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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 A B S T R A C T

Introduction

In the digital era, cities are no longer merely physical spaces for habitation and economic activity; they have evolved into intelligent, network-based units where urban identity, the lived experience of citizens, and brand image are continuously shaped through interaction with digital environments. The emergence of Web 4.0, artificial intelligence, the Internet of Things, and augmented reality has fundamentally transformed traditional urban planning and tourism management. Urban tourism, as a key component of urban identity and branding, plays an essential role in shaping the mental image of a city among domestic and international tourists. Kermanshah Province, with an area of 24,640 square kilometers and a population of 1,952,434, is one of the oldest cities in Iran. Located at the intersection of north-south and west-east corridors, bordering Iraq, and lying on the pilgrimage route to holy shrines, it possesses unique historical, cultural, and geopolitical assets for urban tourism branding. However, the province faces multiple challenges: weak digital and communication infrastructure, limited local financial resources, multi-ethnic and cultural complexities, unstable government support policies, and an ineffective linkage among universities, the tourism industry, and urban institutions. Prior studies have addressed technological, marketing, or environmental aspects of urban branding separately. No comprehensive model that integrates technological, environmental, cultural, and structural dimensions within a coherent and locally adapted framework – grounded in urban ecology and digital ecosystem theories – has yet been developed and empirically tested. Therefore, this study aims to design and validate an intelligent digital ecosystem model for urban tourism brand development in Kermanshah Province within the framework of urban ecology.

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 academic experts, urban managers, and tourism professionals in Kermanshah Province with at least a master's degree and ten years of professional experience in urban policy, tourism management, or urban branding. Purposive sampling combined with the snowball technique identified 35 eligible participants. 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, expert review of analyses, and continuous comparison of concepts were applied. In the quantitative phase, the resulting model was tested using structural equation modeling (SEM) with SmartPLS software. A researcher-developed questionnaire was administered to managers and specialists active

in urban tourism branding. 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. These were organized into six main categories within the paradigm model. Causal conditions included globalization of Web 4.0, international competitive pressure, global requirements and government directives, stakeholder expectations, regional patterns, development indicators, upstream documents, customer demands, deterioration of historical monuments, technology gaps, and new employee needs. The core phenomenon – the central category of the model – was identified as "the intelligent digital ecosystem model for urban tourism brand development within the framework of urban ecology," which is based on system design, integration, a central multi-user platform, data management, and expert solutions. Contextual conditions consisted of technical barriers (inadequate digital infrastructure), financial constraints, audience diversity due to multi-ethnic and cultural structure, local innovation capacity, and cultural challenges (resistance to change, traditional culture). Intervening conditions were classified into three levels: environmental (changes in macro urban policies, economic fluctuations, national and international tourism market developments, technology sanctions), organizational (structural constraints, financial policies, management maturity level, stakeholder conflict, technology adoption), and human resources (shortage of AI specialists, skill gaps, educational and motivational challenges, need for localization). Strategies were identified in three directions: technological and infrastructural (designing and deploying a smart tourism platform, experience-based applications, interactive chatbots, augmented reality); knowledge and educational (enhancing digital literacy of tourism practitioners, holding workshops, fostering a culture of innovation); and participative and economic (synergy with knowledge-based firms, local community participation in brand content development, attracting private and foreign investment). Outcomes were identified at two levels: operational and institutional outcomes (improved efficiency of tourism management systems, enhanced transparency of urban institutions, digitalization of tourism services and content, reduction of operational costs, creation of new revenue streams through online services); and social and communicative outcomes (increased tourist satisfaction with digital experiences, enhanced local community participation in brand production and promotion, improved image of Kermanshah city in public opinion and media, digital preservation of cultural heritage, and modeling for other cities). In the quantitative phase, the KMO measure was 0.965, and Bartlett's test was significant (χ^2 = 11,177.248, df = 435, $p < 0.001$). Cronbach's alpha for all constructs exceeded 0.847, composite reliability ranged from 0.845 to 0.942, and average variance extracted (AVE) was above 0.569, all meeting recommended thresholds. Model fit indices were acceptable: CMIN/DF = 2.521, RMSEA = 0.062, CFI = 0.824, TLI = 0.803, GFI = 0.725, AGFI = 0.705. Structural equation modeling results supported all seven hypotheses with positive path coefficients and p-values less than 0.001: causal conditions → contextual conditions (β = 0.749), causal conditions → core phenomenon (β = 0.798), causal conditions → intervening conditions (β = 0.579), contextual conditions → strategies (β = 0.375), core phenomenon → strategies (β = 0.282), intervening conditions → strategies (β = 0.348), and strategies → outcomes (β = 0.724).

Discussion and Conclusion

The final model demonstrates that the urban tourism industry in Iran, particularly in Kermanshah Province, is transitioning toward an intelligent digital ecosystem centered on a technology-based urban brand within an ecological framework. The model aligns with established international theories: urban ecology theory (Batty & Marshall, 2021; Wu et al., 2021) and digital ecosystem theory (Jacobides et al., 2018; de Reuver et al., 2021). It is consistent with prior empirical studies such as Gretzel et al. (2020) on the foundations of smart tourism, Singh et al. (2020) on the role of big data and AI in smart cities, and Huertas and Moreno (2021) on place branding for smart tourism destinations. However, the proposed model offers significant local innovations by incorporating infrastructural limitations, ethnic-cultural diversity, institutional instability, and technology sanctions specific to Iran. Unlike global models that often 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 three-level intervening conditions (environmental, organizational, and

human resources) provide a nuanced understanding of barriers in developing countries. Furthermore, the strong direct effect of strategies on outcomes (β = 0.724) confirms that well-designed technological, knowledge-based, and participative strategies can significantly improve tourist satisfaction, organizational transparency, and brand image.

Recommendations

At the macro level (national and trans-provincial policy and governance): establish an agile, cross-organizational Tourism Brand Steering Center for inter-institutional coordination, monitoring, and policy-making; formulate a national-regional digital tourism 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 advanced data governance technologies such as blockchain for transaction recording, cultural content ownership, and resource transparency; design foresight scenarios for smart tourism over a five- to ten-year horizon with trend prediction and uncertainty analysis. At the meso level (urban and regional management): design and implement a comprehensive smart tourism 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 tourist-friendly city living lab" as a shared experimental space; develop sentiment analysis systems and online management dashboards for real-time tourist feedback and decision-making. At the micro level (local community, culture, and indigenous businesses): design augmented reality tours based on local cultural narratives in cooperation with native associations; launch a network of local influencers to introduce attractions and produce authentic content; create digital marketplaces for handicrafts and cultural products of Kermanshah 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 urban tourism applications; develop a sustainable engagement framework for returning tourists including digital loyalty services and exclusive packages; analyze the cultural and social dimensions of technology acceptance among Kurdish and Lor communities to enhance digital participation and empathy.

KEYWORDS

Digital Ecosystem, Urban Branding, Urban Tourism, Urban Ecology, Smart Model, Kermanshah Province, Iran.

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