

ORIGINAL ARTICLE

Designing an Intelligent Model of the Digital Ecosystem for Urban Tourism Brand Development within the Framework of Urban Ecology in Iran, Case Study: Kermanshah Province

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EXTENDED ABSTRACT

Introduction

The emergence of Web 4.0 as the fourth generation of the Internet has created a fundamental shift in the structure of human interaction with digital space. Beyond merely employing artificial intelligence, Web 4.0 integrates emerging technologies such as the Internet of Things (IoT), augmented and virtual reality (AR/VR), big data, advanced analytics, and self-learning systems into an intelligent, interactive, and adaptive digital ecosystem. In the global tourism industry, countries such as Vietnam and Singapore have successfully utilized social robots, facial recognition, AI-based chatbots, and AR platforms to significantly increase tourist satisfaction and operational efficiency. For example, leading international brands like Marriott and Singapore Airlines have used intelligent chatbots, behavioral data analysis, and AI-driven customer experience management systems to enhance service processes and improve user experience in real time. However, cultural organizations in developing countries, including Iran, face an urgent need to design intelligent digital ecosystems to align with global standards, as international tourists increasingly use Web 4.0 technologies to choose travel destinations. Domestic research has shown that applying Web 4.0 technologies in cultural tourism organizations can play an important role in sustainable development, stakeholder satisfaction, and cultural heritage preservation. Yet only a small fraction of Iran's cultural institutions have a systematic framework for digital transformation, highlighting the need for localized and integrated models. The Cultural Heritage, Handicrafts and Tourism Organization of Iran, as the governing body responsible for preserving and developing the country's cultural heritage, confronts three key challenges: digitalization of cultural assets, changing patterns of audience interaction, and integration of emerging technologies. Studies indicate that 78% of cultural organizations in developing countries lack a systematic framework for managing digital transformation. Research gaps exist in four areas: theoretical (integration of cultural management and advanced digital technologies), methodological (lack of mixed-method approaches), practical (need for localized models considering Iran's cultural diversity, infrastructure limitations, and legal and religious requirements), and technological (modeling the specific dynamics of Web 4.0 technologies in cultural heritage). Therefore, this study aims to design and develop an intelligent digital ecosystem model for the Cultural Heritage, Handicrafts and Tourism Organization in the context of Web 4.0.

Methodology

This research employed an exploratory mixed-methods design (qualitative-quantitative). In the qualitative phase, the systematic grounded theory approach of Strauss and Corbin (1998) was used. The population consisted of 35 experts, including senior managers, IT specialists, and cultural heritage professionals. Purposive sampling combined with the snowball technique was applied. Data were collected through in-depth semi-structured

interviews until theoretical saturation, which was achieved after the 19th interview. Data analysis involved three stages: open coding (extracting initial concepts), axial coding (identifying relationships among categories), and selective coding (developing the final conceptual model). To enhance trustworthiness, data triangulation and expert review were used. In the quantitative phase, the resulting model was tested using structural equation modeling (SEM) with SmartPLS. A researcher-developed questionnaire was administered to 384 key stakeholders (middle managers, digital service providers, and clients). Validity was assessed through confirmatory factor analysis (CFA), and reliability was examined using Cronbach's alpha and composite reliability (CR).

Findings

Open coding produced 250 initial codes, which were gradually reduced to 40 conceptual codes and, after expert validation, to 25 final codes, organized into six main categories within the paradigm model. Causal conditions included globalization of Web 4.0, upstream documents and government directives, evolving customer demands (e.g., complaints about lack of applications), international competition, the need for digital preservation of heritage (e.g., deterioration of historical monuments), technological gaps (e.g., World Bank reports on digital backwardness), and employee needs (e.g., lack of digital skills). The core phenomenon – the central category – was identified as “the intelligent digital ecosystem model for the Cultural Heritage, Handicrafts and Tourism Organization in the Web 4.0 context,” consisting of Web 4.0 integration, centralized management systems, multi-user platforms, data integration, expert solutions, and benchmarking of successful global experiences. Contextual conditions comprised digital infrastructure weaknesses (e.g., poor internet in some areas), limited budgets, multicultural audience requirements, unstable government support, and local innovation ecosystems (e.g., startup capacities). Intervening conditions were classified into three levels: environmental (macro policy changes, economic fluctuations, technology sanctions), organizational (structural constraints, managerial competencies, financial policies, stakeholder conflict, technology adoption), and human resources (skill gaps, lack of AI specialists, educational and motivational challenges, resistance to change, localization needs). Strategies were identified in three directions: technological and infrastructural (designing a smart tourism platform, AI chatbots, security protocols); knowledge and educational (AR training for guides, digital literacy enhancement, fostering a culture of innovation); and participative and economic (collaboration with knowledge-based firms, local community involvement in brand content development, attracting foreign investment). Outcomes were identified at two levels: operational and institutional (reduced operational costs, new digital revenue streams from apps and content sales, digitalization of cultural assets – over 50% of heritage items, increased transparency in reporting) and social and communicative (increased tourist satisfaction – up to 30% in pilot projects, improved organizational image in the media, modeling for other organizations). In the quantitative phase, the KMO measure was 0.969, and Bartlett's test was significant ($\chi^2 = 12,907.464$, $df = 561$, $p < 0.001$). Cronbach's alpha for all constructs exceeded 0.899, composite reliability ranged from 0.838 to 0.901, and average variance extracted (AVE) was above 0.605, all meeting recommended thresholds. Model fit indices were acceptable: CMIN/DF = 2.651, RMSEA = 0.057, CFI = 0.854, TLI = 0.840, GFI = 0.740, AGFI = 0.701. Structural equation modeling results supported all seven hypotheses with positive path coefficients and p-values less than 0.001: causal conditions → contextual conditions ($\beta = 0.958$), causal conditions → core phenomenon ($\beta = 0.876$), causal conditions → intervening conditions ($\beta = 0.852$), contextual conditions → strategies ($\beta = 0.407$), core phenomenon → strategies ($\beta = 0.325$), intervening conditions → strategies ($\beta = 0.199$), and strategies → outcomes ($\beta = 0.862$).

Discussion and Conclusion

The results indicate that Iran's tourism industry is transitioning toward an intelligent digital ecosystem in the context of Web 4.0, shaped by interactions among structural, managerial, technological, and cultural factors. The proposed model aligns with international frameworks such as those of Jacobides, Cennamo and Gawer (2018) on ecosystem theory, Gretzel et al. (2020) on smart tourism, Tiwana et al. (2019) on digital governance, and Boes et al. (2023) on digital tourism ecosystems. However, the model offers significant local innovations by incorporating Iran's specific cultural diversity (multi-ethnic contexts such as Kurdish and Lor communities), infrastructure limitations, institutional instability, and technology sanctions. Unlike many global models that focus primarily on technical aspects, the present model explicitly emphasizes the representation of local cultural identity, participation of indigenous communities (handicraft artists, local guides), intellectual property rights of cultural content, spatial justice, and digital

sustainability. The strong direct effect of strategies on outcomes ($\beta = 0.862$) confirms that well-designed technological, knowledge-based, and participative strategies can significantly improve tourist satisfaction, organizational transparency, and brand image. The model's six key components – intelligent technological infrastructure (AI, IoT, cloud computing), interactive digital content management (personalized, multimedia, AR/VR), big data analytics systems (behavioral pattern analysis, demand forecasting), smart stakeholder interaction mechanisms (integrated platforms connecting tourists, guides, artists, and investors), digital governance with a multi-stakeholder approach (national standards, adaptive monitoring, performance evaluation), and advanced cybersecurity systems (defense in depth, intrusion detection, RBAC) – form a comprehensive framework for digital transformation in Iranian cultural institutions. Comparative analysis shows that while the model shares common ground with international studies, it uniquely addresses the role of public cultural institutions, integrates cultural and technological dimensions, and provides actionable solutions for challenges such as data ownership, privacy, and digital preservation of heritage under sanctions. The successful experience of smart platforms in countries like Turkey and Malaysia offers inspiration, but the present model is specifically tailored to Iran's legal, cultural, and infrastructural realities.

Recommendations

At the macro level (national policy and governance): establish an agile “Digital Transformation Steering Center for Cultural Heritage”; formulate a national digital transformation document covering data ownership, ethical digital interaction, cultural security, and a participatory evaluation system; conduct comparative studies with South Korea, Estonia, and Finland to localize global frameworks; use blockchain for transaction recording, cultural content ownership, and resource transparency; design foresight scenarios for smart heritage over a five- to ten-year horizon with trend prediction and uncertainty analysis. At the meso level (organizational and regional management): design and implement a comprehensive smart infrastructure plan including IoT, augmented reality, cloud storage, and AI; launch a multi-lingual, location-based, personalized tourism services and brand platform; establish a monitoring and evaluation center for digital brand performance with indicators such as service usage rate, user satisfaction, and stakeholder participation; institutionalize digital talent management by identifying specialists, defining career paths, and connecting with universities; create a digital tourism ideas bank and innovation center; establish a “smart heritage living lab” as a shared experimental space; develop sentiment analysis systems and online management dashboards for real-time feedback and decision-making. At the micro level (local community, culture, and indigenous businesses): design AR tours based on local cultural narratives in cooperation with native associations; launch a network of local influencers to produce authentic content; create digital marketplaces for handicrafts and cultural products using e-commerce platforms; deploy a multi-lingual tourist support system using AI chatbots; implement a digital experience registration system for continuous brand improvement; apply gamification models in heritage applications; develop a sustainable engagement framework for returning tourists including digital loyalty services and exclusive packages; analyze cultural and social dimensions of technology acceptance among Kurdish and Lor communities to enhance digital participation and empathy.

KEY WORDS

Digital Ecosystem, Intelligent Model, Cultural Heritage, Web 4.0, Digital Transformation, Iran.

