Exploiting Virtual Reality Visualisation Feature for Intangible Cultural Heritage in a Tourism Industrial Chain

Shaojun Ji[1], Lu Zhang[1], Zisen Zhou[2], Hongji Yang[2], Meiyu Shi[3]*

[1] Collaborative Innovation Center of eTourism, Beijing Union University, China
[2] School of Computing and Mathematical Sciences, University of Leicester, United Kingdom
[3] Tourism College, Beijing Union University, China
lytshaojun@buu.edu.cn, LuLu_zhang13@163.com, zz254@leicester.ac.uk,
hongji.yang@leicester.ac.uk, shimeiyu72@163.com

Abstract

Virtual reality (VR) has been increasingly used in the exploitation of the source of intangible cultural heritage (ICH) for tourism, and VR-induced ICH tourism products are popping up all the time. However, there is a lack of study on VR-induced ICH tourism from the perspective of the industrial chain and a comparison of media suitable for ICH tourism products. Using the case of the Cloisonne art experience tour of the Beijing Enamel Factory, China, this study explores the application of VR in the marketing aspect of the tourism industrial chain (TIC), and compares existing media and classifies them into flat screen and VR. Researchers used a 360-degree camera to shoot the handmaking skills of metal wire inlay and paint blue, these are important steps of Cloisonne making process and part of the tour. The 360-degree video provides tourists with a pre-trip opportunity to experience the scenery of the Cloisonne production site, which helps arouse their interest in the Cloisonne art experience tour and facilitate their decisions to travel to the field. Additionally, visitors can learn how to make metal wire inlay by themselves by playing/replaying the video, which may arouse their interest in gaining knowledge about the Cloisonne art and, in turn, taking the tour. The findings indicate that the application of VR could contribute to tourism marketing by providing a pre-trip virtual experience to potential tourists and involving them in product marketing.

Keywords: VR, Intangible cultural heritage, TIC, Computer medium

1 Introduction

ICH is defined as "the practices, representations, expressions, knowledge, skills——as well as the instruments, objects, artifacts and cultural spaces associated therewith——that communities, groups and, in some cases, individuals recognise as part of their cultural heritage." [1]. As with tangible cultural heritage, ICH is the spiritual and intellectual property accumulated and transmitted over generations [2], and a powerful driving force for attracting visitors to tourism destinations [3]. Accordingly, tourism practitioners and researchers have put great effort into promoting a sustained relationship of both ICH and the tourism industry. The application of digital technologies, such as VR [4], to the exploitation of ICH resources for tourism is one of the initiated efforts. For example, VR technology has been used to recreate historical environments, reenact important cultural events, offering ICH tourists an opportunity to interact with traditional crafts and skills [5]. VR has also been adopted by marketers to showcase traditional crafts, performances, and cultural events, create a sense of exclusivity, and attract those who are interested in experiencing something truly special. With the increasing applications of VR in the various fields of ICH and tourism, understanding the role of VR in promoting ICH development from an industrial perspective (e.g., the perspective of TIC) is conductive to the ICH tourism development.

Research on the integration of VR and ICH tourism development has mainly been conducted from a consumer perspective through investigating the stimuli and consequences of VR-related tourist behaviours and experiences and from a marketing perspective through exploring the role of VR in promoting tourist attractions and destinations [6]; however, little research has been done from an industrial perspective, and especially the perceptive of the industrial chain. The tourism industry involves a range of services, including attractions, accommodation, food and beverages, and transports, among other services. A highly developed tourism industry is considered an industrial chain that entails the production and trading activities around a final tourism product required by consumers [7]. The extension of VR applications to exploit ICH resources in diverse tourism areas, e.g., theme parks and museums in recent years provides a practical basis for studying VR from the perspective of TIC. Such studies could provide a panoramic view to understand the integration of VR technology in ICH tourism and help expand the theory of the industrial chain by providing cases from the tourism field. In this regard, this research is committed to discovering the use of VR in ICH tourism in the context of TIC. Specifically, this research constructs three industrial chains regarding ICH tourism (i.e., ICH tourism industrial chain, ICH tourism digital content industrial chain,

*Corresponding Author: Meiyu Shi; E-mail: shimeiyu72@163.com
DOI: https://doi.org/10.70003/160792642024072504009

and ICH tourism VR content industrial chain) and compares their characteristics, aiming to providing theoretical guide for the VR-induced ICH tourism industry. Secondly, this study explores VR's immersive advantage for ICH contents compared to traditional flat screen. Thirdly, this research provides a step-by-step method of creating VR tourism product for ICH. Additionally, this study takes the Cloisonne art experience tour provided by the Beijing Enamel Factory Co., LTD, China as a case study, applying the theoretical framework on the ICH crafting skill of paint blue and metal wire inlay, and demonstrating VR content creation for ICH.

The remainder of this paper is structured as follows. In the next section, a literature review of ICH content in the TIC is conducted. Section 3 compares the TIC, digital content chain and our novel VR content chain under the scope of the ICH. Section 4 compares the traditional flat screen device with VR device on their suitability to provide ICH tourism product. Section 5 specifies technical details of ICH tourism VR content industrial chain. Section 6 shows an implementation of theoretical framework through a case study of Cloisonne art experience tour. Finally, a discussion and conclusion are provided, including the implications of the research as well as suggestions for future research.

2 ICH in the TIC

The industrial chain theory was first proposed by Adam Smith, a classical economist, in his illustration of the theory of division of labor using the example of the manufacturing industry in the second half of the 18th century. Smith [8] states that the internal production activities of an enterprise form an industrial chain, which includes: (1) purchase of raw materials or components from the market, (2) production, processing, and transportation, and (3) distribution to consumers. The industrial chain theory was initially used to understand the production and sales process of the manufacturing industry. With the development of the theory, its application has gradually been extended to the service industry including tourism.

2.1 TIC

TIC has received academic attention since the concepts of distribution channel and distribution system were put forward respectively in the two reports of the United Nations World Tourism Organisation in 1975 and 1994 [9-10]. TIC is commonly defined as a network of organisations involved in tourism activities ranging from the tourism product supply to the distribution and marketing of the final product relating to a particular tourism destination [11]. In the TIC, tourism products are typically developed in a specific territory, and tourist consumers are often from a specific source market. Additionally, the number of tourism products provided is limited depending on the reception capacity and carrying capacity of the suppliers. Compared with the rapid development of the tourism industry, TIC has received limited attention from the academic community. Existing studies are primarily descriptive studies, discussing the distribution networks, business process cost, and competition strategies of the TIC.

As one of the tourism resources, ICH domains of folklore, rituals and events provide a variety of tourism activities and can form an entire TIC [12]. However, there is a lack of studies on the TIC relating to ICH. Only a few studies mentioned the ICH-based TIC as a by-product content of the paper. For example, Meng et al. [13] conducted a research on ICH tourism product design using Dalian's industrial heritage as a case study. The researchers point out that the characteristics of TIC regarding Dalian's industrial heritage include architectural landscapes, production scenes, processes, and production products. Unfortunately, the researchers did not carry out any further analysis and discussion. With the continuous integration of ICH and tourism industry, it is necessary to conduct further research on the TIC relating to ICH.

2.2 Digital Content Industrial Chain

With the rise of digital economy, digital content products are emerging, and the digital content supply chain has become a new research area. Based on a few of existing studies, in a digital content industrial chain, the media publisher provides content to the media aggregator platform and independent media service platforms, and earns profits through advertisements and content sales. The key to the chain is whether a media publisher can find the most profitable way in its operation of its distribution channel. Typically, the publisher uses the free service on its direct media service platform to attract more viewers and uses the paid service for additional revenue earning [14].

Research on digital content industrial/supply chain has been in its infancy, and a limited number of studies focus on the industrial/supply chain relating to industries of game, telecommunication, and publishing, while no studies have been done regarding the tourism industry. As an active actor in the family of electronic businesses and digital economy, the tourism digital industrial chain deserves more academic attention.

2.3 VR Applications in TIC

Academic interest on the application of VR in tourism started in the 1990s, a period marked by the emergence of new and affordable VR devices [15]. These devices have been instrumental in fuelling advancements and opportunities for VR's integration into tourism development, leading to a growing demand for virtual tourism experiences and an increasing number of relating studies since then. The recent concerns primarily centre around the role of VR in enhancing tourist experiences and its increasing potential as a marketing tool [6], which correspond to the perspectives of production and marketing of the TIC.

2.3.1 VR Application from the Production Perspective of TIC

Research on the production perspective focuses primarily on tourism consumers regarding factors influencing tourist satisfaction and willingness to adopt/re-adopt the VR tourism products, and how to effectively improve tourist experience of such products. Factors influencing VR tourism satisfaction and travel intention include individuals' motivations [16], VR experience [17], technology predisposition [16, 18], age

[18], etc. These studies tend to identify the conditions under which the abovementioned influencing factors can work. For example, some researchers found that extrinsic motivation, when compared to intrinsic motivation, was more likely to cause tourists to choose tourism products with VR content [19]. Others found that people were likely to choose VR-induced tourism products due to safety considerations during the period of Covid-19 epidemic [20]; with this regard, a few researchers question the sustainability of VR tourism products after the epidemic.

Studies on VR tourist experience improvement pay attention to the relevance of presence, immersion, and flow regarding individual's VR experience and how these states of VR experience can be achieved. A common observation is that the quality of tourist experience is influenced by the interaction between the characteristics of VR system and psychological and physiological mechanisms of tourists, with the ultimate objective of inducing a sense of absorption [21], presence [22], and immersion [23] in the tourist. These studies involve various VR content contexts, including tourist destinations, attractions, heritage sites, and hotels.

2.3.2 VR Application from the Marketing Perspective of TIC

Studies on the market perspective of VR-induced tourism emphasise on the effectiveness of VR as a marketing tool [5]. These studies underline the critical role of VR in creating the perception of authenticity [24] and inducing the sense of low manipulation [25]. It is generally found that VR positively affects cognition, approach/avoidance behaviour and encourages satisfaction, purchase decisions, and intentions of revisitation and recommendation [26]. Existing studies have explored the factors and effects of tourist consumers' VR experience (including intangible cultural heritage travel experience) and the role of VR as a marketing tool from the perspective of production and marketing of the TIC. Regarding the research on enhancing tourists' experience, although most researchers pay attention to the impact of external factors (such as technical ease of use) on VR, few studies involve the role of computer medium that connects products and consumers. Computer medium could enhance the VR-induced tourism experience by providing a highly immersive and interactive environment and allows for easy sharing of experiences. It could also allow for a high degree of interactivity, providing tourists a more dynamic and personalised experience. Therefore, it is very necessary to incorporate computer medium into the research of VR tourism experience, especially for the VR-induced ICH tourism products that have multiple functions, i.e., entertainment, education, leisure, cultural communication. Similarly, high-quality computer medium plays an important role in eliminating consumer resistance to marketing information and improving marketing effect. Therefore, this study first constructs three models of industrial chains——ICH tourism industrial chain, ICH tourism digital content industrial chain, and ICH tourism VR content industrial chain and compares their characteristics, aiming to providing theoretical guide for the ICH tourism practice. Additionally, this study takes the Cloisonne art experience tour provided by the Beijing Enamel Factory Co., LTD, China as a case study and discusses the choice of computer medium of ICH for tourism, so as to enhance the marketing effect of the ICH products in the TIC.

3 A Comparison of Three Industrial Chains regarding ICH Tourism

To better understand the role of VR technology in the tourism industrial chain, this paper constructs the ICH tourism industrial chain, ICH tourism electronic content industrial chain, and ICH tourism VR content industrial chain in the context of tourism development based on ICH resource (Figure 1). Through comparison, this paper illustrates the differences between traditional tourism products, digital content tourism products, and VR content tourism products in the process from resources to end consumers.

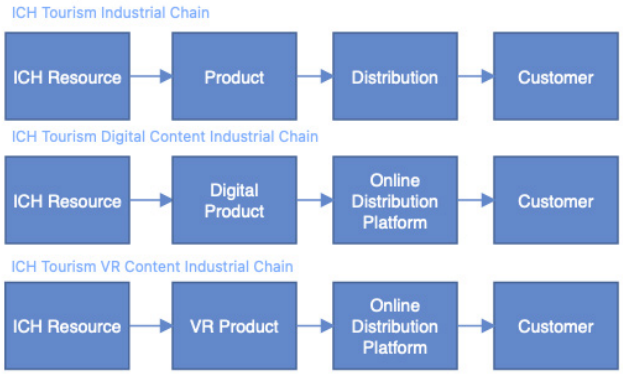


Figure 1. ICH tourism industrial chain, ICH tourism digital content industrial chain, and ICH tourism VR content industrial chain

In the ICH tourism industrial chain, ICH resources are those such as folk customs, traditional crafts, performing arts, festivals, etc. To be developed into tourism products (e.g., ICH tourist attraction, ICH museum), these resources should have high cultural and tourism values, are specific territory-rooted, and can provide tourists with unique ICH cultural experiences [11]. The transformation of ICH resources into tourism products requires the integration of ICH resources with the destinations' physical, environmental and socio-cultural characteristics and consideration of the characteristics and needs of potential tourists. The distribution of ICH tourism products refers to the process of promoting and selling the products to potential tourists. This involves two steps: first, the tourism product information is transmitted to the consumer through online/offline channels; second, the consumer buys the product after receiving the information, and travels to the destination to complete the consumption process. Only after consumers visit tourist destinations can the TIC be finally formed.

ICH tourism digital content industrial chain refers to a process of creating, distributing and sharing ICH-based digital content to potential customers for their purchase consideration [27]. ICH resources here include not only those mentioned in the ICH tourism industrial chain, but also digital content creators who contribute knowledge to

the content creation. The transformation of ICH resources into products involves a process of digitalisation of the ICH resources using digital technologies, including creating digital documentations, videos, audio recordings, or interactive experiences that allow consumers to engage with the ICH culture virtually. These platforms could be websites, social media platforms, or mobile applications that are designed to attract potential tourists and provide them with an immersive experience. Different from that of the ICH tourism industrial chain, the process of tourism digital content industrial chain is primarily completed through the online distribution platform without any physical movement of tourists to a particular destination. For this reason, there is no limit to the number of ICH digital content products available, as long as the product is attractive to consumers. Similarly, the target markets are those who are interested in the ICH digital content product and not categorised based on geographical regions typically used by marketers in ICH tourism industrial chain.

The ICH tourism VR content industrial chain can be considered an advanced version of ICH tourism digital content industrial chain. A major difference is that the former chain adopts VR technologies to create immersive experiences that allow consumers to engage with the ICH culture in a highly authentic and interactive way [28]. Additionally, the online distribution platform is designed to provide an intuitive and user-friendly interface for consumers to navigate and engage with the products. Through the VR experiences, tourists can immerse themselves in the ICH culture, explore historical sites, interact with locals, and gain a deeper understanding and appreciation of the ICH elements.

4 Virtual Reality Devices Compared to Flat Screen Devices in ICH TIC

To research for the best medium for ICH to be used in TIC, a classification of existing computer devices being used in TIC is needed. Based on visual difference, two categories are defined. Flat screen devices are defined as smartphones, tablets, monitors and TVs. VR devices are defined as Head Mounted Displays (HMDs) (e.g., oculus quest) and Mixed Reality HMDs (e.g., Microsoft HoloLens) [29]. To compare the two categories on their capability of delivering ICH tourism product, we will be using qualitative evaluation of immersion. As a measurable aspect of display technology, immersion is considered an objective construct that contains four determinants: (1) inclusive (to what degree is the physical reality neglected), (2) surrounding (to what extent does the display allow a panoramic view), (3) extensive (level of ability to adapt to multiple sensory modalities), and (4) vivid (level of clarity and freshness evoked by, for example, resolution and fidelity) [30]. In short, immersion enables users to feel where they are and what they are doing as if it is real [31]. Based on these four determinants, characteristics of flat screen and VR devices are discussed and compared in 4.1 and 4.2 (Table 1).

Table 1. Comparison between flat screen devices and VR devices on four determinants of immersion

Determinants	Flat screen	VR
Inclusive	Recognisable formfactor	Real world unseeable
Surrounding	Limited peripheral vision	Peripheral vision
Extensive	Indirect peripheral	Direct peripheral
Vivid	High fidelity display	High fidelity display

4.1 Flat Screen Devices

Flat screen devices are the most ubiquitous computer device being used today, allows ICH tourism product made for flat screen devices accessible to more customer than VR devices. On top of this, content creation for flat screen devices have matured through the recent decade, makes it cheaper and more efficient to create ICH tourism product for flat screen devices. However, flat screen devices have shortcomings in immersing the user. Considering the four determinants for immersion, in flat screen devices, phone and tablets can provide user with vivid display and some indirect extensive peripheral for interaction, such as touch screen, keyboard, mouse, microphone, and motion tracking device. The extensive peripherals are indirect because the user is not directly manipulating the virtual item as if it is in a 3d space and have relative distance to the user, user need to use a mediate device to interact with the virtual world, or, in motion tracking's case, lack of real-world depth when interacting due to distance between eye and display. Furthermore, Flat Screen Devices lack real surrounding feeling due to most flat screen not covering the entirety of peripheral vision. While there are bigger sized screens that could cover entirety of peripheral vision, they are often not as cost effective as Virtual Reality device, and still cannot fully surround user when user rotate their head. As for inclusive determinant all use of mediate device and flat screen itself reminds the user of the real world, thus inclusivity is also limited to just screen content.

Depth perception is another factor affecting both vivid and extensive feelings, it is user's ability to perceive depth in the simulated environment. Depth perception in flat screen devices is limited to stereoscopic displays, although it provides perceptual depth almost same as optically calculated depth, the virtual-image position is affected by viewing distance [32]. Stereoscopic displays often require viewer to stay in a zone of comfortable viewing, when outside the zone of comfortable viewing, the conflicting stimuli induces visual discomfort to the user [33]. Panoramic videos are frequently used in ICH preservation, despite flat screen device being able to display panoramic videos most of these devices often requires scrolling and sometimes physically moving the mobile device to adjust viewing angle, such interaction is less direct than user turning their head. Flat screen devices are more suitable to display non-panoramic content with fixed camera angle.

4.2 VR Devices

Although VR have been receiving increasing attention since the 1980s, VR device's presence in the consumer market have not reached as ubiquitous as flat screens, factors such as limited use case, unmature display technology and limited consumer grade computing power over the last decades can be the reason. Thus, the ICH tourism product may not reach an audience group as wide as flat screen device. However, ever since Meta's introduction to their Quest[1] line up of VR device, VR has been attracting greater consumer interest, as it provides better immersive experience than flat screens.

From the visual experience perspective, due to advances in display technology, VR devices can provide vivid feeling on par with flat displays, with Apple Vision Pro containing 23 milling pixels and up to 100Hz refresh rate[2]. VR devices cover a large degree of peripheral vision of user, and changes viewing content based on user's spatial location and rotation through use of camera, depth sensor and gyroscope. This feature makes VR device more suitable to display panoramic contents such as ICH crafting skill or dancing, thus VR device gives user more surrounding feeling than flat screens.

In terms of depth perception, stereoscopy is a fairly used techniques in VR to reproduce the depth of an environment, it presents a set of images, left image present to left eye and right image present to right eye, to reproduce a 3D image when viewed, such visual cue is considered as binocular cue [34]. Different from stereoscopic display mentioned in flat screen devices, viewing distance, disparity of image and disparity of the eye are fixed due to VR display being head-mounted, meaning viewer will always stay in zone of comfortable viewing. Additionally, the ability to spatially change viewing location and rotation allowed implementation of motion parallax visual cues for user depth sensing [34].

As for extensive determinant, various peripherals such as spatially tracked controller, motion capture, and depth sensing camera allowed locomotion, selection, and manipulation within the virtual space naturally. In ICH tourism product, user can virtually participate in ICH activities such as performing, crafting and social practicing, which in turn get higher engagement, better cultural understanding, thus better inclusive experience. With direct extensive peripheral such as hand tracking camera and spatial audio, combined with above mentioned depth perception, the only prominent reminder of reality remains for weight of VR head set on head. Compared to flat screens, user will fill much more inclusive and reminded less of the real world.

Since user is able to view more information, they can choose to pay attention to details they are interested in ICH product, rather than controlled content presented by content creator. This is especially useful for ICH such as skill to craft, as surrounding of the craft artist can be complex. Being included in virtual world also make stereo sounds more realistic for ICH such as ritual and social practice, as directional sounds can have associated visual object rather than out-of-screen.

5 Visualisation Features

Based on United Nations Educational, Scientific and Cultural Organisation (UNESCO) definition[3], ICH are "traditions or living expressions inherited from our ancestors and passed on to our descendants", a list of examples includes 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. From this list of examples, we select three distinctive categories, they are performing arts, social practices, and knowledge and skills to produce traditional crafts. Since the focus of this paper is to discuss VR visualisation features, oral tradition which is more oriented to sound aspect of ICH is excluded from our selection. Rituals and festive events can be seen as comprised by social practices. While practices concerning nature and the universe can be visualised, many can be explained alongside the selected three categories through subtitle or voice over. Ritual and festive events can be considered as combination of performing arts, oral traditions, and knowledge and practices concerning nature and the universe on many occasions. In each of the selected category, different visualisation features will be discussed. Figure 2 gives an overview of our ICH Tourism VR content industrial chain.

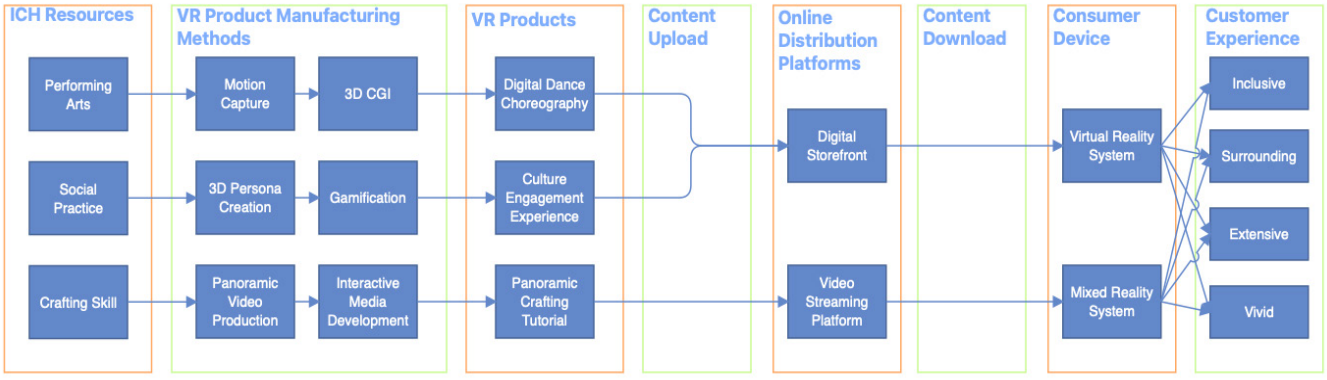


Figure 2. ICH tourism virtual reality content industrial chain

1 Meta Quest lineup: https://www.meta.com/gb/quest/
2 Apple Vision Pro: https://www.apple.com/apple-vision-pro/specs/
3 UNESCO – what is Intangible Culture Heritage: https://ich.unesco.org/en/what-is-intangible-heritage-00003

There are three general visualisation features that regardless ICH type, the software should follow. One general visualisation feature should be prominent subject content, since user is able to pay attention to details, they are interested in within the virtual environment, they may steer away from what content creator wants to show. Thus, a subject content should be made prominent to user to attract their attention visually or verbally. Secondly, since dynamic visual cues can only be induced when observer change viewing position or object move in space, VR contents should not be static, Lastly, software technique that reproduce binocular vision cues such as stereoscopy could lead to discomfort for users [34], thus its use should be limited to situation when depth sensing is necessary.

The tourism product in ICH TIC is the intangible culture touring experience, VR tourism product should replicate experience of ICH touring much like real life. For performing arts, as a tourism product, customer should be able to not only view, but also learn the movement, therefore, it's important to visualise every movement correctly. In such cases, motion tracking of the performer would be a good way to capture performer's skeleton movement. For precise capture of every little movement, we propose using industry's mature solution of inertia tracking, which places inertia sensor on joints of performer, tracks the velocity of each movement and replicate its position in 3D space. From the Tracking data, the dance can be replicated in virtual space using 3D CGI techniques of 3D modelling, 3D animation, and event scripting. The result product will be a digital dance choreography that customer can view and learn from. For this type of ICH, VR head set with no-reality see through would be enough, for a better learning experience, this tourism product should be paired with motion tracking sensors such as inertia sensor for the customer to assess their movement accuracy.

Social practices are interactive activities of local community, such as ceremony, festival, and sports games. Social practice product also involves in recording action of the human, such that customer understand the meaning behind their behaviours, however, rather than mimicking their behaviour through motion, it would be better to practice it with a partner, whether its traditional game, marriage, or rite. Therefore, a virtual persona should be visualised, acting as partner or opponent depends on the social practice occasion, who interact with the customer in the virtual space. Oftentimes, the persona is constructed as 3D model that interact with customer, a gamification process turns the real-life social interactions to appropriate game-like objectives in virtual world. In some few cases where user do not need to directly contact object or persona in virtual world, using 3D real scene recording would suffice, however, since its capability is limited, using 3D persona and gamified events generally provide more immersion due to higher inclusiveness.

As for knowledge and skills to produce traditional crafts, the product would allow user to learn the skill and replicate traditional crafts. Tools, materials and how to use the tools are essential part of the product, they need all to be recorded together, thus panoramic video recording would be a solution. When recording craft artist's skill, to avoid any obstacle in view, multiple viewing angle of the same process should be recorded. The video should be made interactive if the user wants to pause when performing action their selves, rewind video to view previous steps, and change viewing angle to see hand movement from another angle. The product for this ICH would be the interactive tutorials that teaches customer ICH crafting skills. As for hardware, it would be better to use Mixed Reality headset with reality see-through, so for wood, sewing and knotting crafts, customer can view the video and replicate in real life at the same time.

6 Case Study

6.1 Tourism Products

The Cloisonne art experience tour is an industrial-tourism product provided by the Beijing Enamel Factory Co., LTD, China. The company was founded in January 1956 and is the only Chinese time-honoured brand in the Cloisonne industry. The Cloisonne art experience tour relies mainly on the Cloisonne handmaking skills, which is a national-level ICH project. Every year, about 50,000 individual tourists and more than 300 group tourists come to visit. The tour includes the following parts. (1) Tourists learn the history of Cloisonne crafts as well as Cloisonne handmaking skills. (2) Tourists visit the Cloisonne-making exhibition area, which is the highlight of the tour. After viewing the production process of Cloisonne crafts, tourist watch the ICH handmade skills along the way. (3) Tourists visit the Cloisonne Art Museum of China and the Precious Museum to learn about the development of the Beijing Enamel Factory Co., LTD and to see Cloisonne crafts of various historical periods and styles. (4) Tourists exchange ideas about Cloisonne-making skills with senior technician face to face. (5) Tourists visit the Jingfa Art Garden Cloisonne Factory Shop to appreciate and buy Cloisonne commodities. (6) Tourists participate in a 60-minute learning course of mental wire inlay or colour painting.

6.2 ICH Tourism VR Product – The Paint Blue and Wire Inlay Tutorial

For this case study, an Intangible Culture Heritage VR tourism product is created based on part (2) of the Cloisonne art experience tour, highlighting two processes of Cloisonne making, metal wire inlay and colouring blue.

The VR footage is captured with an Insta 360 one X, three footages were captured for each of two processes from centre, left and right viewing angle. Each footage is of 10 minute long, resolution of 5760 x 2880, 30 frames per second, and 90-bit rate, capturing complete steps of metal wire inlay and colouring blue. An example of captured footage of is shown on Figure 3. An interactive software is made with Unity 3D, allowing user to view panoramic video, pause and switch viewing points with a control panel. When switching viewing point, the default facing direction is toward the workspace for better usability and immersion. An example of proposed interactive software is shown on Figure 4.

Figure 3. Example panoramic footage of paint blue

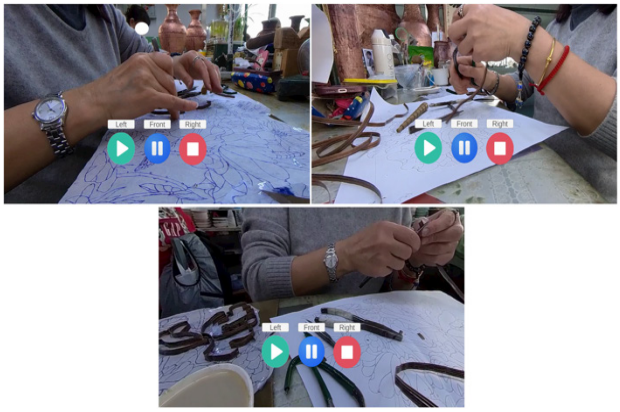


Figure 4. Left, right and front view of interactive software on metal wire inlay

As mentioned in section 5, prominent subject content when visualising scene is needed for a VR device, this is achieved through making the Cloisonne art maker taking about half of the viewer sight. Since this case study is done on skills of traditional craft as a tourism product, work tools and environment are recorded in this product, along with three viewing angles of the same process, to let viewer see without obstruction.

In this product, VR's vivid determinant is achieved through providing high resolution footage of real-world using Meta Quest 2's 1832x1920 resolution[4] display per eye. VR's surrounding determinant is achieved through providing panoramic view of the entire workplace, allowing user to see what exact tools and techniques are needed for Cloisonne making. VR's extensive determinant is achieved through utilisation of gyroscope sensor of VR headset, allowing user to change viewing direction through head movement. VR's inclusive determinant is achieved through brining the user into the 3D real life scene.

7 Discussion

7.1 Three Industrial Chains regarding ICH Tourism

First of all, based on the industrial chain and tourism industry chain in the field of economics, this study constructs three industrial chains, namely, ICH tourism industrial chain, ICH tourism digital content industrial chain, and ICH tourism VR content industrial chain. The construction of the ICH tourism industrial chain takes ICH as the resource of tourism products, and the components of the chain are in no difference from those of the general TIC. However, with the increasing demand for ICH protection and the continuous applications of ICH resources in the innovation of tourism products, the construction of ICH tourism industrial chain will help the industry to better develop corresponding tourism products according to the characteristics of ICH resources, and at the same time contribute to the protection of ICH with the development of tourism. Secondly, the ICH tourism digital content industrial chain integrates the development of the tourism industry with the emerging digital economy. It interprets different aspects of digital applications to the different components of the ICH tourism industrial chain, and provides a theoretical framework for the integration of ICH tourism into the digital economy, which is in line with the current development trend of global tourism. Thirdly, the ICH tourism VR content industrial chain applies VR technology to the ICH tourism industrial chain, which not only brings innovative tourism products and effective channels for product distribution, but also improves the management experience of different institutions involved in the chain, which has a forward-looking guiding significance for the development of tourism industry.

ICH types can be categorised to three main groups: performing arts, social practice, and crafting skills. Following the theoretical framework of ICH Tourism VR content industrial chain, specific manufacturing method for VR tourism product has been composed respectively to each group. This streamlined process can accelerate VR tourism content creation for ICH.

7.2 VR in Traditional TIC

Based on the functions of panoramic videos, VR's role in the TIC can be summarised in the following aspects. First, VR technology helps construct virtual tours of ICH tourism products. Virtual tours allow potential tourists to pre-taste the tourism product they intend to buy, thereby reducing their risk of buying a product they don't like. With the video on the tourism service provider's official website, the intangible feature of the tourism product to some extent is made tangible, and the problem of "how can we get consumers to take notice of a particular product," which often worries tourism marketers, is solved [35].

Second, VR technology helps improve the marketing of the ICH projects by adding virtual tours as part of a destination's promotional mix [36]. Traditional marketing initiatives primarily use static pictures, videos, and word of mouth for ICH publicity. However, with the help of VR technology, a pre-travel experience regarding ICH projects can be provided with high fidelity and strong intuitiveness. Additionally, VR-driven marketing campaigns have advantages such as faster dissemination speed, wider influence, and few geographical restrictions. In this sense, VR marketing is more beneficial to brand building for ICH projects and innovation of destinations' marketing systems. From the perspective of the TIC, potential consumers' pre-trip experience provided by a panoramic video belongs to the latter part of the TIC, which indicates a transmission of production information to consumers.

4 Meta Quest 2: https://www.meta.com/gb/quest/products/quest-2

Third, when the panoramic video is shared on the video streaming platform, people who are interested in the traditional culture and ICH handmaking skills will watch the video and learn the skill. Such a learning experience may stimulate their interest in participating in the Cloisonne art experience tour someday, or they may share their learning experience and recommend others learn about or purchase the tourism product. This includes a process in which product information is transmitted to consumers; however, the difference is that the consumers lead this process.

8 Conclusion

By constructing the ICH tourism industrial chain, ICH tourism digital content industrial chain, and ICH tourism VR content industrial chain, this study aims to integrate the ICH tourism development into the digital economy and VR technologies. The constructed three industrial chains are an extension of the industrial chain theory to the field of tourism, and has practical implications for transforming ICH resources into tourism products and broadening the length and width of the TIC. In addition, this study integrates digital content and VR technologies into the TIC. This helps to promote the production of more creative tourism products and the effective connection between all links of the industrial chain and can better promote the conversion of ICH resources into tourism products, so as to meet the current needs of tourist consumers for in-depth experience travel.

Due to limited recording equipment, despite the viewing angles are viewing the same process, the time of the process is not the same, in the future, it would be better to use panoramic recorder equal to number of viewing points to make sure one action of the craft artist at a single timeframe is same in other viewing angles. Another limitation of the study is the lack of sufficient participants to experience the VR product as an assessment of impact of the VR product. The user interface design of VR should also be made hidden and less noticeable in the future, as current user interface is too obvious and takes up too much viewing space, thus downgrading user's feeling of inclusiveness.

Acknowledgements

This work is partially supported by the National Natural Science Foundation of China──Research on the Value, Mechanism and Symbiotic Model of Intangible Cultural Heritage in Rural Revitalisation (72073011), and the Beijing Social Science Foundation──The Study on Multi-subject Collaborative Strategy of Integrated Development of "Intangible Cultural Heritage+" in Beijing (23JCB014).

References

[1] UNESCO, *Convention for the Safeguarding of the Intangible Cultural Heritage*, October, 2003.

[2] M. Z. Idris, N. B. Mustaffa, S. O. S. Yusoff, Preservation of Intangible Cultural Heritage Using Advance Digital Technology: Issues and Challenges, *Journal of Arts Research and Education*, Vol. 16, No. 1, pp. 1-13, June, 2016.

[3] M. H. Esfehani, J. N. Albrecht, Planning for Intangible Cultural Heritage in Tourism: Challenges and Implications, *Journal of Hospitality & Tourism Research*, Vol. 43, No. 7, pp. 980-1001, September, 2019.

[4] A. Kaur, A. Gazizullina, A. Mantri, Analyzing the Effects of Virtual Reality Headsets on Human Memory, *International Journal of Performability Engineering*, Vol. 19, No. 4, pp. 234-241, April, 2023.

[5] Y. Zhang, M. Q. Han, W. W. Chen, The Strategy of Digital Scenic Area Planning from the Perspective of Intangible Cultural Heritage Protection, *EURASIP Journal on Image and Video Processing*, Vol. 2018, pp 1-11, November, 2018.

[6] M. L. Calisto, S. Sarkar, A Systematic Review of Virtual Reality in Tourism and Hospitality: The Known and the Paths to Follow, *International Journal of Hospitality Management,* Vol. 116, pp. 1-14, January, 2024.

[7] J. B. Houlihan, International Supply Chains: A New Approach, *Management Decision*, Vol. 26, No. 3, pp. 13-19, March, 1988.

[8] A. Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, University of Chicago Press, 1977.

[9] UNWTO, *Distribution Channels*, September, 1975.

[10] UNWTO, *Global Distribution Systems in the Tourism Industry*, March, 1994.

[11] X. Zhang, H. Song, G. Q. Huang, Tourism Supply Chain Management: A New Research Agenda, *Tourism Management*, Vol. 30, No. 3, pp. 345-358, June, 2009.

[12] Q. Qiu, Y. F. Zuo, M. Zhang, Intangible Cultural Heritage in Tourism: Research Review and Investigation of Future Agenda, *Land*, Vol. 11, No. 1, Article No. 1010139, January, 2022.

[13] X. Meng, J. Guo, S. Y. Liu, Design of Cultural and Creative Products under the Characteristic Analysis of Industrial Heritage Elements in Liaoning──Taking Dalian's Modern Industrial Heritage as an Example, *Journal of Civil Engineering and Urban Planning*, Vol. 4, No. 1, pp. 52-58, 2022.

[14] Y. Kim, J. Mo, Pricing of Digital Video Supply Chain: Free versus Paid Service on the Direct Distribution Channel, *Sustainability*, Vol. 11, No. 1, Article No. 11010046, December, 2018.

[15] J. Beck, M. Rainoldi, R. Egger, Virtual Reality in Tourism: A State-of-the-art Review, *Tourism Review*, Vol. 74, No. 3, pp. 586-612, June, 2019.

[16] K. F. Yuen, J. Chua, K. X. Li, X. Wang, Consumer's Adoption of Virtual Reality Technologies for Marine Conservation: Motivational and Technology Acceptance Perspectives, *Technological Forecasting and Social Change*, Vol. 182, Article No. 121891, September, 2022.

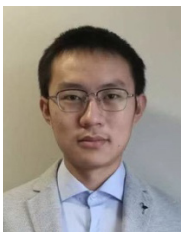
[17] D. Guttentag, Virtual Reality and the End of Tourism? A Substitution Acceptance Model, in: Z. Xiang, M. Fuchs, U. Gretzel, W. Hopken (Eds.), *Handbook of e-Tourism*,

Springer International Publishing, Cham, 2020, pp. 1-19.
[18] V. Bogicevic, S. Q. Liu, S. Seo, J. Kandampully, N. A. Rudd, Virtual Reality is So Cool! How Technology Innovativeness Shapes Consumer Responses to Service Preview Modes, *International Journal of Hospitality Management*, Vol. 93, Article No. 102806, February, 2021.
[19] X. Deng, H. R. Unnava, H. Lee, "Too True to be Good?" When Virtual Reality Decreases Interest in Actual Reality, *Journal of Business Research*, Vol. 100, pp. 561-570, July, 2019.
[20] O. S. Itani, L. D. Hollebeek, Light at the End of the Tunnel: Visitors' Virtual Reality (Versus in-person) Attraction Site Tour-related Behavioral Intentions during and post-COVID-19, *Tourism Management*, Vol. 84, Article No. 104290, June, 2021.
[21] M. Lee, S. Lee, M. Jeong, H. Oh, Quality of Virtual Reality and Its Impacts on Behavioral Intention, *International Journal of Hospitality Management*, Vol. 90, Article No. 102595, September, 2020.
[22] K. Nam, C. S. Dutt, J. Baker, Authenticity in Objects and Activities: Determinants of Satisfaction with Virtual Reality Experiences of Heritage and Non-heritage Tourism Sites, *Information Systems Frontiers*, Vol. 25, No. 3, pp. 1219-1237, June, 2023.
[23] S. Hudson, S. Matson-Barkat, N. Pallamin, G. Jegou, With or without you? Interaction and Immersion in a Virtual Reality Experience, *Journal of Business Research*, Vol. 100, pp. 459-468, July, 2019.
[24] X. Fan, X. Jiang, N. Deng, Imagination Versus Telepresence: Consumer Patronage Intention toward Peer-to-peer Accommodations in Photo-enhanced Imaginative Conditions and Virtual Reality Contexts, *Journal of Travel Research*, Vol. 62, No. 8, pp. 1647-1666, December, 2022.
[25] N. Spielmann, U. R. Orth, Can Advertisers Overcome Consumer Qualms with Virtual Reality? Increasing Operational Transparency through Self-guided 360-Degree Tours, *Journal of Advertising Research*, Vol. 61, No. 2, pp. 147-163, June, 2021.
[26] S. Skard, E. S. Knudsen, H. Sjåstad, H. Thorbjørnsen, How Virtual Reality Influences Travel Intentions: The Role of Mental Imagery and Happiness Forecasting, *Tourism Management*, Vol. 87, Article No. 104360, December, 2021.
[27] J. Holliman, J. Rowley, Business to Business Digital Content Marketing: Marketers' Perceptions of Best Practice, *Journal of Research in Interactive Marketing*, Vol. 8, No. 4, pp. 269-293, October, 2014.
[28] I. P. Tussyadiah, D. Wang, T. H. Jung, M. C. T. Dieck, Virtual Reality, Presence, and Attitude Change: Empirical Evidence from Tourism, *Tourism Management*, Vol. 66, pp. 140-154, June, 2018.
[29] A. Kaur, A. Mantri, Evaluating the Impact of Hybridization of Vision and Sensor-Based Tracking on the Accuracy and Robustness of Virtual Reality-Based Shooting Tutor for Defense Training, *International Journal of Performability Engineering*, Vol, 19, No. 9, pp. 559-567, September, 2023.
[30] M. Slater, S.Wilbur, A Framework for Immersive Virtual Environments (FIVE): Speculations on the Role of Presence in Virtual Environments, *Presence: Teleoperators and Virtual Environments*, Vol. 6, No. 6, pp. 603-616, December, 1997.
[31] M. Slater, A. Steed, A Virtual Presence Counter, *Virtual Environment*, Vol. 9, No. 5, pp. 413-434, October, 2000.
[32] B. Choi, D. Choi, J. Lee, S. Lee, S. Kim, Depth Sensitivity of Stereoscopic Displays, *Journal of Information Display*, Vol. 13, No. 1, pp. 43-49, June, 2012.
[33] M. Lambooij, W. Ijsselsteijn, M. Fortuin, I. Heynderickx, Visual Discomfort and Visual Fatigue of Stereoscopic Displays: A Review, *Journal of Imaging Science and Technology*, Vol. 53, No. 3, Article No. 30201-1, May, 2009.
[34] F. E. Jamiy, R. Marsh, Survey on Depth Perception in Head Mounted Displays: Distance Estimation in Virtual Reality, Augmented Reality, and Mixed Reality, *IET Image Processing*, Vol. 13, No. 5, pp. 707-712, March, 2019.
[35] R. George, *Marketing Tourism and Hospitality: Concepts and Cases*, Palgrave Macmillan, 2021.
[36] J. P. Guerra, M. M. Pinto, C. Beato, Virtual Reality-shows a New Vision for Tourism and Heritage, *European Scientific Journal*, Vol. Special edition, pp. 49-54, March, 2015.

Biographies

Shaojun Ji is an associate professor in the Tourism College at Collaborative Innovation Center of eTourism, Tourism College, Beijing Union University, China. Her research interests include tourism marketing, tourist behaviour, and virtual experience.

Lu Zhang is a associate professor in the Tourism College at Collaborative Innovation Center of eTourism, Tourism College, Beijing Union University, China. Her research interests include creative computing, smart tourism, and tourism experience. E-mail: lytzhanglu@buu.edu.cn.



Zisen Zhou is currently a PhD student in University of Leicester, School of Computing and Mathematics. He is studying under supervison of Professor. Hongji Yang and his research interest are: Creative Computing and Persuasive System Design.

Hongji Yang is a Professor in the School of Computing and Mathematical Sciences, Leiceste University, UK. His research interests include software engineering, creative computing and internetworking. He became an IEEE Golden Core Member in 2010.

Meiyu Shi, professor of Beijing Union University, master tutor, Doctor of Tourism Management of Chinese Academy of Social Sciences, postdoctoral fellow of Business School of Renmin University of China, visiting scholar of Peking University in China, visiting scholar of De Montfort University in UK.