total respondents are bachelor students, consisting of 567 (71%) women and 230 (29%) men. 531 (67%) participants are students majoring in tourism management, while the rest (33%) study social sciences, technic, architecture, and other related subjects. In addition, 302 people (38%) are 17-19 years old, 479 respondents (60%) are 20-29 years old, and the rest (2%) are 30-59. In terms of Indonesian law, a person is considered an adult at 17 years old. S/he is granted the right to obtain a national identity card and vote in elections [Ministry, 2016].

User scenarios and tasks.   The user tasks were designed with aim to assess whether the users could achieve their mission to obtain needed information by accessing the iWareBatik website and mobile app. Figure 5.3 and Figure 5.4 present 27 tasks along with the mean score based on four evaluation variables, namely satisfaction (S), ease of navigation (EoN), visual design (VD), and content conciseness (CC). Among all objectives, the evaluation survey obtained a satisfactory score on most tasks within the Objective 1 and Objective 2 (see Figure 5.3). The tasks related to exploring the interactive maps (Task 3 and 18) obtained the most satisfying scores. This feature is deemed helpful for users to access specific region page. The tasks related to destination (Objective 3) and Batik thematic meanings (Objective 4) earn good evaluation score (see Figure 5.4). Moreover, in terms of accessibility (Objective 5), language and offline function yield highest evaluation scores in the UX survey. The evaluation results further show that gamification as interactive features in the app yield favourable response such as spinning wheel (Task 21) and AI-powered Batik recognition tool (Task 24).

Several tasks on specific Batik content (Task 5, 7, and 14) such as thematic

meanings, production and how to preserve, and tourism related content (Task 10 and 11) obtained lower scores among other tasks. There are several factors contributing to the low evaluation score on ease of navigation (EoN), one of which may be related to the structure of content and the ineffective search feature. This issue can be addressed by making the search function within the mobile app more visible or an icon that directs users to a certain thematic information.

Additional survey questions. Results indicate that the the two most relevant statements according to users are related to Batik exceptional universal values as the primary factor and the sensation of different learning experience and curiosity as the second. This response indicates that iWareBatik, as cultural dissemination instrument, has been regarded as effective in motivating users to learn more about this tradition and to support local producers, such as buying authentic Batik products (see Figure 5.5). Despite the small percentage, a number of users chose altruistic and more action-oriented statements to use iWareBatik in their activity to assist local communities, making ideal tour package, and to shop or look for Batik with certain meanings.

In terms of iWareBatik website, the four most chosen features based on Scenario 1 and 2 are 'Content about Batik meaning in each region' and 'Tourism destination articles'. 'Photos and videos of Batik production, and '1-minute video'. In terms of mobile application, according to both scenarios, the two most chosen features are 'AI-powered Batik recognition tool' and 'interactive map'. A few percentage of the participants chose 'news and events', 'thematic destination', 'thematic Batik', and 'wearing rules'. The reason might be the placement within the content structure that is somehow less accessible to users and other reasons related different users' preferences. Regarding the percentage of users' likelihood to recommend the use of the iWareBatik website and mobile app, 50-60% of users in both scenarios are promoters (9 to 10 scale), 37-44% are moderate promoters (7 to 8 scale), and 3-6% detractors (0-6 scale). Therefore, the evaluation survey is deemed successful as more than 90% of respondents are considered promoters of iWareBatik website and mobile app on various scales, while few results on detractors (3-6%) (see Figure 5.6).

5.5.2   Nvivo text query analysis

Table 5.4 presents the word frequency of evaluation variable-related keywords resulting from text query analysis computed from 79 FGD forms and 628 essays. Those results were analysed based on two defined parameters (see Table 5.3), which refer to iWareBatik's capacity as an instrument to raise users' awareness and its role to support education on Batik ICH and heritage tourism.
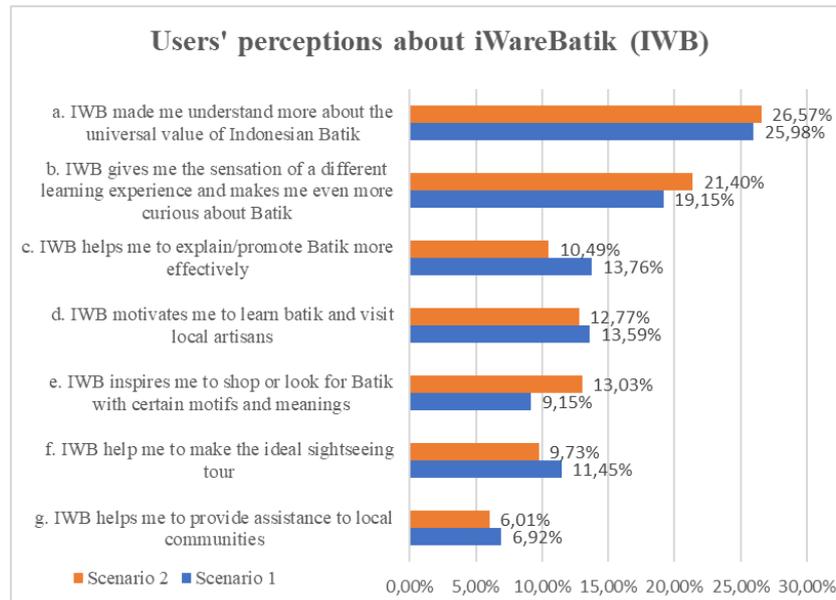
Figure 5.5. Users' perceptions in using iWareBatik
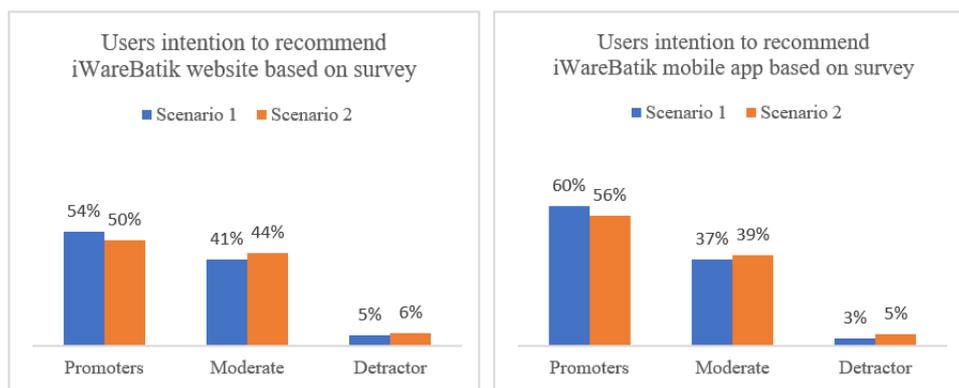
Figure 5.6. Users' responses on likelihood to recommend the use of iWareBatik

5.5.2.1 Access to heritage quality information: a sense of belonging and awareness towards Batik textile heritage

The overall evaluation as depicted from the collected inferences illustrate good evaluation on the effectiveness of iWareBatik to communicate the Batik safeguarding practice and addressing the needs and expectations of diverse stakeholders, while providing a more sustainable outlook of ICH integration within the tourism and creative sectors. Fogg [2002] mentions the importance of persuasiveness in textual and visual design elements of digital technology as infor-

No.	Evaluation elements	Keywords and number of inferences
1.	Awareness	Sense of belonging (10), sense of love (107), preserve Batik (241), awareness (108), easy to access (301)
2.	Effectiveness	Facilitate(79), innovative(59), helpful (380), useful (185), effective (31), efficient(18), practical(49), complete (351), simple (82), interactive(119), interesting (636), fun(49), unique(144), attractive (188), cool (22), satisfaction (12), easy to use (39), clear (115), easy to understand (179), concise (26), informative (107)
3.	Learnability	Insightful (128), educative (93), reliable(18), accurate(28), for young students (149), for children(94), Batik practitioners (294)
4.	Motivation	Excited (12), want to learn (34), want to visit (46), want to practice (9), curiosity (67), inspiration (18), increase motivation (23)

Table 5.4. The result of textual analysis using NVivo Text Query technique

mation supply. iWareBatik helps users connect and dive into the world of textile heritage through interactive features, which lead to an increase of awareness as mediated by iWareBatik platforms, as follows:

• "I became aware of Batik motifs in other areas because so far I only know batik motifs from Java island"

• "iWareBatik provides a sense of awareness that increases student interest in getting to know the intangible cultural wealth of Indonesia"

The textual analysis also identifies various keywords inferring users' opinions about communication quality of iWareBatik content such as 'clear', 'concise', 'simple', and 'easy to understand' (see Figure 5.7). In addition, Table 5.4 presents other keywords such as 'fun', 'cool', 'interactive', 'unique', and 'easy to use', which further elaborate users' positive experience in using the tool.

• "Very satisfying, easy to access for finding some content about batik, brief and easy to understand explanations, very interesting visual design, knowing a lot of history about batik in Indonesia and abroad."

• "Very impressed because many areas in East Indonesia which are famous for weaving also have their own unique batik works, which can be seen from the iWareBatik app."

• "Exploration of content that feels not only monotonous like reading a book. The fragments of information are arranged in relation to each other with a simple design so that users can easily 'connect the dot' to intact information."

• "Another virtue lies in the arrangement of the information presented in a very interactive way so that the reader will not get bored when using the iWare-Batik"
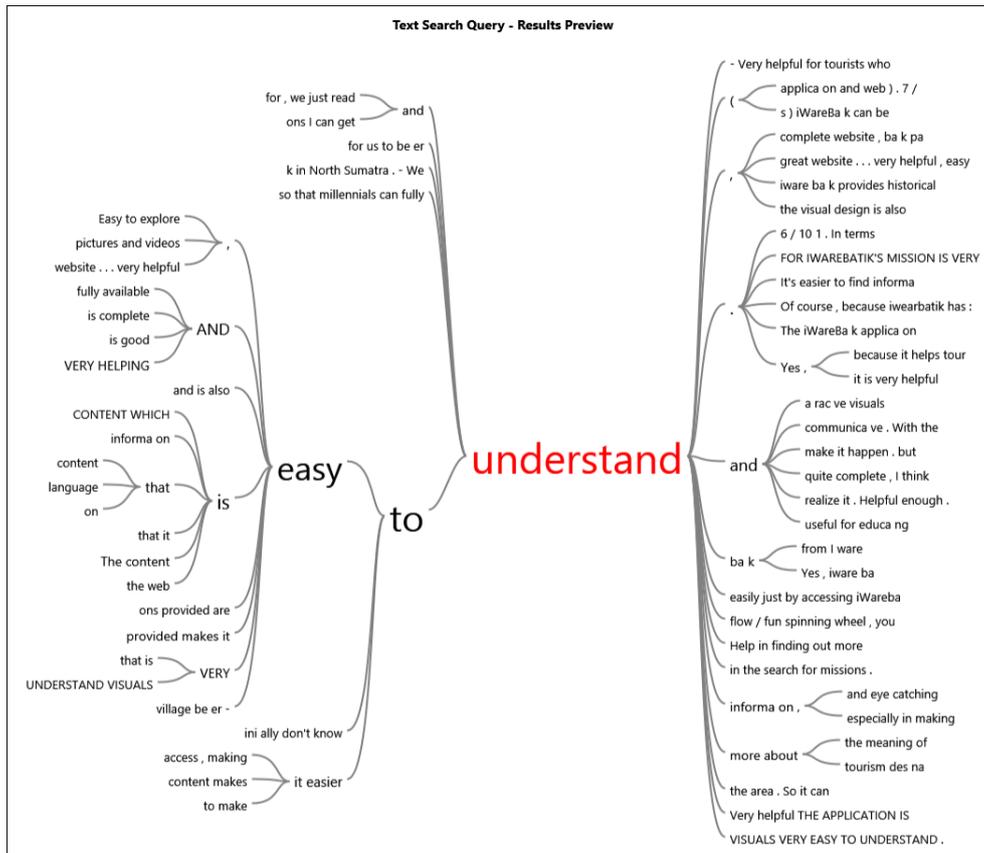
Figure 5.7. Example of Text Query analysis result on keyword "easy to understand", computed from the FGD written answers on Question number 2

5.5.2.2 Role of education on ICH: stakeholders empowerment through shared meanings and cultural representation

Digital technology facilitates knowledge-sharing and interaction in teaching activities [Adukaite and Cantoni, 2016]. Furthermore, perceived enjoyment as a positive experience through gamification is deemed significant in increasing intention to use (ibid). Therefore, this digital initiative facilitates tutors/teachers to use interactive features of the website and the app to conduct games or interactive activities with learners. iWareBatik also presents engaging stories about various actors of this heritage through audiovisual media in order to draw the public's attention to the importance of supporting the textile artisans' community.

As a knowledge-sharing platform, iWareBatik serves as an expert-curated cultural database that facilitates learners to obtain Batik information. This notion was analysed from frequent keywords found in this context, such as 'facilitate',

'innovative', 'helpful', 'useful', 'flexible', 'effective', 'efficient', 'practical', and 'complete'. In order to better understand the nuances of the textual data, special attention was given to the terms 'useful' and 'helpful'. Useful is defined as something designed to serve particular purposes [Lerman, 1997]. From this analysis, the word 'useful', as shown by 185 inferences, indicates users' perceptions to comprehend the practical purpose of iWareBatik as an educational technology for ICH. On the other hand, the term 'helpful', as found in 380 inferences, has another definition in social psychology. Any social action, particularly the invention of technology, is created to improve the state of any social issues [Franssen et al., 2018]. The term 'helpful' expressed in many instances indicate positive feedback from users when accomplishing their mission in the given contexts of Scenario 1 as a tour guide and Scenario 2 as a tourist. Several inferences further elaborate the use of iWareBatik's educational aspect on heritage safeguarding and tourism, presented as follows:

• "With the sophistication of artificial intelligence (AI) technology, iWareBatik facilitates cultural connoisseurs, especially to obtain information about traditional Indonesian fabrics."

• "Considering that global tourism player widely uses the digital platforms, iWareBatik has the vision to build sustainable cultural tourism in Indonesia with efficient and easy access to information."

• "This application is also very helpful for us to guide tours and form tour packages."

• "This app can be accessed offline, so people with limited networks can still access this application. What is even more amazing is that the spin wheel can stop in one of the regions, making it easier for us to learn from any region. What I like the most is the motif recognition camera. There is certain interaction with the in-app camera, as it introduces the identity or history behind a Batik motif."

Regarding educational aspects of iWareBatik, several keywords related to the learnability of the content (insightful, educative, reliable, and accurate) were identified (see Table 5.4). By analyzing these elements, we could analyse to which extent the users perceive the educational qualities of iWareBatik and its impact on users' motivation, which influences users' satisfaction and intention to use the digital platforms. The textual analysis infers emotional expression and user motivations to do action, such as feeling motivated, excited, increased curiosity, inspiration, a desire to learn about Batik, visiting a production centre, and practising Batik textile making. In terms of promoting rural tourism and creative industries during the Covid19 period, several inferences in connection to this context were presented as follows:

• "iWareBatik can really help the search for Batik in various levels of educa-

tion. It can be used by a teacher who wants to teach Batik to elementary school children as iWareBatik provides good pictures. I think elementary school children really like good pictures. This tool can be used to create a guessing game, and they can guess which kind of Batik from a certain area by referring to iWare-Batik."

- "I realized that I am so unfamiliar with our own culture. Therefore iWare-Batik motivates me to know more about my culture."

- "iWareBatik can be accessed under any circumstances, especially during the COVID-19 pandemic, where it is quite difficult to travel to tourist attractions that are usually crowded with visitors. Therefore, I use iWareBatik to feel the sensation of virtual tourism with a Batik theme."

- "iWareBatik can trigger tourism development and support the creative village industry because the introduction given on this website is very interesting, making website visitors want to explore, visit the place, and experience its culture, as seen from the website."

5.5.2.3 Identified problems and technological anxiety

According to Sintonen [2010, p.836], technology anxiety is defined as "the degree to which the usage or idea of using the technology in question arouses unfavourable feelings and fear". Problems may be varied depending on users' subjectivity and situations where technical problems may affect the experience. Individual differences are related to each individual's self-efficacy and experience in using digital applications, while technical issues refer to some instances such as internet access, low connectivity, and other hardware/software related problems [Adukaite and Cantoni, 2016; Isman and Celikli, 2009; Al-Haderi, 2013].

The result of textual analysis identifies different problems encountered by users when using the iWareBatik website and mobile app. A number of technical issues were identified as the primary factors that caused the technology anxiety. The most common problems are mostly experienced by users who participated in the evaluation activities with a low internet connection (see Figure 5.8). Other frequent problems are as follows:

1. Less effective search engine on the website and mobile app that some contents are difficult to be found.

2. The position of language choice on the iWareBatik website is less visible when it is opened from the mobile device's web browser.

3. App installation problem due to lengthy download time and size. It needs five up to seven minutes of time, depending on the type of mobile device.

4. Several contents, pages, and articles could not be easily opened or were slow to open due to the presence of bugs that needs to be fixed.

5. The accuracy of the Batik recognition tool needs to be improved, in addition to the inclusion of other motifs into the existing 8 class motifs.

In terms of the size of the application, this problem had been addressed and deemed normal by the technical experts. However, even if this issue had been communicated and addressed to the participant before the evaluation workshop started, it still contributed to users' increasing level of anxiety. Some started to worry when the app was not appropriately installed and exceeded the indicated time frame. At this point, the role of the facilitator was crucial in helping the participants to remain calm and in control of the situation and ensuring all steps were completed until the evaluation workshop finished. However, despite this lengthy app download time issue, some users acknowledge that their level of excitement increases when they are finally able to discover the app.
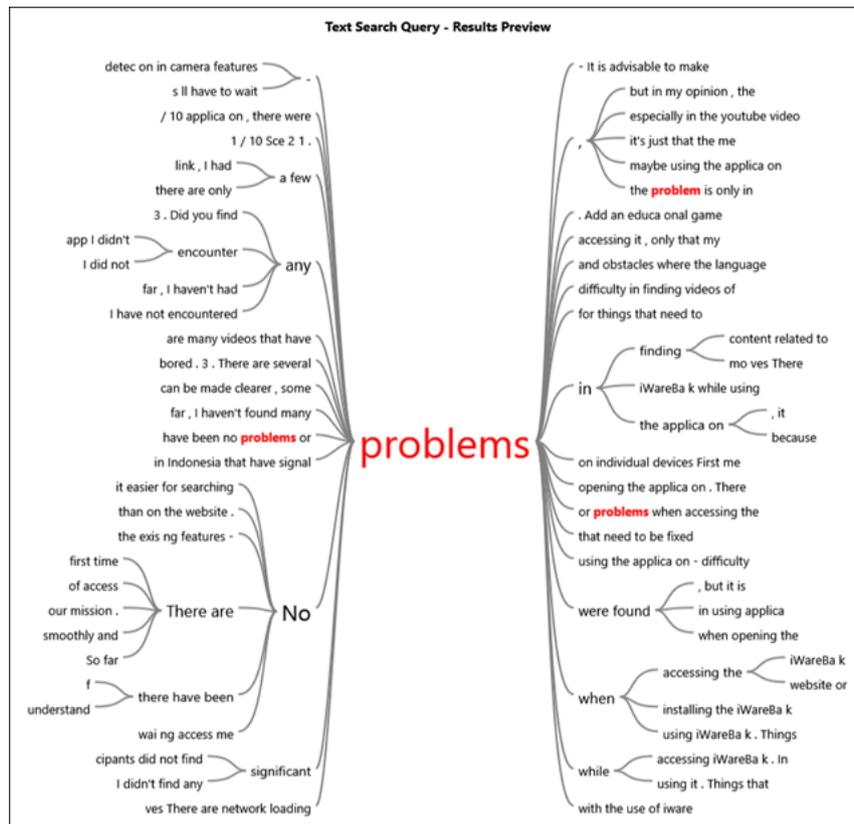
Figure 5.8. Example of Text Query analysis result on keyword "problem" retrieved from the FGD written answers on Question number 3

5.6   Conclusion

Measuring satisfaction is a key indicator to measure the success of a digital arte-
fact through a full exposure of its use to the users. The success of the iWareBatik
digital platform evaluation is achieved thanks to collaborative efforts shown by
multi-stakeholders involved in this activity. OCM and AWARe, as the theoretical
frameworks in this study, are effective in providing guidance for developing eval-
uation research criteria. The evaluation study, conducted through 17 batches of
UX workshops involving 997 bachelor participants from 33 Indonesian universi-
ties nationwide, has yielded 797 survey responses, 79 FGD reports, and 628 in-
dividual essays on iWareBatik UX evaluation. This study has provided a holistic
view of evaluating a digital platform from the perspective of users by employing
a mixed-method approach of using an online survey and NVivo text query anal-
ysis techniques. A number of evaluation variables were used in order to produce
salient results such as satisfaction, visual design, content conciseness, and ease
of navigation and those related to meta-reflection ones, such as awareness, effec-
tiveness, learnability, and motivation. The results presented confirm the ability
of iWareBatik as a digital platform to generate a good user experience in its con-
text of use, which is deemed in line with the fundamental objectives envisioned
by main stakeholders prior to its development.

The overall evaluation activity yields favourable results on most of the 27 user
tasks. The most satisfying evaluation results are indicated by several tasks related
to the quality information of Batik motifs and destinations related contents, ac-
cessibility (language and offline app functions), interactive features such as the
AI-powered Batik recognition tool (BRT). Nevertheless, several issues were iden-
tified in certain tasks. It is deemed important to address several problems and
technology anxiety outlined in the study and use them as constructive feedback
for future development.

Building digital technology devoted to intangible cultural heritage shall main-
tain the congruity from design, development, to evaluation. This ensures a coher-
ent process and yields optimal results in the development of digital technology,
which provides ideal solutions to the addressed social issues. The UX evaluation
activity on digital technology could serve as an effective instrument to promote
heritage safeguarding while providing learning opportunities and fostering re-
lationships among stakeholders involved. Since the research is limited to the
conceptual design, procedures and outcomes of iWareBatik UX evaluation ac-
cording to specific tasks, future studies could be directed to discover the use of
iWareBatik in the special Batik learning environment and other related contexts.

Appendix A

iWareBatik: Promoting the Wise Use of Digital Technology to Preserve Batik Intangible Cultural Heritage in Tourism Context

ABSTRACT[1] Batik hand-drawn textile was inscribed as a UNESCO Intangible Heritage of Humanity since 2009. It possesses outstanding universal values encompassing socio-cultural values, wearing rules and production techniques. As one of Indonesia's prominent fashion heritage, Batik is featured as one of the major attractions in each region. The course presents the creation of iWareBatik digital technologies (website and mobile app) to address the challenges of Batik safeguarding practice, as well as to raise the awareness of international travelers and the Indonesian public on the importance of Batik and its inherent exceptional cultural values.

A.1   Introduction

One of the key points addressed by the Sustainable Development Goals is ensuring sustainable cities and communities (Goal 11)[Nations, 2016], which also strives to achieve the preservation of the tangible and intangible cultural heritage. According to the 2003 Convention for the Safeguarding of the Intangible

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[1]Permatasari, P. A.[2021]. iWareBatik: Promoting the wise use of digital technology to preserve Indonesian Batik intangible cultural heritage in tourism context. URL:https://www.fun-mooc.fr/en/courses/tourism-management-unesco-world-heritage-sites-vol-3/

Cultural Heritage [UNESCO, 2019a], intangible cultural heritage (ICH) refers to the traditions and tacit knowledge practiced by the communities from generation to generation. It also reflects the way of life, wisdom, and philosophical values of the community, embedded in the symbols and the know-how behind the rituals and production practices of cultural objects. This notion also applies to the production of textile heritage, where the fabric and natural dyes are natural products that are transformed into exquisite cultural art objects. ICH practices are connected to the communities whose identity is defined and manifested through the living traditions. Cultural expressions (rituals, art performances, cultural practices) become tourism magnets, attracting visitors to discover cultural experiences through the wealth of ICH, and consequently generate employment and nurture the sense of belonging among communities in a tourism destination [UNWTO, 2020].

The challenge of preserving ICH lies in how to effectively communicate their scientific aspects, usage values, and interpretation of ICH practitioners, in order to meet the expectations of its stakeholders, especially in the tourism domain. ICTs play essential roles in supporting the safeguarding of ICH, such as facilitating learners to better understand the traditions, communities, objects. It is important to invest in developing ICT innovations that effectively provide high quality information and that communicate and promote the safeguarding of ICH, both in local and global contexts. This communication also needs to "respect the socio-cultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to inter-cultural understanding and tolerance" [UNWTO, 2020].

This case study outlines iWareBatik digital innovation (website and mobile app), which aims to communicate the exceptional cultural values of Indonesian Batik to international and domestic audiences. In 2009, Indonesian Batik was inscribed on the Representative List of the Intangible Cultural Heritage of Humanity with four exceptional cultural values [UNESCO, 2009b], namely: (1) historical wax resist dyeing production technique; (2) philosophical values contained in its motifs; (3) special wearing rules characterizing wearing purposes and social status; (4) the social empowerment within its safeguarding practice.

A.1.1   The challenges of preserving Indonesian textile heritage

Indonesia possesses rich textile art capturing the identity of its 633 ethnicities and two major types of Indonesian textile, namely Batik wax resist dyeing textile2 and woven textile. In 2009, apart from its designation as ICH, UNESCO also recognized Indonesian Batik as a "Good Safeguarding Practice": Indonesia provides

structured integration of Batik safeguarding practices at local schools (elementary, junior, senior high school, and especially the vocational art school in Java island)3. The inclusion of interdisciplinary stakeholders (local communities, educators, practitioners, businesses and public entities) ensures the durability and the growth of the Batik cultural practices at national level. The integration of digital technologies to support Batik's ICH started when the national movement to digitize 1 million cultural data was initiated by Sobat Budaya Association in 2008. Due to a strong public policy and bottom-up participation, 5,824 textile motifs across 34 regions were identified in 2015 [Situngkir, 2010]. The increasing tourism initiatives and the growing e-commerce platforms at national level since 2014 also contributed to boosting the growth of the creative industry and facilitated the online promotion of Indonesian textile art. The challenge consists in textile heritage being regarded as a type of cultural commodity in tourism and the fashion industry. The essence of this cultural practice and its safeguarding goals were barely communicated through online platforms. Batik preservation's main issues are currently as follows:

1. *Knowledge gap among Batik stakeholder*s. The particular socio-cultural values reflected in each pattern are not fully known by either producers or information providers. Most information and knowledge about Batik motifs resides in libraries and is rarely accessible to the public.

2. *The lack of interest of young people towards Batik safeguarding practice*. The decreasing number of young Batik producers shows the low interest of young people to engage in traditional Batik production.

3. *Low quality ICT tools covering Batik ICH in tourism contexts*. A benchmarking study on 164 mobile apps on Batik conducted in 2019 shows that there were only two mobile apps providing little information about Batik and destinations in the Java region.

4. *The risk of cultural appropriation on Batik motifs*. Most Batik motifs are not well documented with proper copyright information in terms of names, meanings, history, and place of origin.

How these points were addressed is shown in the next paragraphs.

A.1.2   iWareBatik project: general information

Available in Indonesian and English, iWareBatik website and mobile app were launched on August, 17th 2020, in conjunction with the 75th Indonesian inde-

pendence day [2]. This project was conceived thanks to the collaboration with Indonesian LPDP scholarship, Sobat Budaya Association[3]www.sobatbudaya.or.id, the eLab[4] and UNESCO Chair in ICT to develop and promote sustainable tourism in World Heritage Sites[5] at USI – Università della Svizzera italiana, Switzerland. As of April 16th, 2021, 36'598 visitors from all around the world discovered and explored the world of Batik through its website platform. iWareBatik stands for "I am aWare of Batik", "interactive softWare of Batik" and other homophonic meanings such as "I wear Batik". It provides the following main features:

1. Information on 124 Batik motifs and its meanings, 129 tourism sites including 9 World Heritage Sites and other UNESCO Biosphere Sites across Indonesia

2. Visual materials such as one-minute videos highlighting a region's main destinations and the beauty of its textile heritage

3. Interactive maps covering 34 regions

4. Batik timeline to explore the evolution of Batik motifs across centuries

5. Thematic Batik meanings and thematic tourism destinations

6. Special wearing rules of Batik in different occasions such as casual events, formal social functions, and ritual ceremonies.

The mobile app version is available for free on Google Play [iWareBatik, 2020a] and App Store [iWareBatik, 2020b]. It showcases informative contents about Batik through several interactive features such as spinning wheel and artificial intelligence-based Batik Recognition Tool. The spinning wheel is a gamified feature that allows users to randomly access information about one of the 34 Indonesian regions. Batik Recognition Tool provides users a practical experience to learn the meaning of Batik motifs using a phone camera, which works thanks to the built-in artificial intelligence system of the iWareBatik app. This unique digital intervention was welcomed by international users (800 downloads in the first two weeks) and thanks to the support from international and Indonesian governmental bodies and association partners (Indonesian Presidential Secretary Cabinet, Caventer Indonesia, Overseas Indonesian Student Association Alliance (PPI Dunia), in 8 months since its release, iWareBatik placed in the first rank of the most downloaded Batik educational mobile apps in Indonesia.

Several studies were conducted during the conception of iWareBatik, such as benchmarking studies on Batik websites and mobile apps, prototyping workshops

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[2]Launching Video of iWareBatik in August 17th, 2020: https://www.youtube.com/watch?v=jxQmrFjjbF4

[3]https://sobatbudaya.or.id/jkt/

[4]www.elearninglab.org

[5]www.unescochair.usi.ch

with 12 master students at USI-Università della Svizzera italiana, Switzerland, 15 in-depth interviews and 191 surveys addressing international and Indonesian respondents [Permatasari and Cantoni, 2021]. Such efforts were conducted in order to ensure that the digital technology project could meet the requirements and expectations of all stakeholders with regards to the valorization of Batik textile heritage.

A.1.3   Communicating Batik through digital technologies

According to Garbelli [2015], digital technologies to support the preservation of intangible cultural heritage shall be designed to (i) facilitate identification of ICH, (ii) capture the holistic information of the living heritage, (iii) transmit the tacit knowledge, while (iv) maintaining the authenticity of cultural practices. The development process shall be based on inclusiveness, encouraging all stakeholders to take part in the decision-making. Building a representative digital outlet is crucial in supporting the preservation of ICH, as it showcases high quality information related to the living heritage and effectively communicates them to different audiences. Overall the digital intervention of ICH is required to address the needs of the community to access such information, promote dialogue, facilitate education, and encourage mutual respect towards cultural identity. In order to build comprehensive and representative digital platforms for ICH, the information provided through the ICT shall meet several principles, namely: Accuracy, Objectivity, Currency, Coverage, Intended Audience, and Authority.

The scope of iWareBatik site was intended for international and domestic audiences; the platforms need to be developed as reliable educative digital media on Batik and Indonesian tourism. In order to mitigate the challenges of preserving Batik, the information and contents published on the site should be carefully structured and meet the criteria of a high functional digital platform as follows:

1. *Authority and the protection of cultural intellectual properties*. Authority of the site refers to information related to the persons/organizations possessing definitive qualifications to provide knowledge about a given subject [Tate, 2009]. The goal of the site, the logos and details of involved official parties and partners were presented in the iWareBatik website. Copyright labels and information on each Batik motif were added, in order to ensure the protection towards the cultural intellectual property and acknowledge the cultural identity of the Indonesian Batik producers.

2. *The Quality of Information and Objectivity*. High quality information of a digital platform is reliable when it is accurate, objective, and presented based on the current development (currency). In order to meet these criteria, the pub-

lished materials should be composed based on valid sources such as scientific literature and official media outlets. This is how the database of 124 Batik motifs was built: for the summaries on each motif, experts on Batik history were involved who then verified timelines and historical context. The actual condition and the accessibility of 129 tourism destinations was also checked with the local government in order to ensure the information reliability of tourism sites presented in the digital platform. A YouTube video of each destination is also provided so as to provide clarity and visual information about the site. Such visual materials can be used as future reference by users when planning their visit to Indonesia.

3. *Data Interpretation and Storytelling*. According to Brezovec et al. [Brezovec et al., 2018], interpretation is the art of telling a story about the heritage to tourists. A good interpretation facilitates the readers to comprehend accurate information, which is well-communicated according to socio-cultural contexts in the community through engaging and easy-to-understand storytelling language.

Interpretation and storytelling can also be an effective communication tool to disseminate knowledge about ICH. The interpretation conveyed through a short storytelling might be a mental experience before one visits the sites or before they see and touch the Batik textile. The story behind the Batik motifs may trigger users to learn more about other Batik motifs in certain thematic meanings, types and regions.

A.1.4   iWareBatik as digital innovation to support sustainable heritage tourism: Lesson learned

The continuous development of digital technologies and modern society does not need to hinder the Batik safeguarding practice. It can also be connected with the development of heritage tourism through digital technologies, which is designed to promote mutual understanding and respect towards local culture. According to Cantoni [2018], digital technology helps support sustainable heritage and tourism in 5 areas: Access, Better, Connect, Dis-intermediate, and Educate (ABCDE). Despite strong valorization of Batik usage values in fashion and tourism contexts, the creation of iWareBatik website and mobile app presents as a solution to revive the original tradition of Batik cultural expression, support the practitioners, reigniting people's passion towards its inherent cultural values. To this extent, the ABCDE framework serves as the basis of iWareBatik digital innovation, as it facilitates all stakeholders to understand Batik by providing access for users to detailed information about Batik, its motifs and connected tourism

sites through various digital means (interactive map, offline and online mode for easy reference, especially for people with limited internet access).

iWareBatik presents efficient and high quality information for users' better experience in learning about Batik's heritage and values on-the-go through interactive, practical and surprising digital gamification tools (spinning wheel, Batik Recognition Tool) Furthermore, those unique functionalities may trigger engaging interaction among users (peers or even producers) that leads to them discussing and discovering more about iWareBatik connects international audiences with domestic stakeholders: They share their passion about Batik, their stories, current events and developments on the website, where they can also become guest authors and contributors. It also serves as a hub that facilitates Batik experts, educators, and public entities to supply information on Batik to wider audiences, dis-intermediating the role of libraries and serving as a unique source of information. iWareBatik also facilitates educating several types of learners (from beginners to experts) in order to deepen their understanding towards this cultural practice. This includes Batik educators and instructors who use the app as a learning material and share the acquired knowledge with young apprentices in educational settings.

The responsibility of supporting the Batik safeguarding practice lies in the hands of all stakeholders who care for the heritage of all humanity. Promoting the wise use of technology to support the preservation of intangible cultural heritage has shown to create positive outcomes for all of humanity, and especially those communities that try to protect their outstanding universal values. In conclusion, iWareBatik serves as a case study, whose approaches can be adopted and inspire similar projects of a kind or those related to heritage preservation in general.

Appendix B

Reviving the Lost Heritage: Batik Cultural Route in the Indonesian Spice Route Perspective

ABSTRACT[1] Known as a spice producer country, Indonesia possesses a wondrous history of spice routes. Some intricate patterns of woven textile and the wax-resist dyeing Batik textile, as the evolutionary textile arts across centuries, describe the story of spice and its importance for the local community in many spice regions. This paper identifies Indonesian cultural routes with strong history spice cultivation, characterized by the presence of their textile heritage. This study provides an in-depth analysis on the context of developing Indonesian sustainable cultural routes, by considering the valorization of textile heritage and spice culture as the element of intangible cultural heritage (ICH) in the direction of sustainable tourism and heritage preservation. The creation of digital technologies, cultural hubs of textile and culinary, as well as thematic tourism, offers on spice routes are discussed, all in the framework of addressing the overarching community goals and the sustainable rural tourism development.

B.1   Introduction

This paper explores Indonesian batik-cultural route and its dimensions manifested in the making of national identity. The spice route perspective might di-

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rect us to easily understand the spread of Indonesian batik. The spice route is defined as a cultural route formed by spice trade and shipping. Therefore, the commercial affairs force multinational merchants and adventurer to interact and share their knowledge and culture. This perspective is used to describe the origin and spread of Indonesian batik. Batik is not merely a cloth but also a tool to reinforce the national identity. People believe that Batik comes from Java and is transported to other regions. Interestingly, Indonesia does not have a single batik motif but Indonesia has various batik motifs. When the batik cloth arrives in the Spice Islands, the people of the Moluccas do not use the Javanese batik motif but they try to develop their own batik motif. In addition to sup-port governmental efforts to preserve and promote Indonesian Batik and tourism, this research further one of the recent international governmental collaboration initiatives in digital technology, which is manifested through the iWareBatik digital project. This project was done in light of increasing the role of information communication technology (ICTs) for promoting the sup-porting cultural textile and its linkage with Indonesian existing spice routes.

Many previous scholars have already described the spice route. However, they merely re-construct the past without placing the spice route as a perspective [Raman et al., 2019; Raman and Bau, 2020; Meilink-Roelofsz, 1962; Matos, 1995; Lobato, 1999; Wijaya et al., 2020; Suprapta et al., 2021] try to use spice route as a cultural route to understand the global cultural encounter in Ambon and its surrounding Uliase islands, Haruku, Saparua, and Nusalaut, all of which are called Ambon-Lease proxy. This paper attempts to revisit Indonesian spice route in the presence of Batik textile heritage in the spice producer regions, strengthen the national identity from the perspective of spice history and civilization. The pivotal position of Indonesian Batik as renowned UNESCO intangible cultural heritage, this cultural practice greatly con-tributes to the landscape of Indonesian tourism and its exposure at international level.

B.1.1   Spice route as cultural route

Spice route is a strategic project developed by Direktorat Jenderal Kebudayaan (Indonesian General Directorate of Culture). This project attempts to fulfill the 2020 presidential instruction number 18 on the cultural affairs and the national blue-print establishment road map of 2020 to 2024. The enactment of spice route is regarded as a way to develop and valorise the cultural richness; to reinforce the national character; and to empower Indonesian society. In addition, the spice route is also implemented as part of Indonesian cultural diplomacy overseas. In this line, the spice route has a multiplier effect for the involved regions.

However, spice route concept has gone through several debates. Many questions arise so as to which notion the term "route" is addressed. The term of "route" refers to a trading and sailing route. This route is the traffic connection of demand and supply of the commercial merchandises [Sulistyo, 2020]. To this day, spice route is connected to the notion of historical routes where socio cultural interactions happened through the interaction of multinational agents who share their culture and knowledge[ICOMOS, 2008].

In this regard, many Indonesian cultural remains have similar characteristics. At least, some Islamic graves and colonial buildings, scattered in many regions in Indonesia, become a sup-porting evidence of the cultural network existence [Lombard, 1990]. In line, Margana [2020] seems to stick on the concept of "spice network" or zone rather than "spice route". The spice route is not merely counted as the sailing and trading route but also to be recognized as a socio-cultural route to enrich the rainbow of Indonesian culture.

From the historical perspective, the international spice trade and shipping forced the world to connect each other. Therefore, the port-cities in the common frequented spice network possess social plurality. According to Andaya [2019, p.xix], the social plurality is composed by its ethnical formation. This ethnical formation could not be separated from the trading determination. The interaction between foreign agents, such as scholars, venturers, and merchants with locals gives also influence the locals stimulated cultural sharing.

Societal plurality in Indonesia is fastened by the global interaction. This analysis leads to a deeper connection of the ethnical formation and identity. This identity could be represented by the cultural items, for instance dress, cloth, food, language, and religion. As cultural items are differ from a society to the others, it might not limit a possibility if a society adopts similar culture and tradition. It is common for any flexible and dynamic society to absorb and adopt another culture, as they continually interact and adapt with structural and sudden change [Andaya, 2019, pp.xxii-xxxi].

B.1.2   Batik and the making of national identity

Batik is a pivotal element of Indonesian civilization. This textile making tradition is preserved for centuries since its arrival in 6th Century in Indonesian archipelago [Ministry, 2013b, p.29]. The motifs are often used to represent stories related to the great journey of human life: birth, marriage, and death [Ministry, 2013b, p.15]. The Batik making process requires at minimum 3 to 12 weeks depending on the complexity and the degree of its finest quality. The Batik making activity is usually conducted by village women, who mostly works

on this creative work in an open-air structure or in green shelters, assisted with indirect natural lighting. This cultural activity is seen as social activities where several women may work together, while supervising their children [Ministry, 2013b, p.41].

Batik industry spread vastly in north coast of Java in transition of the 19th century, many Batik makers from Surakarta and Yogyakarta moved to the big cities. They joined their foreign masters, who came from Europe and Chinese, and continued making new patterns and motifs according to their consumer's request. As a result, some Batik textile origin from north java coastal appears to adopt European fairy tales and floras as their motifs. In line, they also adopted the Chinese symbology like the omnipresent butterfly and phoenix [Ministry, 2013b, p.16-29].

Historically, batik has been an identity for most people by using the distinctive motif and coloring. Hinterland society tends to make a batik with darker color and the coastal people likes batik with colorful motifs and symbolizes a particular maritime culture. The availability of dye plant would be a consideration in Batik coloring. In hinterland, Batik producers use certain ingredients composed of spice plants and other endemic plants in order to produce natural indigo color. Batik is also used to distinguish a social class, depicted by the existence of royal batik. The royal family of Yogyakarta and Surakarta Courts are permitted to wear the royal batik with the specific motifs [Ministry, 2013b, p.29].

Batik making techniques and designs represent the global-cultural crossroad either the foreign culture affecting the Indonesian culture or vice versa. In West Africa, Javanese batik techniques have contributed to a flourishing batik industry and in Europe, resist-dye technique became popular method used by designers and craft enthusiasts. Conversely, patterns from foreign textiles have been incorporated into Indonesian designs. A good example is the motif of Patola cloths of Gujarat in India once traded in the archipelago or those found in Sumba which resemble the heraldic animals on old Dutch coins [Ministry, 2013b, p.33].

In modern period, batik has been an identity for each province as well as national cultural heritage. Since the establishment of one village one product (OVOP) each province is encouraged to develop batik motifs based on the local characteristics [Industry, 2020]. The reinforcement of national identity was started when Soekarno, the Indonesian founding father, encouraged Indonesian to produced and wore batik with the new motifs representing the spirit of independence. Soeharto then continued its tradition. In the mid-1970s, the governor of Jakarta Ali Sadikin decreed that long-sleeved batik shirts for men were acceptable as formal wear at receptions. This has become standardized and remained the norm until today. Long-sleeved batik has always been an acceptable alter-

Figure B.1. Map of Indonesian spice regions [JawaPos, 2020]

native to business suits. In 2009, after the inscription of Indonesian Batik as a UNESCO Intangible Cultural Heritage of Humanity, another president decree was issued, instructing all Indonesians to wear batik outfits as formal wear or business attire every Friday [Ministry, 2013b, pp.34-39].

B.1.3   Batik and spice route to revive the magnificent living heritage of Indonesia

Indonesian archipelago lies in the southern hemisphere of the Asian continent with tropical climates supporting the growth of various types of spice. As one of the Asian countries that is renowned as 'Land of Spices', Indonesia is the home of 13 major spice plants out of world's 70 plant species [Chomchalow, 2001]. Not only know as the place of origin and production, the consumption and exportation of those spices become major historical events, shaping the landscape of Indonesian culture and civilization across centuries (see Figure B.1). The presence of spice as the endemic plants in three main Indonesian regions, namely western, central, and eastern part of Indonesia are celebrated not only in the gastronomic expression but also in the motifs of textile heritage, such as Indonesian Batik.

For example, in the western part of Indonesia, Aceh is known as the land of Bungong Jeumpa where Yellow Champaka (Magnolia Champaka) grows as an endemic plant in the region. It is used as traditional skincare and medicine [Santhosh and Shanmugam, 2020]. Aceh has its typical Batik textile with Bungong Jeumpa outlined as the main motif (Figure 1). Another Batik textile depicting typical spice is exhibited by coffee and black pepper motifs in Bangka Belitung (see Figure B.2). Bangka Belitung is a province located in Sumatra island that
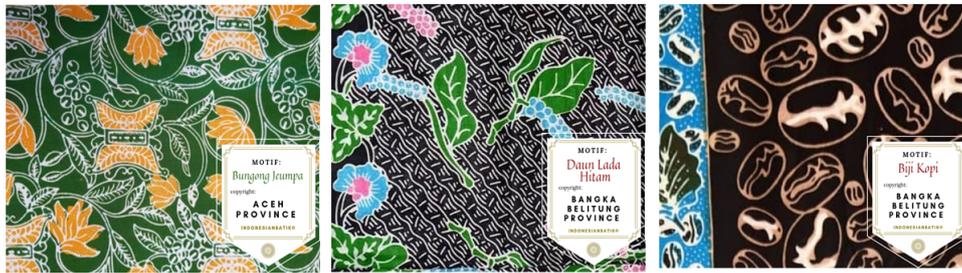
Figure B.2. Western part of Indonesia, Bungong Jeumpa of Aceh, Black Pepper and Coffee of Bangka Belitung (source: www.iwarebatik.org)

Figure B.3. Central Part of Indonesia: Bunga Raye of North Kalimantan and Tengkawang Ampiek of East Kalimantan (source: www.iwarebatik.org)

is known as black pepper (Piper nigrum) and major coffee production areas in Indonesia. According to Chomchalow [Chomchalow, 2001], India and Indonesia produce about more than 90'000 tons, which is more than half of world's total production. In central part of Indonesia, Tengkawang is an endemic Borneo tallow tree (Dipterocarpaceae), which is used by local Dayak tribe as ingredients for traditional medicine and healing purposes.

This plant is present in the Batik textile produced in East and West Kalimantan (see Figure B.3). Bunga Raya (Hibiscus rosa-sinensis) motif is known as a healing spice ingredient in North Kalimantan. This plant is massively for medicine, spice, and ceremony used by Tidung tribe that inhabits the North Kalimantan, Indonesia [Listiani and Abrori, 2019].

In eastern part of Indonesia, clove (Syzygium aromaticum) and pala nutmeg (Myristica fragrans) are the major spice products in Maluku (Moluccas) islands. The Batik motifs in both Maluku and North Maluku regions illustrate the clove
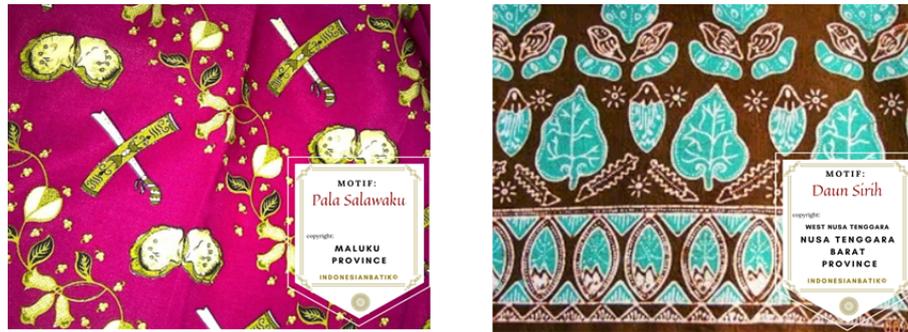
Figure B.4. Eastern Part of Indonesia: Pala Salawaku of Maluku and Daun Sirih (betel leaf) of West Nusa Tenggara (source: www.iwarebatik.org)

and nutmeg as the main features on their textile heritage. As spices have been a precious commodity in the global market since centuries, spice glory become the collective memory of Maluku people. Therefore, local textile producers conserve this history-related spice memory in their batik motif. Using spice as source of inspiration, this textile art represents the storyline of spice cultivations since colonialism era, through which symbols contain and transmit the identity of the Moluccas people across generations. Another spice motif is depicted in Batik textile of West Nusa Tenggara. Betel leaf (Piper betle) is typical plant in the region used by the local tribe for healing purposes (see Figure B.4).

B.1.4   Promoting spice route in connection to Indonesian Batik through digital technologies

Theoretically, the roles of ICT in heritage preservation could be sustained by ABCDE framework [Cantoni and Tardini, 2008], considering the point of access for the quality information, to provide Better experience for users to use the digital artefacts, to connect locals, to streamline or (dis)-intermediate between the travelers and tourism hospitality, and to educate learners and increase the competence of professionals in the sectors. Therefore, the previous studies [Permatasari and Cantoni, 2021, 2019b; Werthner et al., 2015] showed the contribution of ICTs to preserve cultural heritage through the development of digital heritage platform. In addition to support the capacity building in tourism through e-learning [Cantoni et al., 2009; Nafiah, Suprapta and Wijaya, 2019; Nafiah, Mashuri and Wijaya, 2019; Wahyuningtyas, 2021] also attempt to highlight the preserve Indonesian culture and Batik by providing e-learning in forms of digital books. Connecting to the idea of valorising spice route in connection to

Figure B.5. The website interface of www.jalurrempah.kemdikbud.go.id, an official website dedicated for the valorisation and the promotion of Indonesian Spice Route [Education and Culture, 2020]

Indonesian Batik and other textile heritage, this study proposed identification of potential spice route to develop through the promotion of Batik textile regions.

Looking at the presence of Batik textile that characterises the richness of spice regions, several points of cultural tourism are proposed. In order to provide seamless and strategic connection between local traditional producers with spice producers, tourism stakeholders may create tour offers connecting the history of spice within the region with the local textile producers (see Figure B.6). Indonesian government sees the importance of connecting the storyline with regards to the history of spice, through the trace, existing route, and the future through digital technologies [Education and Culture, 2020]. In 2020, authors investigate two big initiatives from Indonesian government and international collaboration with USI UNESCO Chair in Switzerland. The first one is www.jalurrempah.kemdikbud.go.id, an official website dedicated for the valorisation and the promotion of Indonesian Spice Route [Education and Culture, 2020]. It has been built by Indonesian Ministry of Education and Culture with the aim of reviving the storyline between the history of spice in Indonesian regions and its centurial influence within the history of global civilization (see Figure B.5).

The second initiative is iWareBatik, an official digital platform built by through Indonesian LPDP research funding with USI UNESCO Chair [Permatasari and Cantoni, 2021]. It provides information related to the meanings of 124 Indone-

sian Batik in 34 regions in Indonesia, com-prising its names, types, motifs, socio-cultural values in the motifs, and history. The platform also enriches the knowledge of the users by providing cultural landscape from the western to the eastern part of Indonesia through its textile motifs. It also highlights the specificity of Batik textiles in many spice regions such as in Aceh, Bangka Belitung, North and East Kalimantan, Maluku (Moluccas) and West Nusa Tenggara. This platform further elaborates some information related to the local batik makers and stores in all Indonesian regions. In addition, iWareBatik digital platform connects Indonesian batik and tourism, as well as the information of UNESCO sites. The Indonesian tourism sites are divided into two categories of cultural and natural tourism.

Meanwhile, UNESCO sites in Indonesia have been categorized into global geoparks and world heritage sites. The users of iWareBatik digital can access the interactive map within the website (www.iwarebatik.org) and through the iWareBatik mobile app, which can be downloaded in Android and iOs. The mobile app version also provides Batik recognition tool feature that uses artificial intelligence in order to recognize 8 Batik motif classes such as Ampiek, Ceplok, Gurda, Lereng, Kawung, Mega Mendung, Merak, and Parang.

B.1.5 Conclusion

New tourism products may be developed by encouraging the spice producers to create licensed and authorised consumable products (for health, well-being, skincare, etc), which can be combined with local Batik or woven textile heritage [Iberia, 2021]. The new tour packages may combine with the visits to UNESCO world heritage sites and other heritage sites related to the healing tradition as part of the strategy aiming at raising the awareness of visitors and locals of spice history importance.

Indonesian Batik can be seen from various point of views including the connection with centurial spice history in Indonesian archipelago. The spice route as part of the cultural centurial legacy is not only seen as tangible cultural heritage but also living heritage. Indonesian Batik, as millennial textile art, has been mostly developed in Java island. Across centuries, the spread of wax-resist dyeing method characterised in Batik production to all 34 Indonesian regions influence and affect the variety of local textile heritage. This gives a leeway for textile artisans in the regions to actualize their creative expression into visual pattern that represents local identity, which in some cases may relate to the spice history of the island. The Batik motif deconstruction begins when they accept and receive the influence of Javanese batik both in terms of the production method

Figure B.6.   The connection between spice route and the richness of textile heritage presented by the iWareBatik interactive map (source: www.iwarebatik.org)

and the philosophy.

The cultural adjustments as a result of the craftmanship and art interaction enriches the motifs variety and the knowledge mastery within Batik society. Consequently, through the presence of spice and its association with Batik textile art, this proposition gives a new opportunity to the opening of Batik Spice Route, which combines powerful assets of both local tangible and living heritage into a strategic valorisation of cultural tourism. The intervention of the two digital platforms, both Jalur Rempah and iWareBatik, provides new experience and facilitation to the preservation and promotion of Indonesian batik in connection to the spice route. The digital platform also promotes the local batik makers and attracting tourism objects in all Indonesian regions. It is important to maximise the digital platform in order to revive people's awareness on the exceptional cultural values of the proposed living heritage and to foster the sustainable cultural tourism in favour of local development.

Appendix C

Contemporary Artwork for Batik Painting: Astral Moon

C.1 Contemporary Artwork: Astral Moon

A contemporary artwork for Batik painting inspiration entitled 'Astral Moon' was created in April 2020 during the Covid19 Pandemic. It illustrates a meta-reflection of the ocean and astral creatures during the full moon and the starry night sky. This hand painting represents personal contemplation of dissertation research journey, the emotions, the findings, the gains, and all hidden treasures that finally came up to the surface.

Batik is not just defined by the past. Its beauty evolves through continuous redefinition of times and personal meanings.

Figure C.1. Title: Astral Moon. Contemporary artwork for Batik painting inspiration (c)Puspita Ayu Permatasari

Glossary

ABCDE = Access, Better Experience, Connect, Dis-intermediate, and Educate
ADDIE = Analysis, Design, Development, Implementation and Evaluation
AREA = Access, Representativity, Educate, and Engagement
AWARe = Analysis Web App Requirement
CRM = Cultural Ressource Management
HCI = Human Computer Interaction
ICT = Information and Communication Technology
ISO = International Organization for Standardization
OCM = Online Communication Model
UNESCO = The United Nations Educational, Scientific and Cultural Organization
UNWTO = The United Nations on World Tourism Organization (UNWTO)
UX = User Experience

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